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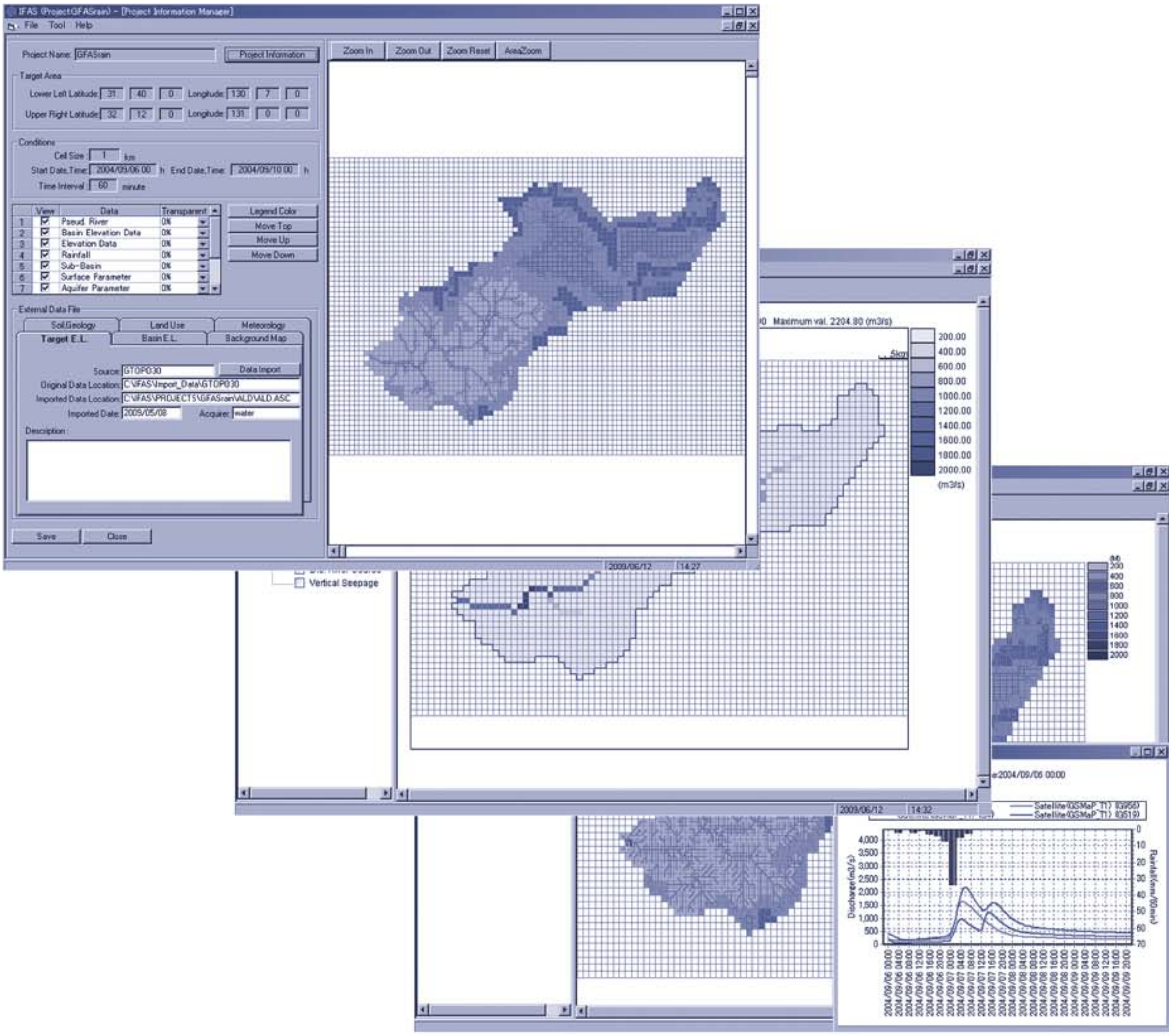
IFAS

Integrated Flood Analysis System (IFAS Version 1.2) User's manual

June 2009



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PWRI

UNESCO

United Nations Educational, Scientific and Cultural Organization

International Centre for Water Hazard and Risk Management under the auspices of UNESCO (ICHARM)

Public Works Research Institute(PWRI)

Technical Note of
PWRI　No.４１４８

Integrated Flood Analysis System
(IFAS version 1.2)
User’s manual

by

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Hydrologic Engineering Research Team has developed a concise flood forecasting tool “IFAS (Integrated Flood Analysis System)” using satellite observed rainfall data for poorly gauged basins in developing countries. In ver1.2 of IFAS, intake function of some additional satellite-based rainfall products, modification function of satellite-based rainfall and output function to display results on general geographic information system are implemented. This report is a manual of how to use IFAS ver1.2.

Key Words：Satellite-based rainfall, GIS, Flood forecasting system, Run-off analysis,
Distributed hydrological model

CONTENTS

1. Introduction

1.1 Purpose of development

Development of a flood forecasting and warning system is highly expected as a quick and efficient means to reduce flood disaster and minimize human damage in various countries, where river improvement and development are not necessarily sufficient.

However, it is hard to say that, at present, the progress in improvement of flood forecasting and warning system is satisfactory. One of the main reasons is that it is difficult for some countries to set up sufficient observation stations and adequately maintain such facilities and equipment, although implementing flood forecasting and warning essentially requires the collection of data on rainfall and the water level in the upstream area. Another reason is that even though real-time data are available, a lack of past hydrological data still makes identification of rainfall-flooding relationship difficult. Thirdly, the cost of coupling a flood forecasting/prediction system to each specific river basin is high.

Hence, by using rainfall data from earth observation satellites (EOS) and implementing runoff calculation and flood prediction without excessive dependence on ground observation hydrological data, it is possible to promote said development and improvement in flood forecasting and warning system on river basin level. And runoff calculations, the indispensable factor in flood forecasting and warning, are different within river basins (such as the number of measurement points, the values of rainfall or flow rate), however there are still many similarities, including items of input and output data and the values, drawings of output. Therefore, by preparing program with functions that parameter setting is based on those similar conditions (such as common input/output interfaces, model creation modules, topography, geology, soil and land use) which are necessary for runoff calculation and flood prediction, it is considerable to establish a flood forecasting and warning system effectively.

Based on the above considerations, we started the development of IFAS (Integrated Flood Analysis System) program.

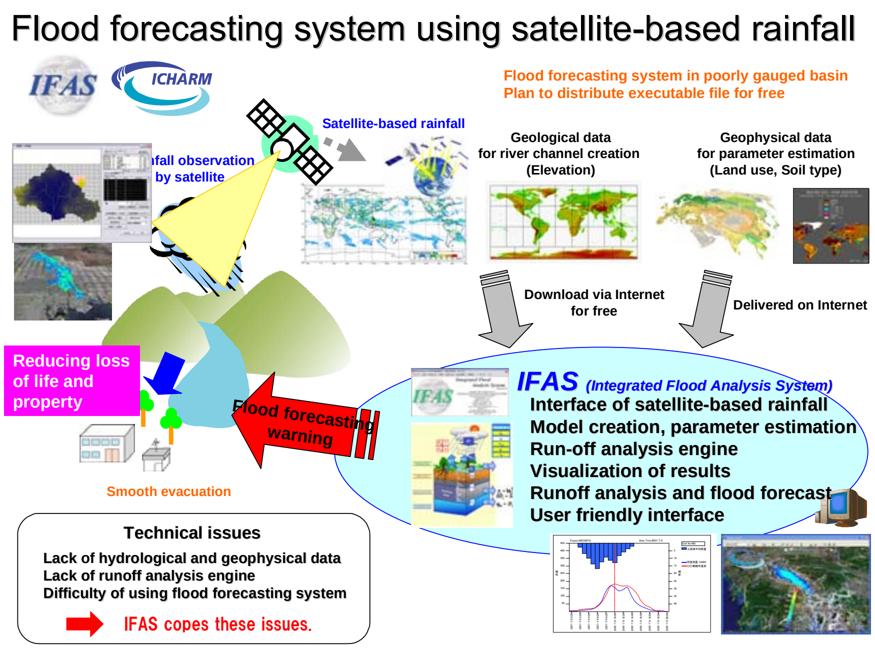


Fig. 1.1 Purpose of IFAS development

1.2 Main functions

Integrated Flood Analysis System (IFAS) Ver.1 is a runoff calculation program conducting a distribution-model runoff analysis with employing “PWRI (Public Works Research Institute) distribution-model as runoff analysis engine.

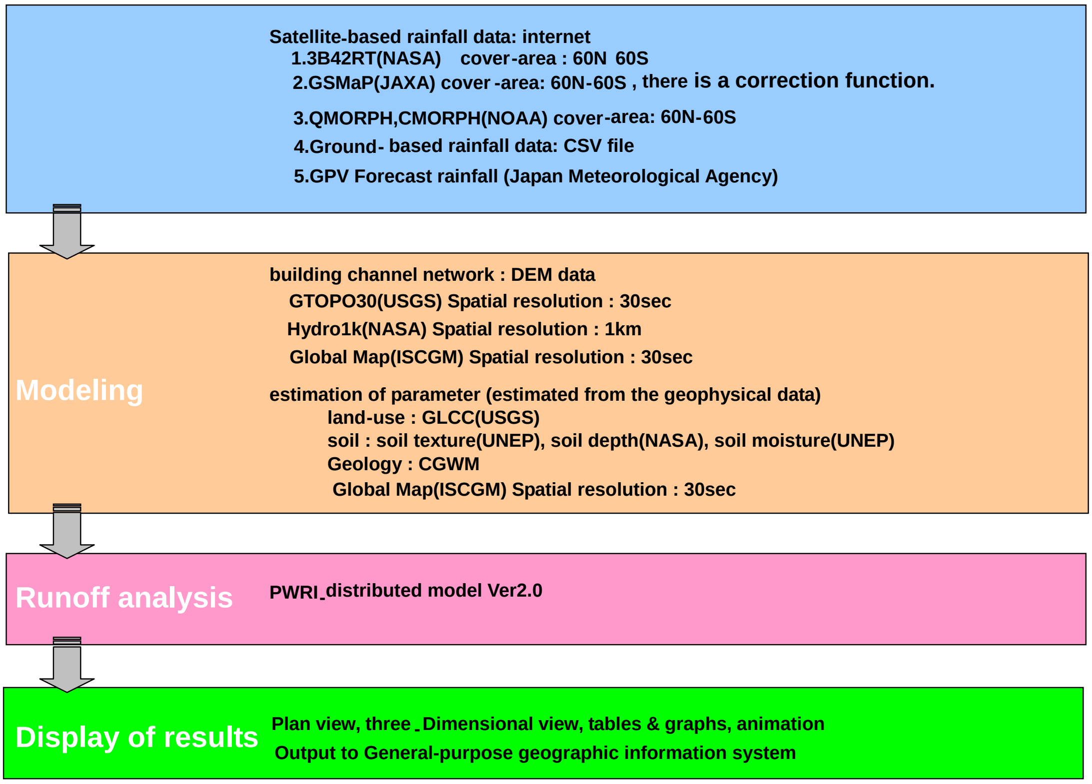


Fig. 1.2 Main functions of Integrated Flood Analysis System (IFAS) Ver.1.

Satellite rainfall and ground observation rainfall are imported as grid data, water-fall lines are created from DEM data, calculation model is created by setting parameters based on data of land use, geological and soil conditions. Calculation results are capable to export to graph or table.

2. Operation Environment and Installation

2.1 Operation environment

The operation environment for conducting IFAS is as follows. However, because the external data to be mentioned later is too large (more than 1 GB), necessary capacity of hard disk will be different according to volume of input data or whether other disk is used to save these data. While calculation results are different according to size of object river basin, mesh and duration of calculation, per calculation need at least 1 GB capacity of hard disk.

-OS: Windows Vista (SP1 or higher), Windows XP or Windows 2000 (SP3 or higher)
English Version 32bit

-Memory: 512MB or more

-Available space of hard disk: 10 GB or more

(Minimum requirement of hardware, maybe more according to calculation frequency conditions and times)

2.2 Coordinates

IFAS uses UTM method as the coordinate. It will be automatically changed to UTM coordinate when external data are imported.

In addition, GMT is used as the base of time. While there is no problem in importing GMT based satellite rainfall data, it is necessary to consider the time difference when importing data like ground observation rainfall based on local time (although importing and runoff calculation is capable without considering time difference, it can not be compared with GMT based satellite rainfall data and runoff calculation results of that).

2.3 Installation

Installation of IFAS needs two procedures as follows:

1) Installation of “Microsoft.NET Framework 2.0”;

2) Installation of “IFAS”;

2.3.1 Installation of “Microsoft.NET Framework 2.0”

Because the main program of data transformation like “GTOPO30 grid transformation” used in “IFAS” is made by "VC++2005" and "C#", it is necessary to install “Microsoft.NET Framework 2.0” in PC for IFAS operating.

There is no need to set PC where installation / setup of “Microsoft.NET Framework 2.0” are finished. (It can be confirmed at “Control Panel" - "Add or Remove Programs")

Install file of “Microsoft.NET Framework 2.0 Service Pack 1 (x86)” and Japanese Package can be downloaded at the URL as follows:

http://www.microsoft.com/downloads/details.aspx?familyid=79BC3B77-E02C-4AD3-AACF-A7633F706BA5&displaylang=en

In the installer, the "Microsoft.NET Framework 2.0" setup situation is confirmed. The installation is interrupted when not set up.

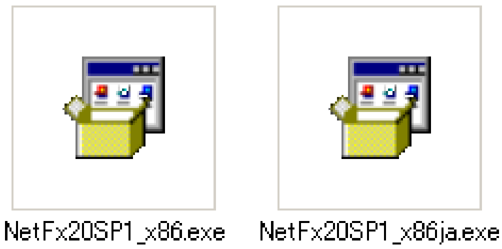


Fig. 2.1 Install file

It is necessary to set up "Windows Installer 3.1" for the setup of "Microsoft .NET Framework 2.0".

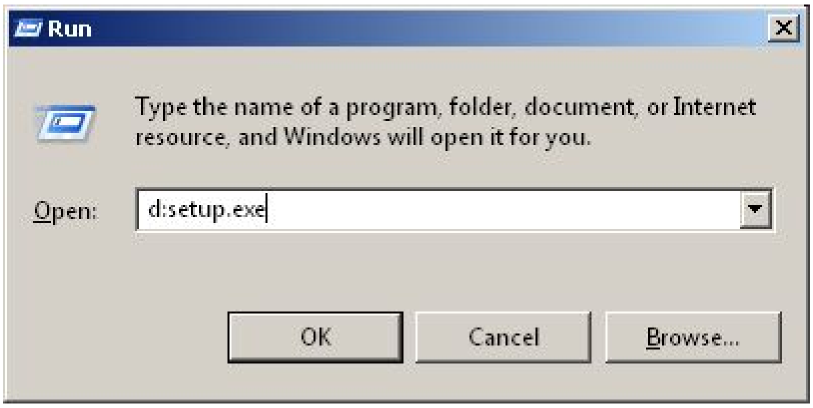
When installing it, the message concerning "Windows Installer 3.1" is displayed.

Refer to following URL.

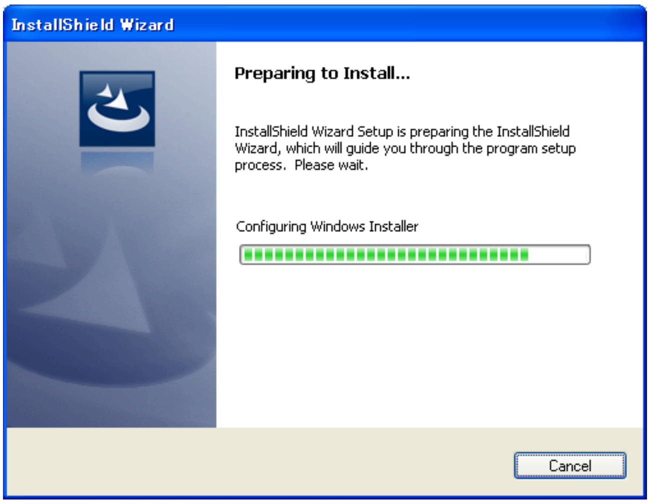
http://www.microsoft.com/downloadS/details.aspx?familyid=889482FC-5F56-4A38-B838-DE776FD4138C&displaylang=en

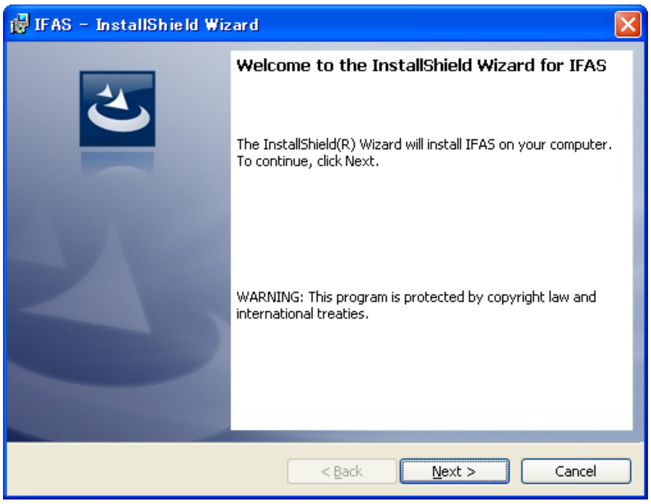
2.3.2 Installation of “IFAS”

Open “setup.exe” (double-click the icon or run the file name) to start the installation; or, run it from “Start->Run” menu as below.

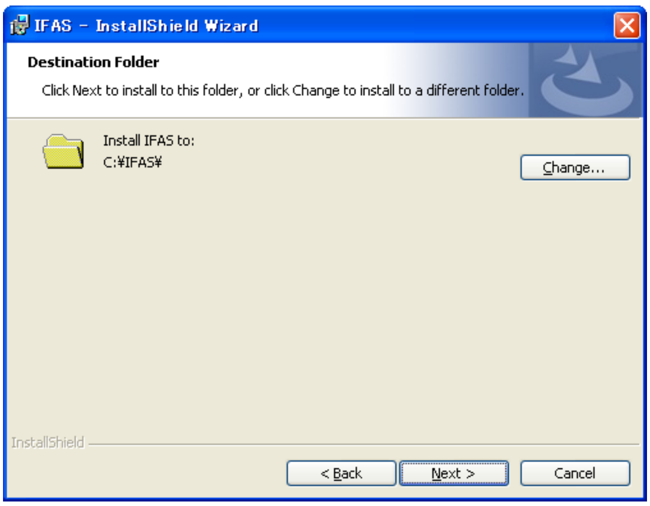


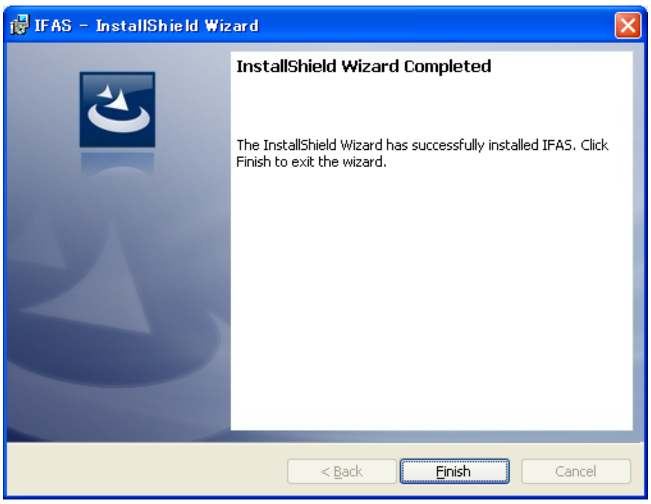
In case of setup.exe is located in driver d:





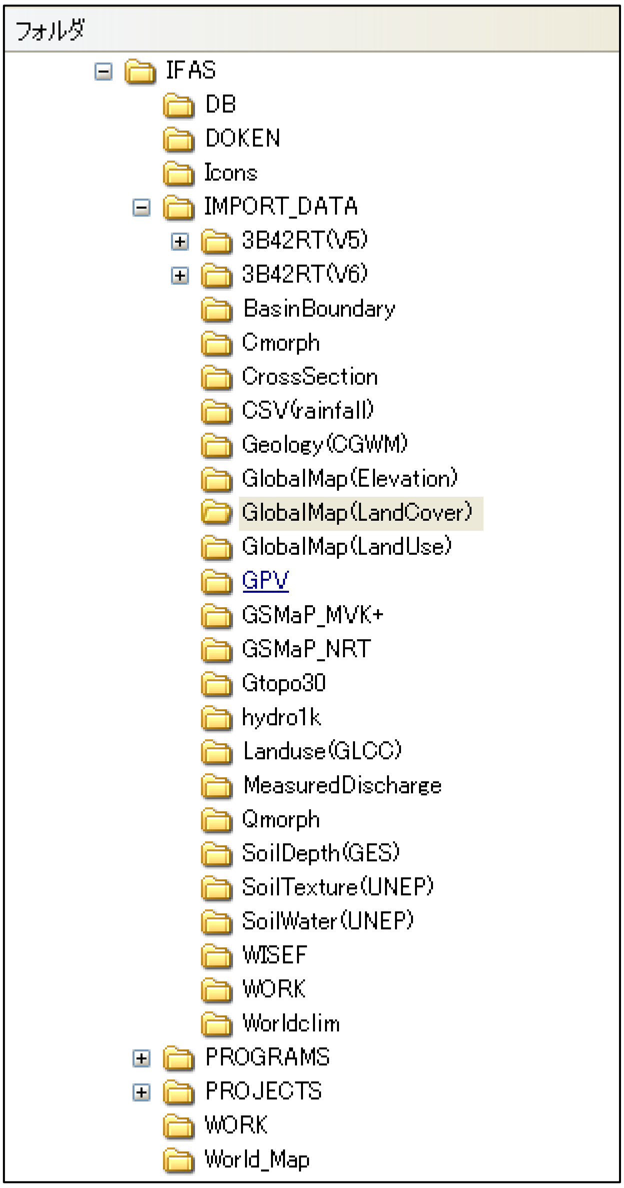
Click on the “Next” button to continue.





Files will be installed in “C:\IFAS”. Leave It as default. If it is not “C:\IFAS” then change it to install to “C:\IFAS” folder.
“IFAS” would have been registered to “Start” menu and Desktop after installation.
Run IFAS from the start-menu or Desktop Icon Click on.

Folder composition after it installs



2.3.3 Copying of reference external data and etc.

Because operations like model creation using external data will be held in IFAS, the installation needs matching to such required data.

When system installation/setup finished successfully, an “IMPORT_DATA” folder will have been created in the destination folder by IFAS installation, copy elevation and/or observation data for use in system. The download function of the system is used or the user voluntarily downloads and it uses it.

From where to get the data will be discussed later. Basically there is no need to install useless data and items. However if those are required, install them to the folder designated when reading and saving data. It is not necessary to necessarily install it in the folder displayed by default.

Table 2.1 External data folder to be installed

3B42RT(V5)
3B42RT(V6)
BasinBoundary
Cmorph
CrossSection
CSV(rainfall)
Geology(CGWM)
GlobalMap (Elevation)
GlobalMap (LandCover)
GlobalMap (LandUse)
GPV
GSMaP_MVK+
GSMaP_NRT
Gtopo30
Hydro1k
Landuse(GLCC)
MeasuredDischarge
Qmorph
SoilDepth(GES)
SoilTexture(UNEP)
SoilWater(UNEP)
WISEF
Worldclim

2.3.4 Error when installing it

"Microsoft ActiveX Control Pad" may be required during installation. The reason is "Fm20.dll", of which the redistribution is not allowed, has already been installed.

In the installer, the existence of "Fm20.dll" file of the system folder is confirmed. The installation is interrupted when not existing.

Reference: http://support.microsoft.com/kb/224305/ja

Download and setup the install folder "Microsoft ActiveX Control Pad" at the following URL to deal with that.

http://msdn.microsoft.com/en-us/library/ms968493.aspx

(1) Download "setuppad.exe"

(2) Download "setupjpn.exe"

(3) Run orderly as "setuppad.exe", "setupjpn.exe"

This phenomenon does not occur if Offic95 or higher version was installed.

Reference: http://support.microsoft.com/kb/224305/ja

The message concerning "Dx7vb.dll" and "Dx8vb.dll" files might be displayed while installing it. This sets not to overwrite in IFAS though this is a message related to update/superscription of each file.

3. The Overall Configuration of the Software

3.1 Configuration of the software

IFAS is configured by four TASKs and calculation engine module. The overall configuration and treatment process of software are as follows:

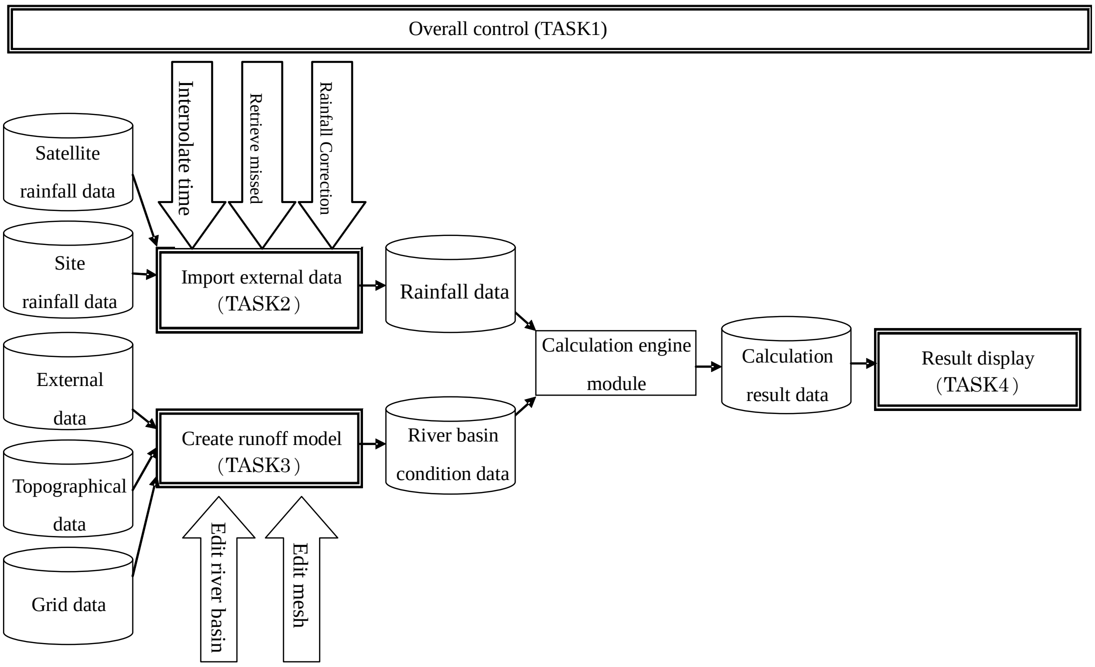


Fig. 3.1 The overall configuration and treatment process of IFAS

3.1.1 Configuration of module

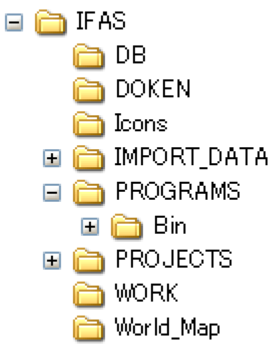
Major functions of four TASKs and calculation engine are shown as follows:

Table 3.1 Configuration of module

Module	Major functions
Overall control (TASK１)	Module for overall control as a main menu. Managing overall analysis based on per project. Capable of holding multiple simulation cases for the comparing between different analyzed results from different parameters.
Rainfall data importing (TASK２)	Module for treating rainfall data. Converting imported each type of external data (such as satellite, site rainfall) and creating required rainfall information for analysis.
Runoff model creation (TASK３)	Module can import topographical, land use data. Creating river basin, river course, and drainage course based on the imported data. Creating model configuration data for runoff analysis.
Calculation engine module	Module for runoff analysis on rainfall data created in TASK2 and model configuration data created in TASK3.　Doken distribution type model Ver.2 is mounted now.
Results display (TASK４)	Module for displaying results exported by calculation engine module. Capable of displaying hydrograph, tank image of any location rather than plan image. Capable of displaying analyzed results in 3D and animation.

3.1.2 Configuration of files

The programs required in system will be installed to three folders: DB, DOKEN, and PROGRAMS.



(1) The files to be installed in folder DB

.\DB\	
Cgwm.leg	ResultAnalysis.mdb
DLT4.ini	TASK3.mdb
EditLog.txt	TASK4.mdb
Glcc.	Unep.leg
legLegend1.ini	WISEF_STATION.dat
ProjectDB01.MDB	AllJapanRaifall.xls

(2) The files to be installed in folder DOKEN

.\DOKEN\
DokenModelV2_1.exe

(3) The files to be installed in folder PROGRAMS

IFAS.ICO	.\Bin\	. \Bin\kg\
IFAS.exe	3B42Finder.exe	input.dat
IFASTsk4.exe	3B42RT2grid.exe	Kriging.out
TAR.EXE	3b42rtToShp.exe	.\Bin\EVP
tar32.dll	akmid.exe	eva_ave.dat
TAR32.LIB	akmid12.exe	
	Ald2Ponds.exe	
	AscToKml.exe	
	bin2grid.exe	
	clipEsriAsciiGrid.exe	
	demToShp.exe	
	esriAsciiGridToShp.exe	
	globalmap2grid.exe	
	GLCC2GRID.exe	
	grib2_dec_gpv_tpr.exe	
	gtopo2grid.exe	
	hdrToShp.exe	
	idw.exe	

	IFASimport.dll ifasimport.net.dll impeva.exe impgsmap.exe impgsmap025.exe impgsmap2.exe Kriging.exe LAEA2Eqirectangular.exe mergeEsriAsciiGrid.exe proj.dll qm2gr.exe QMFinder.exe R4IFAS.exe shapelib.dll shpToEsriAsciiGrid.exe UTMMeshsize.exe	

(4) The files to be installed in folder World_Map

\World_Map africa.bmp asia.bmp australasia.bmp europe.bmp n_america.bmp s_america.bmp world.bmp

3.2 How to operate IFAS

3.2.1 How to start the system

IFAS system can be started by running IFAS from the icon on desktop or from the start menu.

During the starting of system, a title logo will be shown and continued with the project selection window as follows.

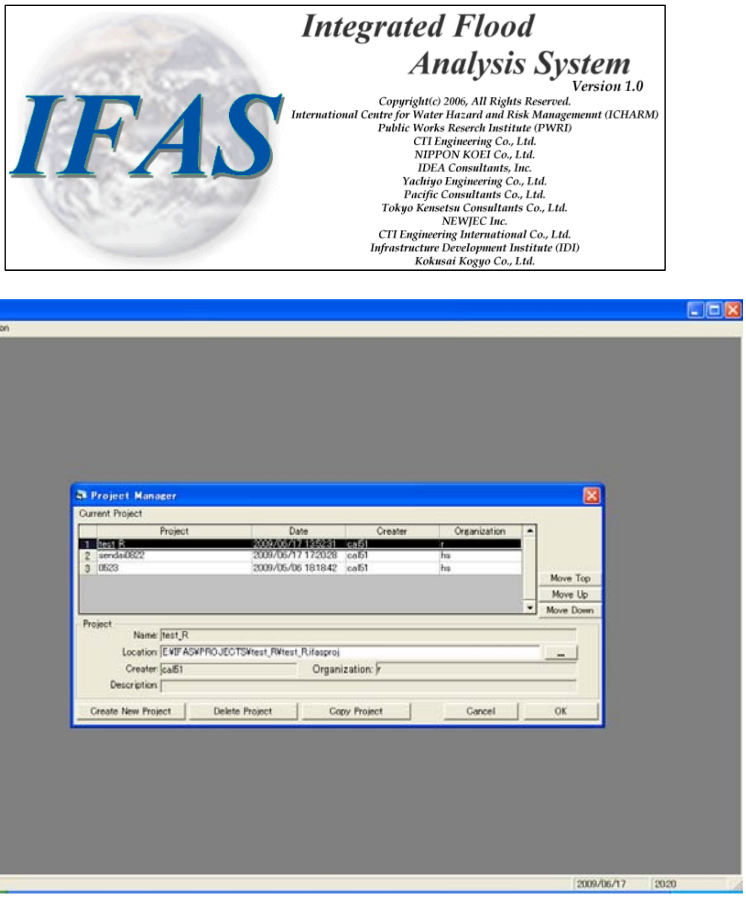


Fig. 3.2 The splash and project selection windows

The functions of IFAS can be divided to eight items, which are summarized as follows.

(1) Project Information Manager

To set model information and calculating condition of target area, sell size, target period, and calculation time interval, which are for runoff simulation.

The IFAS treats all data as an integral project based on the model information.

In addition, to read external data like elevation, land use and geology data to designated target area.

(2) Basin Data Manager

To hold hollow ground treatment based on elevation data; and to create basin, waterfall, and river course data.

The treatment results of Basin Data Manager cannot be displayed when any other Manager is already in use. To display any changes occurred in Basin Data Manager, please shut off other Manager and restart the Basin Data Manager. Therefore, we recommend treating data by using the managers one by one (i.e. one to six), instead of using two or more managers at one time.

(3) Rainfall Data Manager

It is for downloading the satellite rainfall data from each data's product. To cut the downloaded data for target area, and/or create rainfall date by using observed ground rainfall data. It is also able to edit or correct the cut data.

(4) Parameter Manager

To set parameters of tank in surface, aquifer, and river course (containing auto setting function); and to edit the values of that.

(5) Dam Control Manager

To set position, adjust format (defined rate / defined mass / defined rate + mass / others), and/or capacity of reservoir.

(6) Simulation Manager

To select and check the created rainfall data and parameter; and to conduct the runoff simulation and calculation.

(7) Result Viewer

To display the list of runoff analysis and calculation results, the plane distribution of hydrograph / hyetograph. The Result Viewer displays plane distribution in animation.

(8) KML Exporter

To export files in the form of .kml that can display the calculation results in general geographic information system (Google Earth).

3.2.2Method of operation

(1) Operation of the system

There are three optional menu buttons: “File”, “Tool,” and “Option” on main window of IFAS.

Fig. 3.3 Manu on main window of IFAS

(2) Flow of overall operation

① Project Manager --- A project is created.

② Project Information Manager --- Topographic data, land use data, etc. are imported.

③ Basin Data Manager --- The subject river basin is determined.

④ Rainfall Data Manager --- The satellite, ground observation rainfall data are imported. The rainfall data for calculation are created.

⑤ Parameter Manager --- Surface, aquifer and river course tank parameters are determined, and simulation calculation is conducted.

⑥ Dam Control Manager --- Creation of flood regulation feature using a dam.

⑦ Simulation Manager --- The input file is checked, and simulation is executed.

⑧ Result Viewer --- The result of the simulation calculation is displayed.

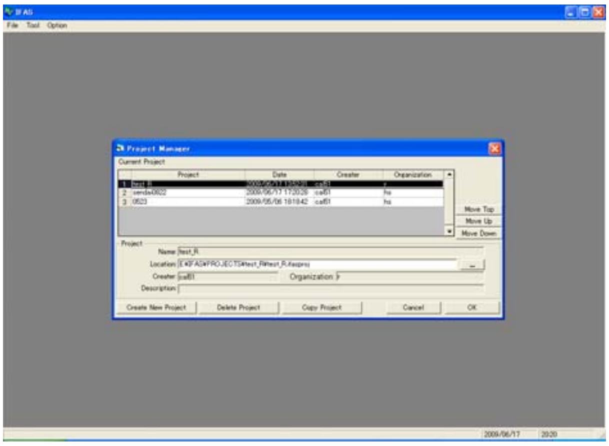
⑨ KML Exportor --- The file for the general-purpose geographic information system display is output from the simulation result.

Fig. 3.4 Flow of runoff analysis using IFAS

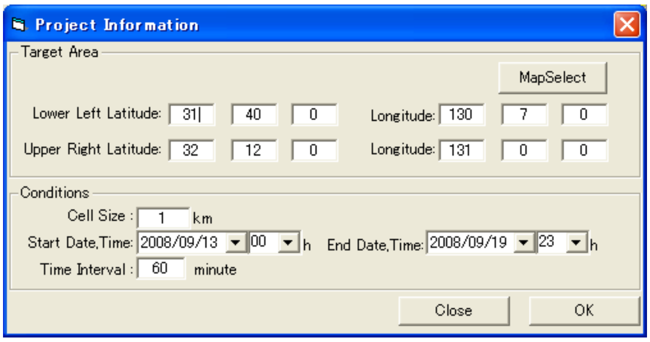
(3) Transition of windows

① Project Manager(Creating a project)

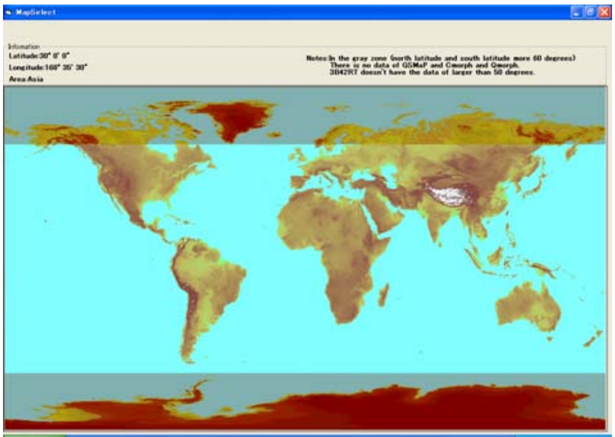
Creating a project



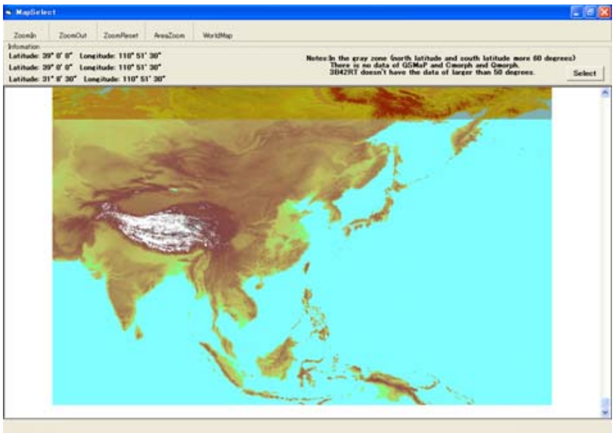
Setting project information



Select Target Area

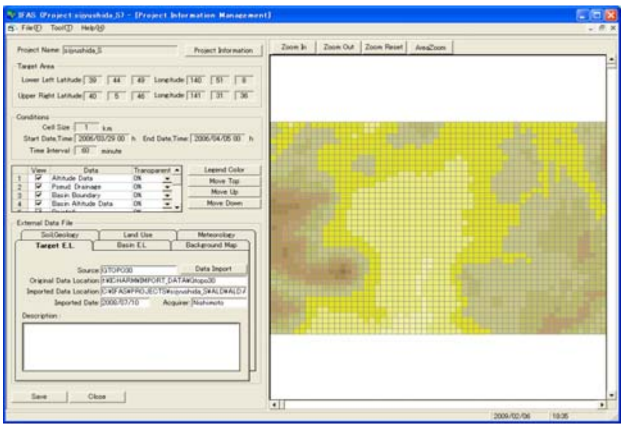


Select Target Area

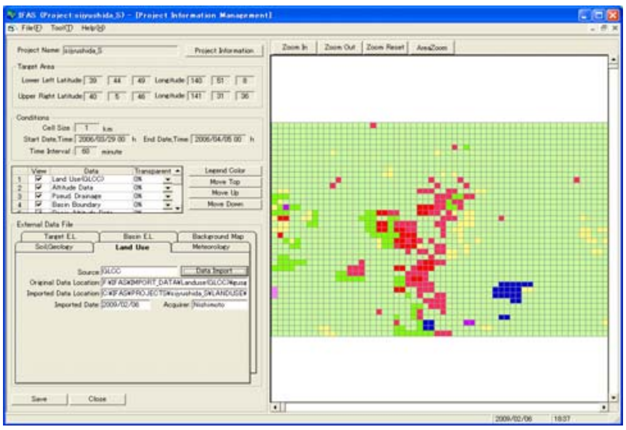


② Project Information Manager(Importing external data)

Elevation data

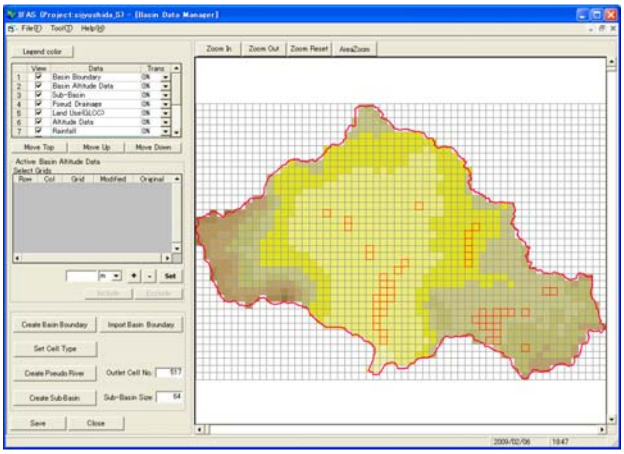


Land use data

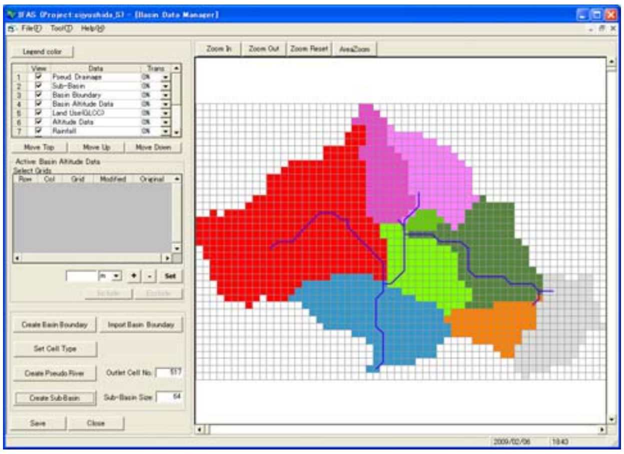


③ Basin Data Manager(Creation of river basin data)

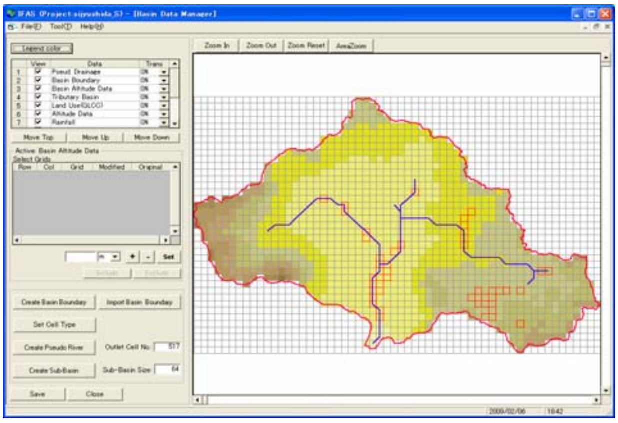
River basin boundary



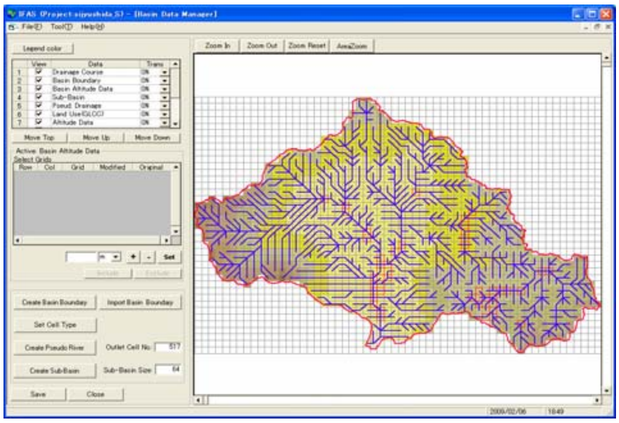
Division of tributary basin



Pseudo network of river course

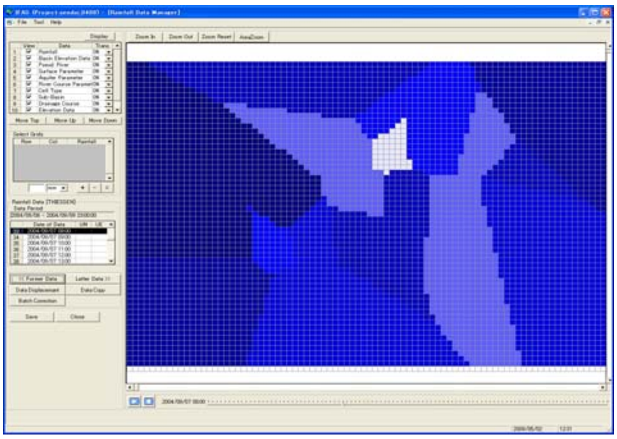


Drainage course

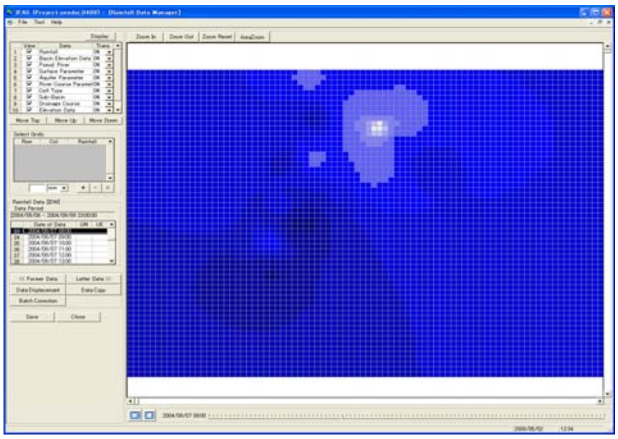


④ Rainfall Data Manager(Creation of rainfall data)

Thiessen Tessellation

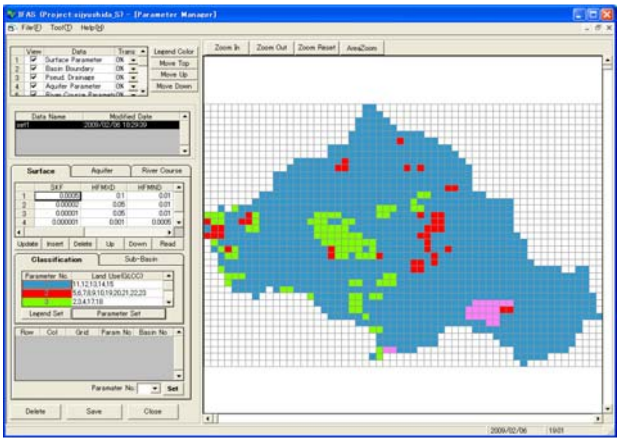


Distance Weighted

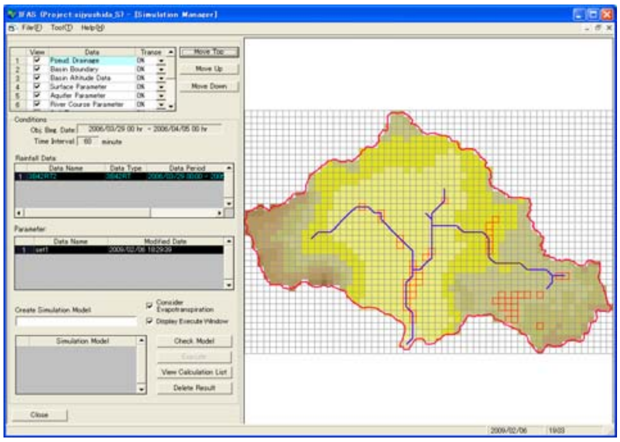


⑤ Parameter Manager(Creation and editing of parameters)

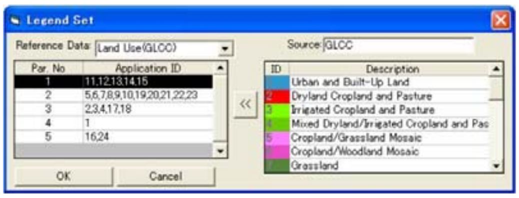
Parameter setting and display



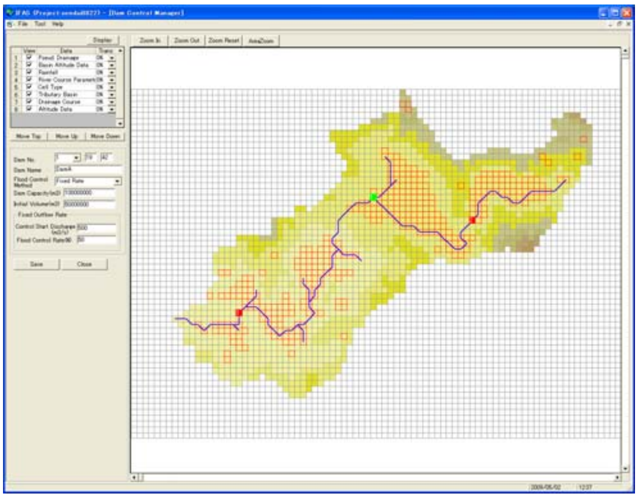
Implementing calculation



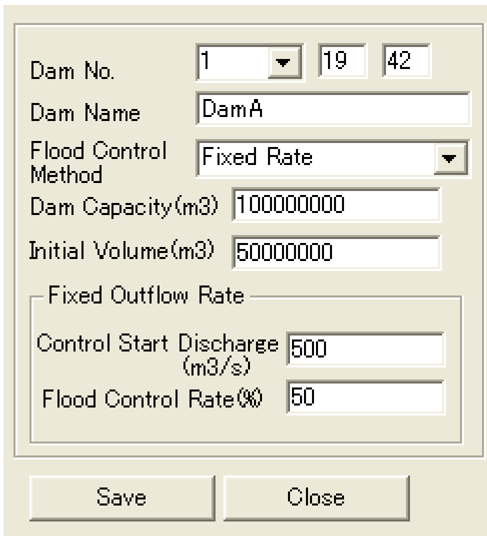
Setting legend



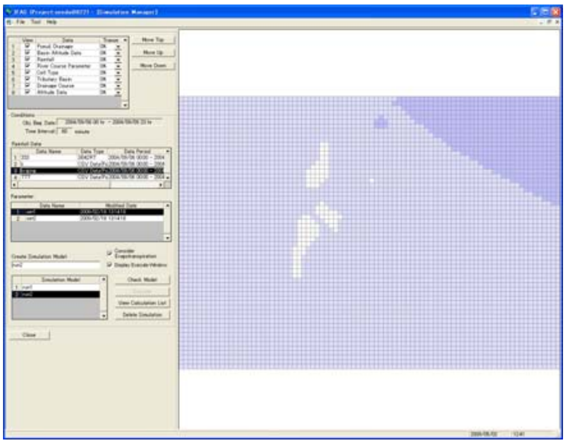
⑥ Dam Control Manager(Dam Control setting)



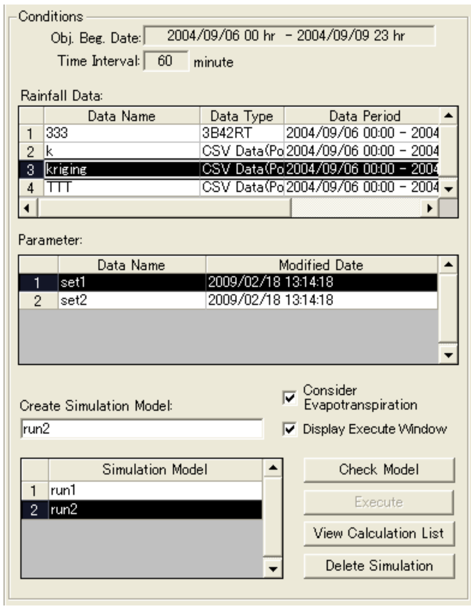
Dam control setting



⑦ Simulation Manager(execute simulation)

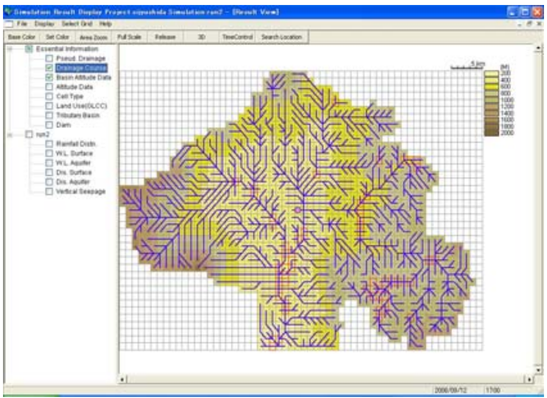


Calculation condition setting

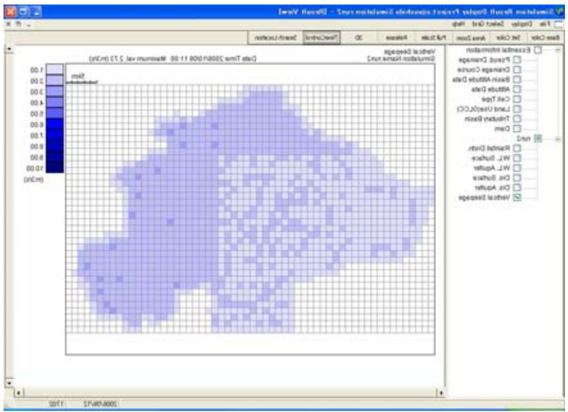


⑧ Result Viewer (Calculation and results)

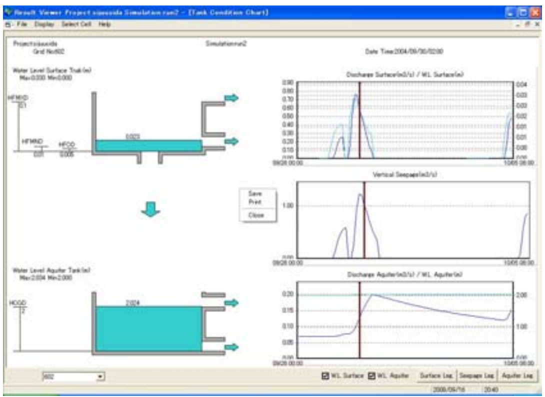
Drainage course



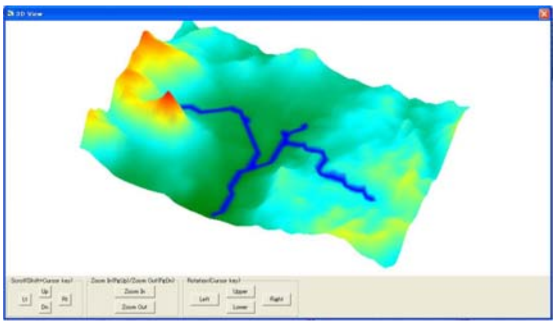
Display of infiltration



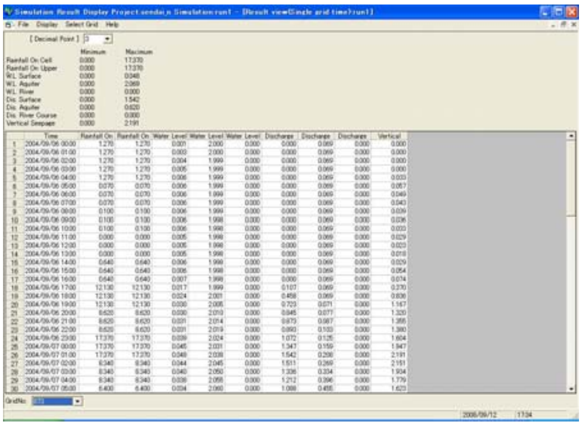
Water level of tank



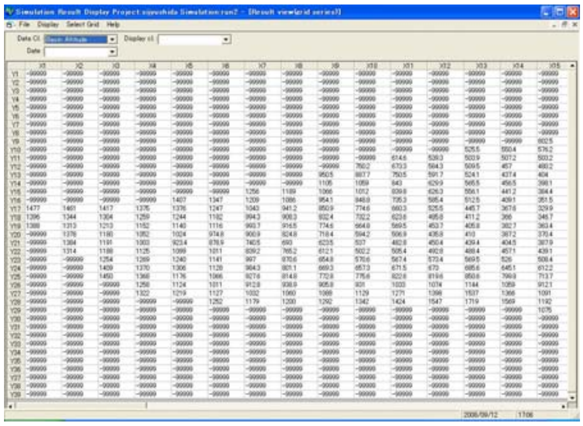
3 D display



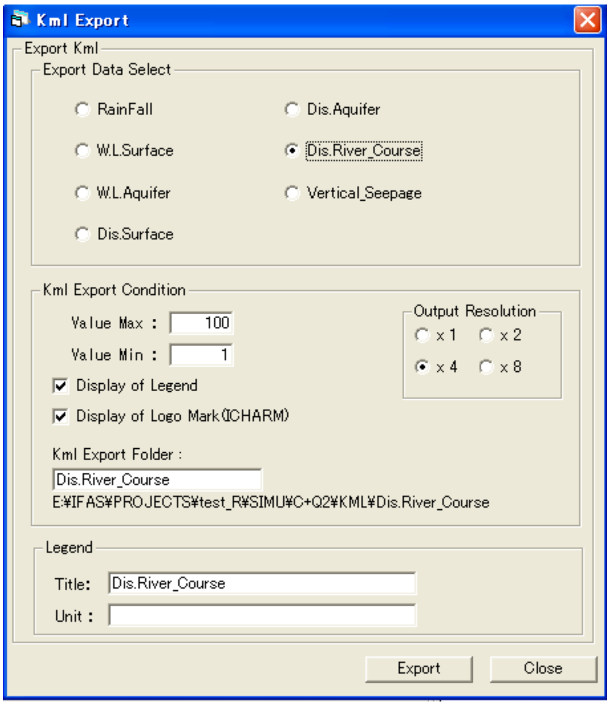
Display of calculation results in time series

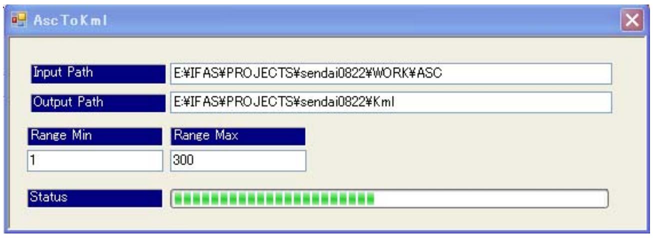


Plan display of calculation results

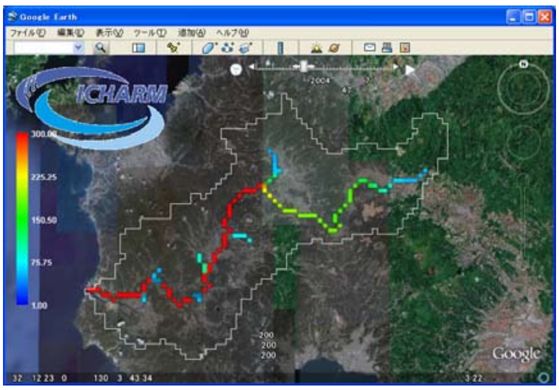


⑨ KMLExpoter(Output Kml format file from Simulation result)





Display sample



4. Project management (Project Information Manger)

4.1 Concept of project management

Data are managed by each project in IFAS, project folder is created at C:\IFAS\PROJECTS by default. The project folder also can be created to other drives or folders.

Elevation data, land use data and etc. are saved to project folder. Simulation results are saved to SIMU folder. Distinct calculation results like rainfall and parameters can be individually stored in a same project.

Project folder

ALD	Elevation data
BASIN	Elevation data of river basin
DB	Flood calculation data
EVPT	Evaporation data
FLOW	Water-fall line data
KML	KML Output Folder
LANDUSE	Land use data
PARAM	Tank parameter data
RAIN	Rainfall data
RIVER	River course data
SIMU	Flood calculation results data
SOIL	Soil / Geology data

Notes) the previous projects

We recommend creating a new project instead of previous one, which was created by former version of this software, because the calculation condition and setting method have been changed in the newest version.

4.2 Creation, selection, deleting, copying of a project

4.2.1 The project of IFAS

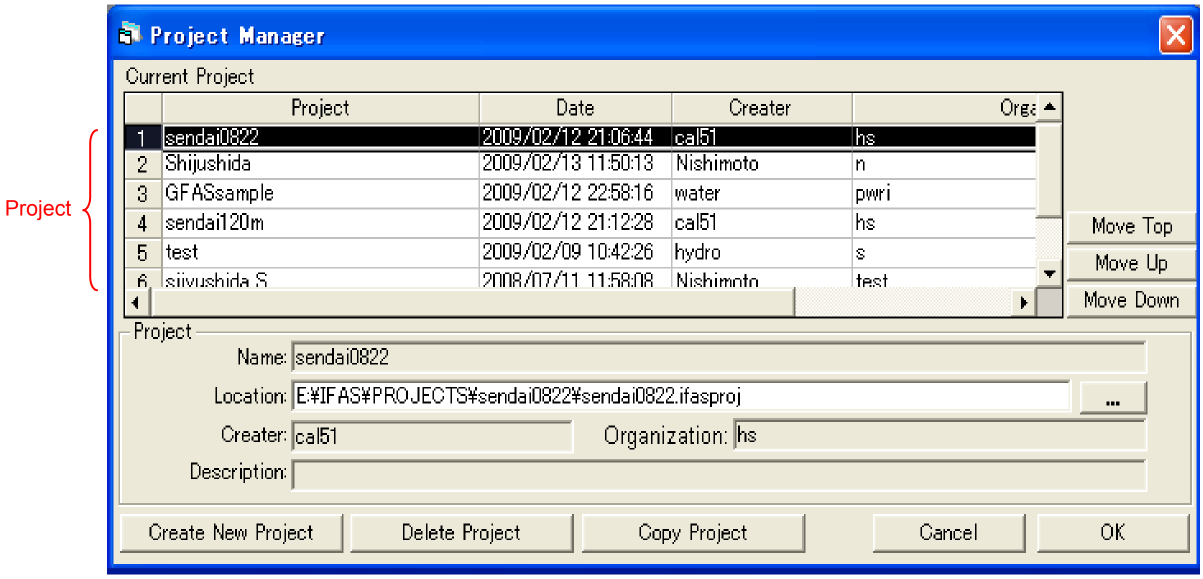
Data are managed by each project for the purpose of IFAS operation. A project must be selected when using IFAS. Projects may be selected in two ways: creating a new project or selecting an existing project. Created project will be displayed in a project select window.

Project name should be less than 20 letters, space is not allowed.

e.g.) Project name

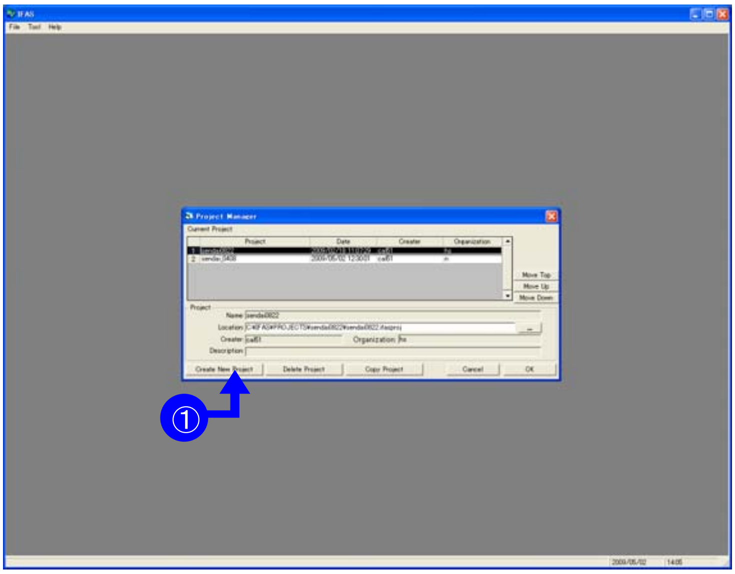
"TESTIFAS" ------ OK

"TEST IFAS" ------ NG



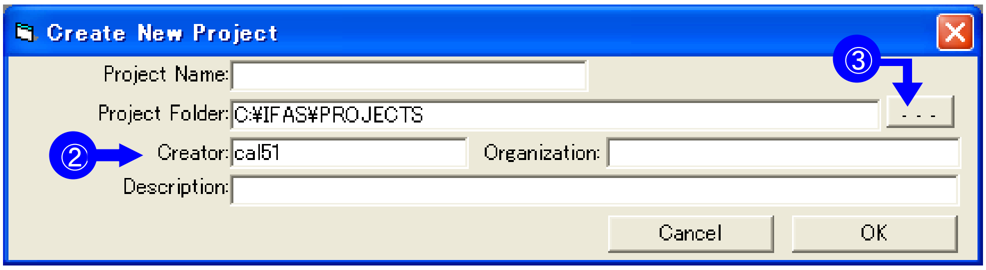
4.2.2 Creating a new project

Type the name of the project you want to create in the “Project Name” field and press the Enter key. A project folder with the same name as the “Project Name” will be created automatically to C:\IFAS\PROJECTS.



①Click the “Create New project” button

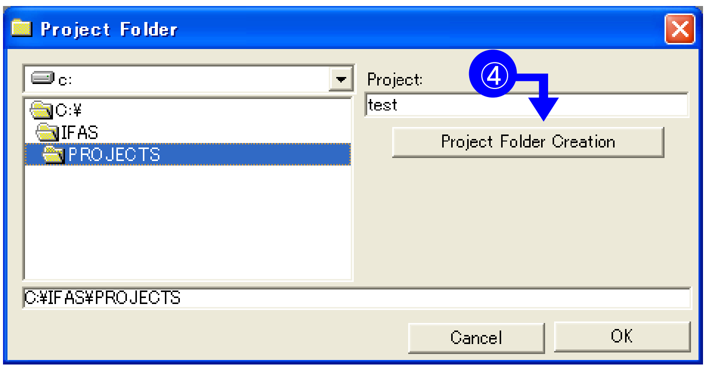
②Here, user account of PC is written in the “Creator” field by default, and it can be retyped. You may type, the name of department that project creator belongs to in the “Organization” field, and comment of project in the “Comment” field. Comment may be about the name, features etc. of the subject river basin in project.



③Click the “. . . ” button.

④Choose a place where you want to create and click the “Create project folder” button, a project folder will be created to the place you selected.

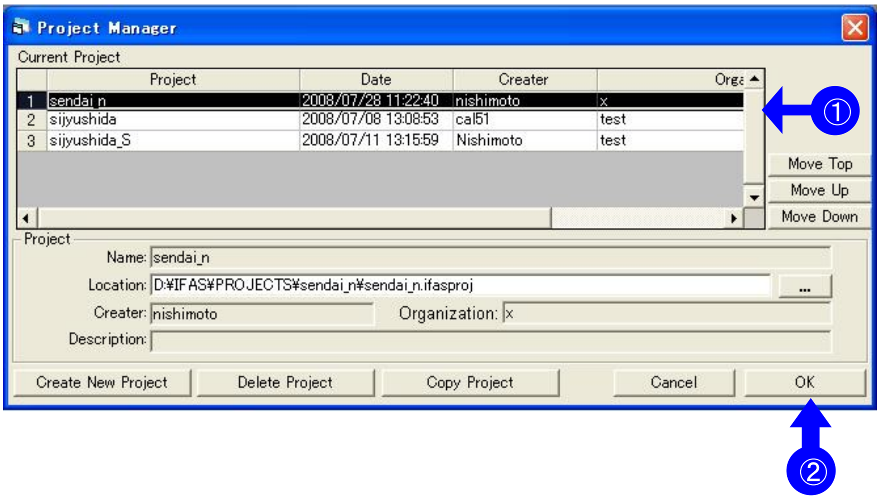
Taking the above one as an example, a “Test” project folder will be created to an “IFAS” folder. (Creation is automatically implemented after typing the project name and pressing the “OK” button).



4.2.3 Selecting and deleting a project

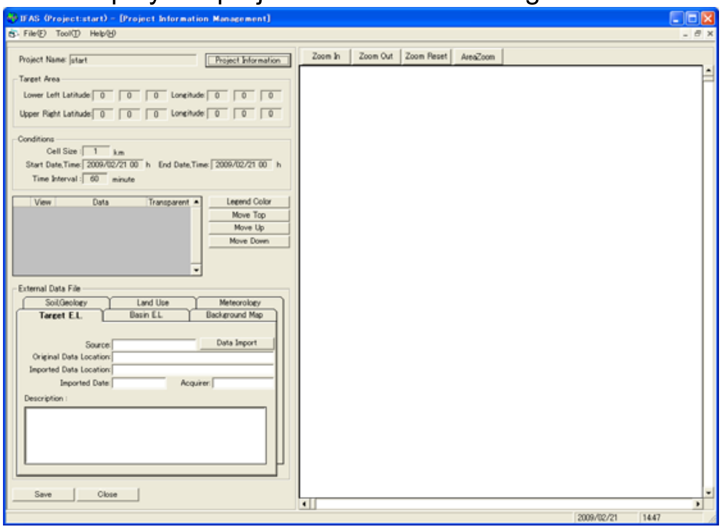
You may select any existing project file in the project select window. A maximum of 10 existing projects are shown in the window(It is not displayed from the one with an old operation). Unshown project can be selected from the folder “PROJECTS” by pressing “Select” button.

All existing projects are shown in the project select window. You may change the position of projects from “Move Up”, “Move Down”, and “Move Top” buttons.

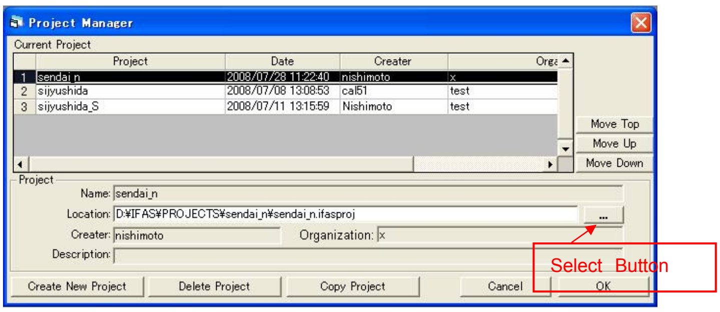


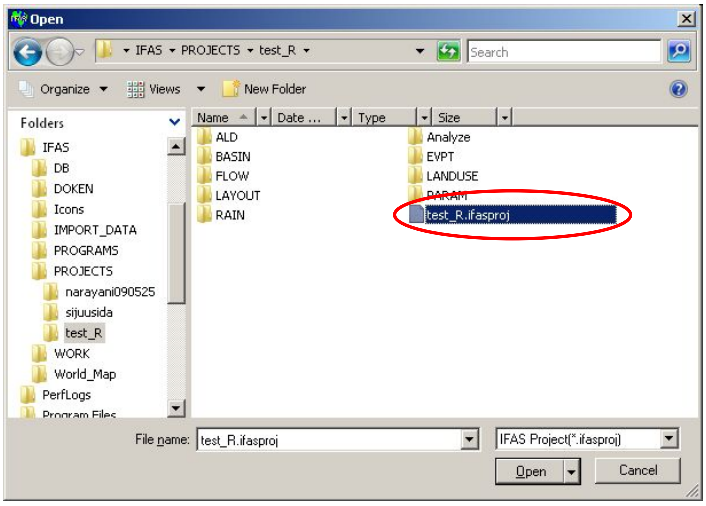
① Select the project you want to use. (Click on the cell of the project that you want to select and the color of the cell will be inverted.)

② Click on the “OK” button to display the project information management window.



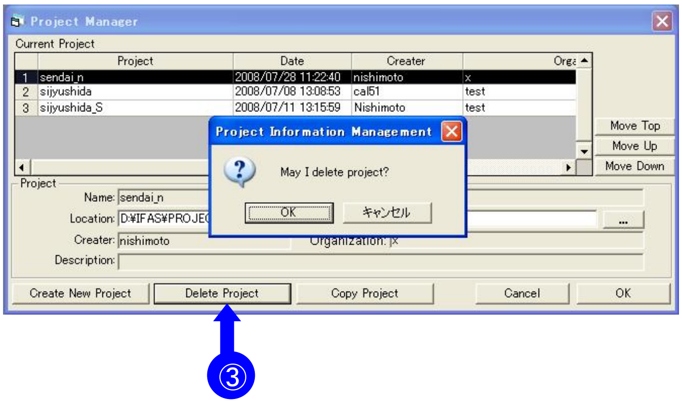
Project also can be selected anywhere by double-clicking on project name and selecting the file “folder name.ifasproj” from the folder.





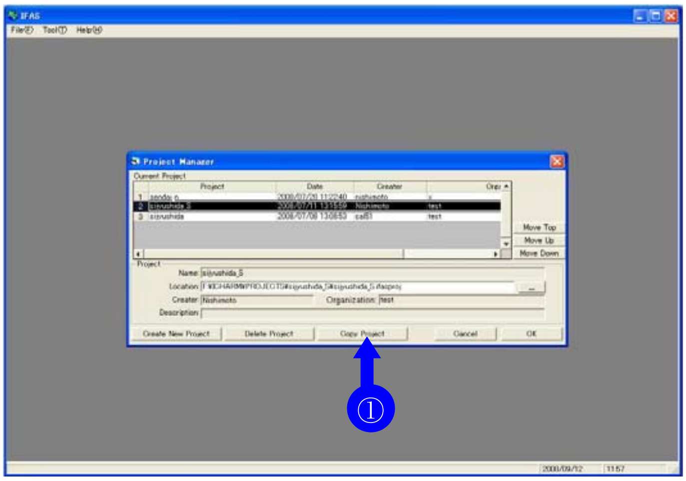
* Project can not be renamed after creation is finished. Readout of an existing project from a PC where project data is copied and transferred from another PC is possible. However, both the conditions of full path to folder PROJECTS should be the same.

③ Select a project, click on the “Delete Project” button, then a message box will appear. Click on the “OK” button and the project folder will be deleted. In this way, all files and folders under the selected project folder will be deleted.



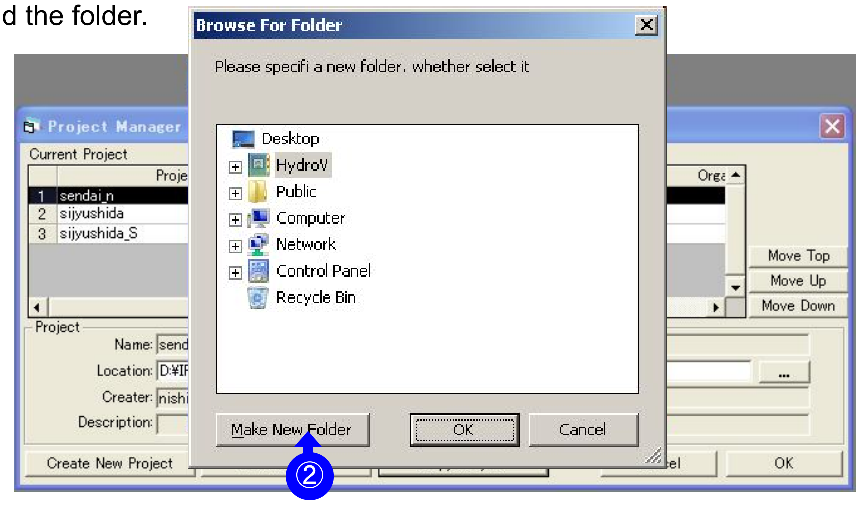
4.2.4 Copying a project

① Click on “Copy Project” button and a folder reference window will appear.



② Select the created place and click on “Create New Folder” button from the tree table as showed, you can name the new folder to be created. Click on the “OK” button to implement data copying.

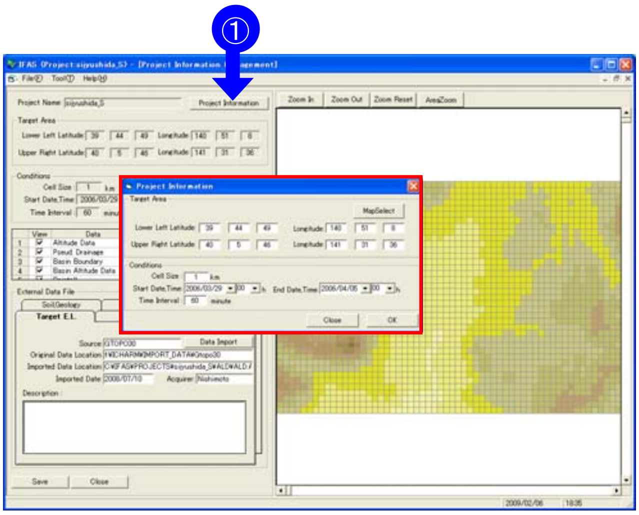
The setting with the folder of the alphanumeric character is indispensable though the copy can set an arbitrary drive and the folder.



4.2.5 Setting project information

After “Creating new project” and “Selecting project” are finished, the project information management window will appear. Here, you may set the scope of river basin data and basic conditions.

① Click on “Project Information” button to display the project information setting window.



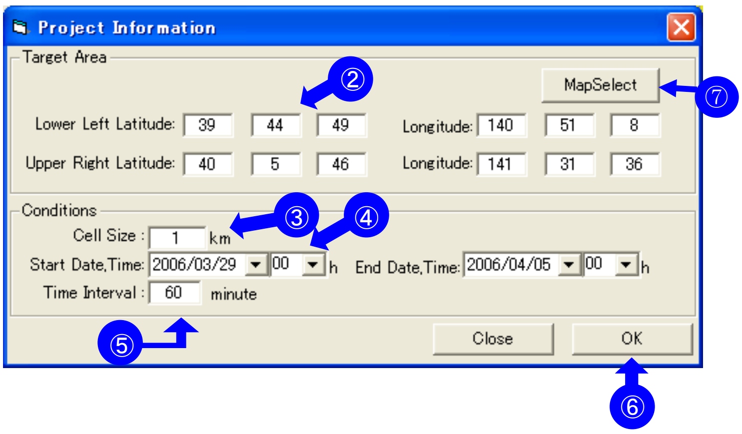
Specify the range of river basin data and setting conditions in the project information setting window.

⑦“MapSelect" Button To the valley range selection from the map

There are two ways to set the basin data area:

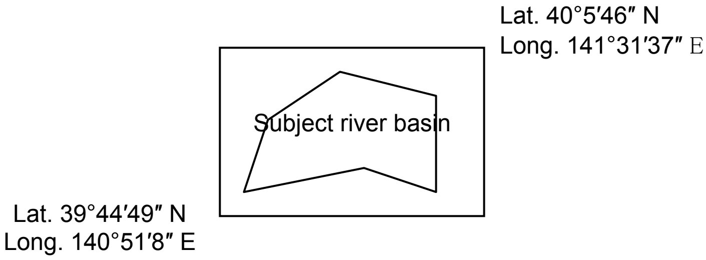
1) to select from map ⑦

2) to designate the latitude and longitude ②



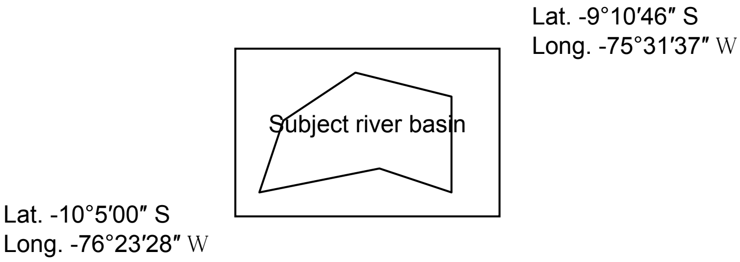
② Input the latitude and longitude of the bottom left and top right point of the subject river basin area. However, the satellite observation rainfall is not being offered both the north and south latitude should be less than 60 degrees (Decimal fraction should be rounded).

For example



Add “-” to the values, when longitude and latitude represent west longitude and south latitude.

For example



③ Input the cell size. In IFAS, river basin is represented with an aggregate of multiple cells, and distribution model which conducts calculation processing at a cell unit is used. Cell size is the length of a cell, the unit is km.

Because the resolution of the altitude data such as GTOPO30 and Hydro1k is 1km, an effective, minimum unit is assumed to be 0.1km. Moreover, it is necessary to note it because very big time is required to take and to calculate when the size of the cell is reduced or specs and the period covered of PC are long terms.

④ Input the relevant period. Relevant period is the period that flood simulation takes. Here, no simulation can be performed for dates and times outside the set period. Relevant starting time also can be inputted from calendar.

⑤ Input time interval. Time interval is the time ΔT that flood simulation calculation takes. When applying a calculation, rainfall data file according to time interval set *isData* is made for the work folder for every 60 minutes when the interval time of 180 minutes of 120 minutes etc. is set, and it responds to the interval time, and the rainfall data use matches and makes.

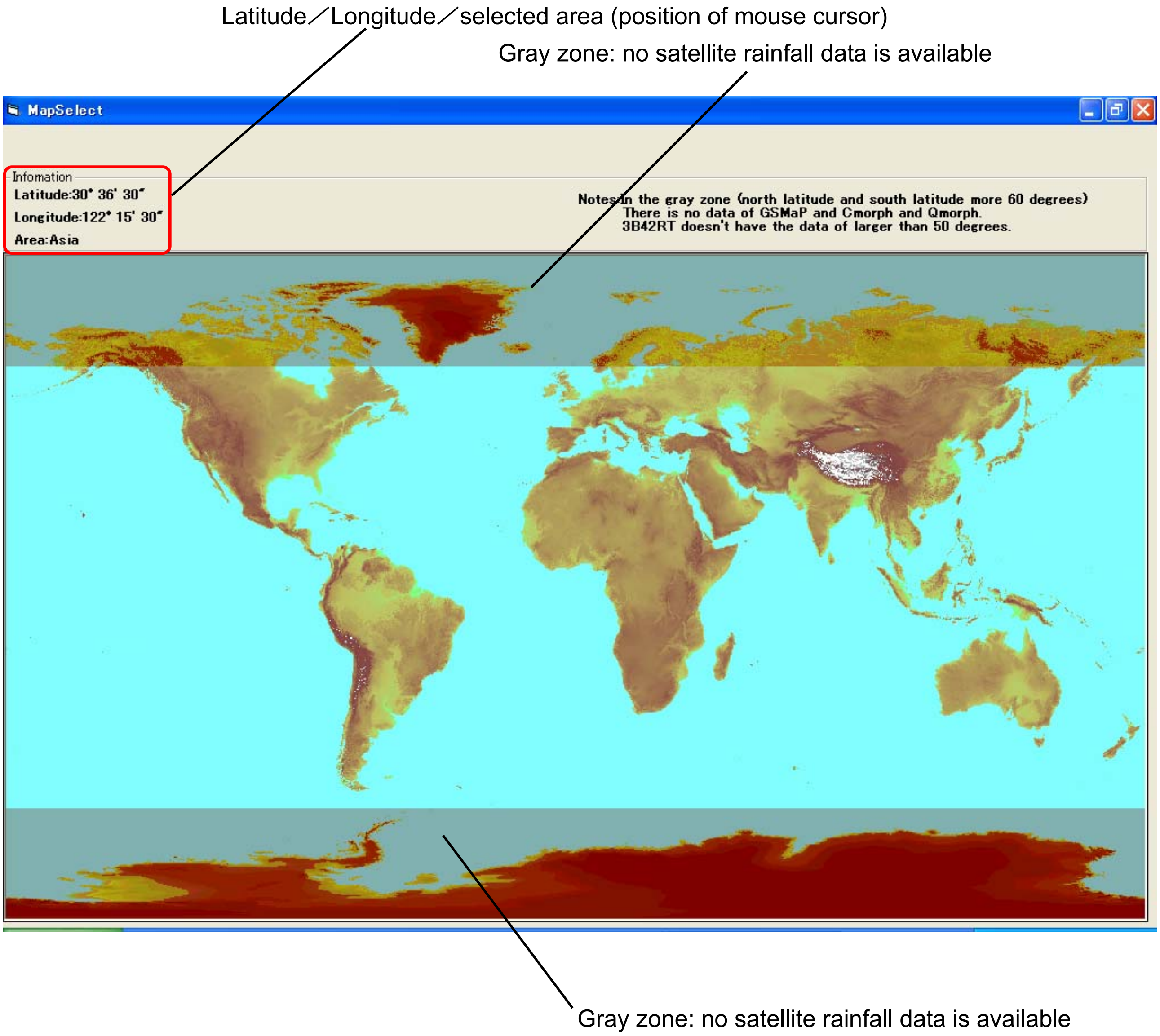
It costs more time to read and/or calculate rainfall data when shortening target period and calculation time interval as the same as sell size. It is necessary to pay attention to PC’s specification due to the increased capacity of created file according to calculation.

⑥ Click on the OK button to reflect the input contents, and the data will not be changed unless the “Project Inf. Arr.” button is clicked on again.

Warning) All importing data like elevation will be initialized when scope of river basin data and cell size are changed in project information setting. Rainfall data will be initialized when relevant period and time interval are changed.

4.2.6 Selecting the target area

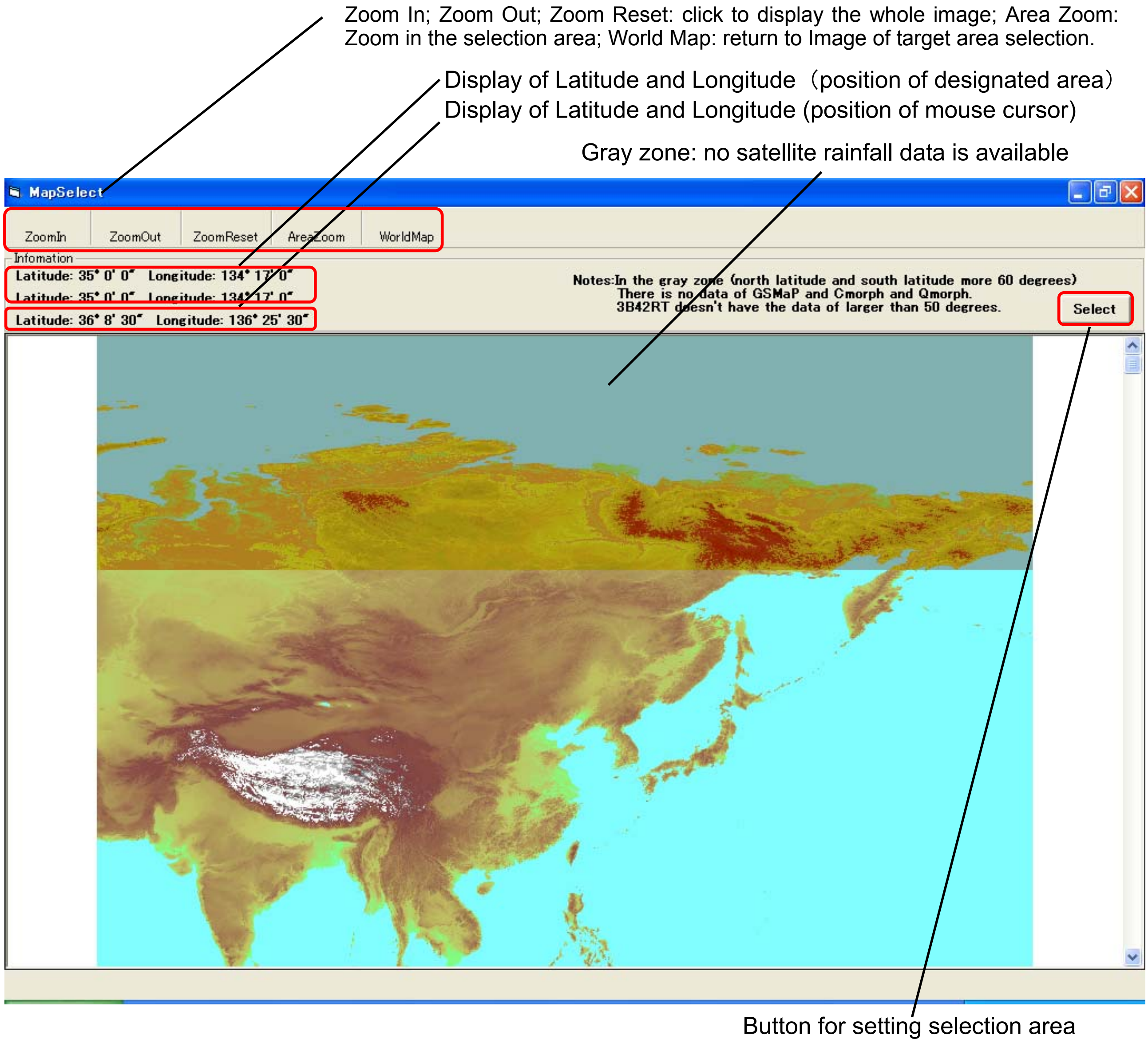
① Image of selecting a target area



The gray zone represents the area that northern than 60 degrees N latitude and southern than 60 degrees S longitude. This is a case that there is no satellite rainfall dataset, GSMaP, Cmorph, and Qmorph. There is no data in the area that northern than 50 degrees N latitude and southern than 50 degrees S longitude.

Click the target area to link the map of each area (i.e. Asia, Africa).

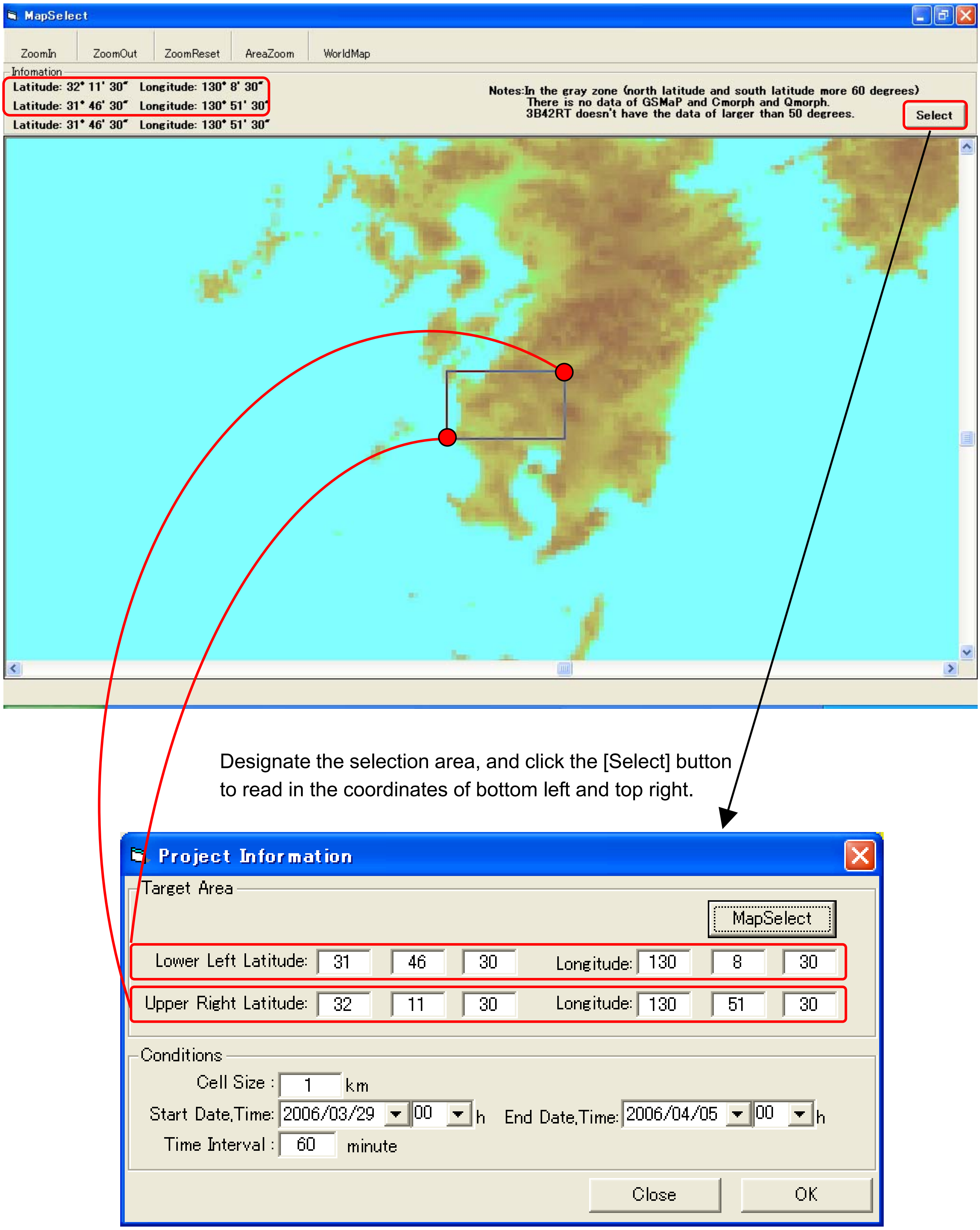
4.2.7　Image of selecting a target area: Asian area (a sample of selected Asian area)



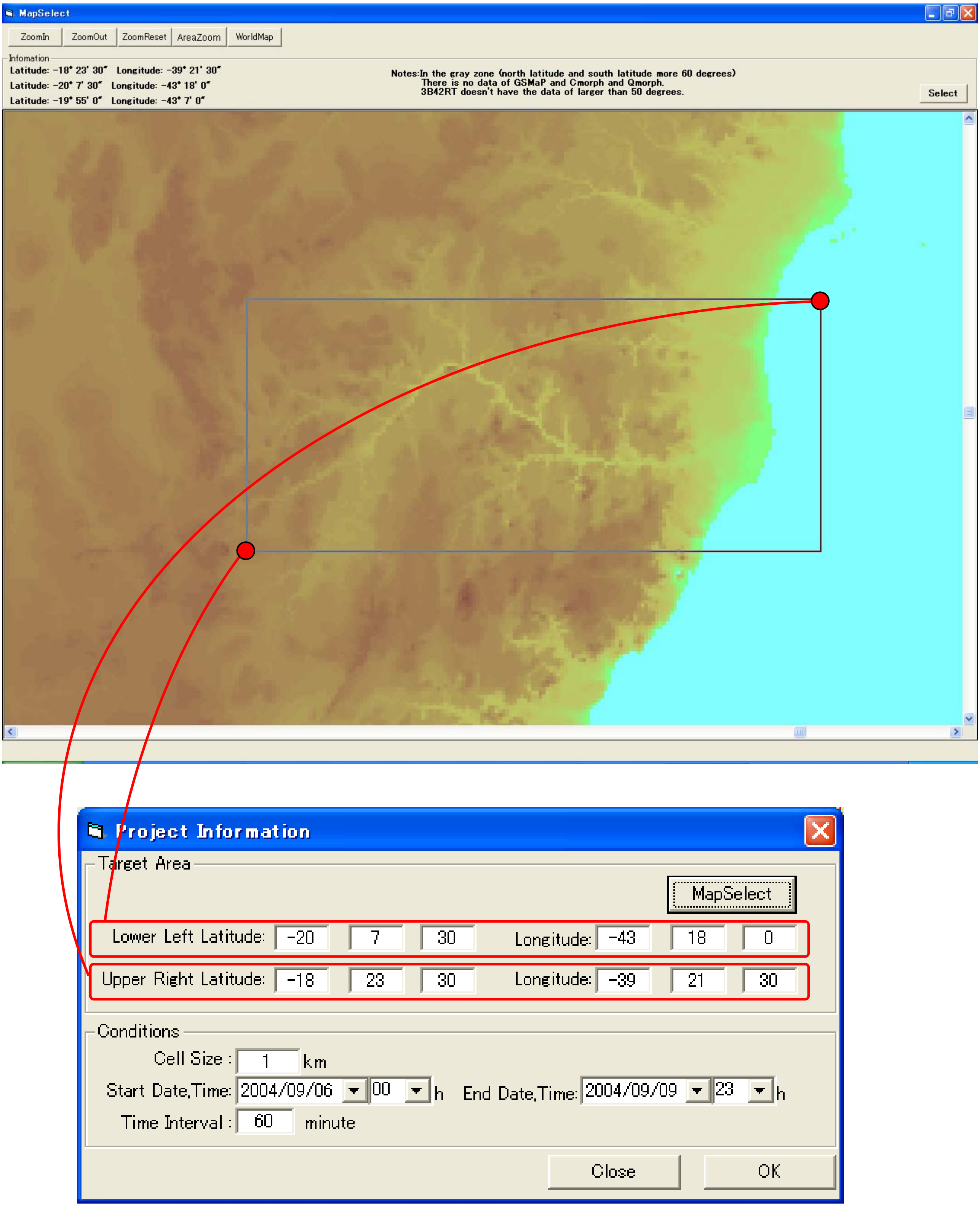
In this screen, set the area by drawing a rectangle from dragging the mouse.

Use “ZoomIn”／”ZoomOut”／”ZoomReset”／”AreaZoom” button to expand or shrink the image. Click “Select” button to set the scope of target area, by means of using the southwest and northeast latitude and longitude of the drawn rectangle.

4.2.8 Image of target area selection (a sample)



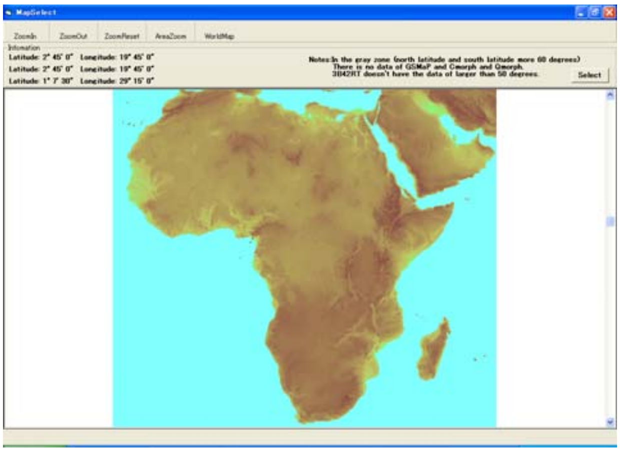
A sample of setting in Southern Hemisphere



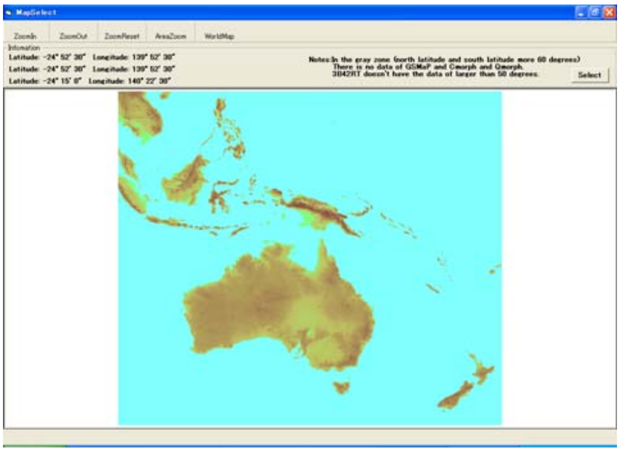
The IFAS treats the value of south latitude and west longitude as negative.

4.2.9 Display of images for selecting target area

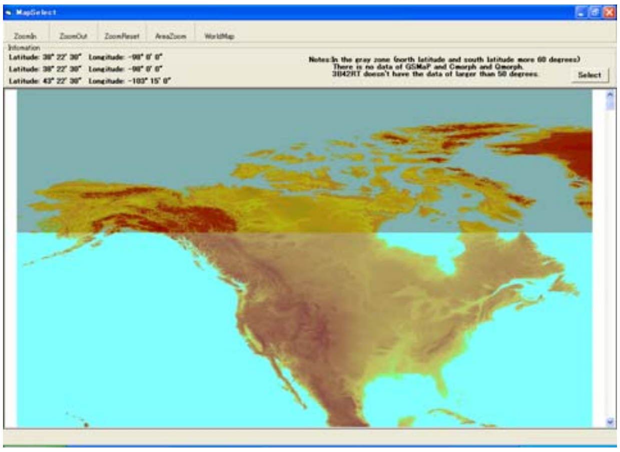
Africa



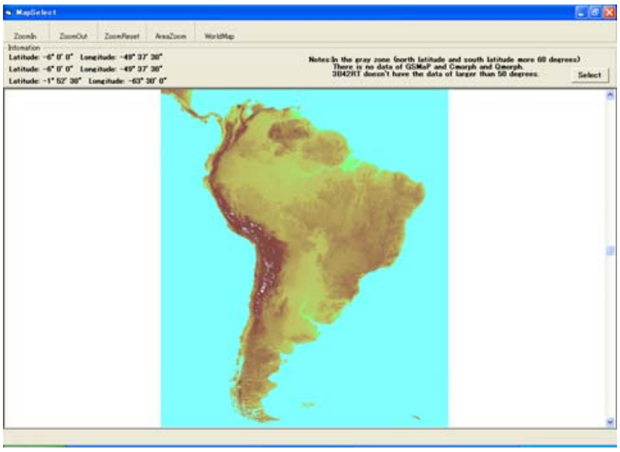
Australia



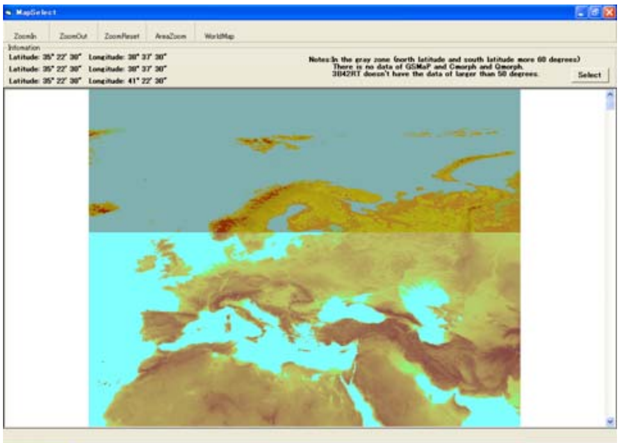
North America



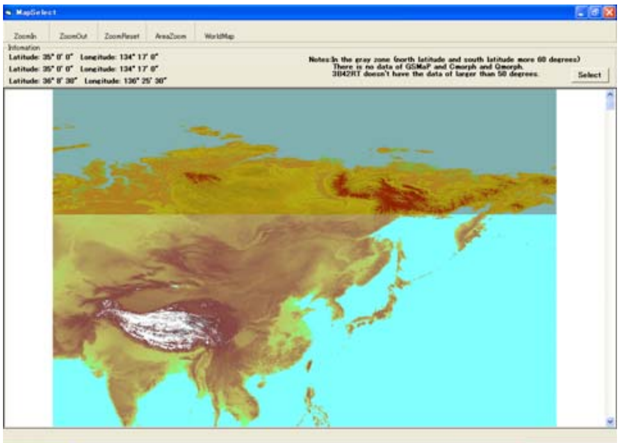
South America



Europe



Asia



4.3 Importing Various Data

4.3.1 Type and features of external data

Generally, IFAS creates runoff calculation model by using those data normally obtained from internet ("GTOPO30" data are required at least). Type and general information of external import data relevant to IFAS are shown as follows

Table 4.1 Type of import data provided on internet relevant to IFAS

Division	Name	Creator	Grid size	Coordinate	Data format
DEM	GTOPO30	USGS	Horizontal grid (1 km mesh) spacing is 30-arc seconds	Horizontal direction WGS84 Vertical direction, meter unit from average sea level	Data of 33 tiles are provided as 8 files.
	Hydro1k	USGS	Horizontal grid (1 km mesh)	lambert Azimuthal Equal Area	af_dem.bil,as_dem.bil ,au_dem.bil,eu_dem. bil,na_dem.bil.sa_de m.bil as 6 files
	Global Map	ISCGM	Horizontal grid (1 km mesh) spacing is 30-arc seconds	Horizontal direction WGS84 Vertical direction, meter unit from average sea level	Data of 33 tiles are provided as 8 files.
Land use	GLCC	USGS EDC	1km grid	Spatial coordinate---ITRF94 ellipsoid---GRS80	Raster data (img), binary data
	Global Map	ISCGM	Horizontal grid (1 km mesh) spacing is 30-arc seconds	Horizontal direction WGS84 Vertical direction, meter unit from average sea level	Data of 33 tiles are provided as 8 files.
Climate	WORLDCLIM	NatureServe	30 seconds mesh (about 1km mesh)	Horizontal direction WGS84	bil format esri format
Soil, Geology, and so on	Soil classification	UNEP/DEWA/GRID	1 degree	Origin point of 90 degrees North latitude and 180 degrees West longitude	bil
	Soil depth	GES DISC,NASA	1 degree (111km)		bil、sol
	Soil water holding capacity	UNEP/DEWA/GRID	1 degree	Origin point of 90 degrees North latitude and 180 degrees West longitude	bil
	Geological classification	CGMW		Mercator image method	Bsq CD（Arc Info format）

4.3.1.1 Topographical elevation data

① GTOPO30 / elevation (DEM)

http://www1.gsi.go.jp/geowww/globalmap-gsi/gtopo30/gtopo30.html

GTOPO30 is a global elevation database (DEM data), which is first created from those data provided by 8 institutes including NASA, UNEP/GRID, NIMA, USAID, INEGI, GSI, and SCAR. The horizontal coordinate system is decimal degrees of latitude and longitude referenced to WGS84. The vertical units represent elevation in meters above mean sea level. GTOPO30 covers the full extent of latitude from 90 degrees south to 90 degrees north, and the full extent of longitude from 180 degrees west to 180 degrees east. The horizontal grid (1 km mesh) spacing is 30-arc seconds, resulting in a DEM having dimensions of 21,600 rows and 43,200 columns.

GTOPO30 has been divided to 33 tiles, and is available free as eight files.

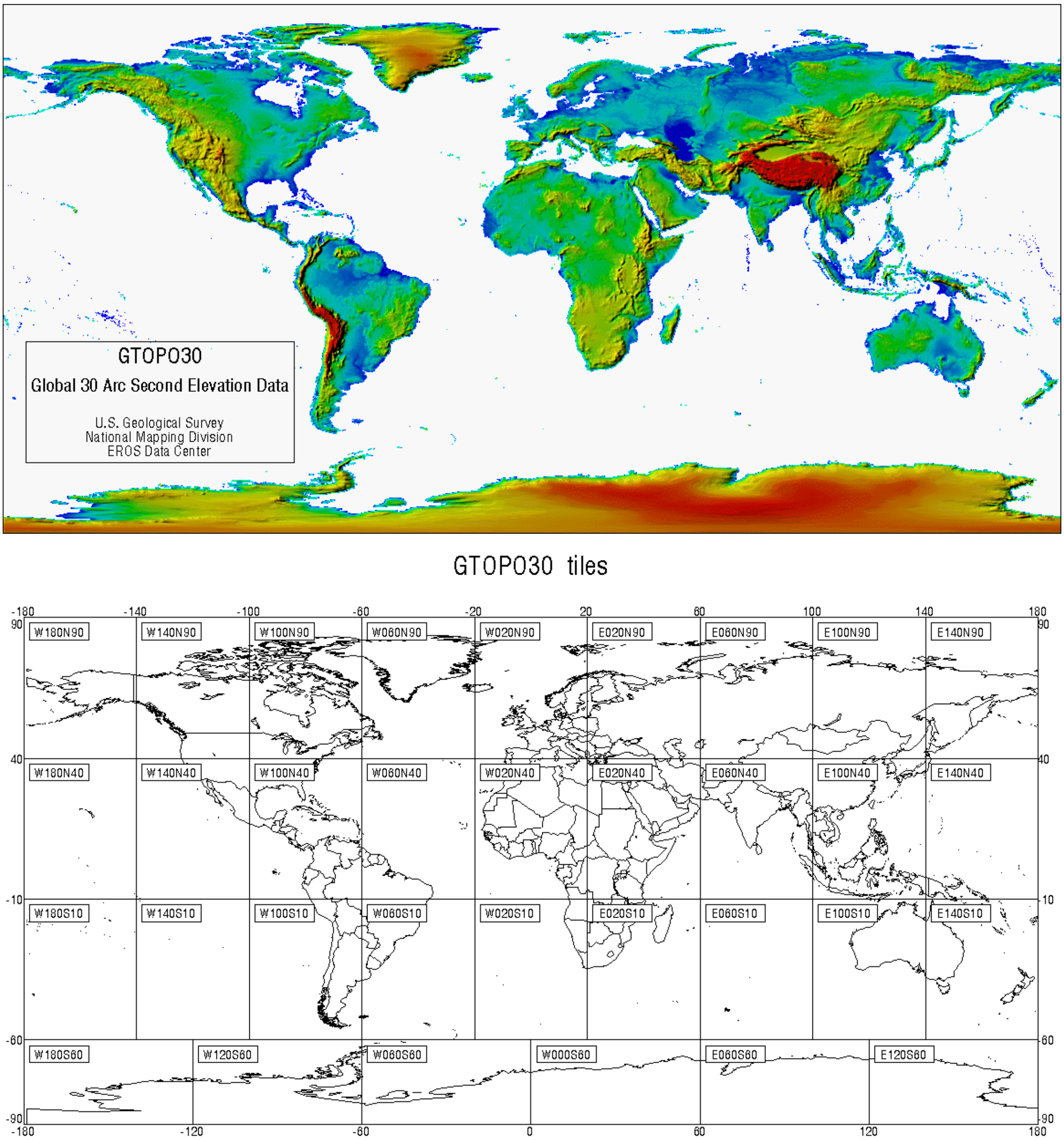


Fig. 4.1 Tile division of GTOPO30

②Hydro1k / elevation (DEM)

http://edc.usgs.gov/products/elevation/gtopo30/hydro/index.html

Hydro1k is a geographic database developed to provide comprehensive and consistent global coverage of topographically derived data sets, including streams, drainage basins and ancillary layers derived from GTOPO30 and projected by lambert Azimuthal Equal Area. Hydro1k provides a suite of geo-referenced data sets, both raster and vector, which will be of value for all users who need to organize, evaluate, or process hydrologic information on a continental scale.

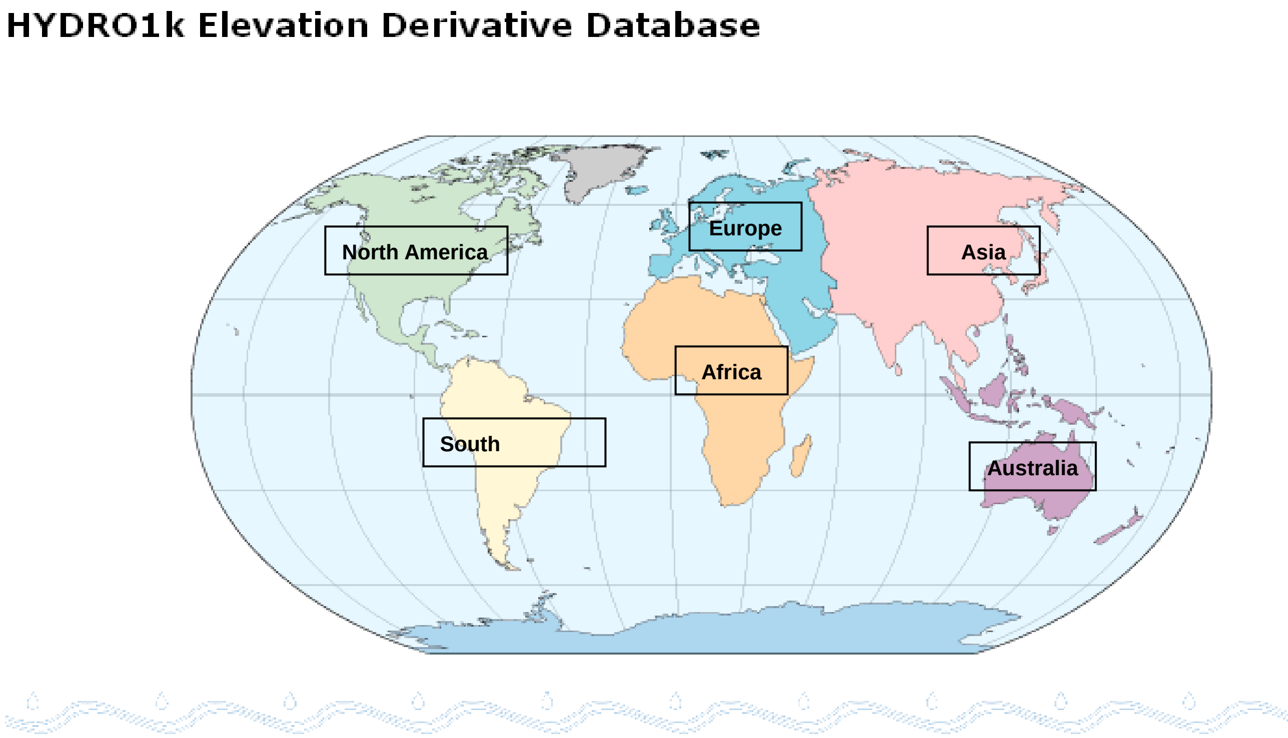


Fig. 4.2 Tile division of Hydro1k

③ Global Map / elevation (DEM)

http://211.19.49.27/gmd/

Global Map is made of each country's public map data aiming to develop digital geographic data sets of the whole globe. The project is in charged of the national mapping organization of each country, the Geographical Survey Institute of Ministry of Construction of Japan (current Ministry of Land, Infrastructure and Transport of Japan) is such a organization in Japan.

The IFAS only uses Global Map's raster data. The raster data is all 30" by 30" latitude/ longitude grid as one pixel as Binary (bil) files without header.

The raster data covers elevation, vegetation, land cover, and land use data, among which the elevation, land cover, and land use data are used.

The resolution of data is 30" by 30" grid, as the same as GTOP30 and Hydro1k.

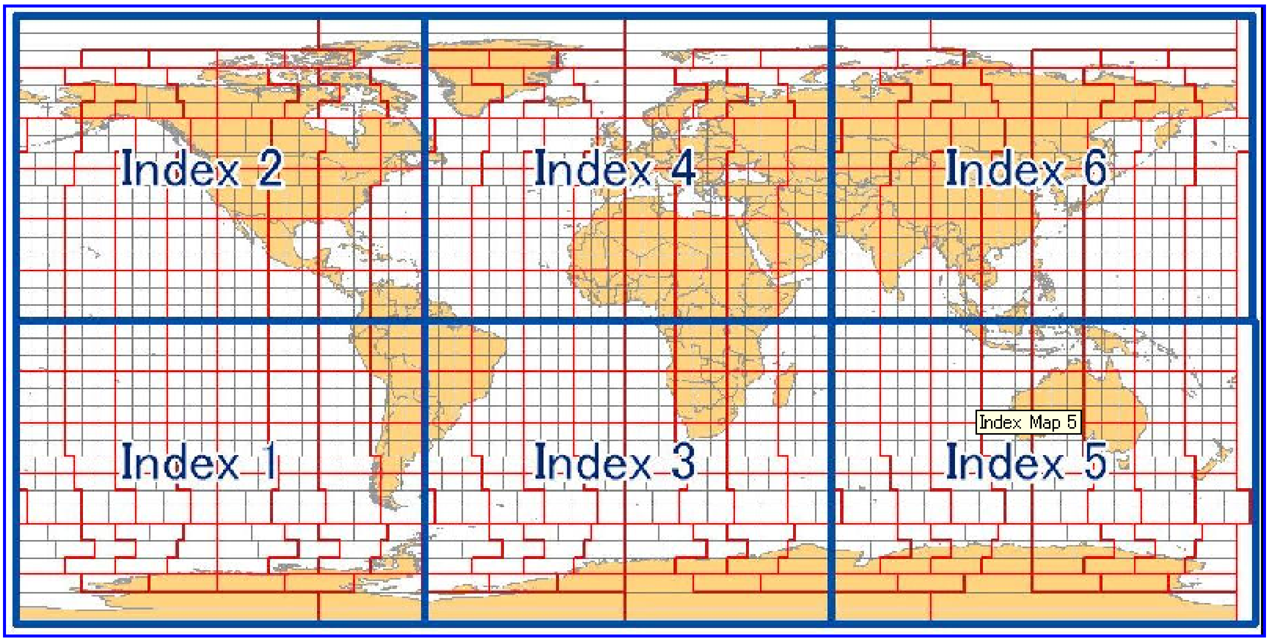


Fig. 4.3 Tile division of Global Map

Table4.2 Land use division in GlobalMap

Classification	Code value
Forest	10
Mixed Forest	20
Meadow, scrub, and open forest	30
Cropland	40
Wetland	50
bare land	60
Urban	70
Lakes and marshes and river	80
Sea	90

Table4.3 Land cover division in GlobalMap

Land cover GLCNMO（Report of WG4 in ISCGM 15th Meeting)−

Classification	Code value
Broadleaf Evergreen Forest	1
Broadleaf Deciduous Forest	2
Needleleaf Evergreen Forest	3
Needleleaf Deciduous Forest	4
Mixed Forest	5
Tree Open	6
Shrub	7
Herbaceous	8
Herbaceous with Sparse Tree/Shrub	9
Sparse vegetation	10
Cropland	11
Paddy field	12
Cropland / Other Vegetation Mosaic	13
Mangrove	14
Wetland	15
Bare area,consolidated(gravel,rock)	16
Bare area,unconsolidated (sand)	17
Urban	18
Snow / Ice	19
Water bodies	20

4.3.1.2 Climate data (WORLDCLIM) (This feature has been stopped)

http://www.worldclim.org/

WORLDCLIM is a global (except Antarctica) climate database. They are available at 4 different spatial resolutions; from 30 seconds (about 1 km) to 2.5, 5 and 10 minutes. The datum is WGS84. Data are recorded as a monthly mean from year 1950 to 2000. The data set includes mean temperature, minimum temperature, maximum temperature, precipitation, bioclim and altitude. Data can be downloaded in the format of bil or/and esri.

Bioclim represent the variation or season temperature/precipitation of said monthly mean, minimum, maximum temperature and precipitation. Bioclim is shown as follows:

BIO1 = Annual Mean Temperature (°C * 10)
BIO2 = Mean Diurnal Range (Mean of monthly (max temp - min temp)) (°C * 10)
BIO3 = Isothermality (BIO2/BIO7) (* 100)
BIO4 = Temperature Seasonality (standard deviation *100)
BIO5 = Max Temperature of Warmest Month (°C * 10)
BIO6 = Min Temperature of Coldest Month (°C * 10)
BIO7 = Temperature Annual Range (BIO5-ＢＩＯ6) (°C * 10)
BIO8 = Mean Temperature of Wettest Quarter (°C * 10)
BIO9 = Mean Temperature of Driest Quarter (°C * 10)
BIO10 = Mean Temperature of Warmest Quarter (°C * 10)
BIO11 = Mean Temperature of Coldest Quarter (°C * 10)
BIO12 = Annual Precipitation (㎜)
BIO13 = Precipitation of Wettest Month (㎜)
BIO14 = Precipitation of Driest Month (㎜)
BIO15 = Precipitation Seasonality (Coefficient of Variation) (㎜)
BIO16 = Precipitation of Wettest Quarter (㎜)
BIO17 = Precipitation of Driest Quarter (㎜)
BIO18 = Precipitation of Warmest Quarter (㎜)
BIO19 = Precipitation of Coldest Quarter (㎜)

Each of the monthly minimum, maximum, mean temperature, precipitation, and Bioclim (as climate data) data can be imported in separate in IFAS (Only in bil format).

Volume of Wordclim data is large, and download can be conducted by dividing the dataset to tiles as following at a resolution of 30 seconds mesh.

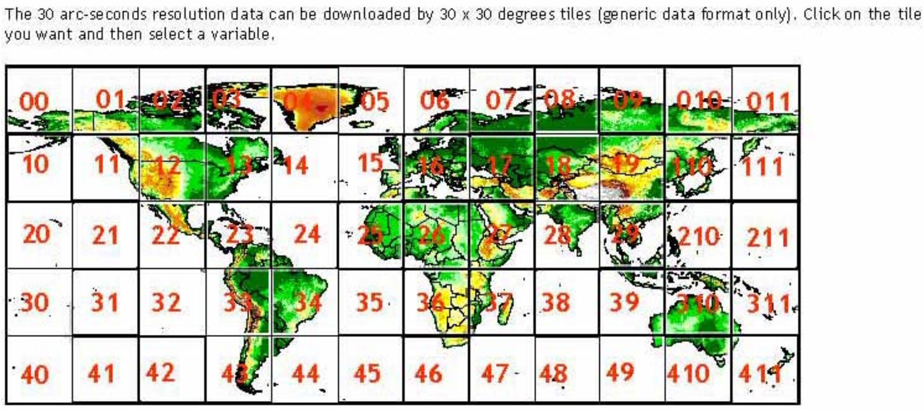


Fig. 4.4　Tile division in WORLDCLIM（as 30 seconds mesh）

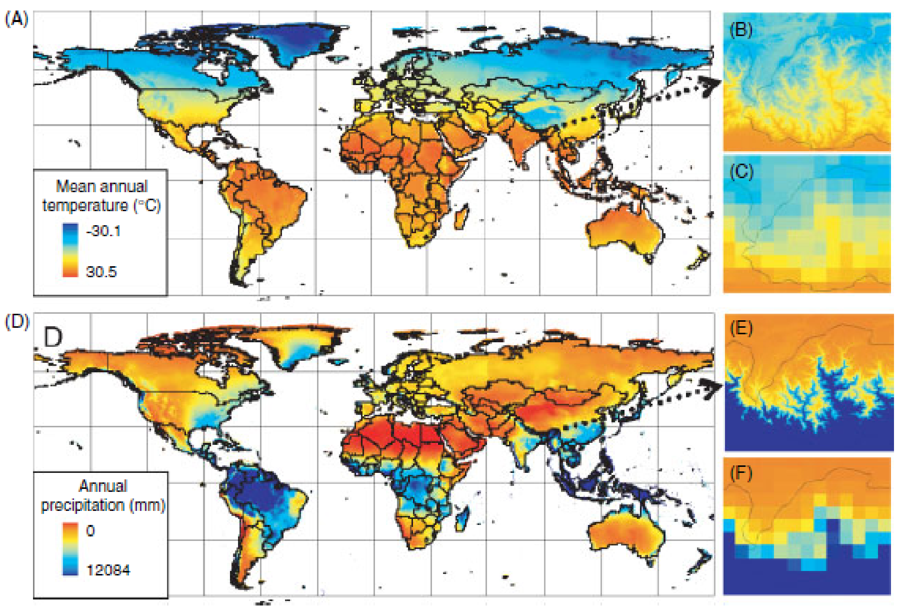


Figure 4. Mean annual temperature (A) and annual precipitation (D). Close ups for an area including western Bhutan of about 220 by 190 km at the 30 arc s (~1 km) resolution (B and E) and at a 10 arc min (~18 km) resolution (C and F). This figure is available in colour online at www.interscience.wiley.com/ijoc

Fig. 4.5　Global mean temperature and precipitation according to WORLDCLIM

(Reference：VERY HIGH RESOLUTION INTERPOLATED CLIMATE SURFACES FOR GLOBAL LAND AREAS)

4.3.1.3　Land use data GLCC

http://edcsns17.cr.usgs.gov/glcc/

GLCC, generated by the U.S. Geological Survey (USGS), the University of Nebraska-Lincoln (UNL), and the European Commission's Joint Research Centre (JRC), is a 1-km resolution global land cover characteristics database for use in a wide range of environmental research and modeling applications. Its land use characteristics are classified to 24 divisions as follows:

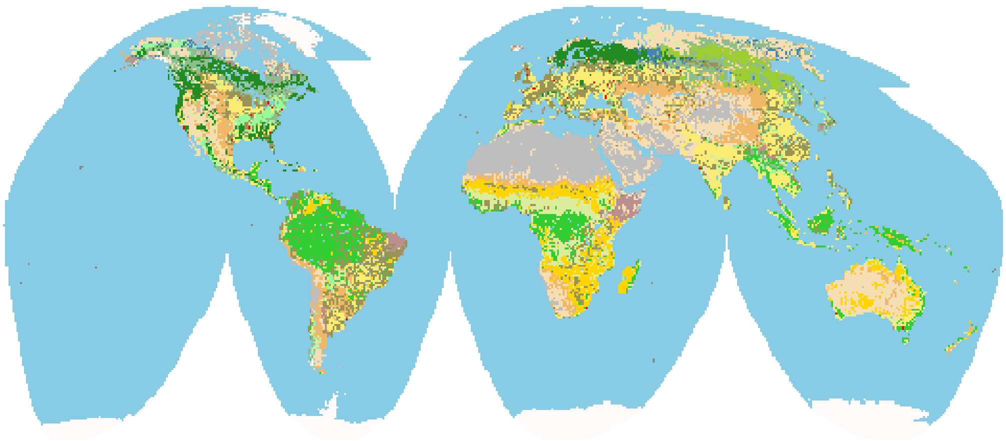


Fig. 4.6 Divisions of land use in GLCC

Value	Code	Class Name
0		INTERRUPTED AREAS (GLOBAL GOODES HOMOLOSINE PROJECTION)
1	100	Urban and Built-Up Land
2	211	Dryland Cropland and Pasture
3	212	Irrigated Cropland and Pasture
4	213	Mixed Dryland/Irrigated Cropland and Pasture
5	280	Cropland/Grassland Mosaic
6	290	Cropland/Woodland Mosaic
7	311	Grassland
8	321	Shrubland
9	330	Mixed Shrubland/Grassland
10	332	Savanna
11	411	Deciduous Broadleaf Forest
12	412	Deciduous Needleleaf Forest
13	421	Evergreen Broadleaf Forest
14	422	Evergreen Needleleaf Forest
15	430	Mixed Forest
16	500	Water Bodies
17	620	Herbaceous Wetland
18	610	Wooded Wetland
19	770	Barren or Sparsely Vegetated
20	820	Herbaceous Tundra
21	810	Wooded Tundra
22	850	Mixed Tundra
23	830	Bare Ground Tundra
24	900	Snow or Ice
100		NO DATA

4.3.1.4 Soil and geological data (UNEP)

a) UNEP (World soils for global climate modeling) / Soil classification (Soil phase division)

http://www.grid.unep.ch/data/data.php

This is a soil classification dataset resident on GRID (Global Resource Information Database) belonging to UNEP (United Nations Environment Programme).

GRID integrates various environmental data, including remote sensing data, data gathered and processed by GEMS, to raise awareness and support decision-making processes for researcher and policymakers. GRID also aims to provide and transfer technology in processing environmental data for developing countries.

The Zobler "World Soil File for Global Climate Modeling" shows the global distribution of soil types, including data for dominant soil units (classification of soil types), slope classes, soil texture classes and soil phases. These have been generalized from the FAO Soil Map of the World (FAO, 1974) and the Matthews Vegetation data (1984) into one-degree square latitude/longitude grid cells, using a dot grid overlay technique to determine the largest map unit of each one-degree cell.

Data files have the following characteristics: spatial resolution of one degree latitude/longitude; one byte or eight bits per pixel; 180 rows (lines or records) by 360 columns (elements/pixels/samples) of data; origin point of 90 degrees North latitude and 180 degrees West longitude; extent to 90 degrees South latitude and 180 degrees East longitude.

However, all results be relative to GRID data have the obligation to reference original provider GRID and UNE. For example, please note “provided by UNESCO (1987), GRID”.

The five data files available from UNEP/GRID are the following:

i) A generalized version of the soil units with 27 categories, which correspond to the 26 so-called “Great Soil” groups and ice;

ii) The complete version of the soil units with 106 soil classes;

iii) The dominant soil slopes with seven slope categories;

Iv) The dominant soil textures with eight texture categories;

V) The dominant soil phases with 18 phase categories (not all one-by-one degree land cells have phase values associated with them, and the GRID version of this data layer shows only one out of up to four phases).

New legends have been developed for each of the five data layers, which include the same classes but slightly different numbering schemes than the original Zobler "World Soil File".

IFAS is capable to import the mentioned phase classification.

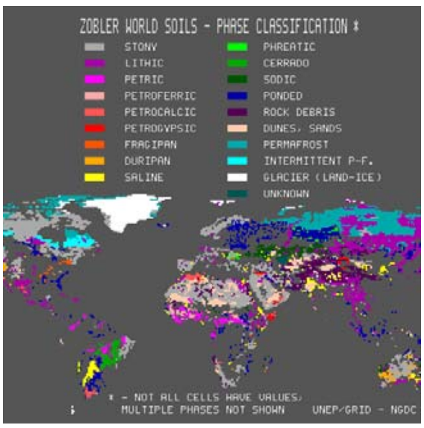


Fig. 4.7 World soil file (Phase classification)

Table 4.4 World soil file (Legend of phase classification)

Number	Soil phase classification
0	Water
1	Stony
2	Lithic
3	Petric
4	Petroferric
5	Petrocalcic
6	Petrogypsic
7	Fragipan
8	Duripan
9	Saline
11	Phreatic
12	Cerrsdo
13	Sodic
21	Perm afrost
22	Perm afrost; intermittent
23	Glacier(i.e.,land-ice)
24	Ponded
25	Dunes,Sands
26	Rock debris
27	Unknown

b) UNEP (Soil Water Holding Capacity)

http://www.grid.unep.ch/data/data.php

This data set shows the global distribution of soil water holding capacity, at field capacity for the top 30 centimeters of soil (0-30 cm.). It was derived from information on soil type and texture at a one-by-one degree latitude/longitude resolution from the FAO Soil Map of the World. The data set was developed in 1990 at the NASA/Goddard Institute of Space Studies (GISS), Columbia University, New York City by Lex Bouwman of the National Institute of Public Health and Environmental Protection (RIVM; P.O.Box 1; 3720 BA; Bilthoven, the Netherlands) and scientists at NASA/GISS.

The data set has the following legend and values.

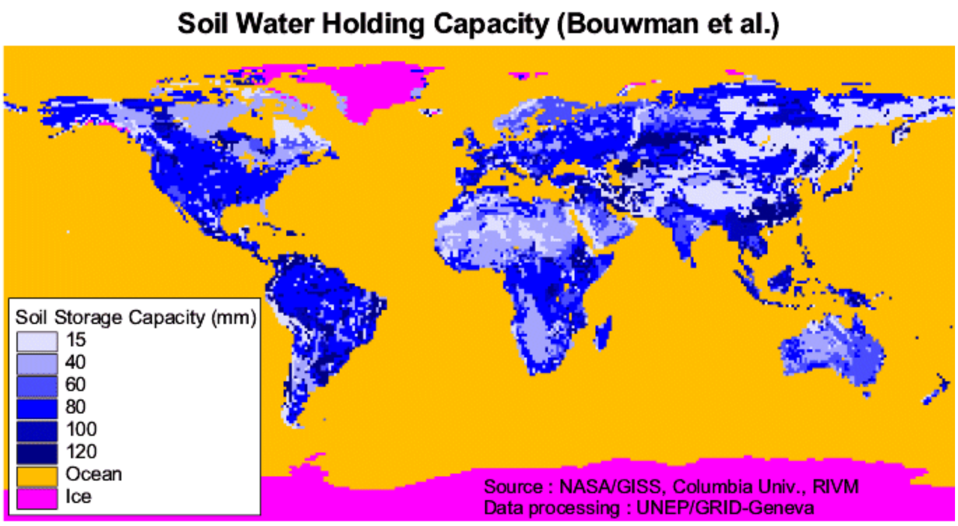


Fig. 4.8 Soil water holding capacity

Table 4.5 Legend of soil water holding capacity

Soil property classification	d.n. Value(mm)
Rendzina Lithosol Ranker	15 (FAO code 22,40,85)
SAND	40
ORGNIC	60
Vertisol	60 (FAO code 86,87)
MEDIUM	80
Vertic Cambisol Luvisol	80 (FAOcode 13,55)
Ferralsol	80 (FAOcode 23~28) 100
FINE	120
Andosol	120 (FAOcode 81~84)
Oceans	-250
Ice	-251

4.3.1.5 Geological classification (CGMW)

http://ccgm.free.fr/index_gb.html

CGMW (Commission for the Geological Map of the World) is a global geological classification map developed in 2000. The CD is a joint publication of UNESCO, and on sale.

4.3.1.6 Soil depth (GES)

http://web.archive.org/web/20040311134024/daac.gsfc.nasa.gov/CAMPAIGN_DOCS/ISLSCP/DATASET_DOCUMENTS/SOILS.html

This is a soil depth data set developed by Goddard Earth Sciences Data and Information Services Center(GES DISC) and NASA.

Data set is provided by CD, and cannot be downloaded.

4.3.2 Type and format of other data

Beside the discussed external data, IFAS can import topographical elevation data and background figures made by GIS or other software. User has to create these data freely by software on sale.

Because the form of elevation data imported by the IFAS is text file (ESRI Arc/Info), user has firstly to edit the data using notepad and/or WordPad and then create the data file in the later discussed form. User then select the created files from the GRID (ESRI Arc/Info) item of elevation importation to complete the whole data importation.

Type and format of data are shown as follows.

4.3.2.1 Topographical elevation data and Elevation grid data (ESRI Arc/Info)

User may create topographical elevation data by software like GIS instead of those GTOPO30 data. Grid data are generally made by GIS. However, because text data are also available, grid data can be created by text editor or software like table calculator.

Following is a display of the format of grid data.

```
ncols 58          ←column
nrows 39          ←row
XLLCORNER 487339.289969151   ←X coordinate of bottom left
YLLCORNER 4399671.14425054   ←Y coordinate of bottom left
CELLSIZE 1000.000   ←cell size (m)
nodata_value -9999   ←no data
685.4 585.4 469.3 399.1 503.2 537 635.7 593 571.4 581 582.1 512
729 614 445.8 489.4 580.1 638.7 681.4 655.3 604 615.4 620.9 543.
637.7 511.5 466 550.4 669.7 739.4 780.8 725.9 639.9 616.7 641.2
598.3 492.5 520.8 597.6 676.1 784.7 870.4 792.7 662.1 605.3 604.
622.9 511.6 579.2 723.9 804 843.6 849.3 758.1 650.1 583 555.9 58
623.1 535.8 645.4 745.1 808.5 809.6 737.3 678.1 587.6 526.2 526.
586.6 601.8 696.8 768.1 724.4 714.6 637.6 617 542.5 504.8 497.2
624.2 662 700.7 775.1 781.7 747.1 729.6 688 590.2 504 481.6 494.
691 696.4 705.1 758.6 832.7 832.8 798.1 755.2 587.5 512.6 503 50
769.8 751.8 796.7 800.5 848.8 809 708.4 710.5 669.3 601.1 565.5
897.9 829.8 853.5 874.3 899.1 830 755.1 794.2 734.6 668.3 614.6
1022 932 929.3 991.8 930.1 864 861.1 860.9 809.5 750.2 673.3 584
1174 1100 1057 1130 1012 983.9 970 978.5 950.5 887.7 750.5 591.7
1364 1223 1207 1228 1136 1144 [illegible] [illegible] 1105 1059 843 629.9 565.
1499 1374 1337 1329 1302 1287 1256 1189 1066 1012 839.8 626.3 55
1559 1501 1448 1425 1407 1347 1209 1086 954.1 848.8 735.3 585.4
1477 1461 1417 1375 1376 1247 1043 941.2 850.9 774.6 660.3 525.5
1396 1344 1304 1259 1244 1182 994.3 908.3 832.4 732.2 623.6 485.
1388 1313 1213 1152 1140 1116 993.7 916.5 774.6 664.8 569.5 453.
1407 1378 1180 1052 1024 974.8 900.9 824.8 718.4 594.2 506.9 435
1319 1384 1191 1003 923.4 878.9 740.5 693 623.5 537 482.8 450.4
1249 1314 1188 1125 1099 1011 839.2 765.2 612.1 502.2 505.4 492.
1206 1371 1254 1269 1240 1141 997 870.6 654.8 570.6 567.4 573.4
                              Elevation
```

Fig. 4.9　Format of grid data

4.3.2.2　Background image

Any following graphic data (raster data) can be imported in background image.

① Bitmap data (*.bmp)

Bitmap data is one kind of graphic data. It is composed of 4 structures as follows:

-File header (general information of bmp file is stored);

-Information header (detailed information of bmp image is stored);

-Color palette (definition of being used color is stored);

-Bitmap data (image is stored in pixel).

② Jpeg data (*.jpg)

Jpeg image data is a kind of method to compress digital data of unmovable image. Generally, the format cannot be compressed reversely.

Files (word files) for appointing coordinate are required when using those background images (raster data). Word files are text file, their format are the following:

0.000347905999737426	Degree of Longitude direction of 1 pixel
0.0	Rotation speed of row
0.0	Rotation speed of column
-0.000347901717764735	Degree of Latitude direction of 1 pixel
130.116840619667	Longitude of center in top left pixel
32.1998260491411	Latitude of center in top left pixel

As raster data, images data in format of BMP and JPEG can be used. However, extensions of word files are different according to image format. World file extension is a corresponding extension of image data, to which letter “w” is attached (“bmpw” when BMP, “jpgw” when JPEG).

4.3.3 Selection and storage destination of each import data

Required files and storage destination of each import data are as follows. They are extracted from each data set and the latitude/longitude scope in a rectangular shape designated by the project.

Table 4.6 Files and storage destination of import data

Category	Target external data	Files necessary	Storage folders	Storage files	Remarks
Elevation data	GTOPO30	*.DEM *.HDR *.DMW *.STX *.GIF *.SRC *.SCH	ALD	ALD.asc	select any *Height data indispensabl e
	Hydro1k	*.bil			
	Global Map Elevation	*.hdr *.bil			
	Elevation grid data	*.asc			
Background Map	Bitmap data	*.bmp *.bmpw	MAP	MAP.bmp	Optional
	Jpeg data	*.jpg *.jpgw		MAP.jpg	
Land Use data	GLCC	gusgs2_Oll.hdr gusgs2_Oll.img	LANDUSE	LAND.asc	Optional
	Global Map LandUse	*.hdr *.bil			
Meterogy data	Worldclim (Min.Temperature)	*.hdr *.bil	WORLDCLIM	METE1.asc	Optional
	Worldclim (Max.Temperature)	*.hdr *.bil		METE2.asc	
	Worldclim (Precipitation)	*.hdr *.bil		METE3.asc	
	Worldclim (Bioclim	*.hdr *.bil		METE4.asc	
	Worldclim (MeanTemperature)	*.hdr *.bil		METE5.asc	
Soil,Georogy data	CGWM	CGWM.bsq CGWM.hdr	SOIL	SOIL1.asc	Optional
	World soils for Global climate modeling (Zobler)	Zobphase.bil Zobphase.hdr (gnv007.zip)		SOIL2.asc	
	Thickness of soil	PROFDEP.bil PROFDEP.hdr PROFDEP.SOL		SOIL3.asc	
	Soil Water holding Capacity (Bouwman et al.)	Soil_h2o.bil Soil?h2o.hdr (gnv025.zip)		SOIL4.asc	

4.4 How to download the external data

In IFAS, the external data can be downloaded from each data provider's website. Make sure the internet is connect to your PC before downloading.

Table 4.7 Summary of the external data that corresponding to the IFAS and downloadable from internet

Division	Name	Creator	URL	Storage folder (\IMPORT_DATA)
DEM	GTOPO30	USGS	http://edcftp.cr.usgs.gov/pub/data/gtopo30/global/	Gtopo30
	Hydro1k	USGS	http://edcftp.cr.usgs.gov/pub/data/gtopo30hydro/	Hydro1k
	Global Map	USCGM	http://211.19.49.27/gmd/	GlobalMap(Elevation)
Land use	GLCC	USGS EDC	http://edcftp.cr.usgs.gov/pub/data/glcc/globe/latlon/	Landuse(GLCC)
	Global Map	USCGM	http://211.19.49.27/gmd/	GlobalMap(Land use) GlobalMap(Land cover)

4.4.1 How to download

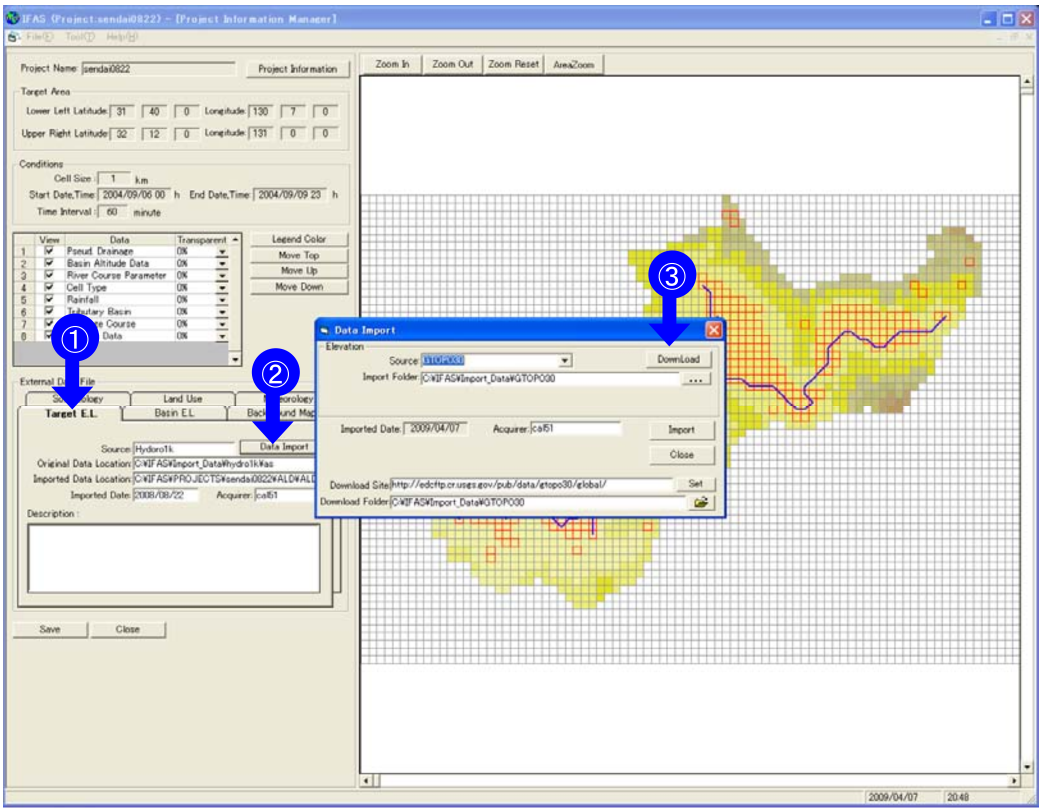
4.4.1.1 How to download GTOPO30, Hydro1k and Global Map

Download the DEM data from each provider's website refer to Table 4.5, then extract data files and save each of them to "Gtopo30", "Hydro1k" and "GlobalMap" folders, which are under the IMPORT_DATA folder.

① For Project Information Manager, select the tab "Target E.L." of External Data File.

② Click the "Data Import" button to display the "Data Import" dialog, then select "Gtopo30", "Hydro1k" and "GlobalMap" from "Source" and ③click the "DownLoad" button.

Because the elevation data has been divided to multiple files and the resolution is very high as 30" by 30" grid, and the file size is very big as several GB, it needs time to download.



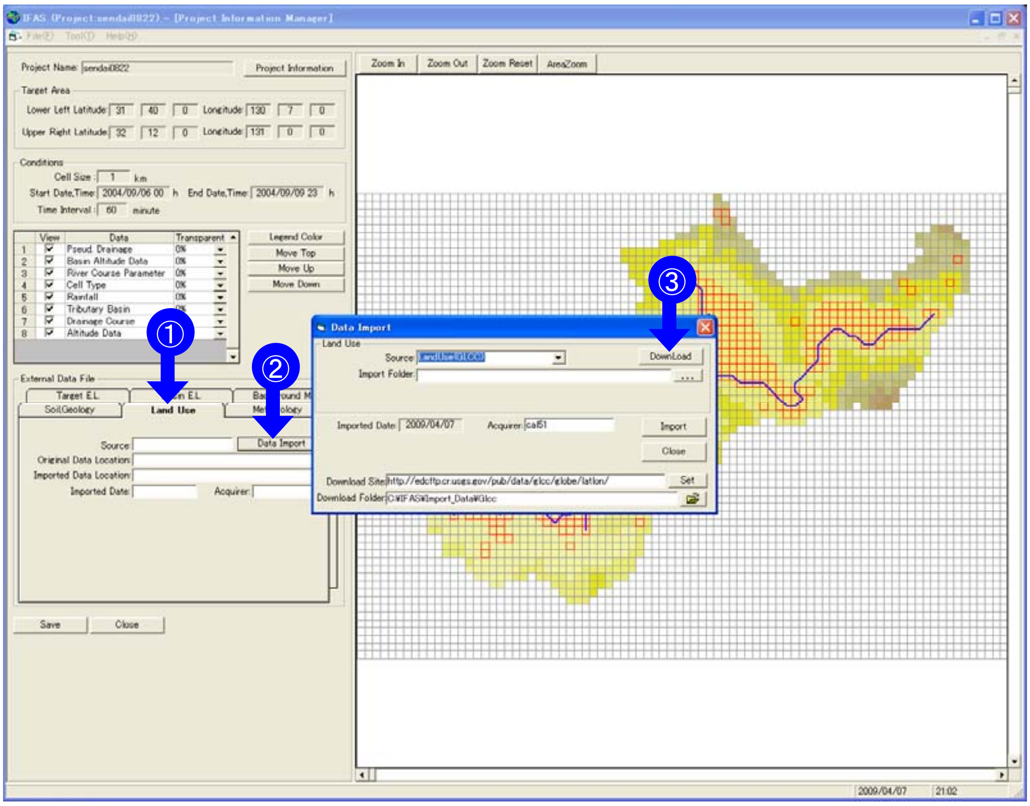
4.4.1.2 How to download Land Use (GLCC)

Download the land use data from the provider's website refer to Table 4.5, then extract data files and save them to "GLCC" folder, which is under the IMPORT_DATA folder.

① For Project Information Manager, select the tab "Land Use." of External Data File.

② Click the "Data Import" button to display the "Data Import" dialog.

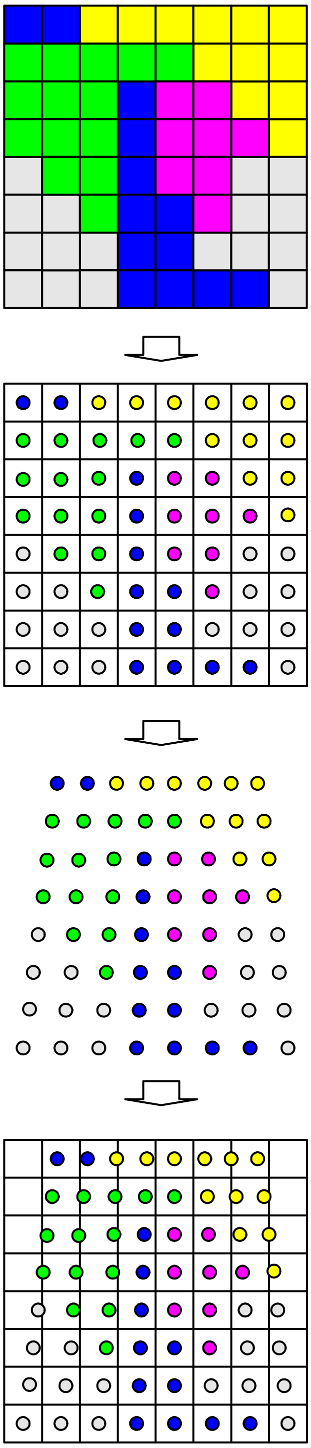
③ Click the "Download" button.



4.5 How to import external

4.5.1 How to import

Grid data in IFAS are treated as data deployed by an approach called UTM (Universal Transverse Mercator). Satellite data used in IFAS are raster format data and the formats are different according to data's properties. Data in IFAS are imported, converted to UTM coordinate, and displayed in grid as the order in following:



a) Prepare the original data and import that as raster data in term of each data's format (i.e. original mesh data by 30 seconds).

b) Assume there are data in the center of mesh. Add spatial coordinate (latitude /longitude) and convert them to vector data.

c) Project points to UTM space, convert spatial coordinate from latitude/longitude to UTM.

d) Interpolate the value of the central point in each of the mesh (i.e. 1 km) defined by user from the point aggregate showed in (4). Interpolate the source data with continuous value (i.e. elevation) by IDW method and theme data (i.e. land use) by Nearest Neighbor method, and convert them to raster data. Then, project points to UTM space.

Fig. 4.10 Schematic representation of method for importing external data

Importing method is shown as follows:

1) Importing each data set as raster data

First, import each data set (elevation, land use, geology, rainfall) as raster data according to their format. Data are divided by latitude/longitude referred to WGS84 (or ITRF94 with comparable same value).

Data are plan binary data, whose configuration is represented by standard text header file (*.HDR). Text header files are read and imported to binary data by import program.

2) Convert to vector data

The imported data are raster data, which can be described as lined real data. Add spatial coordinates to these data and convert them to vector data.

Spatial coordinate is represented by latitude/longitude, because of the original data are raster data which were divided by latitude/longitude in term of WGS84.

3) From latitude/longitude to UTM.

Convert the spatial coordinate of vector data from latitude/longitude to UTM.

ITRF94 is used in the coordinate system. GRS80 is used in the ellipsoid. Because the original data are pre-treated by the WGS84 system, and the WGS84 is the same as IERF94.

4) Interpolate and convert to raster data

After changing the coordinate to UTM, convert data to raster data again. Because it is difficult to overlap the position of vector data with that of the central point of raster cell, use a) the value of nearest vector data or b) the inverse distance weighted mean value of those near points to determine the value of central raster cell.

① Nearest Neighbor (NN) method

Value of the vector data which is the nearest to spatial coordinate of central raster cell is used for the value of central raster cell.

This method can be applied to the data in following, which are represented by code

- -GLCC,Global Map Land use
- -UNEP (World soils for global climate modeling) soil classification
- -CGMW Geological classification

② Inverse Distance Weighted (IDW) method

The values of vector data points near to center coordinate are used as weight instead of distance to take the weighted average value.

To save the labor in points searching, import program just searches the nearest vector and then takes a number of 8 points around the vector. Weight is defined as the square of distance's reciprocal. Data are numerical values which represent volumes, and can be applied to data as follows:

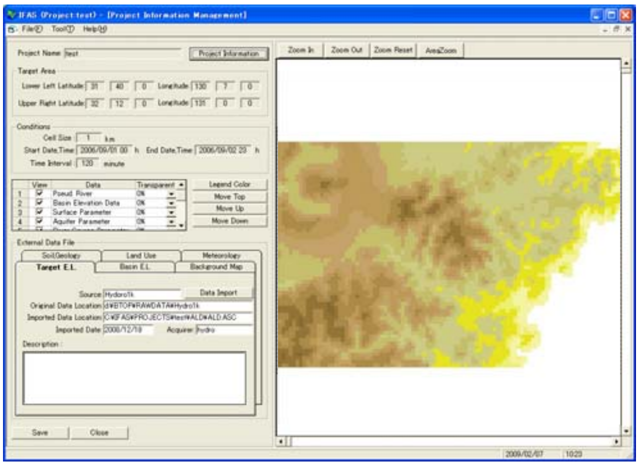
- -GTOPO30 ,Hydro1k,Global Map elevation (DEM)
- -WORLDCLEM (Min.Temperature, Max.Temperature, Precipitation, Bioclim, Altitude) climate
- -UNEP (Soil Water Holding Capacity)

Inverse Distance Weighted Function $V = \sum (w \times v) / \sum w$

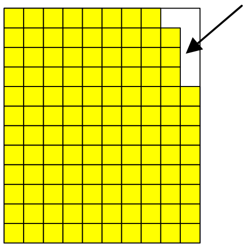
V: mean value; w: weight = $(1/d)^2$; v: value of sample point; d: distance.

4.5.2 Examples of import

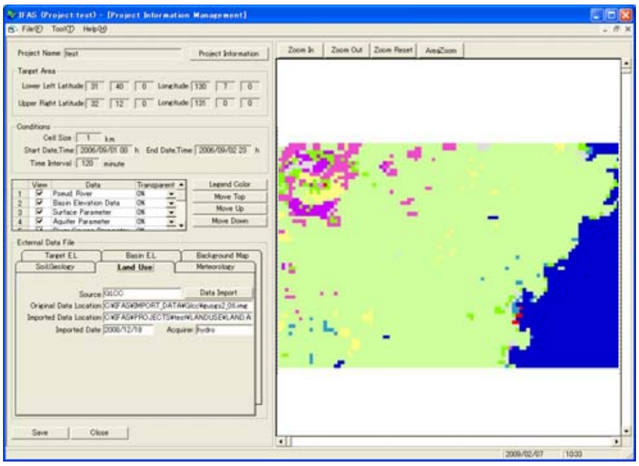
① GTOPO30 (Elevation)



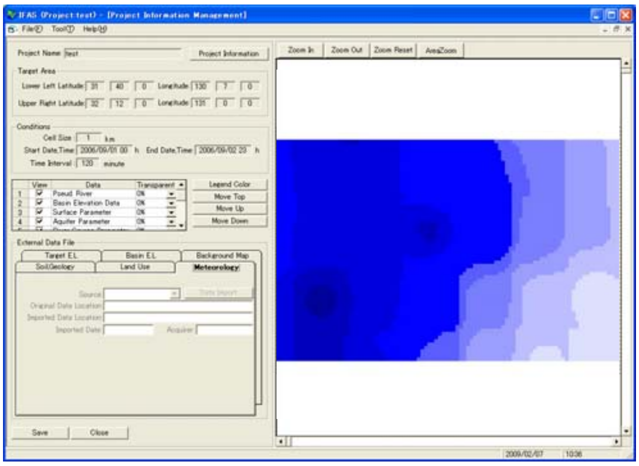
In IFAS, because the original data are extracted and converted to UTM coordinate from the latitude/longitude of the 2 points at bottom left and top right, when the scope becomes larger, a lack of cells at the top as showed in following may occur. This is not error, however an inevitable phenomena which occurs when changing the coordinate to UTM.



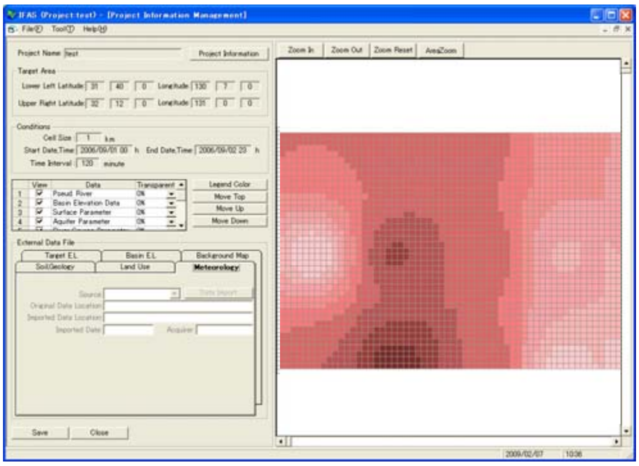
② GLCC (Land use)



③ WORLDCLIM(Minimum temperature)



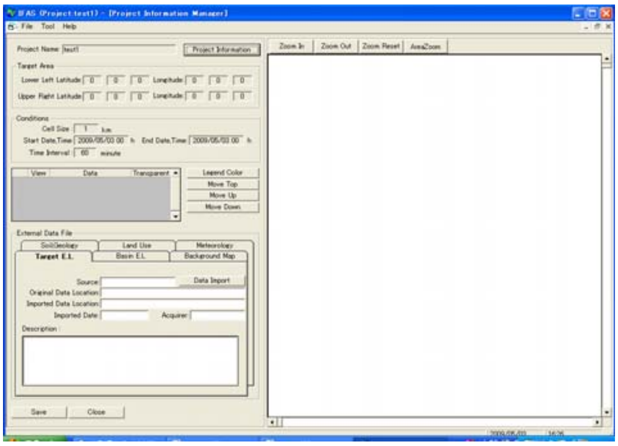
④ WORLDCLIM (Maximum temperature)

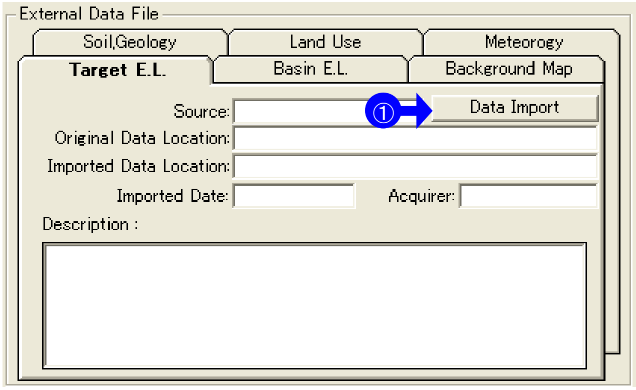


4.6　Operation of importing external data

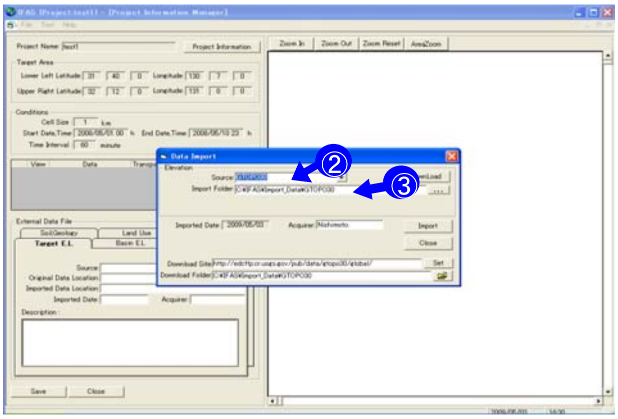
All of the download data or user downloaded data can be imported. Here, “topographical elevation data” is used as an example to explain this procedure.

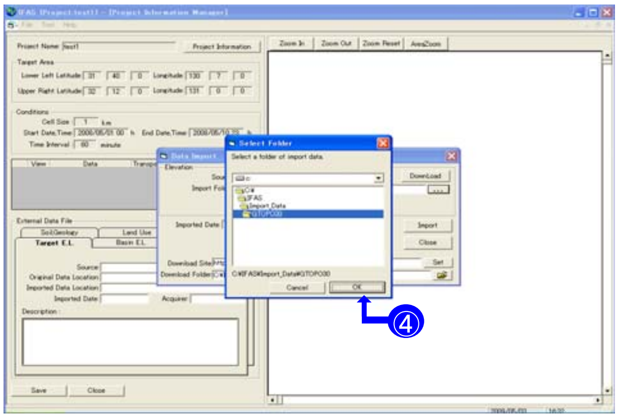
① Select a topographical elevation data tag and click on the “Data Import” button to display the “External Data File” window.





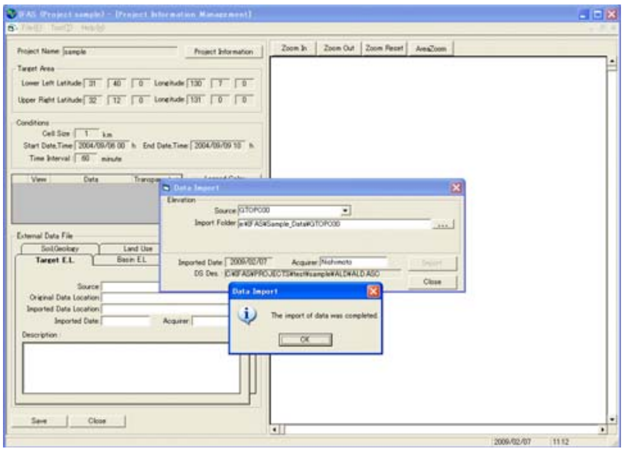
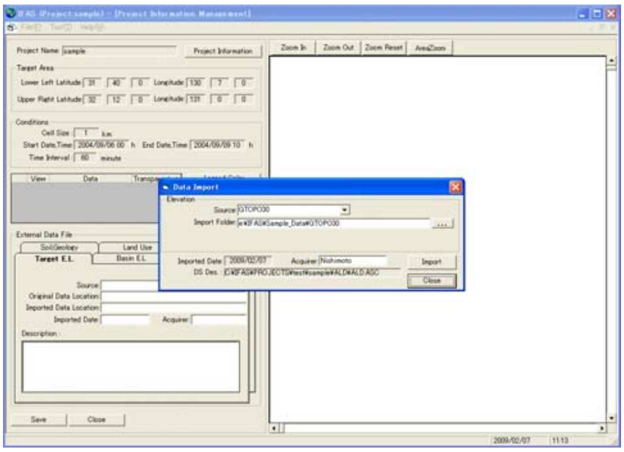
② Select the type of topographical elevation data that you want to import from the type of import data field.



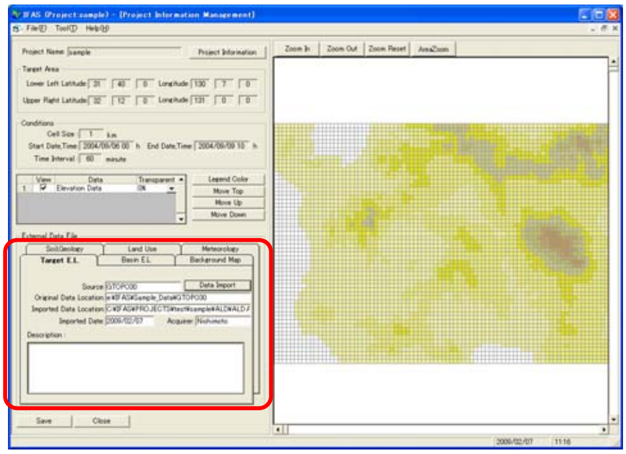


③ Click on the Select button to show the data folder selection window.

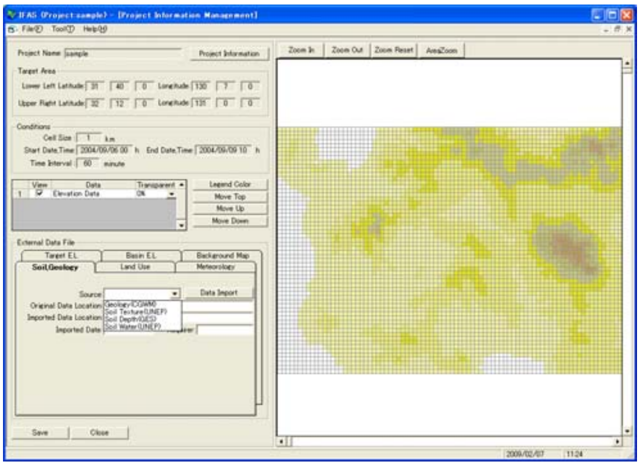
④ Select the folder to which topographic elevation data are being imported to (double-click the folder name) and click on the “OK” button.

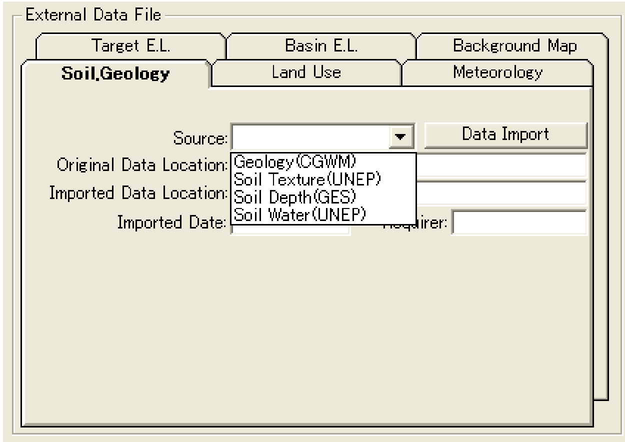



⑤ Click on the “Import” button to display the confirmation window. Click the “OK” button to start data importing. (When the data have been imported, data file will be created at \IFAS\PROJCTS\Project name\Work). Click on the “Close” button to finished import. (Imported topographical data will be saved as temporal file in “Work” folder. Basing on the said file, data will be saved to the “ALD” folder as a file named by “ALD.ASC”. Storage destination and file name can not be changed)



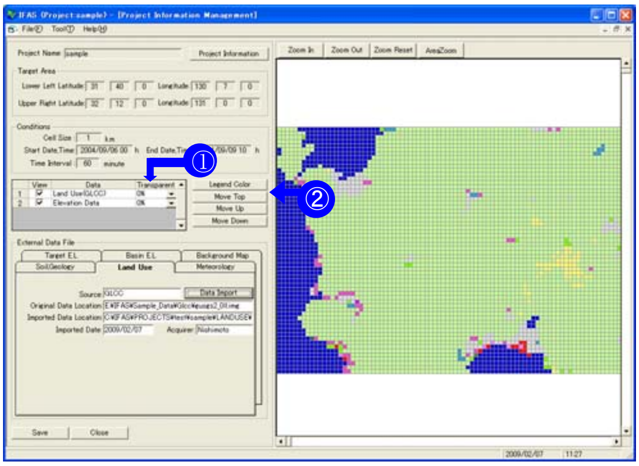
When importing is completed, detailed information of importing will be shown in each data tag.

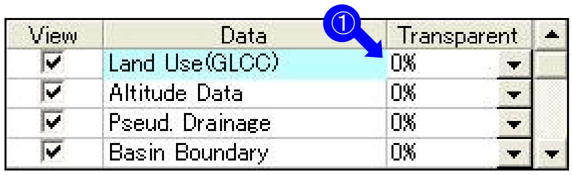




Soil and geological data have four importing data types including “Geology(CGWM)”, “Soil Texture(UNEP)”, “Soil Depth(GES)”, and “Soil Water(UNEP)”. Any of the four types can be selected from the “Source” field. Climate data The import function has stopped now.

4.7 Display of imported data





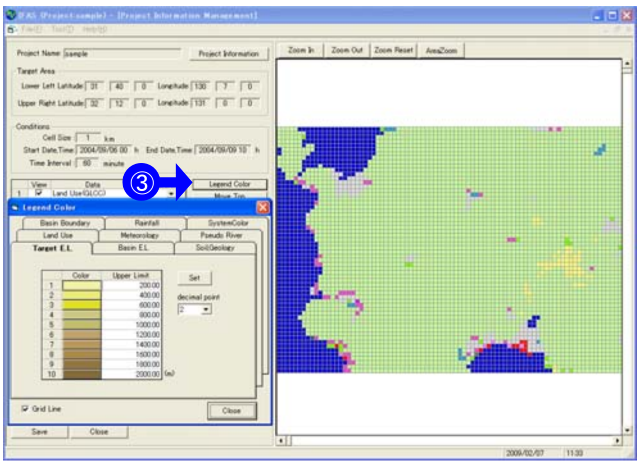
① Check the View option in layer control list to display the layer. Order of layers is same with that in lists (imported data have been saved to layer control list automatically). Layers can be permeated by changing the permeation value in the option field Transparent.

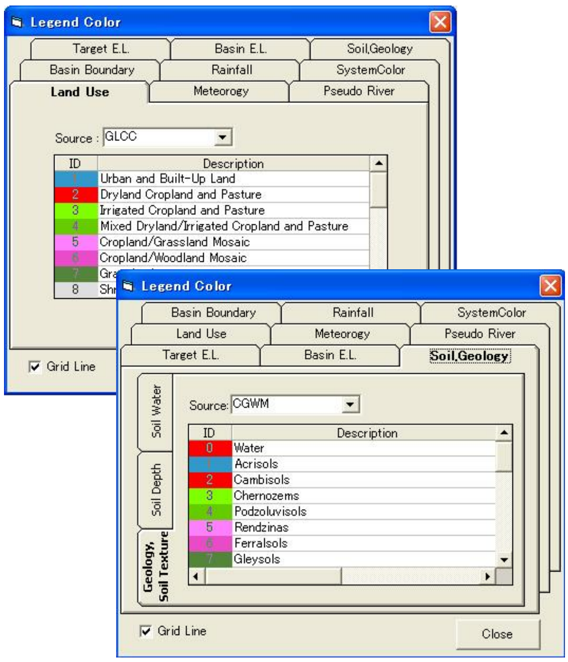
② Layers can be reordered by selecting the data and clicking on the “Move Top”, “Move Up”, and “Move Down” buttons.

“Move Top” button --- to move the selected layer to top of the list

“Move Up” button --- to change the place with upper layer

“Move Down” button --- to change the place with under layer

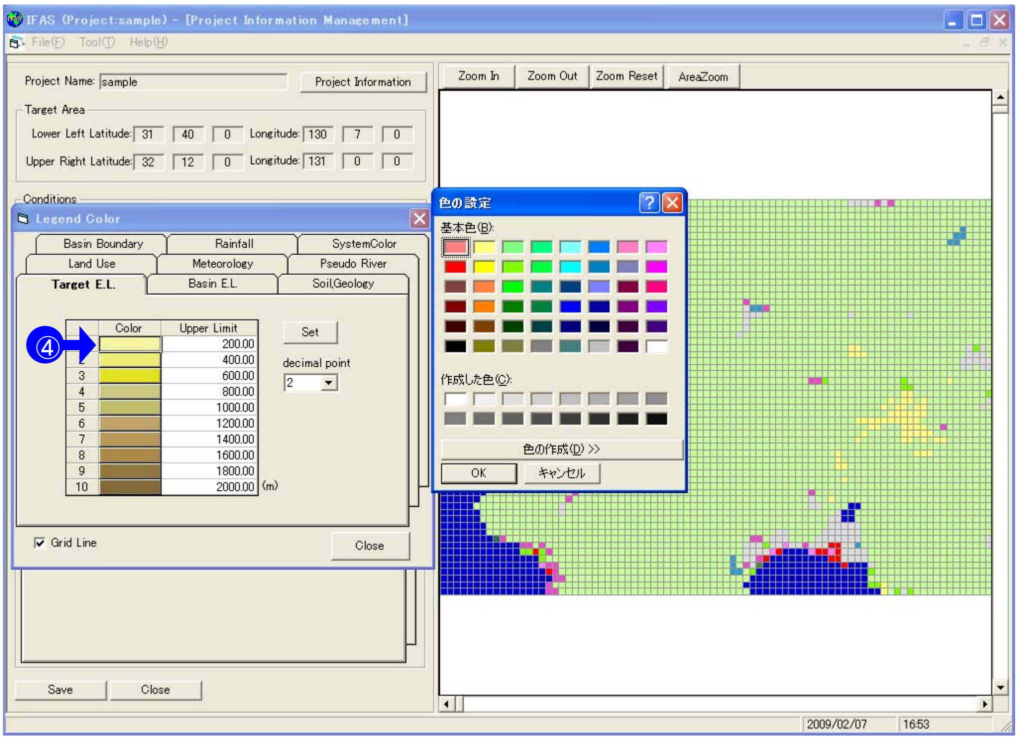




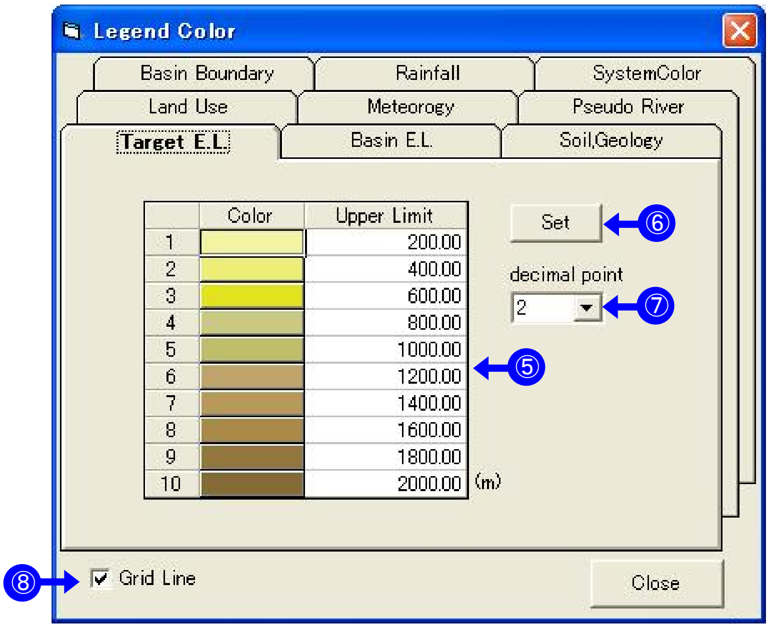
③ Legend, display setting, system color of imported data can be changed by clicking on “Legend Color” button.

Legends are displayed in “Land Use” and “Soil Geology”. In “Soil Geology”, legend of “CGMW” and “UNEP” can be selected, and the display setting of “PROFDEP” and “SOILWATER” can be changed.

The legend can be set according to each project. The changed setting cannot be reflected in other projects.



④ Legend of color is displayed by per item in “Color Bar”. Click on the Color part to display the “Color Set” window. Choose a color to change the setting of legend.



Input a value for relevant item and click “Set” to change the setting of display.

⑤ Click the value part you want to change to edit the value directly.

⑥ Press the “Set” button to complete the changing after editing color or value.

⑦ Decimal digit can be set at “decimal point”.

⑧ Check on “Grid Line” to display the grid line, remove check on “Grid Line” to cancel the display of grid line.

(Remark) The display color when the maximum in altitude value is exceeded is displayed by the color of one (It is yellow in the example).

5 Creation of Runoff Analysis Model (Basin Data Manager)

5.1 Outline of runoff analysis model creation

5.1.1 Procedure of basin data creation

In IFAS, basin region can be determined by following two ways.

① Creation of basin region elevation data

A method to create pseudo river course network based on the difference of elevation estimated from imported topography elevation data, and set river basin boundary.

② Importing river basin boundary elevation data

Existing river basin boundary data (shape file) are imported to determine the river basin boundary.

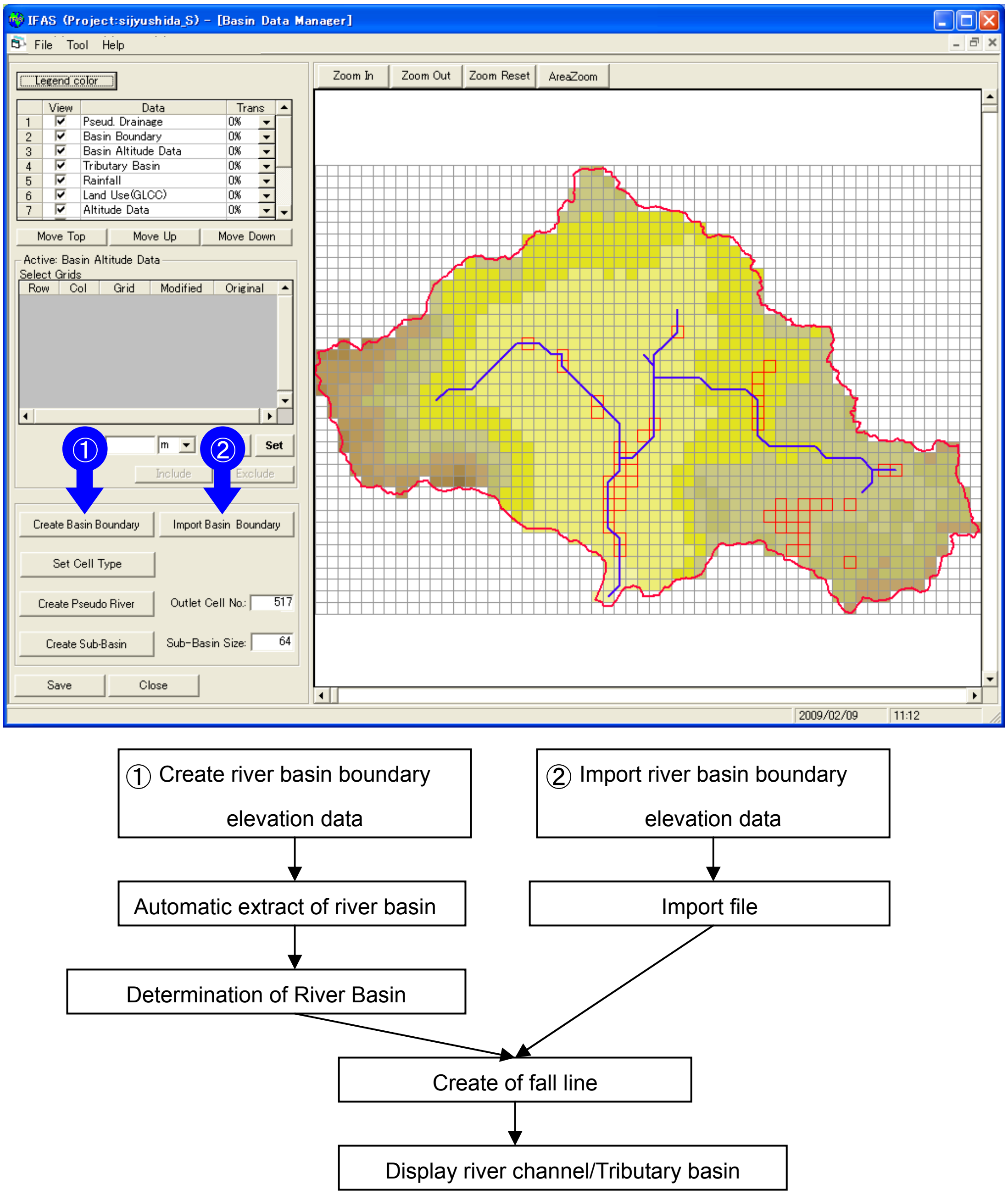


Fig. 5.1 Creation of river basin

5.1.2 Attention items when creating river basin model

When setting river basin boundary from importing river basin boundary elevation data, setting of river basin boundary and pseudo river course which is respond to elevation difference of grid topography is processed. If elevation difference in each grid does not exit, elevation correction by automatic depression process is conducted. Due to elevation with bigger value after correction and process of depression with large and flat value without convergence, failure of river basin model creation also exist.

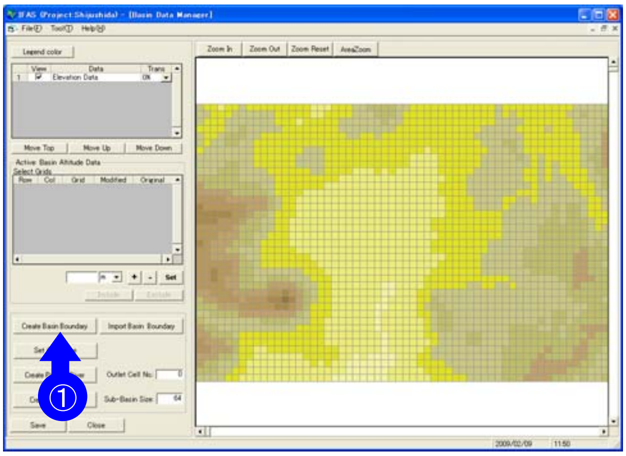
Also for final creation of drainage and pseudo river course, calculation of one of river end drainage net, respond to created elevation difference should be programmed. So following points should be understood.

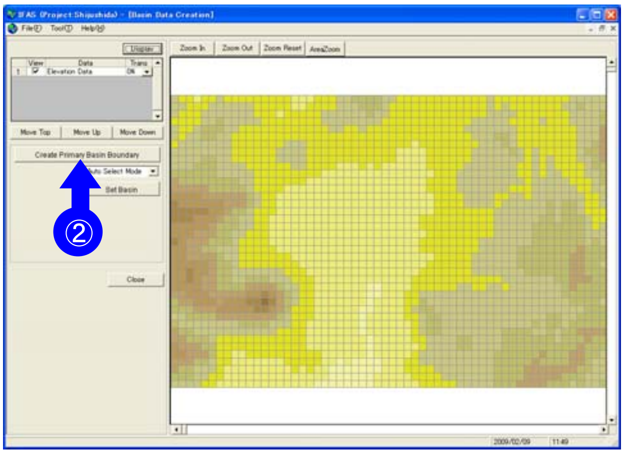
As for river basin with several ends (e.g. Delta), it is necessary to consider in which way to process either by means of setting end of river branch location or correcting elevation of each branch river basin into one river end.

Additionally, when there is difference between data of river basin boundary and imported elevation with set data import format (section of ramp out of river basin also operated as river basin boundary), elevation data of varied part is conducted with depression process compulsorily and imported as data within river basin.

5.2 Creation of the river basin boundary

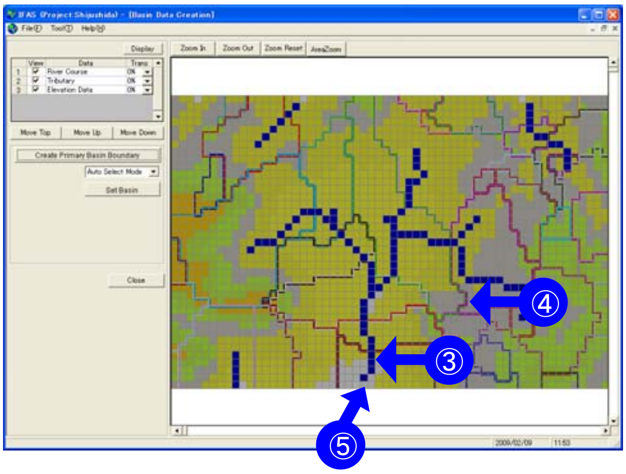
5.2.1 Creation from river basin elevation

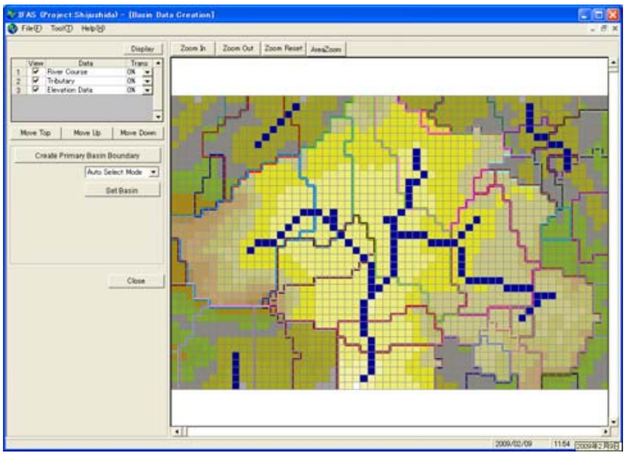




① Click on button “Create Basin Boundary” and picture of “River Basin Data Creation” is shown.

② Click on button “Create Primary Basin Boundary” and standard of each cell elevation, automatic small river basin and pseudo river course network are created.

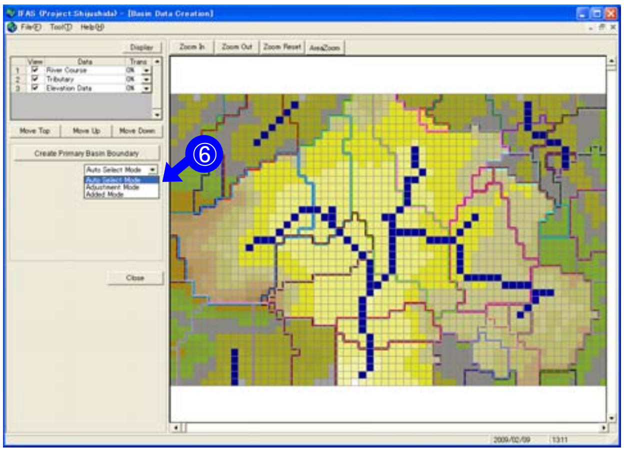


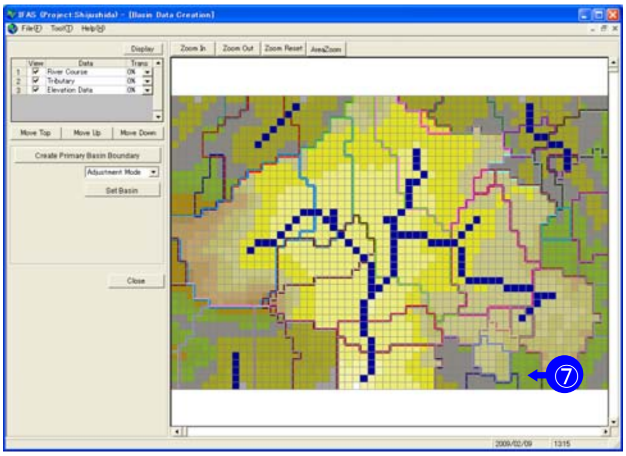


③ Pseudo river channel is displayed by big blue cell.

④ Assembly of each cell presents small river basin which is not conducted with depression process.

⑤ As long as click location of runoff calculation or cell of the lowest downstream, upstream location above clicked cell and river basin subject to is chosen as figure on the right.

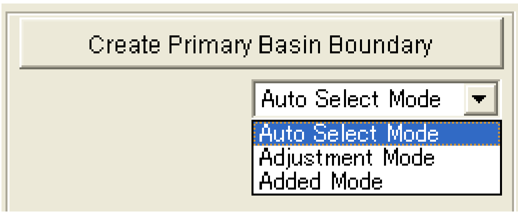




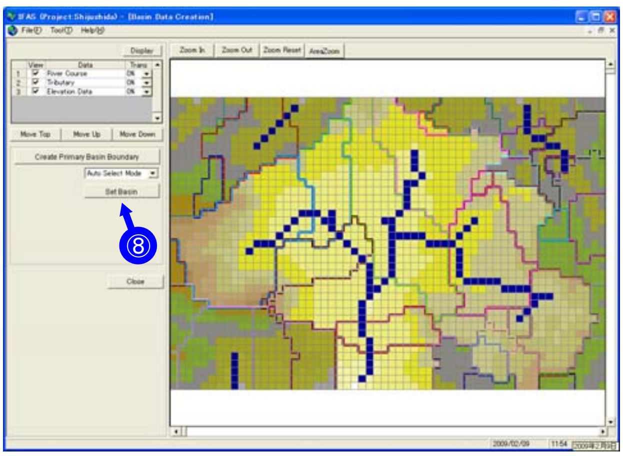
⑥ When shape of subject river basin needs changing, it is possible to change earlier-mentioned small river basin with unit (change of cell at unit is processed and method mentioned later is available).

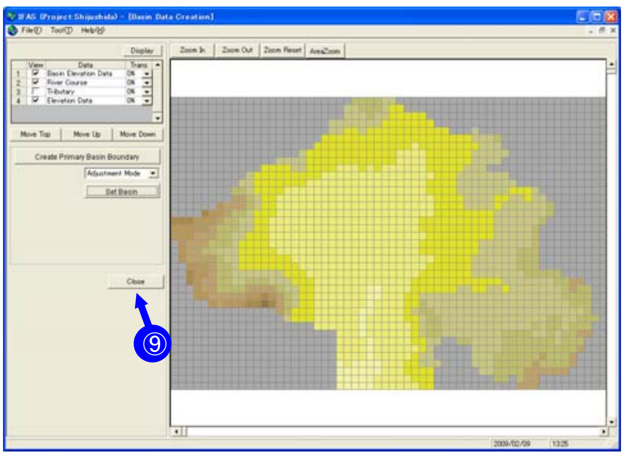
Change “Adjustment Mode” from “Option Mode”

Moreover, all the small river basin where it touches the range (rectangle) specified that "Added mode" is selected with the mouse drug are added to the basin.



⑦ Click on small river basin except subject (highlight will disappear). On the contrary, when small river basin out of river basin is to be added, click the small river basin and highlight will appear. Any multiple option is possible.





⑧ Click on button “Set Basin” if river basin shape is decided.

⑨ As long as choosing, setting of river basin boundary is finalized.

5.2.2 Creation of river basin boundary (Creation from shape file)

River basin boundary elevation model in option by IFAS includes Two types:

-River basin boundary shape file (Shape File)

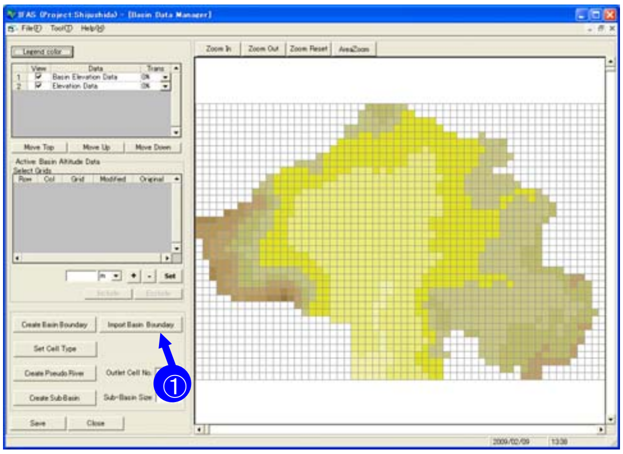
-River basin boundary elevation (Grid data: ESRI Arc/Info)

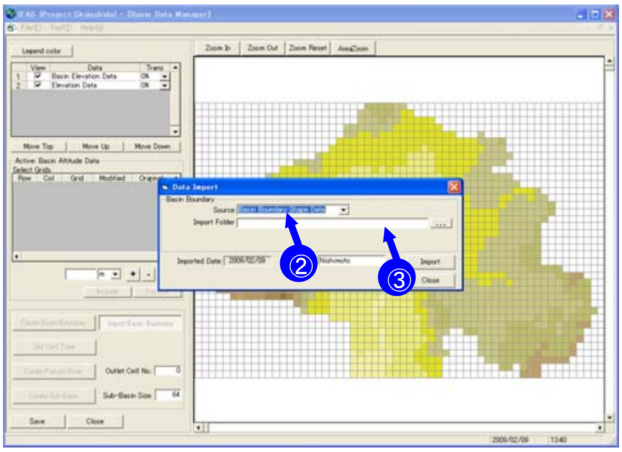
These data should be created through GIS in advance. Further, river basin boundary elevation shape file and river basin boundary elevation grid data should have the elevation value as an attribute.

Because IFAS treats these data as image projected to UTM, when creating shape file or grid file, the figure should be projected to UTM. When shape file is converted to grid file, elevation value in mesh with equal interval must be arrayed.

When the basin is determined by the Basin Shape File, it's necessary to import the topographic elevation data. Under the premise that the Basin Boundary Elevation Shape File is a shape file having the value of the elevation as an attribute, the topographic elevation data are not necessary.

Under the premise that the Basin Boundary Elevation Grid Data (ESRI Arc/Info) has the value of the elevation as an attribute, which is like what the Basin Boundary Elevation Shape File does, also the topographic elevation data are not necessary. The Basin Boundary Elevation Shape Data and the Basin Boundary Elevation Grid Data is in an interchangeable relation.



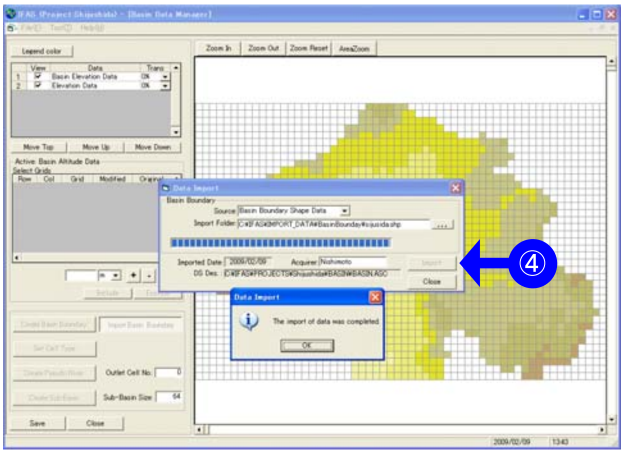


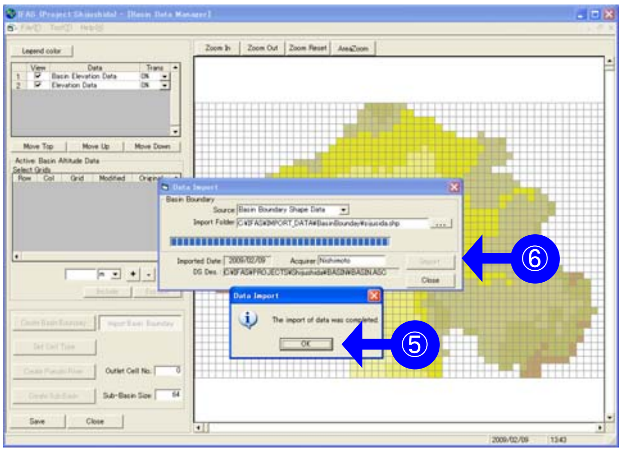
① Click the "Import Basin Boundary" button. The external file import window will be displayed.

② Select the import data type and the type of drainage divide elevation model to be imported.

③ Click the "・・・" button. The data folder selection window will be displayed. Assign the drainage divide elevation model import folder (double-click the folder name) and click "Open". The import folder will be selected.

Notes) Because the shape file of river basin boundary is created as polygon data, the name of property data can only be in English,



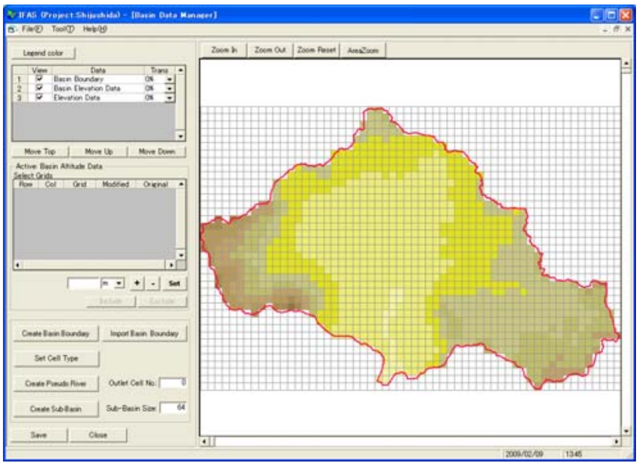


④ Click “Import”. The confirmation window will be displayed. Click “OK” and importing will begin.

⑤ Once importing is complete, the confirmation window will be displayed. Click “OK”. The drainage divide elevation model import will be complete and the data storage location will be displayed at the bottom of the external file import window. Click “Close” and it will be saved.

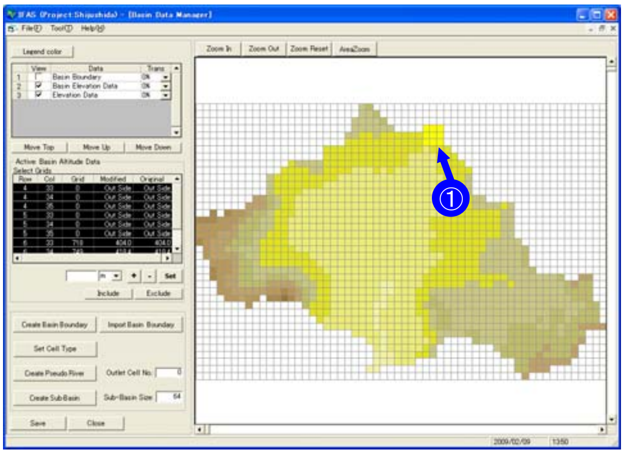
⑥ Click “Close”. The imported drainage divide elevation model will be named as “BASIN.ASC” and will be stored in the assigned folder. The storage location and the file name cannot be changed.

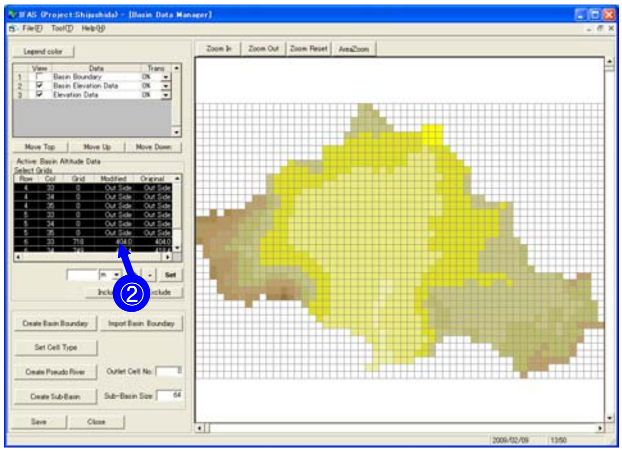
The drainage divide elevation model storage location is:
\IFAS\PROJCTS\PROJECT NAME\BASIN\ BASIN.ASC



⑦ For a basin boundary created using the Shape file, the read basin boundary line will be displayed. It will not be displayed for any created using the elevation data.

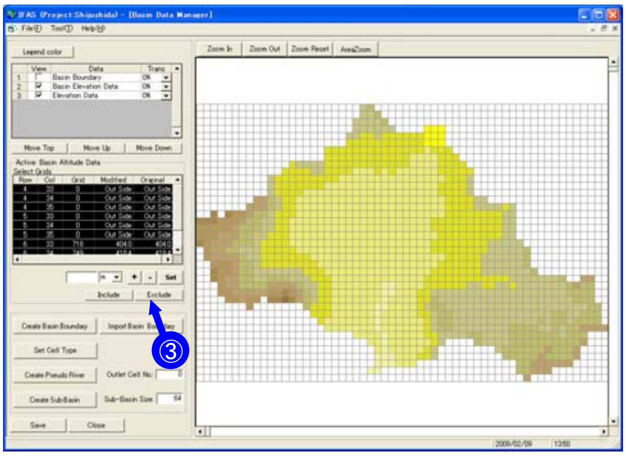
5.2.3 The change of Basin Boundary

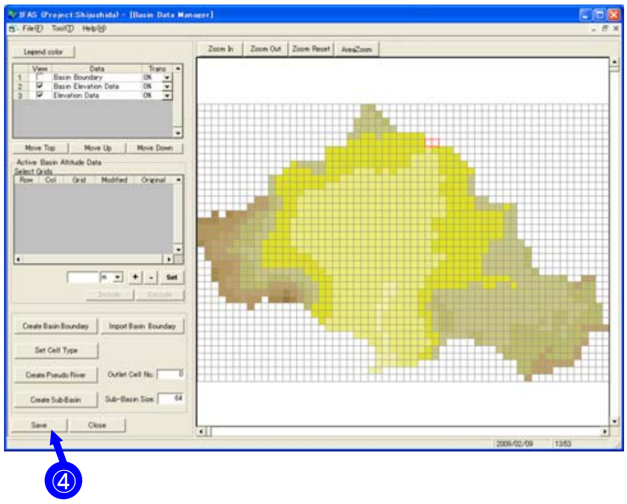




① Click the cell to be changed, or select the cell area.

② The selected cell/s will be displayed.





③ If the elevation configuration for “Exclude” button is clicked, the cells can be changed to outside the water basin. The red grid-line cells within the selected cells show cells included in some kind of alteration, and here the cells within the basin become the cells outside the basin.

④ Click “Save”. The cells outside the basin will be changed, the data will be saved, and the data will be reflected. Conversely, for cells outside the basin that will be added to the inside of the basin, select the cells, click “Include” and they will become within the basin.

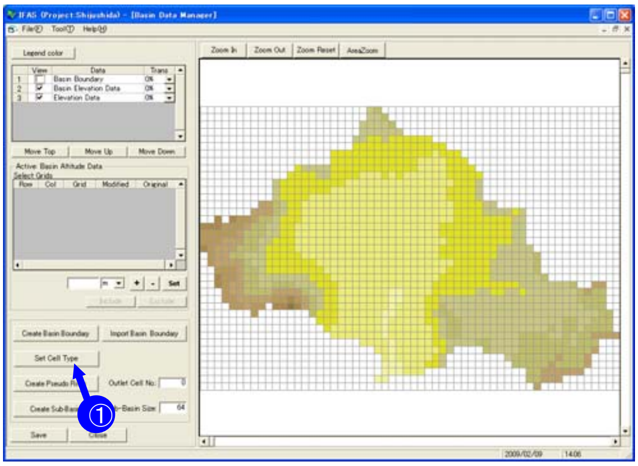
5.3 The creation of drainage course

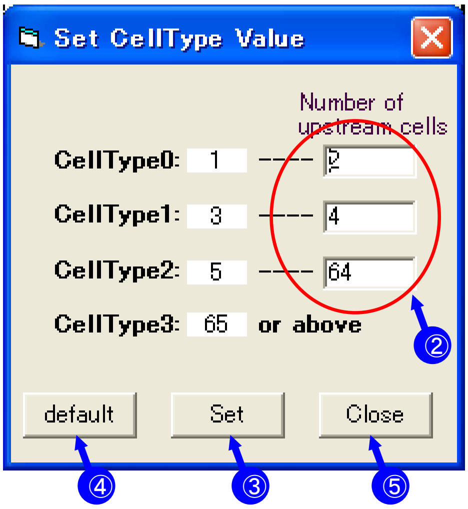
5.3.1 Setting cell type value

To set the value for judging cell type (number of upstream cells)

The default value for CellType0 is 1-2, CellType1 is 3-4, CellType2 is 5-64, and CellType3 is 65 or more.

The mentioned number of cells indicates to the number of upstream cells of each cell (target cell included)





① Click the “Set Cell Type” button.

② The setting dialog will display, type the number of upstream cells.

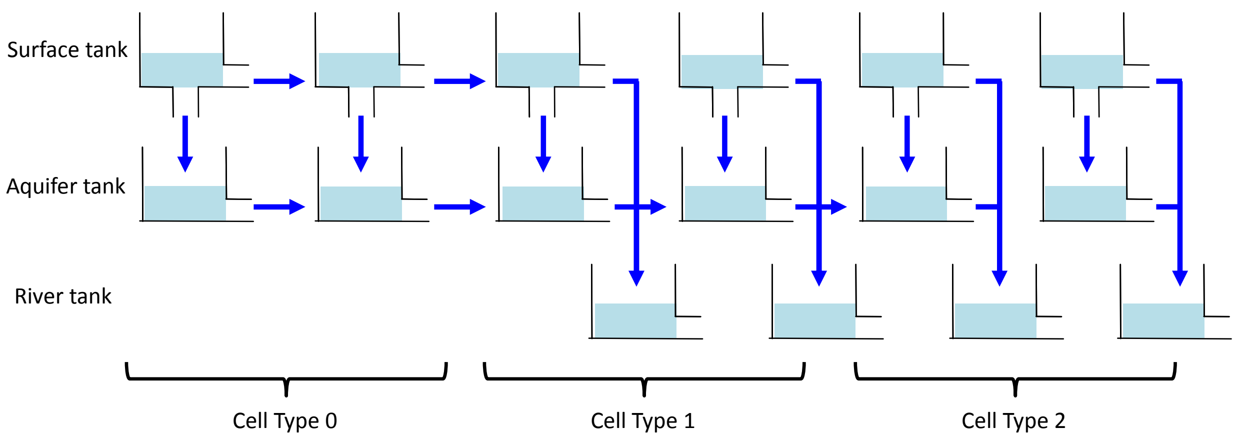
③ Click the “Set” button to complete setting.

④ Click the “Default” button to return default setting.

⑤ Click the “Close” button to close the dialog.

Cell type outline chart

Cell Type 0: The cell through which water flows only into a surface tank and an aquifer tank from a surface tank
(The cell without a river channel tank of the upstream part)
Cell Type 1: The cell through which water flows into an aquifer tank and a river channel tank from a surface tank
Cell Type 2: The cell through which water flows into a river channel tank also from an aquifer tank
Cell Type 3: The cell which performs operation pursuit by the kinematick waving method among river channel tanks
(The cell displayed as a Pseude river channel)



5.3.2 The creation of drainage course

The Drainage Path Diagram shows the direction in which the rain water flows. Here, it is assumed that the direction of the underground water, the intermediate flow, the surface flow and the river flow are all the same. In order to calculate the volume of the flow, it is necessary to determine the direction in which all the cells flow (the drainage path), and there will be only one place for end of downstream (the exit for the water to flow outside the basin).

In addition, depending on the number of the cells that constitute the basin, the thing which shows only the relatively big river courses(It corresponds to CellType3) will be made into a pseudo river course.

Last but not least, when using elevation to create the drainage path, a coordinate which does not determine the direction of the flow will be shown if the elevation of the spot makes a hollow which is lower than the surrounding spots. The IFAS conducts elevation revision that carries out the establishment of the drainage path for all the cells and will eliminate the hollows. However, in some cases river courses do not converge because they flow through large area of level ground, and the positions of the river courses and elevation would be changed dramatically from the original data because of the elevation revision. Therefore, attention is necessary.

The maximum loop of repeating hollow ground treatment is 1000000. If exceed the number, calculation can not cover that.

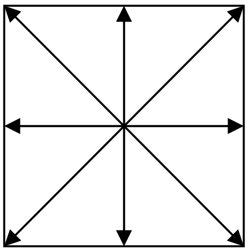
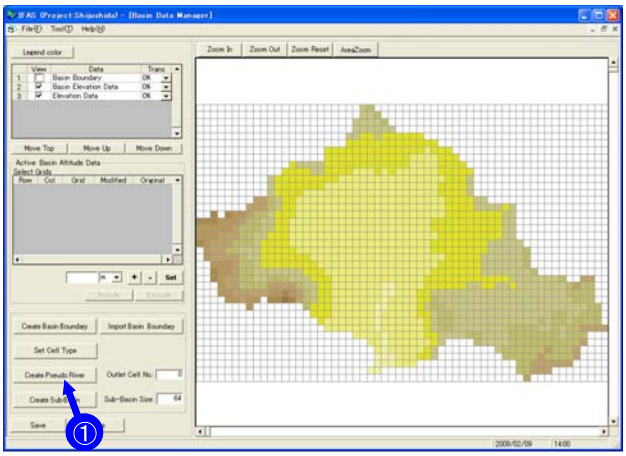
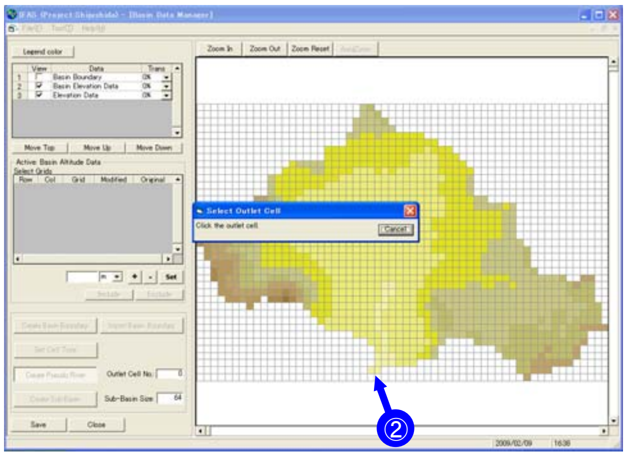


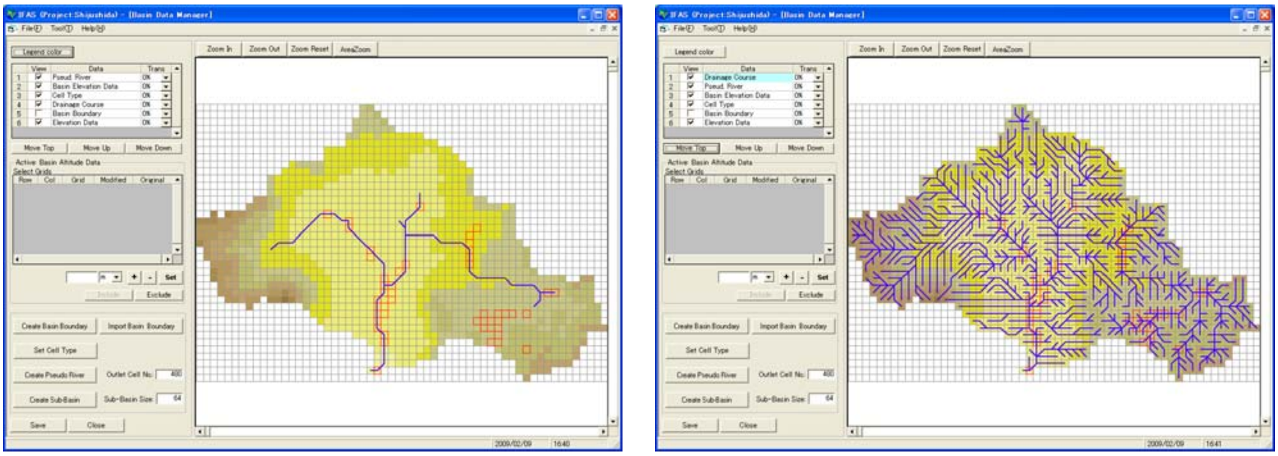
Fig. 5.2 Directions of the drainage path



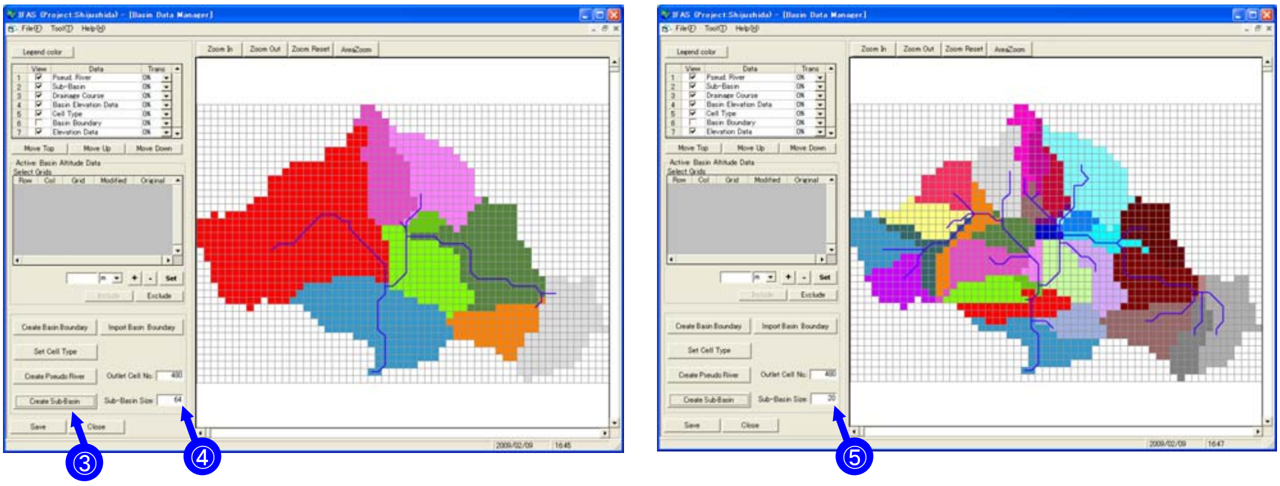


① Click the “Create Pseudo River” button and the drainage network processing will be performed. The river basin end grid selection window will be displayed.

② Select the river basin end grid above the ground plan. Select only one part of the river basin end and make it the outermost cell of the basin interior.



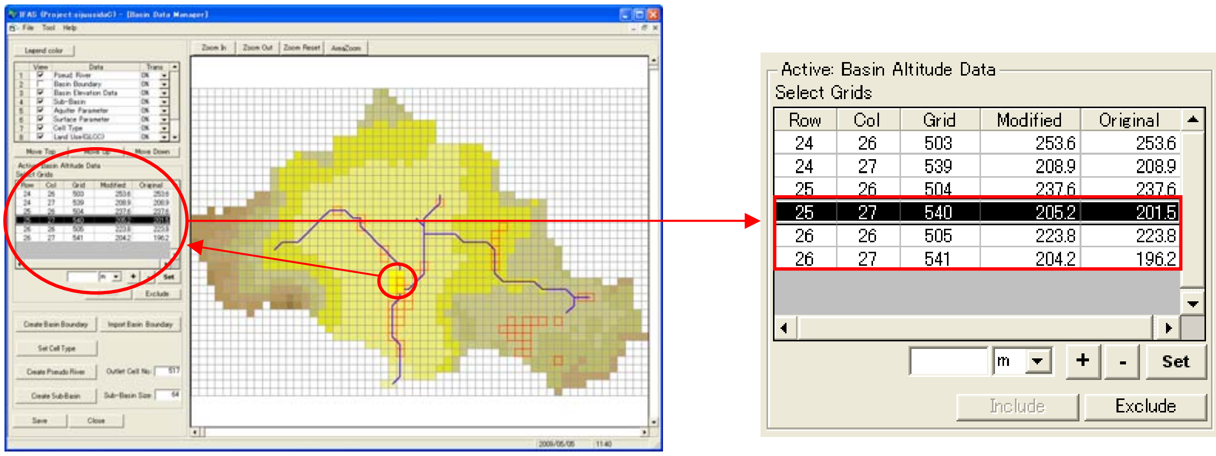
③ The confirmation window will be displayed. Click “OK”, and the drainage course will be created. Click the “Create Sub Basin” button. It will automatically divide into the tributary stream basin, and will be displayed. The threshold amount of the pseudo water way shows the number of cells that ascribe to the tributary stream, and the tributary stream basin display can be changed. When the threshold amount is set to zero, the drainage network for every cell is shown.



④ For a threshold amount set to 64, a drainage course forms from an upstream location of more than 64 cells to a water gathering location, and the cells gathered in each tributary river will be created as a tributary river basin. The default division is the same as above-mentioned CellType3.

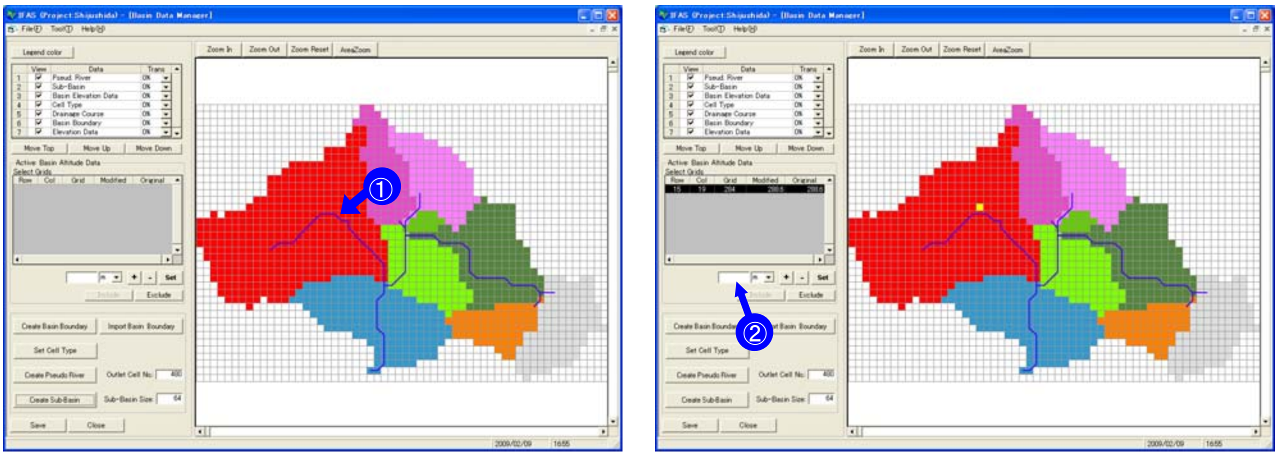
⑤ An example of a threshold value of 20.

Confirm that the pseudo river course was created correctly, then save and close.



⑦ The red framed cells displayed above the ground plan show the result of the performed depression processing and the cells with changed elevation variables. The changed elevation variables will be displayed in a list by selecting a cell and it can be used to confirm that they match the unchanged elevation variables.

5.3.3 Alternation of elevation inside the basin



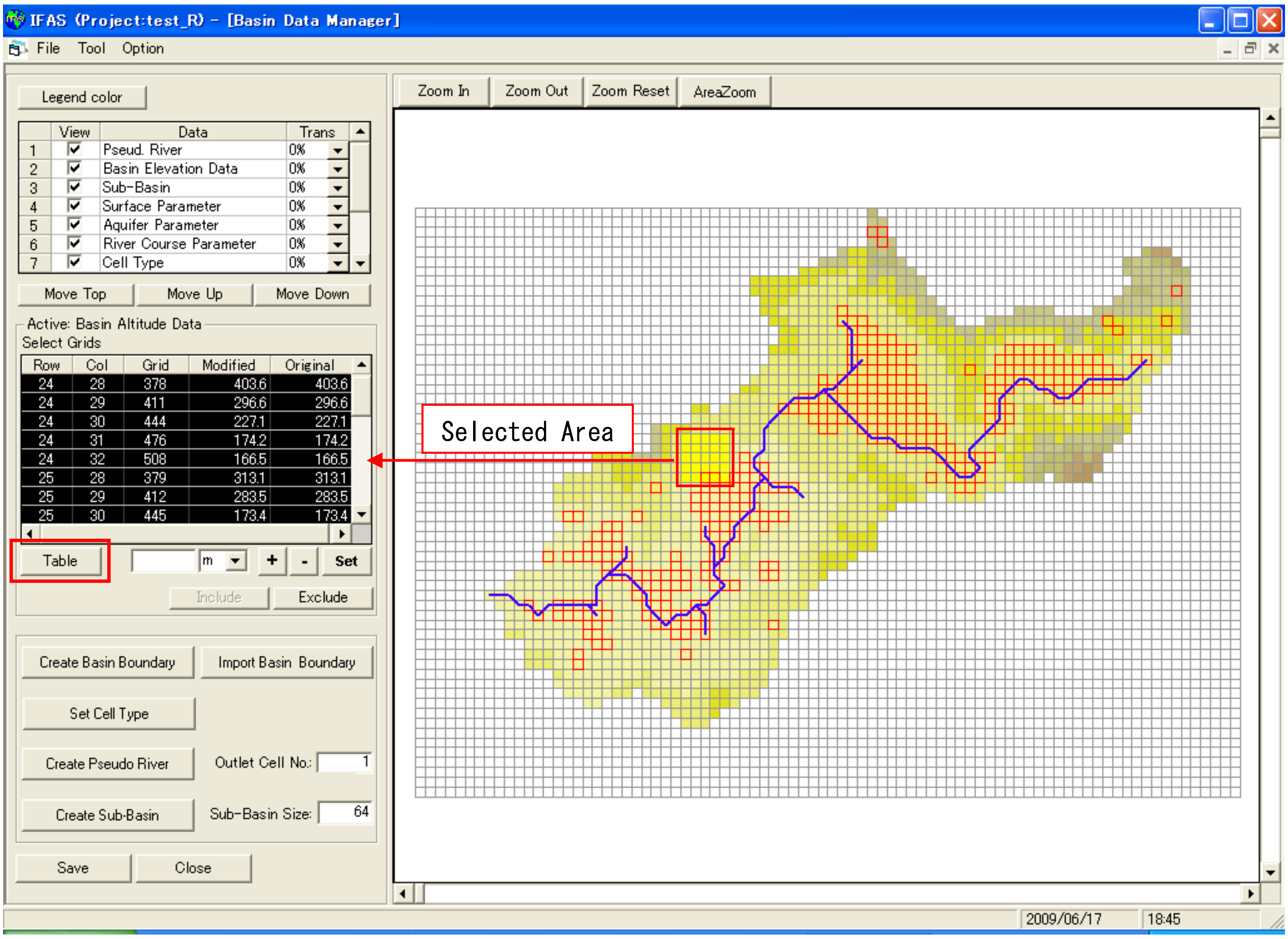
① Click the cell to be changed, and select the range. b) Input the value to

② Click the elevation setting button of the cells outside the basin after selecting the unit which is either m or %, the alternation of cells outside the basin to the cells in the basin is done. After the elevation alternation, in order to set the Drainage Path for all cells, it is necessary to carry out the process of River course Network Creation(5.3 The creation of drainage course).

5.3.4 Alternation of elevation by Table Edit function

When the altitude is corrected, the value can be edited using the Table Edit function.

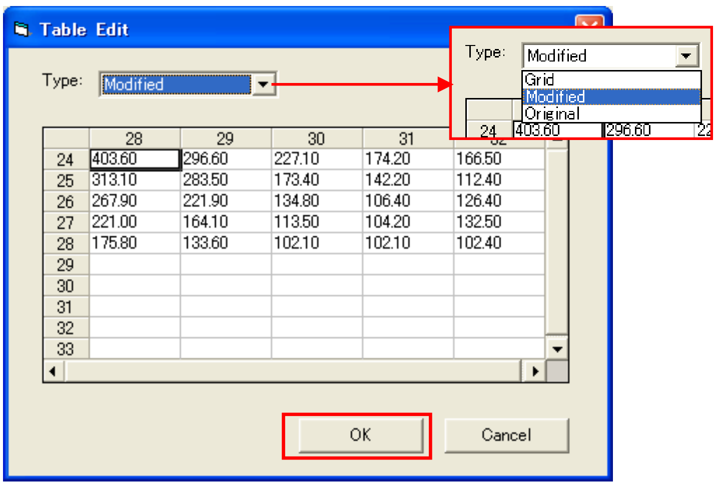
The cell within the range corrected as shown in the figure below is selected with the mouse drug.



"Table" button is clicked, the following dialog is displayed.

The value of an arbitrary cell can be edited. "OK" button is clicked, the edited value is rewritten in the altitude value.

Besides, it is not possible to edit it though "Grid" and "Original" can be selected with Type, and it is possible to inspect it.



6 Importing Rainfall Data (Rainfall Data Manager)

6.1 Outline

6.1.1 Importing rainfall data in IFAS

Global rainfall information observed by satellite is free for downloading on internet. A product called 3B42RT provided by NASA is such a rainfall data set. These rainfall data cover extent of latitude from 50 degrees north to 50 degrees south, and being provided at 25 km mesh and 3 hours pixel.

Here we present the description of internal format of rainfall data, concept of time, methods for importing and editing data.

Item	Satellite rainfall				Forecast rainfall	Observed rainfall
	3B42RT	GSMaP	Qmorph	Cmorph	GPV	Ground-based
Selecting rainfall data	Selecting items from combo box of download dialog					
	V5 V6	MVK+ NRT	—	—	—	—
	Timely rainfall (3-hour interval)	Timely rainfall Daily rainfall	Timely rainfall	Timely rainfall	Timely rainfall	Timely rainfall Daily rainfall
Setting period	Setting start and finish data and time				Newest data	User preparation
Download Storage folder (IMPORT_DATA)	Downloading from registered website					User preparation
	3B42RT (V5) / (V6)	GSMaP_MVK+ GSMaP_NRT	Qmorph	Cmorph	GPV	CSV(rainfall)
Import (Detail will be discussed later)	Selecting items from combo box of download dialog					
	V5 V6	MVK+ NRT	—	combined with +Qmorph	—	—
	Hourly rainfall	Hourly rainfall Daily rainfall	Hourly rainfall	Hourly rainfall	Hourly rainfall	Hourly rainfall Daily rainfall
	Contracting files pathway:IMPORT_DATA\WORK					—
	Interpolation function ・nearest neighbor method					Import method ・Inverse distance weighted ・Thiesson Tessellation ・Kriging method
	Import treatment (cutting target area) （3B42RT and daily rainfall data is created as hourly data） Pathway of process file: PROJECTS\folder in project name\Work\RAIN					
	Creating rainfall data file (creating time interval data) Pathway of imported rainfall data file: PROJECTS\folder in project name RAIN\name of rainfall data					
	【Correction function】there is correction function considering the movement of rainfall area when importing temporal rainfall of GSMaP Anyway, the ground rainfall has to be imported firstly					
Edition and treatment	Function of manual-editing					
	Treating missing data Searching, replacing, and covering of missing data.					
	Treating irregular data Searching, replacing, and auto-editing of irregular data					
	Deleting rainfall data					
	Copying rainfall data					

Fig. 6.1 Flow of rainfall data importing

6.1.2 How to set folder when importing rainfall data in IFAS

If the IFAS is installed in driver C, the default storage folders that have been created when importing original data are listed as follows.

3B42RT（V5）	: C:\IFAS\IMPORT_DATA\3B42RT(V5)
3B42RT（V6）	: C:\IFAS\IMPORT_DATA\3B42RT(V6)
GSMaP_NRT(hourly)	: C:\IFAS\IMPORT_DATA\GSMaP_NRT\hourly
GSMaP_NRT(daily0-23)	: C:\IFAS\IMPORT_DATA\GSMaP_NRT\daily(0-23)
GSMaP_NRT(daily12-11)	: C:\IFAS\IMPORT_DATA\GSMaP_NRT\daily(12-11)
GSMaP_MVK+(hourly)	: C:\IFAS\IMPORT_DATA\GSMaP_MVK+\hourly
GSMaP_MVK+(daily)	: C:\IFAS\IMPORT_DATA\GSMaP_MVK+\daily
Qmorph	: C:\IFAS\IMPORT_DATA\Qmorph
Cmorph	: C:\IFAS\IMPORT_DATA\Cmorph
CSV(Ground-based Rainfall)	: C:\IFAS\IMPORT_DATA\CSV(rainfall)

Notes) If user has saved original data to other drivers and folders, the rainfall data will be discussed in section 6.3 should use the same folder composition and be saved in the same subfolder.

In addition, because the import method has changed, the data files downloaded by previous version are unusable because the storage way is different.

The system will create a subfolder (yyyy: year, mm: month, dd: date) automatically according to the created date when importing data.

6.2 Treatment of rainfall data in IFAS

6.2.1 Internal format of rainfall data in IFAS

6.2.1.1 File format

Rainfall data in IFAS are treated as a file format called ESRI ASCII Grid.

Format of ESRI ASCII Grid contains a header part which presents data's configuration of files, and a data part in text files. The format is represented by an extension of ASC.

Format of ESRI ASCII Grid is treated as following grid data, which is adaptive to IFAS, because IFAS also treats data as cells.

Files are named by the observation date and time of rainfall data in IFAS.

Format and example are shown in following:

```
NCOLS xxx        (Number of columns of data)
NROWS xxx        (Number of rows of data)
XLLCORNER xxx    (X coordinate of bottom left data /m)
YLLCORNER xxx    (Y coordinate of bottom left data /m)     Header
CELLSIZE xxx     (Distance between data /m)
NODATA_VALUE xxx (Value of No data)
x x x x x x x x x x x x x x x x x x
x x x x x x x x x x x x x x x x x x
x x x x x x x x x x x x x x x x x x
x x x x x x x x x x x x x x x x x x      Data
x x x x x x x x x x x x x x x x x x
x x x x x x x x x x x x x x x x x x
```

Fig. 6.2 Format of ESRI ASCII Grid

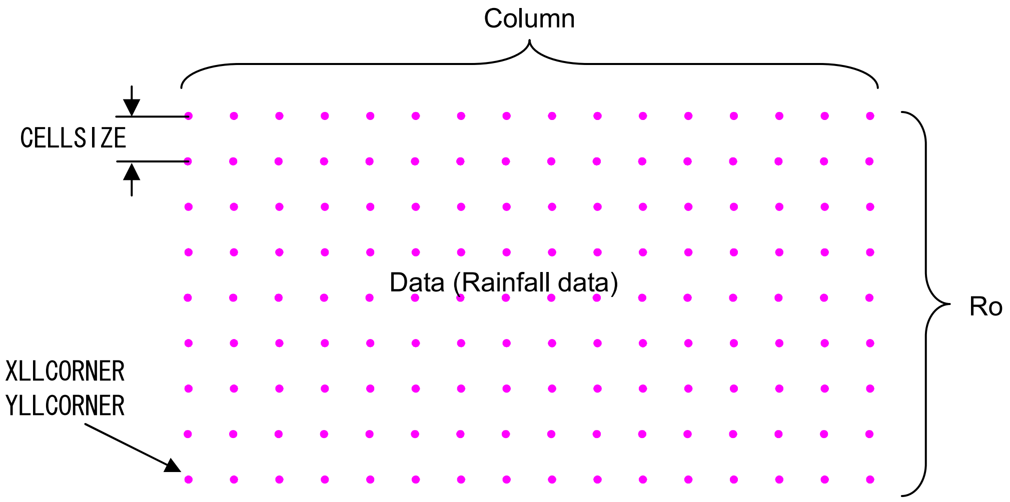
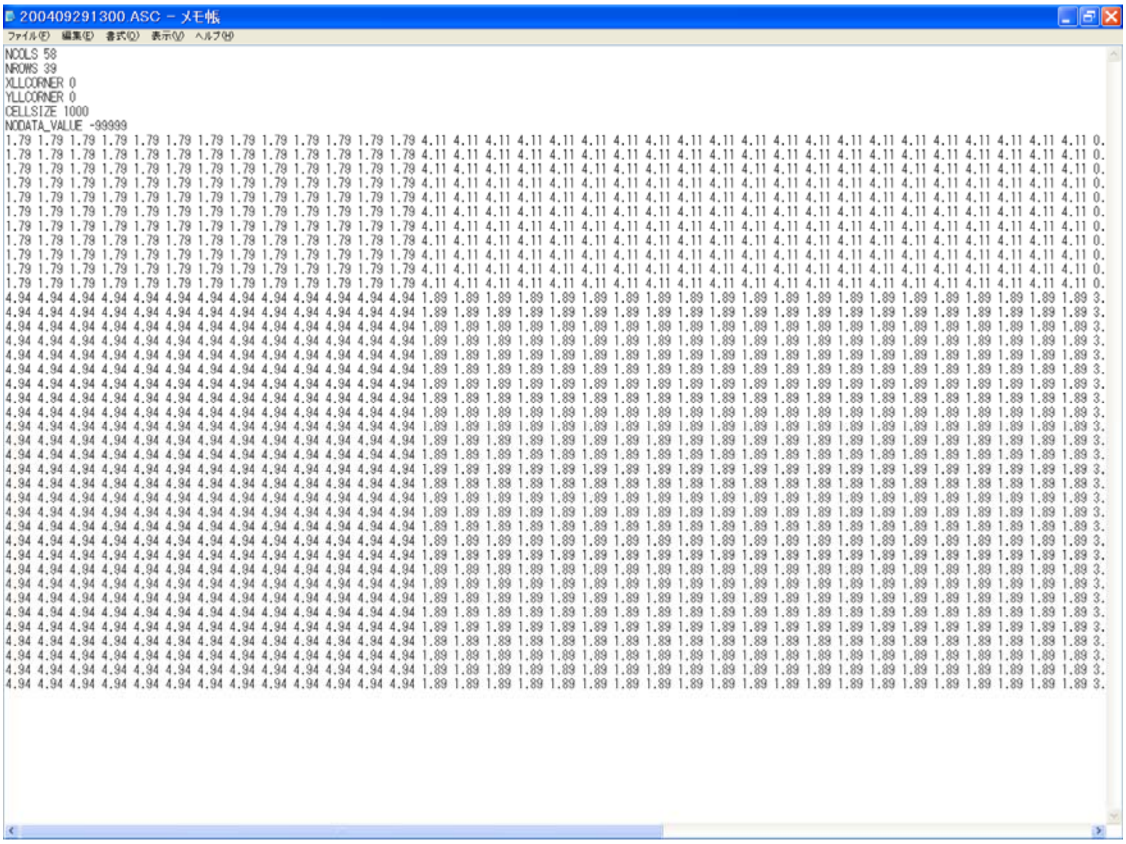


Fig. 6.3 Model of rainfall data



```
200409291300.ASC - メモ帳
ファイル(F) 編集(E) 書式(O) 表示(V) ヘルプ(H)
NCOLS 58
NROWS 39
XLLCORNER 0
YLLCORNER 0
CELLSIZE 1000
NODATA_VALUE -99999
1.79 1.79 1.79 1.79 1.79 1.79 1.79 1.79 1.79 1.79 1.79 1.79 1.79 4.11 4.11 4.11 4.11 4.11 4.11 4.11 4.11 4.11 4.11 4.11 4.11 4.11 4.11 4.11 4.11 4.11 4.11 4.11 4.11 4.11 0.
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```

Fig. 6.4 Rainfall data file (200409291300.ASC)

6.2.1.2 Storage folder and path of rainfall data

In IFAS, rainfall data are divided and stored to folders in each project. Storage folder and path inside IFAS is presented as follows.

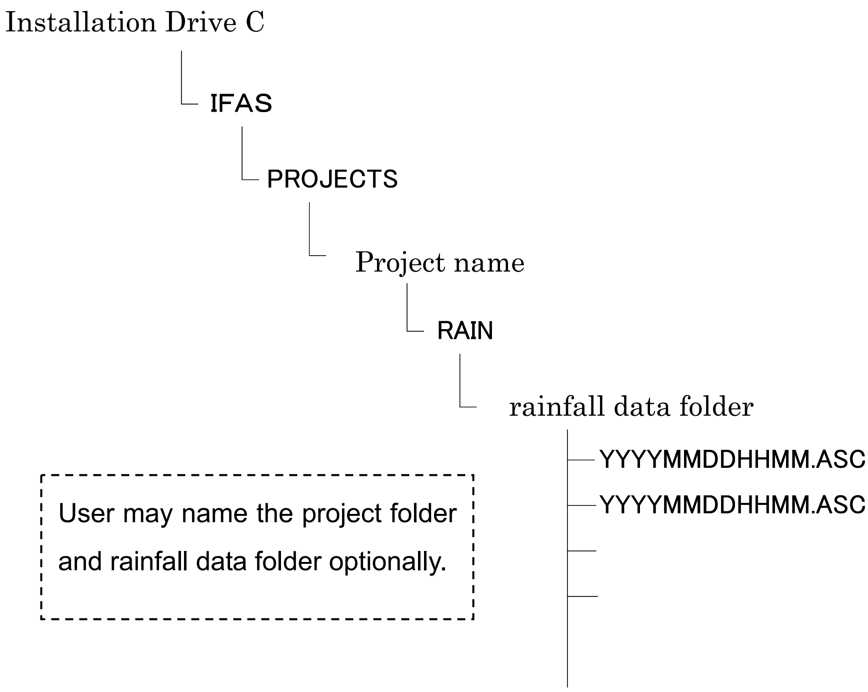


Fig. 6.5 Rainfall data saving folder and path

6.2.2 Period conception of IFAS

There are two periods of IFAS as follows:

6.2.2.1 Subject period

--- system input item

All periods of the project are defined, and the period when rainfall data acquisition is done is set within this range.

6.2.2.2 Period of data obtaining

--- system input item

The period from rainfall data be observed to be imported.

6.2.3 Observation rainfall data can be handled in IFAS

6.2.3.1 Type of observation rainfall data can be handled in IFAS

IFAS can handle the following 4 types of observation rainfall data

-3B42RT (satellite rainfall data)

-GSMaP (satellite rainfall data)

-Qmorph (satellite rainfall data)

-Cmorph (satellite rainfall data)

-GPV (forecast rainfall)

-Site rainfall data file defined with IFAS (CSV file)

6.2.3.2 Conditions of treating data by IFAS

Following conditions must be considered when treating observation rainfall data by IFAS.

① File in format of ESRI ASCII Grid

As stated above, rainfall data cannot be treated by IFAS without file in format of ESRI ASCII Grid (ASC file in following). In IFAS, applicable observation rainfall data should be original ASC files or those data can be converted to ASC files.

In IFAS, due to IFAS's importing function (function of data conversion), the mentioned six types of observation rainfall data are treated after converting those to ASC file.

Features of observation rainfall data and importing methods will be explained later.

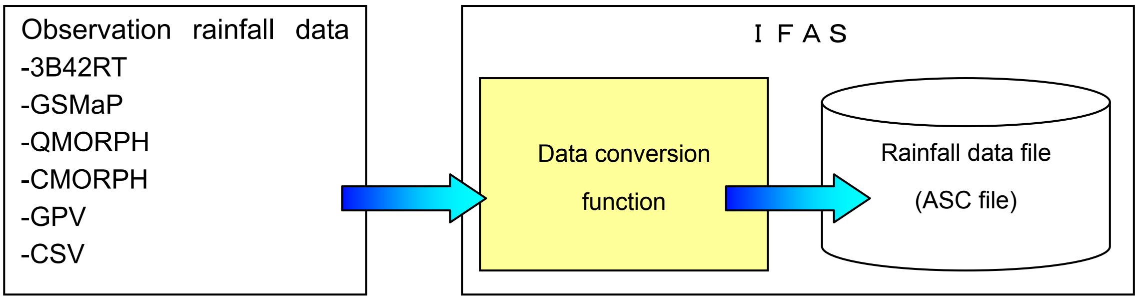


Fig. 6.6 Rainfall data file creation

② Time sequence of observation rainfall data

In IFAS, the graph presents input of time interval of flood calculation when project is created and value of time interval must be calculated accurately. Therefore, creation of rainfall data file and runoff calculation will be failed if value of time interval is adjusted.

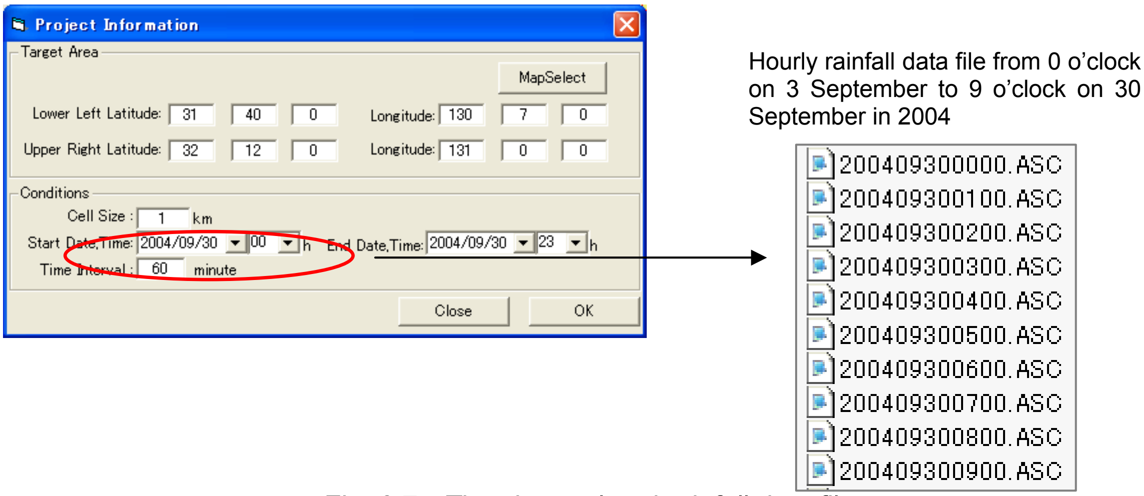
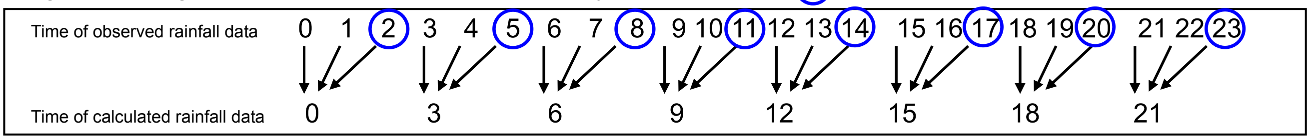


Fig. 6.7 Time interval and rainfall data file

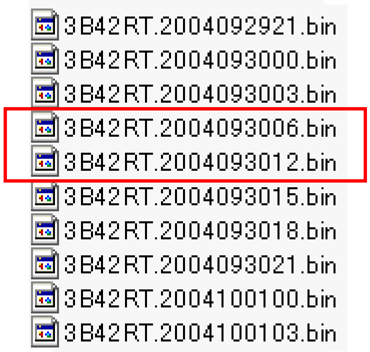
Take the hourly rainfall data file shown in Fig. 6.7 as an example, if the time interval is chosen as 1 hour, the IFAS will conduct the runoff calculation without any changing on original data. However, if the time interval is chosen as 180 minutes, the IFAS will take a sum of the rainfall data and create a file as the three hour's accumulation.

Hence, the number of hour used for setting period must be the multiples of three. If the start hour is 0:00, the finish hours should be any of 2:00, 5:00, 8:00, 11:00, 14:00, 17:00, 20:00, 23:00. When any other time is set, the alert will occur. User has to change the value of time interval or reset the start and finish time. See the following image.

Image of creating 3 hours accumulated rainfall data (only the marked time ○ can be set as finish time)



In addition, due to continuity of time order, ASC FILE cannot be applied when partial file is interrupted. The case of interruption of ASC File and continuity that rainfall observation data depends will be stated in details later.



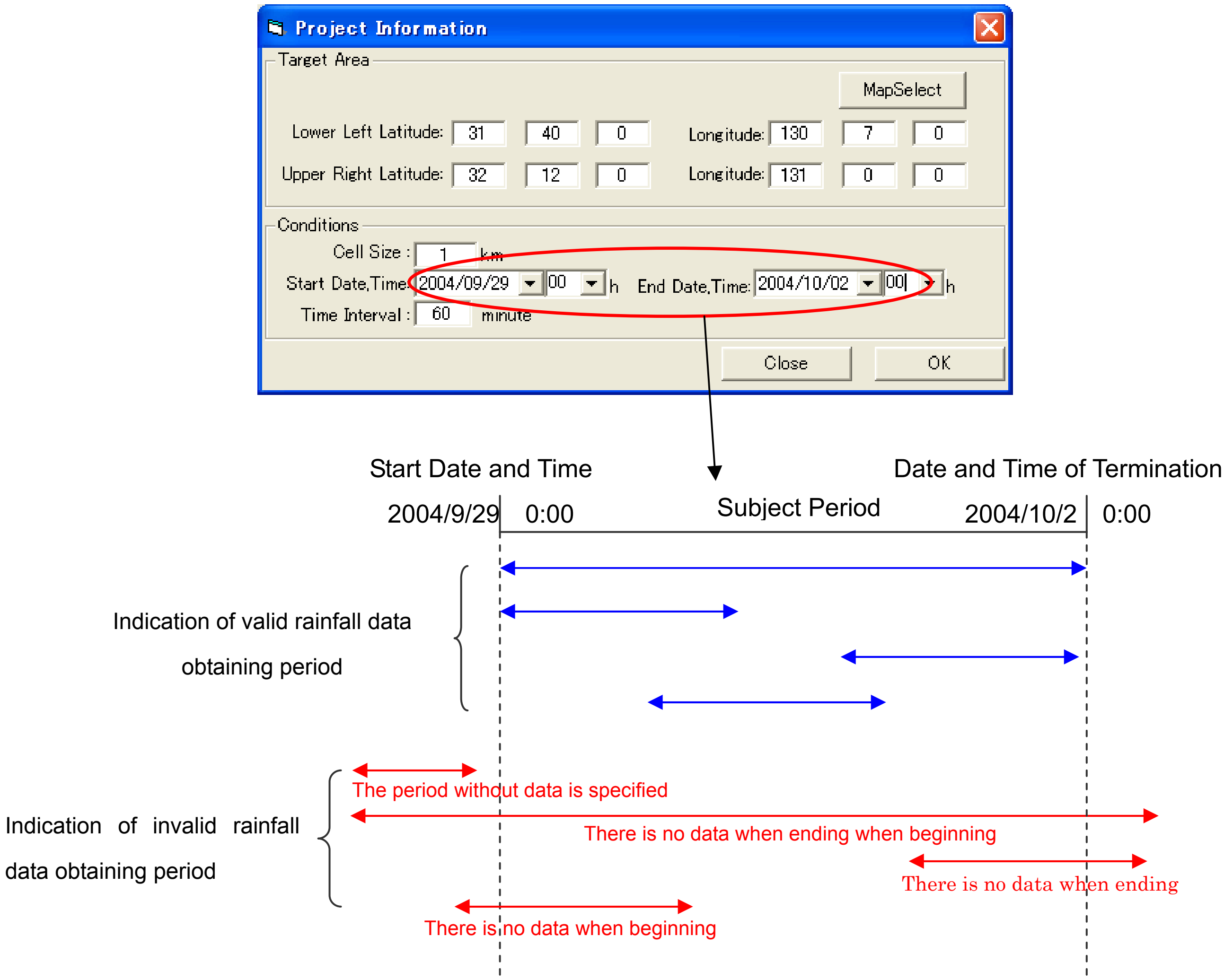
←It is not working without 3B42RT.2004093009
Precipitation of 0 mm will be created, then the number of missing data files can be displayed.

Fig. 6.8 Lack of observation rainfall data

③ Existence of rainfall observation data during necessary period for runoff calculation

With IFAS, when project is generated the whole term of project as Object Period is input. Rainfall data obtaining period which exceeds the term extent cannot be assigned.

Therefore, preparing rainfall observation data should be within Subject Period and also includes extent of necessary rainfall data obtaining period.



※Rainfall Observation Data is based on hypothesis of data in the period noted by red and blue arrow

Fig. 6.9 Restriction of rainfall data in subject period

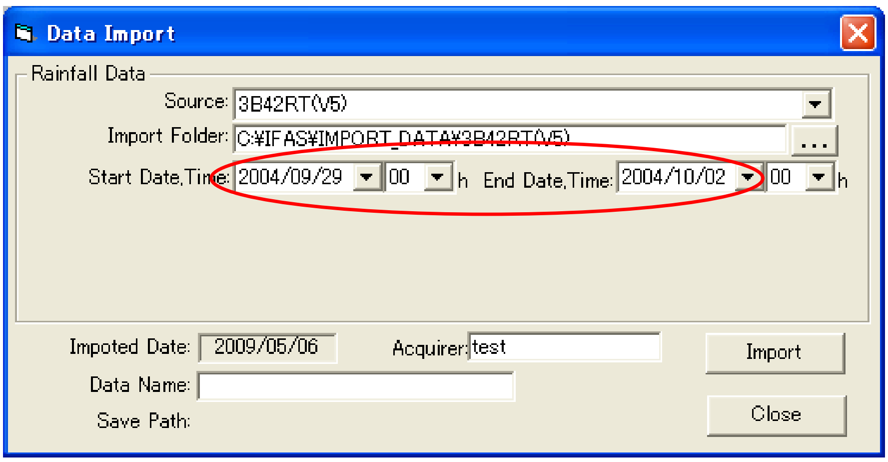


Fig. 6.10 Import form of rainfall data obtaining period

6.2.4 Rainfall data file interpolation of precipitation “0”

In IFAS, object period and rainfall data obtained period input from project information management are compared. If difference between two periods exits, time interval based on unit of precipitation 0 mm is created to project information management interface and the file of rainfall data file difference will be generated automatically.

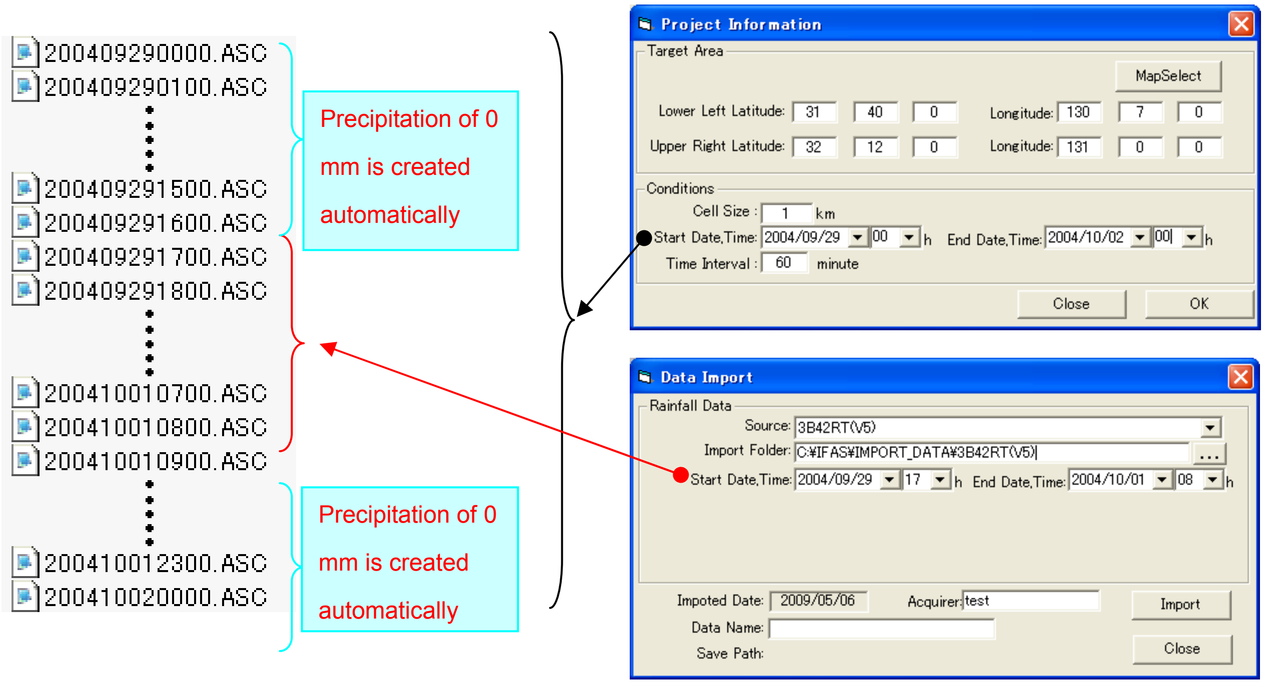


Fig. 6.11 Data file interpolation of precipitation “0”

6.2.5 Creating rainfall data based on calculation time interval

The IFAS creates all imported rainfall data as hourly data. It uses the GSMaP, Qmorph, Cmorph and forecast rainfall without any changes, because their resolution is less than one hour. However, because the time interval for rainfall data 3B42RT is three hours, the IFAS temporarily creates the hourly data for calculation by copying a value and pasting that before and after it.

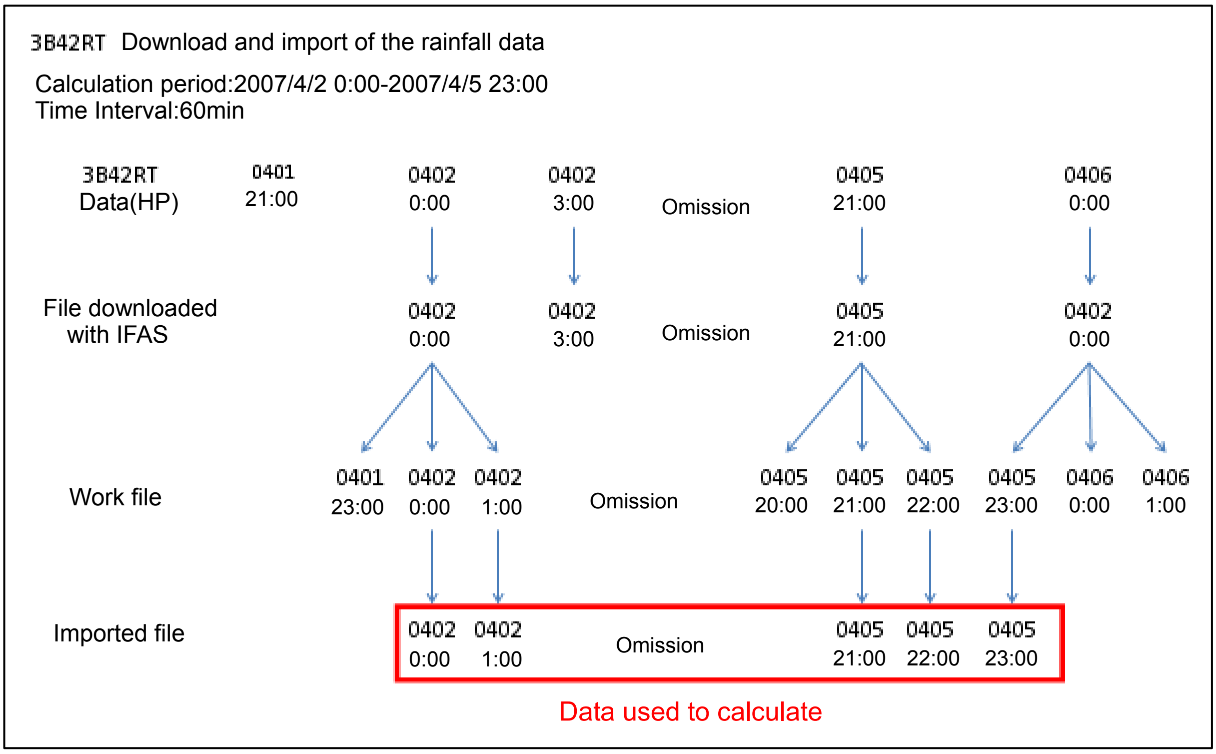
If the time interval for calculation is not one hour, the IFAS treats the accumulated value that from start time to set interval time as the rainfall for the set time interval.

For example, if the time inertial for calculation is three hours and the start time is 0:00, the rainfall for “0:00” is treated as the accumulated value of 0:00, 1:00, and 2:00, which are created as mentioned above.

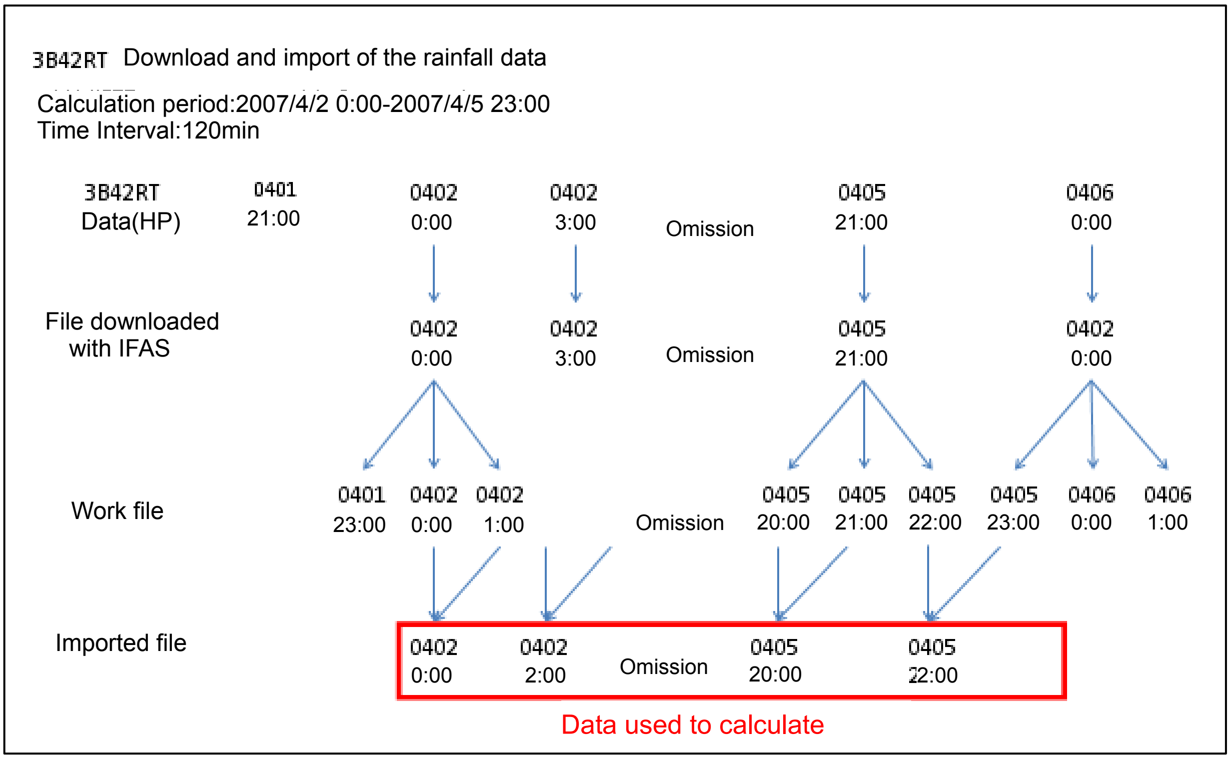
In addition, if the GSMaP and ground rainfall data are imported as daily ones, the IFAS creates time interval rainfall for calculation as a proportional division of the set time interval to 24 hours.

For example, if the time interval for calculation is six hours, the time interval rainfall will be daily rainfall / 24 × 6.

Sample of creating one hourly data



Sample of creating two hourly data 120



6.3 Rainfall data importing method

6.3.1 3B42RT (Satellite rainfall data)

6.3.1.1 Features

3B42RT is one of rainfall item provided by NASA, U.S.A. The specification is presented as follows.

The latest data is provided as V6. The IFAS can treat both the latest version of V6 and the former one of V5. Their specifications are shown as follows.

Being used satellite data: TMI (TRMM microwave observation device)
SSMI (Microwave radiation device)
IR (Infrared ray)
Data transmission Interval: 3 hours
Transmission time: semi -real time (10 hours delay)
Mesh size: 0.25°≒25km, A≒600km²
Observation extent: Altitude 50 degrees North～Longitude 50 degrees South
Data provided at URL: (V6) ftp://trmmopen.gsfc.nasa.gov/pub/merged/mergeIRMicro/
(V5) ftp://trmmopen.gsfc.nasa.gov/pub/merged/mergeIRMicro/V5/

6.3.1.2 Data format

3B42RT is rainfall data located in 0.25 degrees space of coordinate system grid. Data structure is composed of three parts: precipitation, precipitation_error, and source. Import program is only imported to "precipitation". Data which has 3-hour time interval can be executed by import program within assigned period.

File name is denoted by

(V5) "3B42RT." Observation Date and Time ".bin" (e.g. 3B42RT.2002070903.bin).

(V6) "3B42RT." Observation Date and Time "6A.bin" (e.g. 3B42RT.2002070903.6A.bin). ~2009/02/16 3

Observation Date and Time "6.bin" (e.g. 3B42RT.2002070903.6.bin). 2009/02/16 6~

File format is presented as follows.

-Head section	2,880 byte
-Precipitation	2 byte × 1,440（Latitude）× 480（Longitude）
-precipitation_error	2 byte × 1,440（Latitude）× 480（Longitude）
-source	1 byte × 1,440（Latitude）× 480（Longitude）

6.3.1.3 Import method

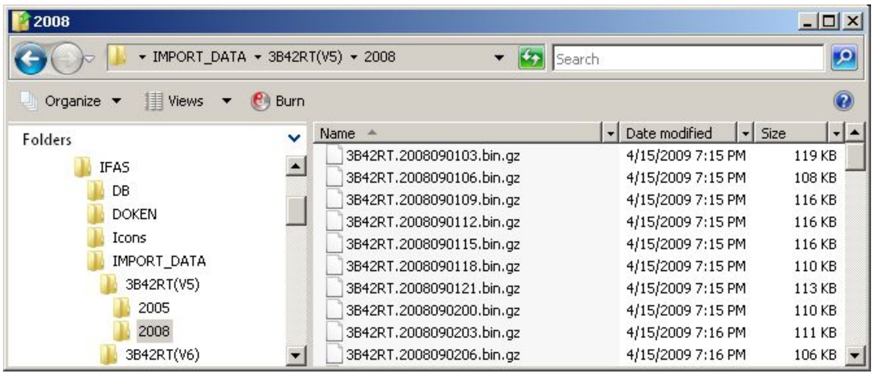
3B42RT can be imported to system by using the importing function of IFAS.

1) Download

3B42RT rainfall data can be automatically downloaded to IFAS by using the downloading function of rainfall data manager. However, the internet should have been connected. Otherwise, original 3B42RT rainfall data have to be stored to the PC for starting the IFAS system.

Generally, data are saved the folder shown as follows.

3B42RT(V5)



3B42RT(V6)

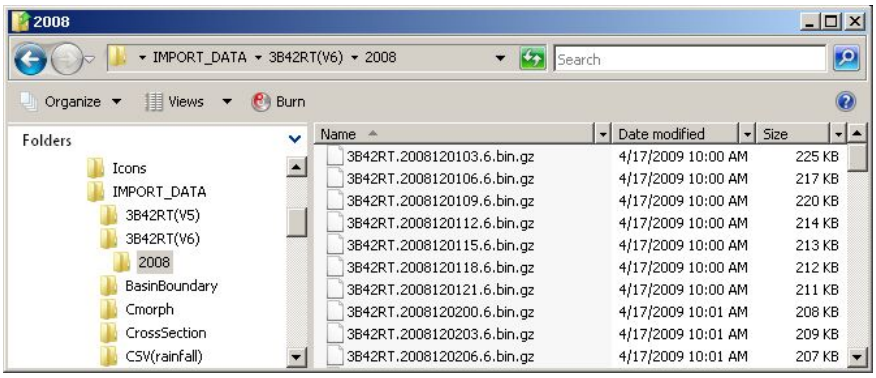
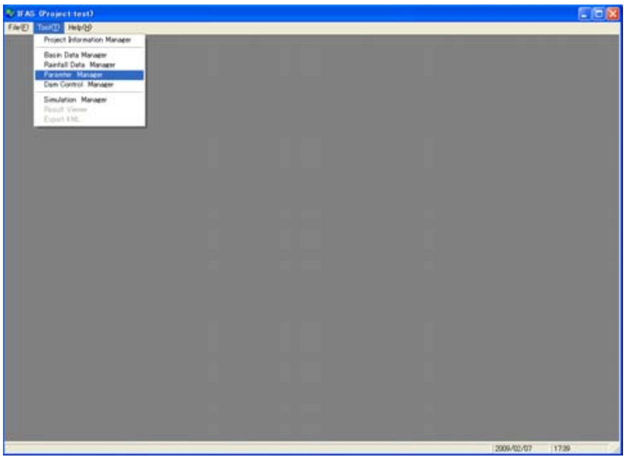
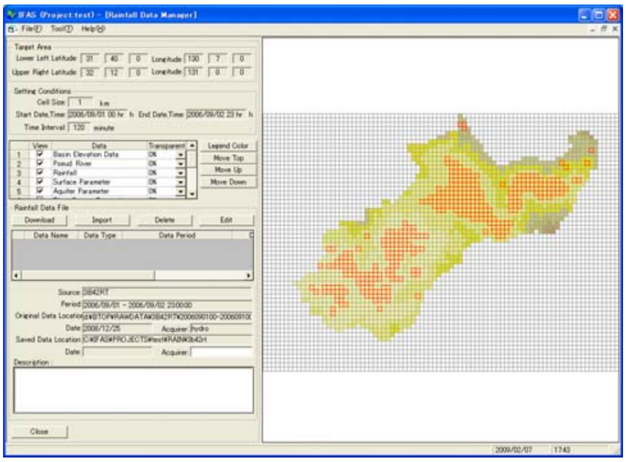


Fig. 6.12 Observation rainfall data of 3B42RT

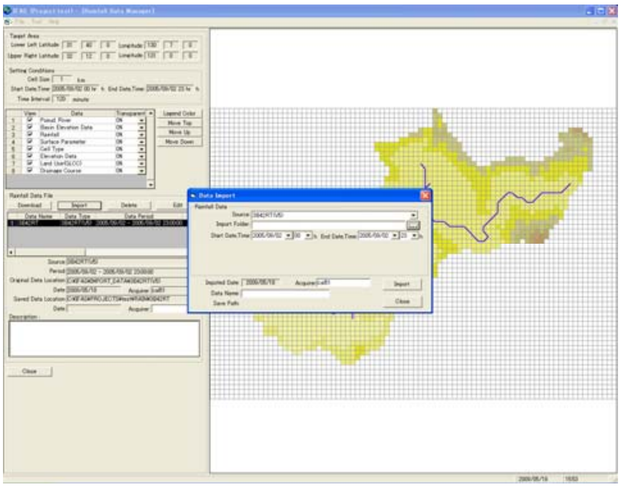
2) Import method

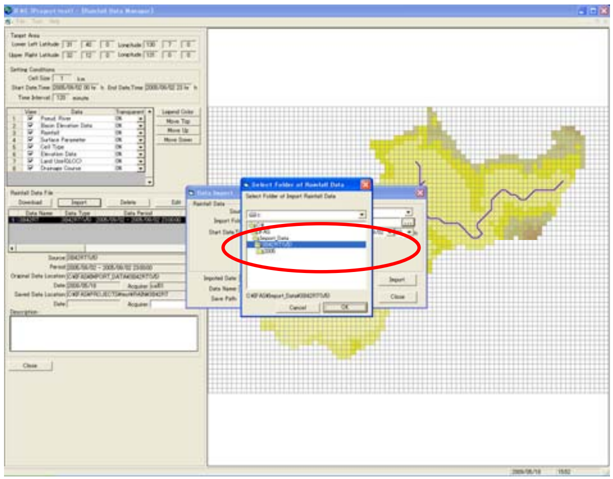




① Select “Rainfall Data Manager” menu from “Tool” menu

② Click button of “Import” from rainfall data creation window

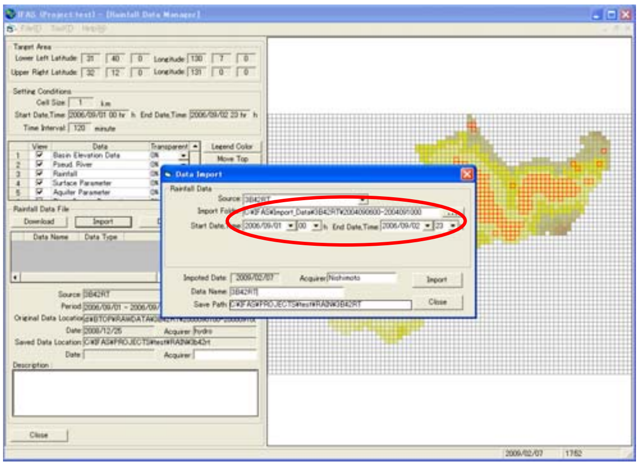




③ Click “3b42RT(V5)” or Click “3b42RT(V6)” from pull down menu in “Source”

④ Click the button “･･･” of “ Import Folder”, choose pre-saved rainfall data folder(IMPORT_DATA/3B42RT(V5) or 3B42RT(V6)) and click the button “OK”.

The folder “3B42RT(V5)” or “3B42RT(V6)”will be focused automatically. Otherwise, the “IMPORT_DATA” folder will be focused, user can select that optionally.



⑤ Input obtaining period of rainfall data into the filed “Data Obtaining Period”. Obtaining period is input with unit of one hour within project object period. It is necessary that the rainfall observation data file must be existed in assigned importing folder.

【Time interpolation of 3B42RT】

Rainfall observation data of 3B42RT is provided by data (.bin) of every three hours (0 o’clock, 3 o’clock, 6 o’clock, 9 o’clock, 12 o’clock, 15 o’clock, 18 o’clock, 21 o’clock).

In IFAS, when time interpolation is processed automatically in 3B42RT, the rainfall data file (.asc) as rainfall data within one hour could be produced.

The following is time interpolation logic of 3B42RT.

When rainfall observation data is the one with none time, the former rainfall data file is copied and the copied rainfall data file is time interpolation of 3b42RT. So it is usual that rainfall data file with the same precipitation occurs in succession in three hours.

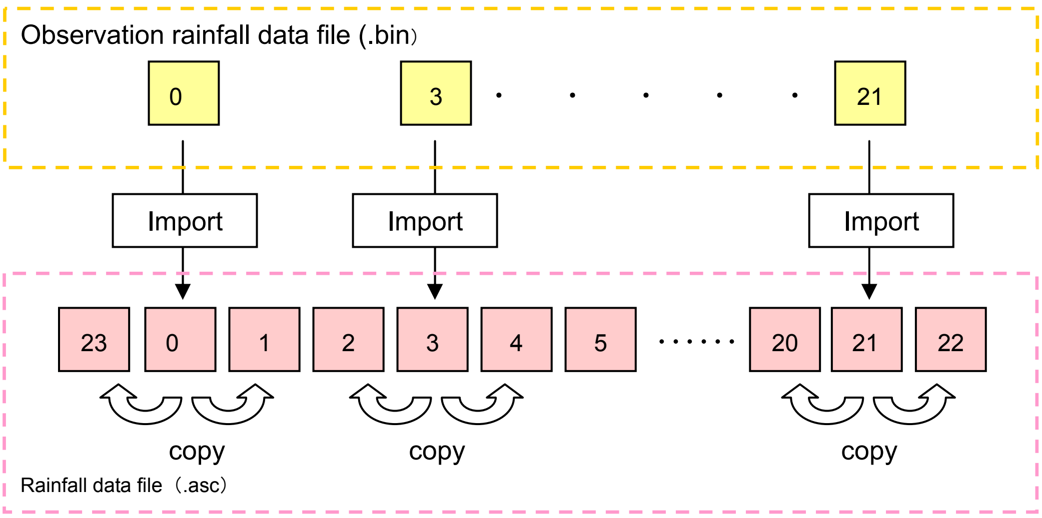


Fig. 6.13　Time interpolation of 3B42RT

“Data Obtaining Period” of 3B42RT is set as unit of one hour. If there is no observation rainfall data file (1 o’clock or 2 o’clock etc) within set time of “Data Obtaining Period”, rainfall data file within set time can be completed automatically as replacement. (The observation data file at 0 o'clock immediately before is downloaded by the automatic operation.)

In below graph, although “Data Obtaining Period” is set from 1 o’clock till 22 o’clock including time without information of observation rainfall data file, rainfall data file of 1 o’clock and 2 o’clock in the first half and 22 o’clock in the second half is still produced automatically.

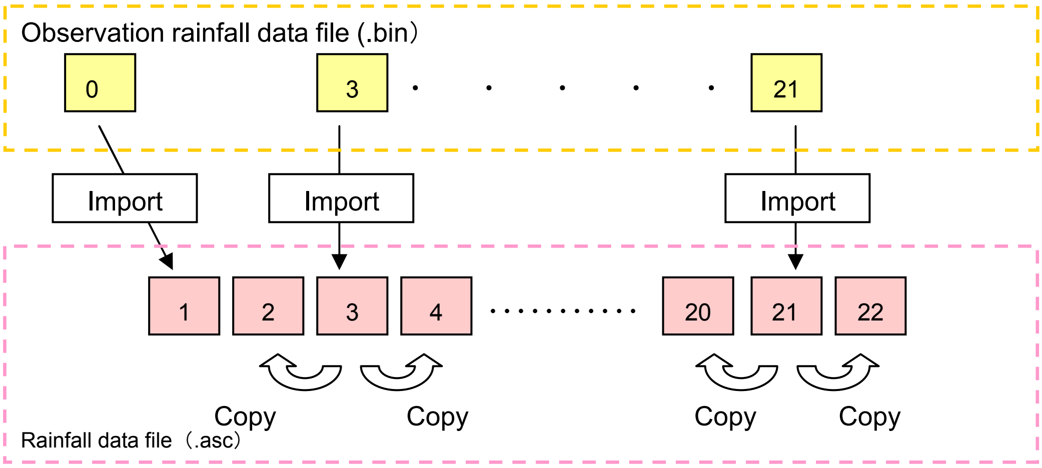
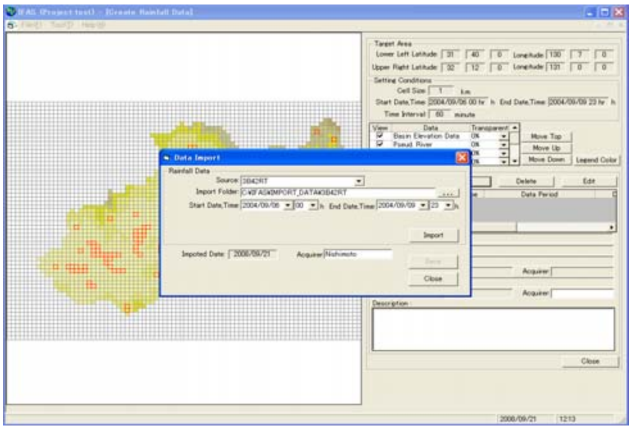
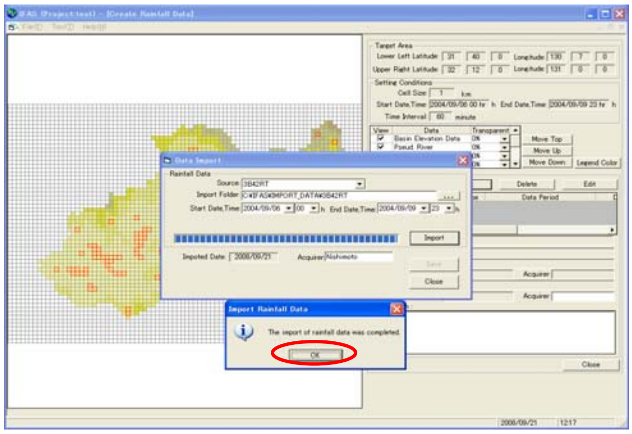


Fig. 6.14 Time Interpolation of 3B42RT (Case of observation rainfall data file within set time without information)

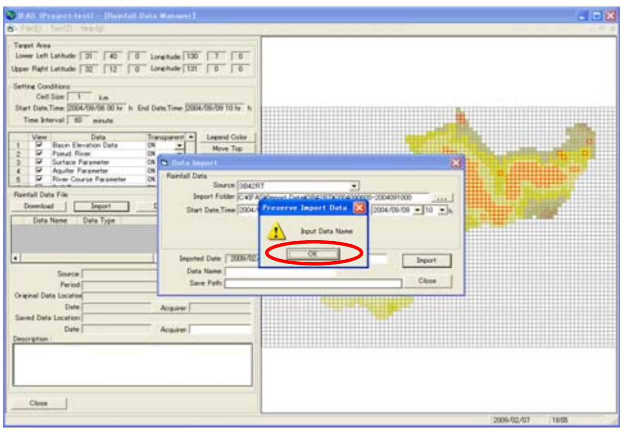


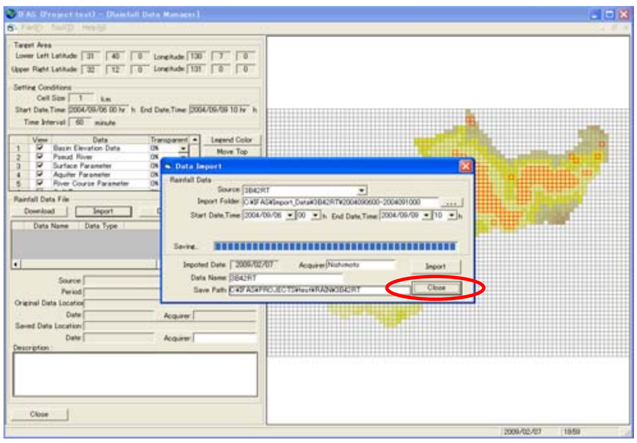


⑥ Type the data name and click the “Import” button.

⑦ Click the “OK” button.

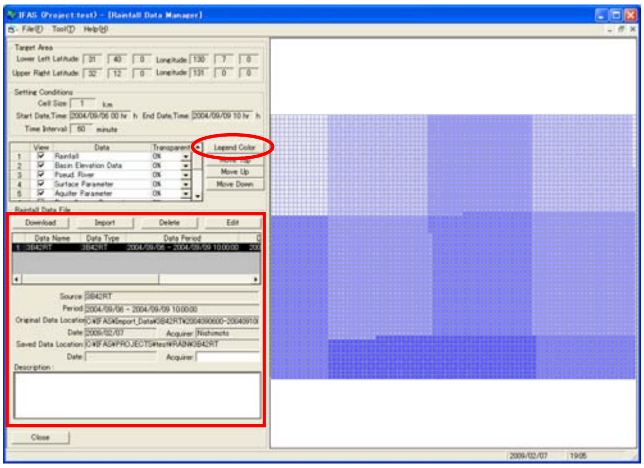
If the "DataName" is empty, a message box will pop-up to show that the importation is failed. The folder name that can reflect the content of rainfall data file is expected. The import date will be input automatically, however, it can be changed when setting project according to the default of “Acquirer”.

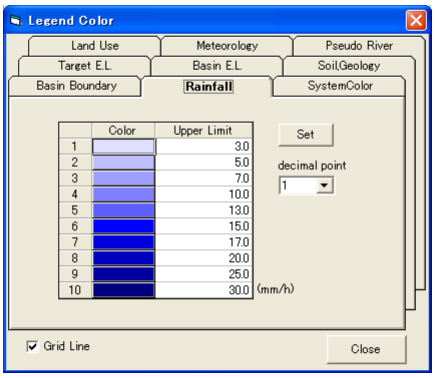




⑧ Click button “Close”

⑨ Importing of 3B42RT is finished when folder name is displayed. Click “Display Set” button to display the legends.





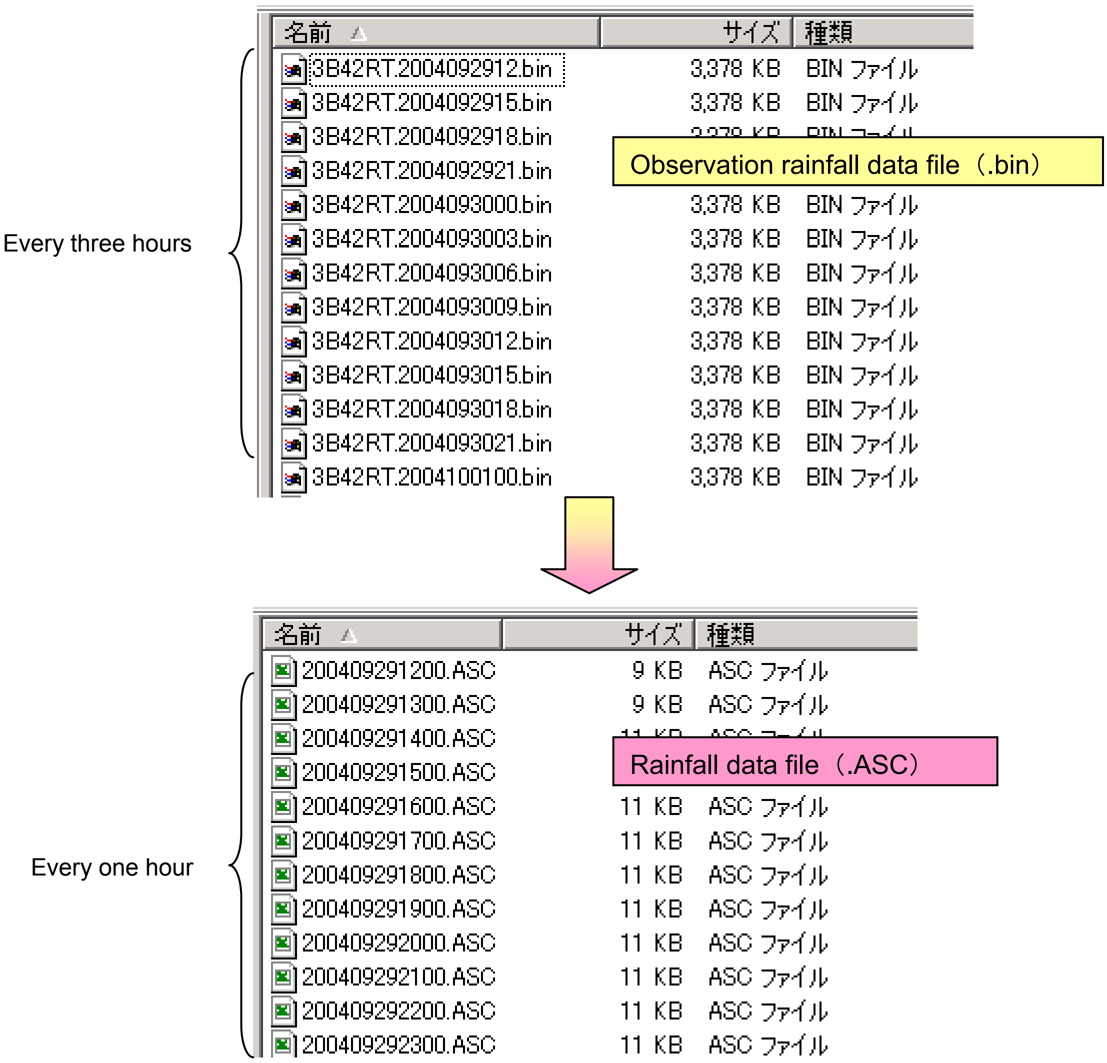


Fig. 6.15 Imported result of 3B42RT

6.3.2 GSMaP (Satellite rainfall data)

6.3.2.1 Features (MVK+(~2006),NRT(2008~))

GSMaP (Global Satellite Mapping of Precipitation) is the name of a research project team “Creating global satellite mapping of precipitation with high precision and resolution”, which belongs to the research area of Core Research for Evolutional Science and Technology (CREST) / Japan Science and Technology Agency (JST).

Being used satellite data: Microwave radiation device equipped with satellite TRMM/TMI, Aqua/AMSR-E, ADEOS-II/AMSR, DMSP/SSMI (F13, 14, 15) Data transmission Interval: 4hour Mesh size: 0.1°≒ 11 km, A ≒ 120 km², NRT_daily：0.25° ≒275km, A≒75,625km² Observation extent: Altitude 60 degrees North～Longitude 60 degrees South Data provided at URL MVK+(hourly)：ftp://hokusai.eorc.jaxa.jp/pub/gsmap_crest/MVK+/hourly/ MVK+(daily) ：ftp://hokusai.eorc.jaxa.jp/pub/gsmap_crest/MVK+/daily/ NRT(hourly) ：ftp://hokusai.eorc.jaxa.jp/realtime/archive/ NRT(daily) ：ftp://hokusai.eorc.jaxa.jp/realtime/daily

6.3.2.2 Data format

Data contains GSMaP precipitation (0.1 degree grid value: lon=3600, lat=1200 / extent: 0.05E-0.05W, 59.95N-59.95S）and Grid Analysis and Display System (GrADS) control file (.ctl). Binary data are all little endian (4 byte real number).

Data is all compressed as the format of UNIX/GZIP. Daily is mean daily value, and hourly is mean hourly value. Unexpected value is -999.9. The unit is mm/hr.

Filename

MVK+(hourly) ：“GSMaP_MVK+.ObserveDay.time.0.1deg.hourly.v484.gz”
(ex：GSMaP_MVK+.20051201.00.0.1deg.hourly.v484.gz)
MVK+(daily) ：“GSMaP_MVK+. ObserveDay.0.1deg.daily.v484.gz”
(ex：GSMaP_MVK+.20051201.0.1deg.daily.v484.gz)
NRT(hourly) ：“gsmap_nrt. ObserveDay. time 00.dat.gz”
(ex：gsmap_nrt.20080901.0500.dat.gz)
NRT(daily:0~23) ：“gsmap_nrt. ObserveDay.0.25d.daily.00Z-23Z.dat.gz”
(ex：gsmap_nrt.20080901.0.25d.daily.00Z-23Z.dat.gz)
NRT(daily:12~11) ：“gsmap_nrt. ObserveDay.0.25d.daily.p12Z-11Z.dat.gz”
(ex：gsmap_nrt.20080909.0.25d.daily.p12Z-11Z.dat.gz)

File Format

・MVK+(hourly, daily) Precipitation 4byte×3,600（longitude）×1,200（latitude）
・NRT(hourly) Precipitation 4byte×3,600（longitude）×1,200（latitude）
・NRT(daily) Precipitation 4byte×1,440（longitude）×480（latitude）

6.3.2.3 Import method

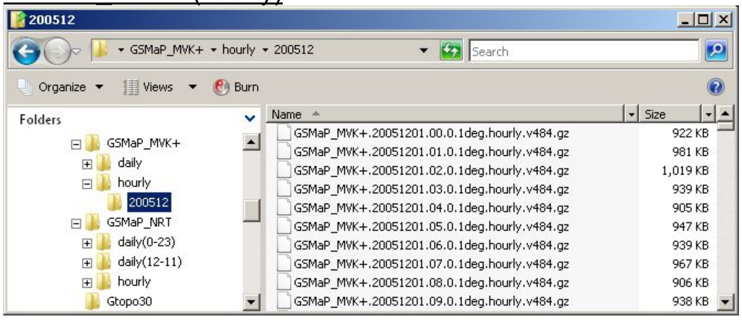
GSMaP can be imported to system by using the importing function of IFAS.

1) Download method

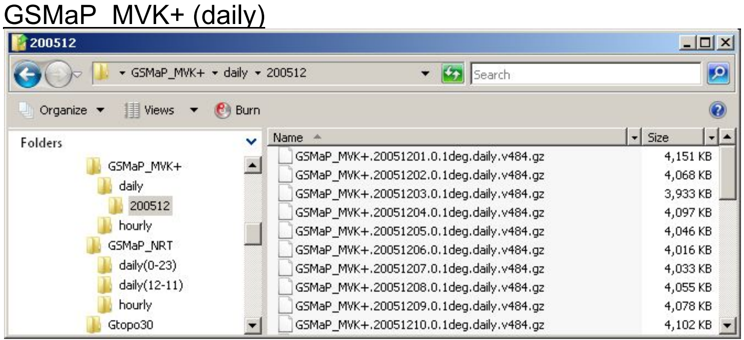
GSMaP rainfall data can be automatically downloaded to IFAS by using the downloading function of rainfall data manager. However, the internet should have been connected. Otherwise, original 3B42RT rainfall data have to be stored to the PC for starting the IFAS system. Generally, data are saved the folder shown as follows. Considering multiple types of 3B42RT observation rainfall data will be saved, it is convenience to add data’s year, month and date to folder name for avoiding confusion.

The GSMaP_MVK+ (hourly) is provided as monthly downloading data, the size of one file is about 600 MB, and it needs time for downloading. Therefore, “no response” may be shown sometimes due to the said condition.

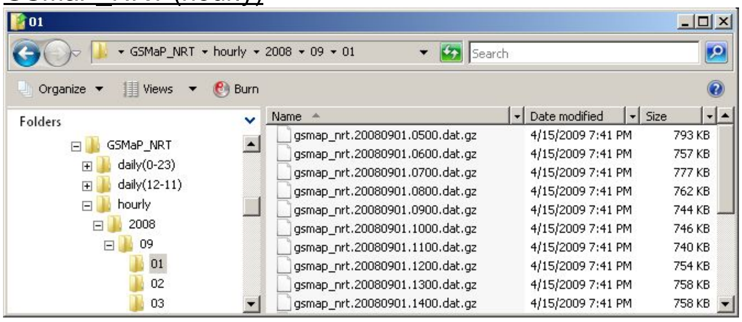
GSMaP_MVK+ (hourly)



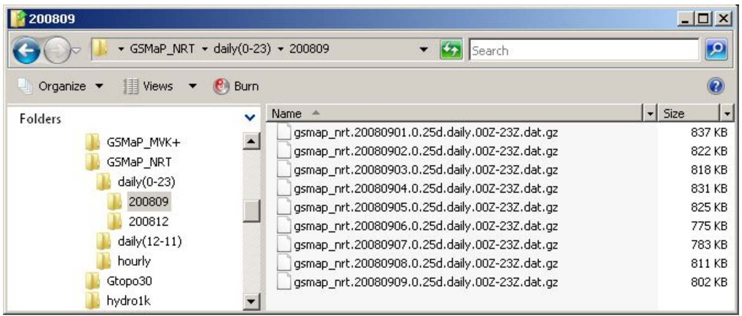
GSMaP_MVK+ (daily)



GSMaP_NRT (hourly)



GSMaP_NRT (daily：0～23)



GSMaP_NRT (daily：12～11)

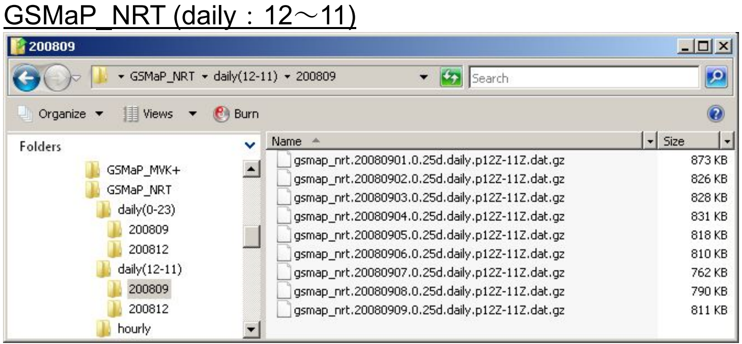
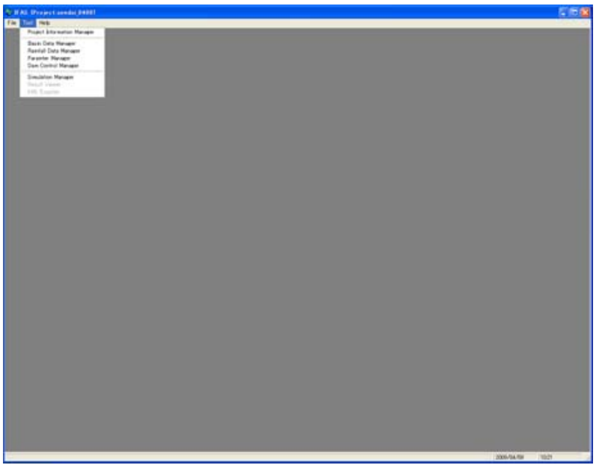
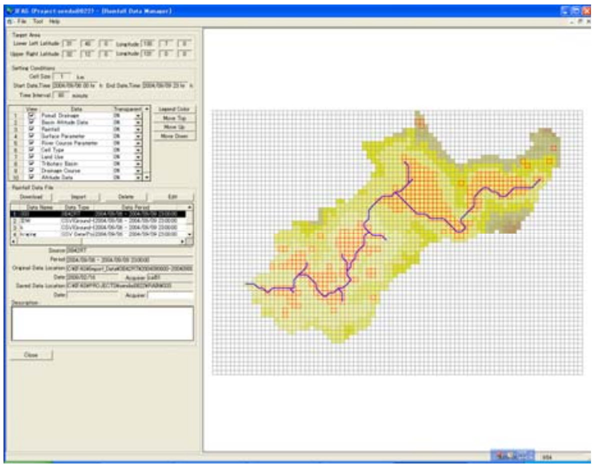


Fig. 6.16 Observation rainfall data of GSMaP

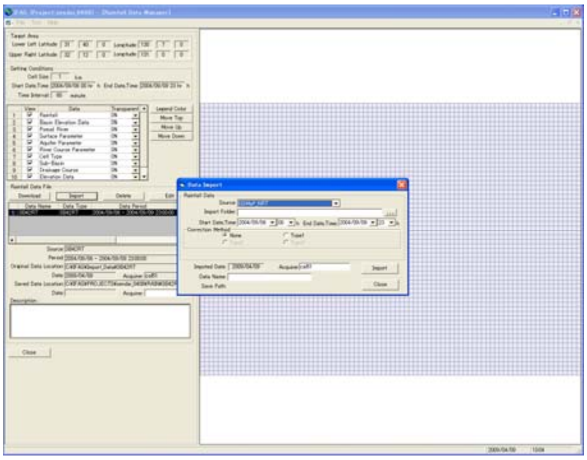
2) Import method

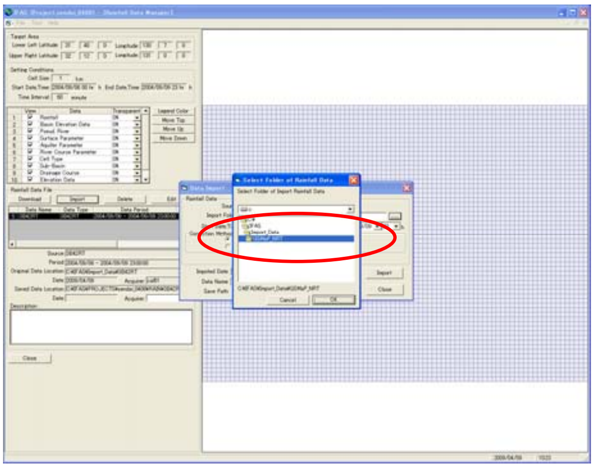




① Select “Rainfall Data Manager” menu from “Tool” menu.

② Click button of “Import” from “Rainfall Data Manager” window.

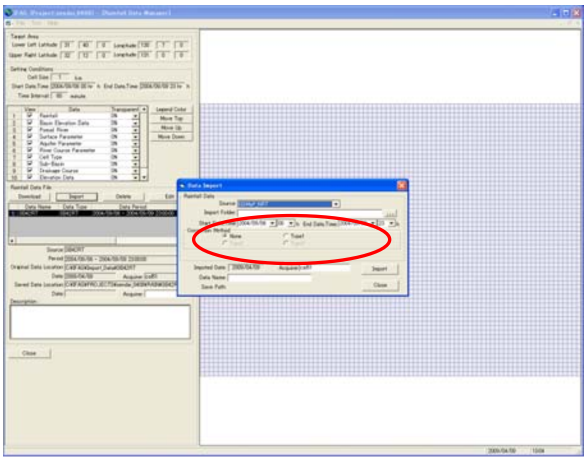


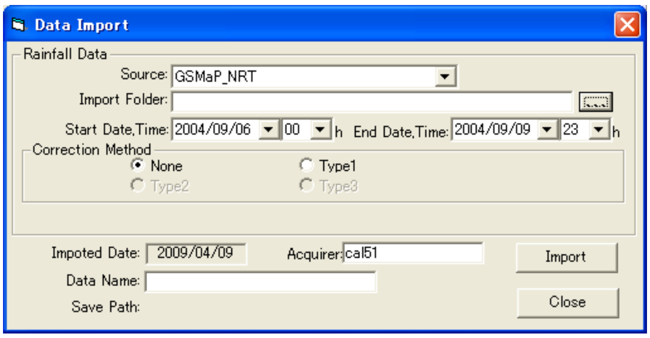


③ Click “GSMaP_NRT” from pull down menu in “Source”.

④ Click the button “･･･” of “ Import Folder”, choose pre-saved rainfall data folder and click the button “OK”.

The folder named “GSMaP_NRT” will be focused automatically. Otherwise, the “IMPORT_DATA” folder will be focused, use can select that optionally.





⑤ Selecting None／Type1／Type2／Type3 from “Correction Method”

None: observed value

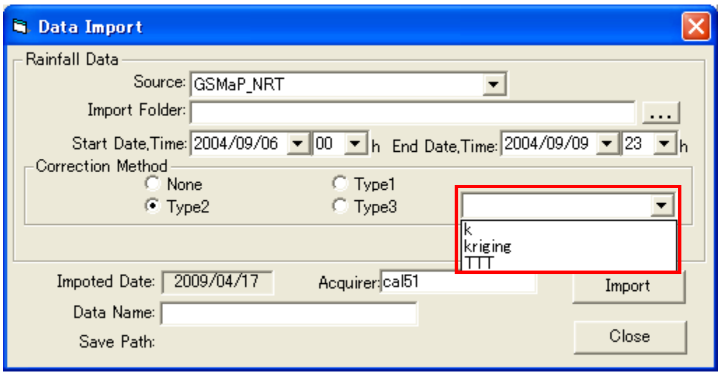
Type1: correction method that considering the movement of rain area
(three hours accumulated value)

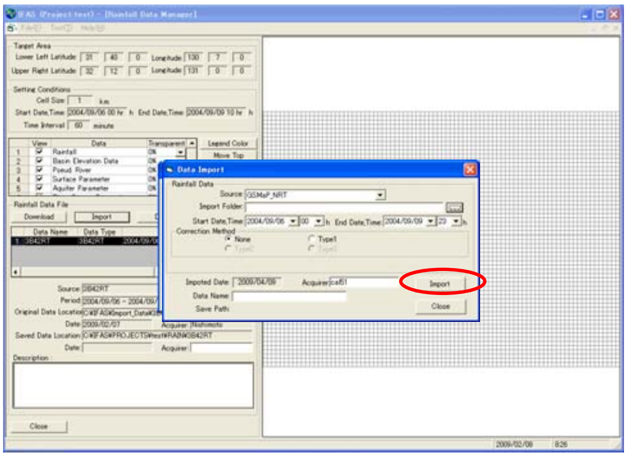
Type2: correction method considering the movement of rain area and mean ground rainfall
(three hours accumulated value and mean rainfall of river basin)

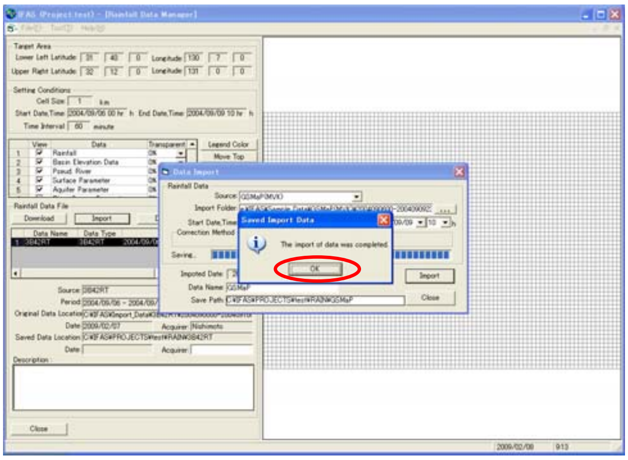
Type3: correction method considering the movement of rain area and mean ground rainfall
(three hours accumulated value and rainfall of each cells)

Corrections of Type2 and Type3 need ground rainfall data. If Type2 and Type3 are selected, a combobox will be displayed as shown in the right-hand figure. Select the imported ground rainfall data to conduct the correction.

In addition, to conduct the correction that considering ground rainfall (Type2 and Type3), the river basin should has been created firstly.







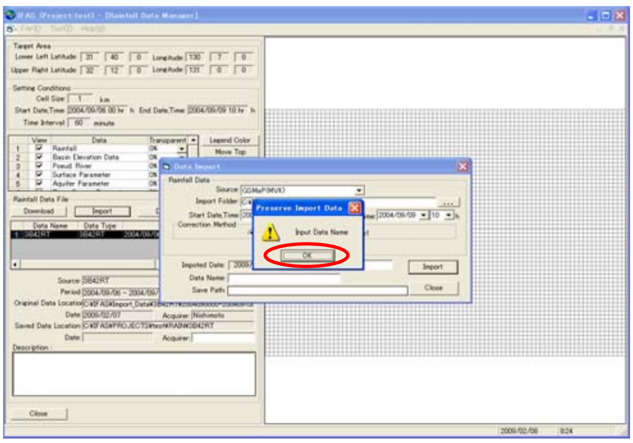
⑥ Click the “Import” button.

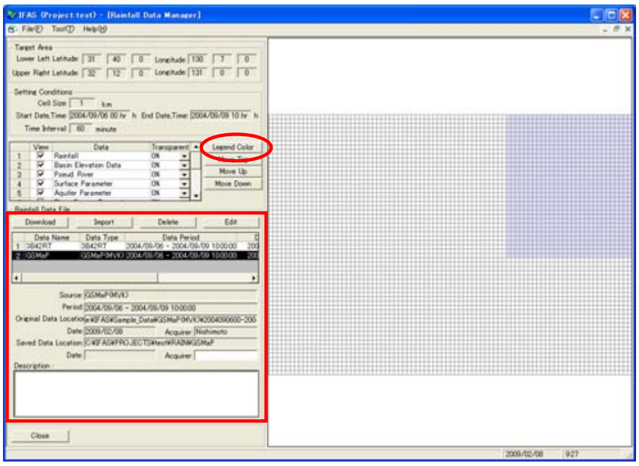
⑦ Click the “OK” button.

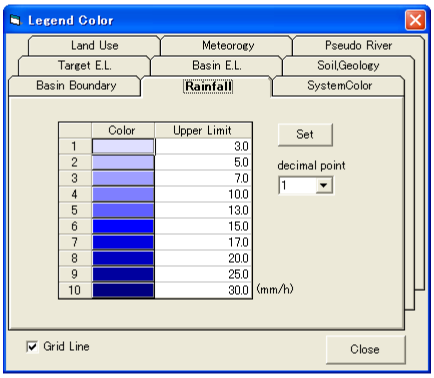
If the "DataName" table is empty, a message box will pop-up that indicating import is failed. The folder name that can reflect the content of rainfall data file is expected. The “import date” will be input automatically, however, it can be changed when setting project according to the default of “Acquirer”.

⑧ Click the “OK” button.

⑨ Click the “Close” button.







⑩ Importing of GSMaP is finished when folder name is displayed. Click "Legend Color" button to display the legends.

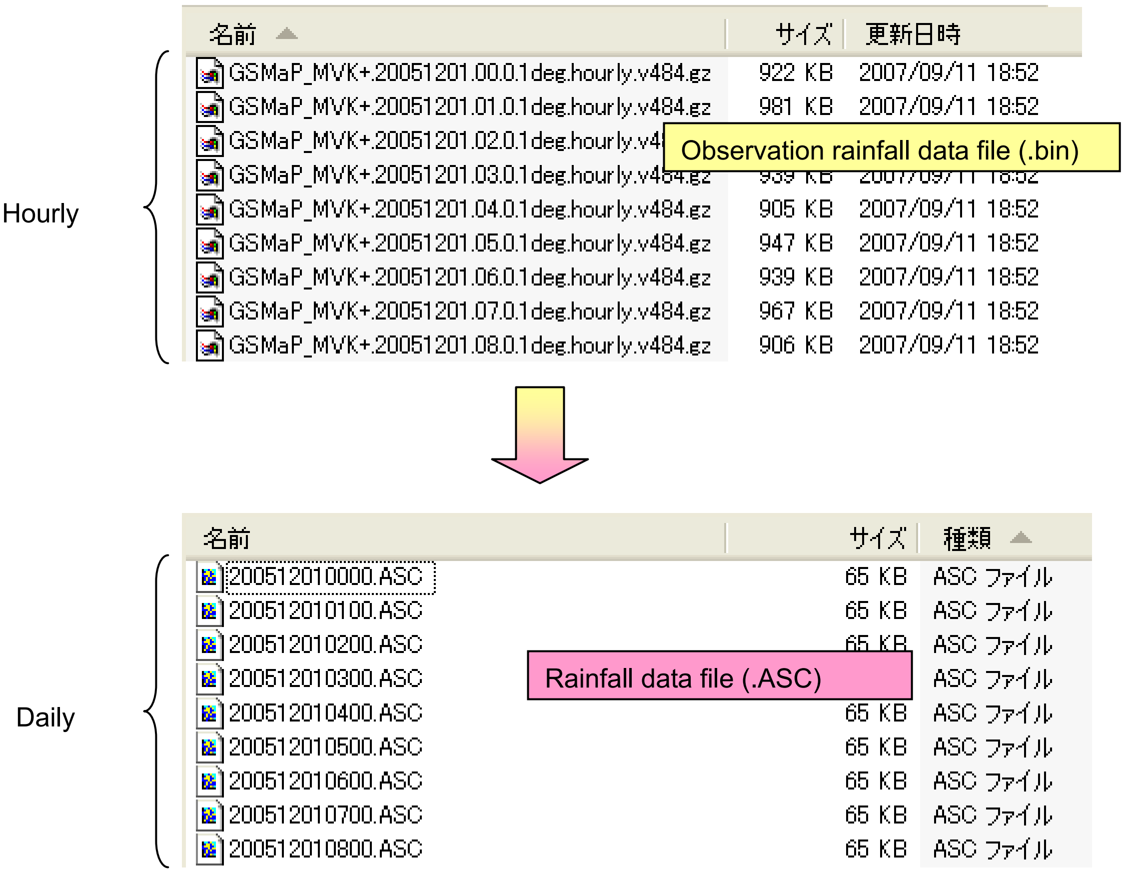


Fig. 6.16 Imported result of GSMaP (hourly)

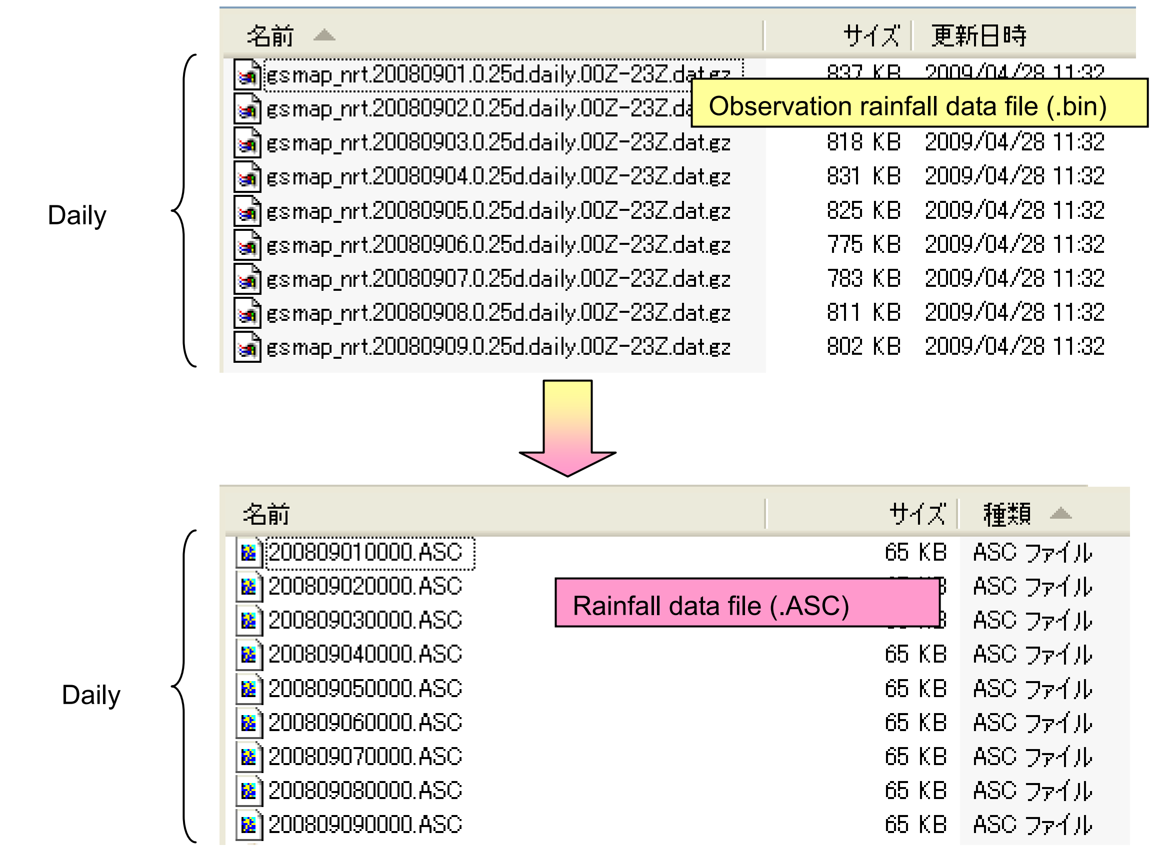


Fig. 6.17　Imported result of GSMaP (daily)

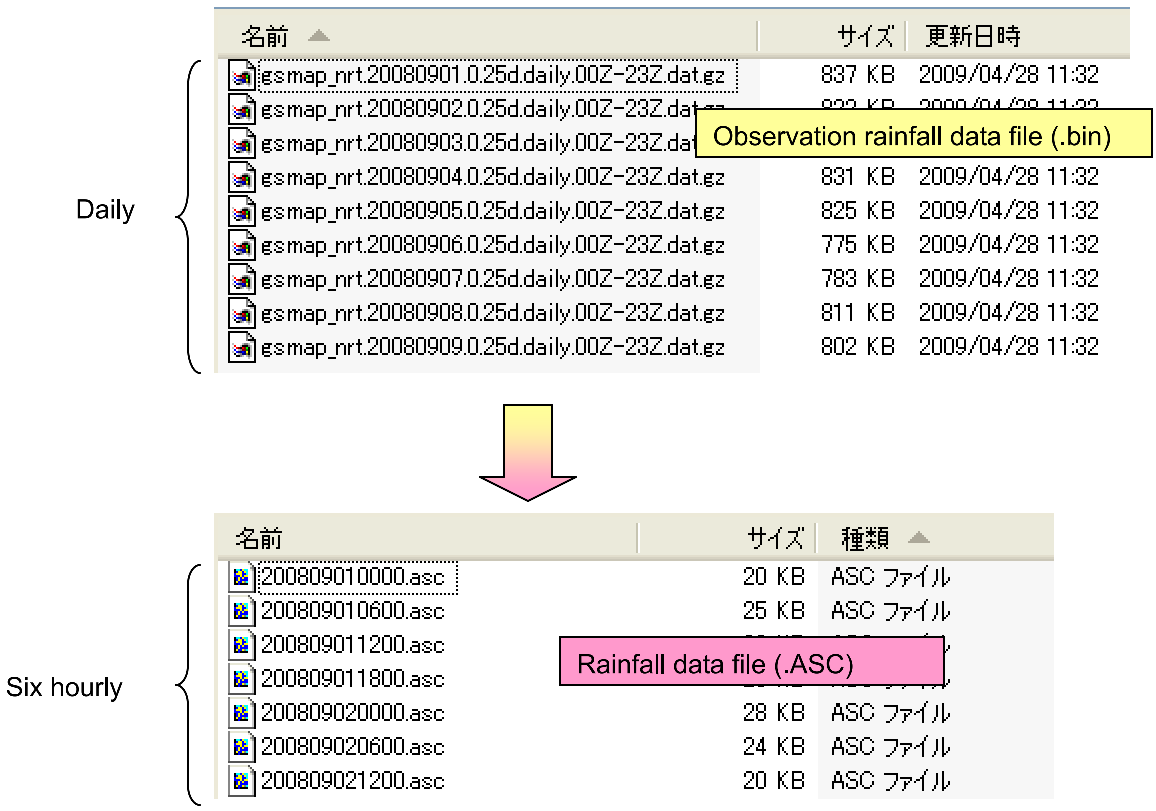


Fig. 6.18　Imported result of GSMaP (daily=>six hourly)

6.3.3 Qmorph,Cmorph (Satellite rainfall data)

6.3.3.1 Features

Data of Qmorph and Cmorph is rainfall data of 8km mesh, infrared data and observation of rainfall with a time interval of 30 minutes.

> Data Source : Rain Area Movement Information of Microwave and Infrared
> Data Transmission Interval: 30 minutes
> Transmission Time : Semi-Real time (2.5hours delay)
> Mesh Size : 0.25°≒25km, A□600km^2
> Observation Extent: North Altitude 60 degrees ～ South Altitude 60 degrees
> The data kind uses "30min_8km" though are three kinds ("30min_025deg" and "30min_8km" and "3-hourly_025deg").
> Data provided at URL :
> QMORPH : ftp://ftp.cpc.ncep.noaa.gov/precip/qmorph/30min_8km/
> CMORPH : ftp://ftp.cpc.ncep.noaa.gov/precip/global_CMORPH/30min_8km/

6.3.3.2 Data format

Qmorph and Cmorph is rainfall data located in coordinate system WGS at interval of 0.25 degrees or grid with interval of 8 km (0.072756669 degree in Latitude and 0.072771377 degrees in Longitude). Data's interval is 30 minutes. Import program can get data in assigned time zone.

Data format of Qmorph and Cmorph is composed of 6 groups and each group is formed from 1 byte data at 4,948 (altitude direction) × 1,649(longitude direction).

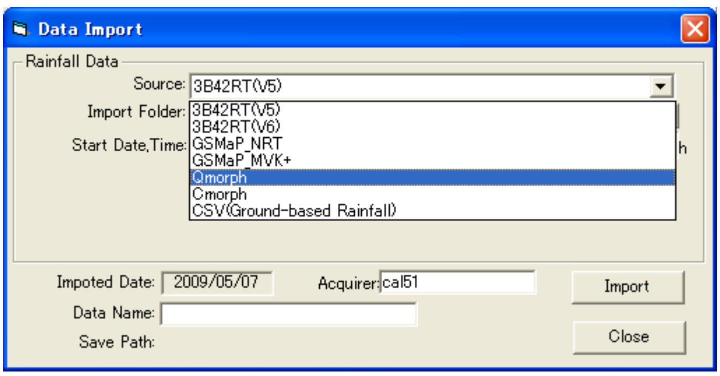
File name is presented by "QMORPH_8km_observation date and time"
(e.g.QMORPH_8km_2007102301) and file format is explained as follows.

-Value of Estimated Precipitation Qmorph and Cmorph Contains -the most recent microwave's value -Value containing Satellite's ID	30 minutes of the first half
-Value containing Qmorph's and Cmorph's estimated precipitation -the most recent microwave's value -Value containing Satellite's ID	30 minutes of the second half

The second and the fifth data are extracted in IFAS as one-hour precipitation.

6.3.3.3 Imported method

Operation method is the same as 3B42RT: select "Qmorph" or "Cmorph" from "Import Data Source" Menu



6.3.4 WISEF (Ground rainfall data) (This feature has been stopped)

(Remark) WISEFF data presented here is a brief one from Japan

6.3.4.1 Features

Rainfall data with hydro information exchange format in accordance with standard of Ministry of Land, Infrastructure and Transport Hydrology Observation Service regulation can be applied. That is standard example of hydrology and water quality database and applied as national standard data.

Spot Rainfall Data: Normal Observation, Self-record Observation, Night Observation with Telemeter System
Data Transmission Interval: 1hour
Observation Extent: around 2,800 spots country- wide
Data provided at URL: http://www1.river.go.jp/ (Water Information System of Ministry of Land, Infrastructure and Trasport, Japan)

6.3.4.2 Data Format

By WISEF defined rainfall data is text data composed of head and data section. Rainfall data with unit of one hour can be recorded.

File is presented as extension of .wsf.

WISEF format applying with IFAS is denoted as follows.

When applying IFAS, observation spot type is “R” and data set name is “RH”.

Observation Spot1 (lines STATION through the first EOD):

```
FILE
STATION, Observation SpotType(R), Database register code, quality code, sensor code
DATA, Data set Name(RH)
YYYY/MM/DD, rainfall data of 1o’clock, rainfall data of 2o’clock・・・・rainfall data of 24o’clock
YYYY/MM/DD, rainfall data of 1o’clock, rainfall data of 2o’clock・・・・rainfall data of 24o’clock
YYYY/MM/DD, rainfall data of 1o’clock, rainfall data of 2o’clock・・・・rainfall data of 24o’clock
EOD
STATION,
  ~
EOD
EOF
```

Fig. 6.19 WISEF format

(3) Operation method

IFAS operation function is applicable to WISEF and it can be operated in the system.

1) Preparation

When operating WISEF rainfall data in IFAS, it’s necessary to save original observation rainfall data of WISEF in computer before system starts.

Data obtained from observation spot of Ministry of Land, Infrastructure and Transport, and observation rainfall data are fitted to WISEF format which can be treated in IFAS. Text files are created from such fitted data.

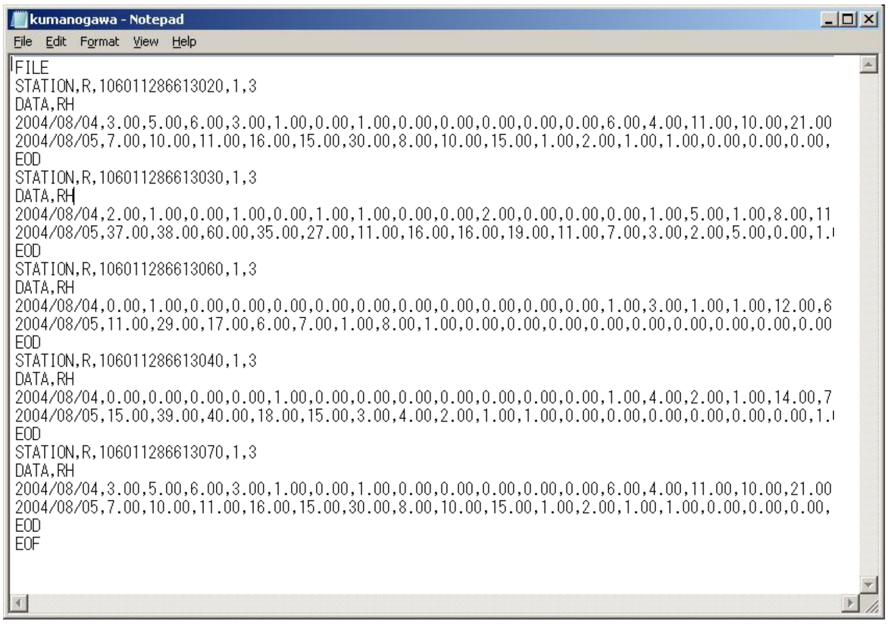


Fig. 6.20 Observation rainfall data of WISEF format (kumanogawa.wsf)

Generally, data are saved in the below folder. Considering there are multiple types when saving WISEF rainfall observation data, data's year, month and date are added to file name of rainfall observation data for convenience to avoid confusion when selecting folder.

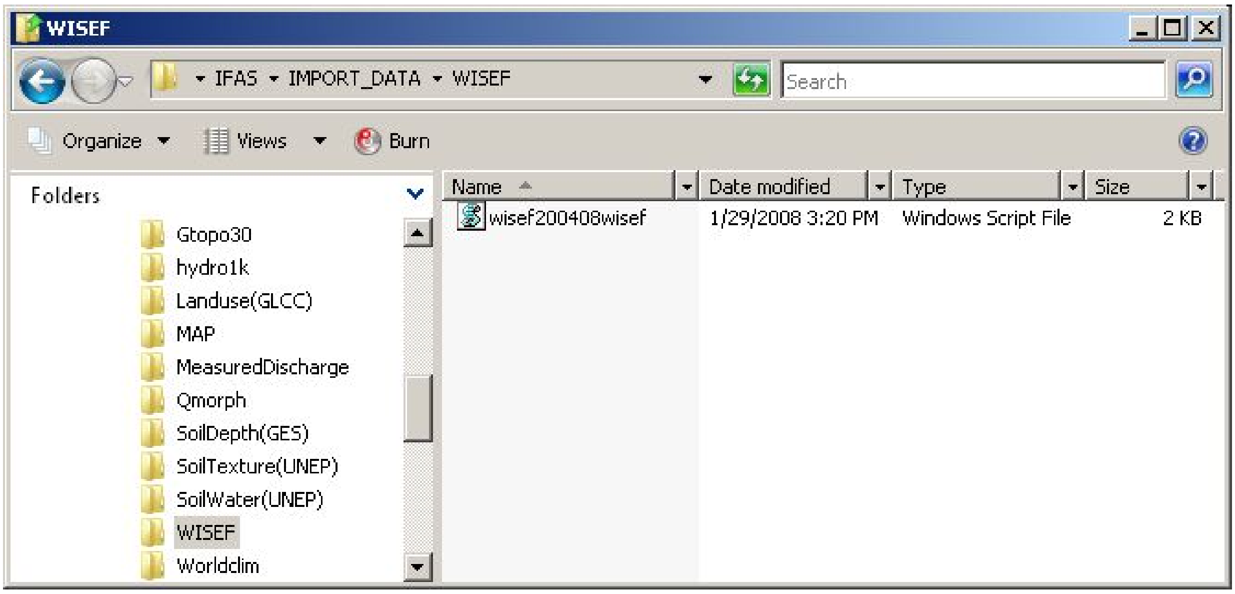
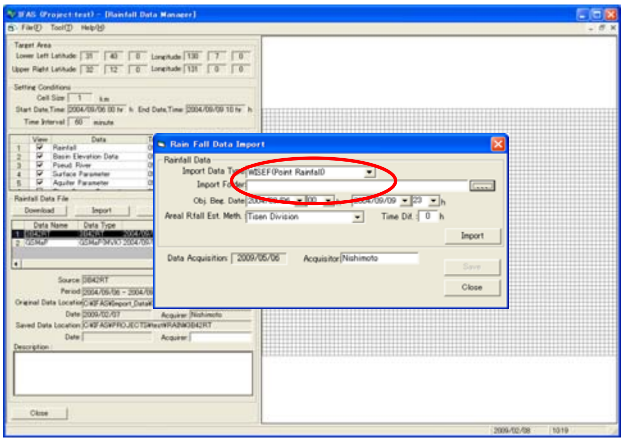
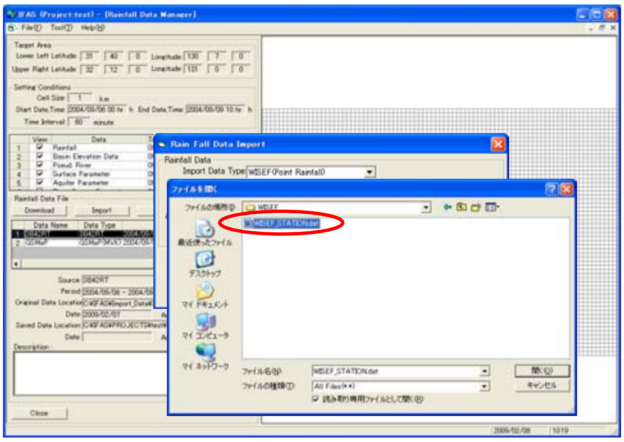


Fig. 6.21 Observation rainfall data of WISEF

2) Imported method

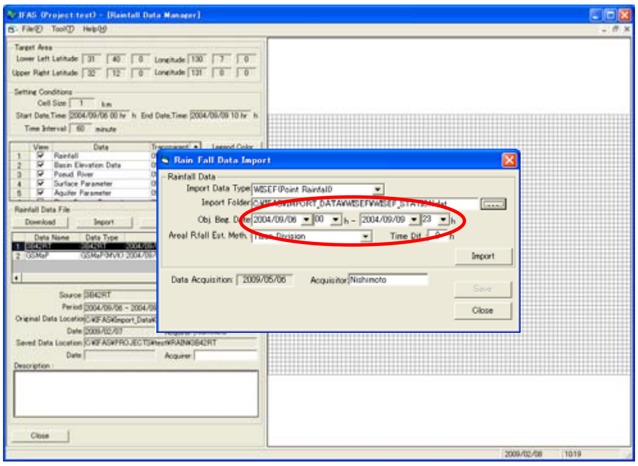
The basic operation progress is the same as satellite rainfall importing operation. The following shows the difference of satellite rainfall importing operation.





① Select “WISEF (Site Precipitation)”from pull down menu of “Import Data Type

② Click button “･･･”of “Import Folder” and then to select saved rainfall observation data folder in preparation by click button “OK”. User can optionally select input folder of “Import_Data”.



③ Input obtaining period of rainfall data in column of “Data Obtaining Period”

Obtaining Period is input with unit of one hour in subject period of project and folder which contains previously treated observation rainfall data file should exist.

Select “Area Rainfall Calculation Method” from folder menu. In IFAS, “Area Rainfall Calculation Method” can be selected from “Inverse Distance Weighted Method” and “Segmentation Method”. When comparing satellite data result of 3B42RT, time difference can be input by IFAS in order to fit rainfall time to GMT (Greenwich World Time)

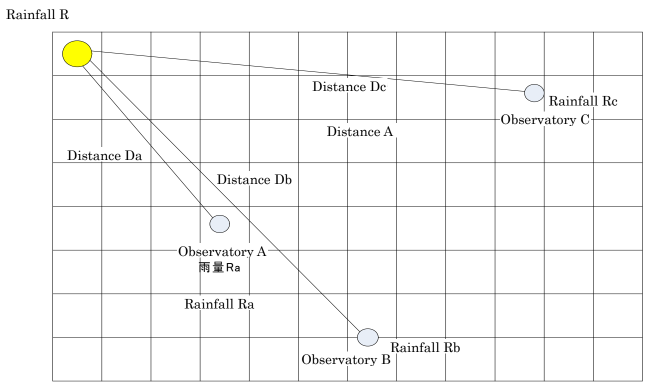
【Area rainfall calculation】

(IDW：Inverse Distance Weighted)

Inverse Distance Weighted Method is to estimate each mesh precipitation presented as follows.

$$V = \sum (w \times v) / \sum w$$

V: average value w: weight= $(1/d)^2$ v: Value of sample point d: distance



$R = (Ra \times (1/Da^2) + Rb \times (1/Db^2) + Rc \times (1/Dc^2)) / (1/Da^2 + 1/Db^2 + 1/Dc^2)$

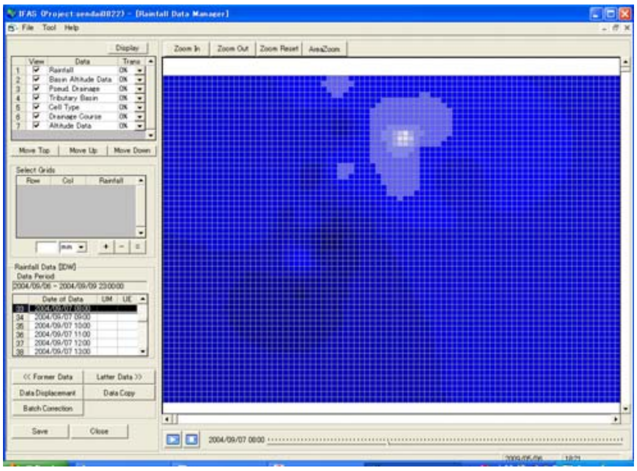


Fig. 6.22 Inversed Distance Weighted Fig. 6.23 Area rainfall with Inversed Distance Weighted

【Thiessen Tessellation】

Through Thiesson Tessellation, grid precipitation calculation is the area, which is surrounded by two perpendicular and 2 bisectrix line between one of following observation spot and the other observation spots, is assigned as effecting extent of the observation spot and the area is extent cell for distributed precipitation of observation spot.

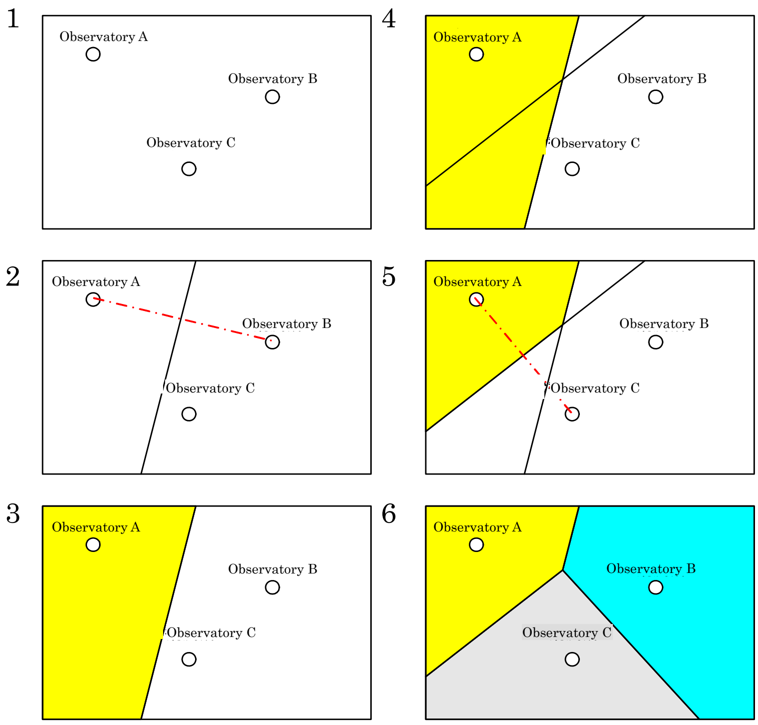


Fig. 6.24 Thiessen Tessellation

Precipitation spot is involved within subject extent.

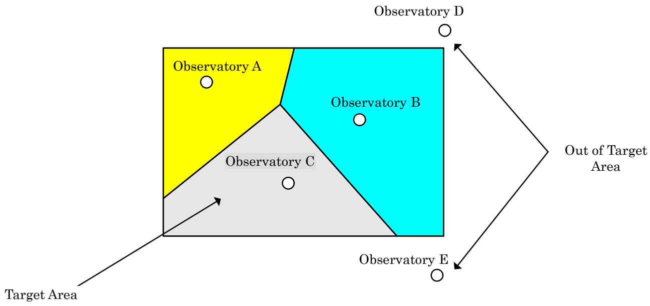


Fig. 6.25 Precipitation observation spot that becomes subject

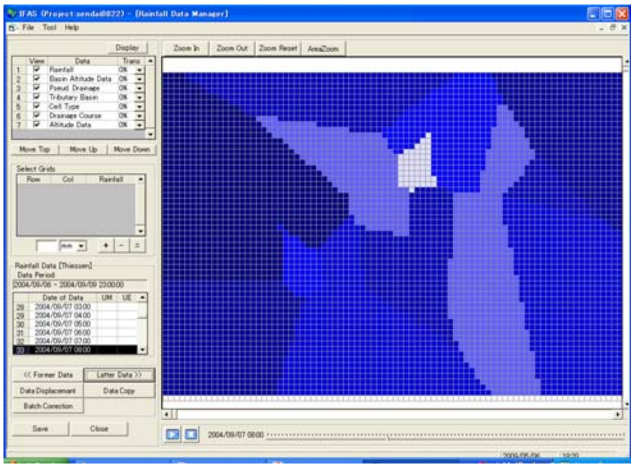


Fig. 6.26 Area rainfall with Thiessen Tessellation

【Kriging Method】

The kriging method uses ordinary kriging to interpolate the rainfall value of a random field at an unobserved location from observations of its value at nearby locations in a given time. The ordinary kriging is the best linear unbiasedness prediction for a random field with the intrinsic stationarity.

It runs calculation as the algorithm below, and predicts the rainfall.

The "intrinsic stationary" is defined as follows.

Concept of Intrinsic Stationary

Define the random field of an area $D \subset \mathbf{R}^d$ as $Z = \{Z(\mathbf{s}); \mathbf{s} \in D\}$, the actual value of random variable $Z(\mathbf{s}_1), \cdots, Z(\mathbf{s}_n)$ in observation location $\mathbf{s}_1, \cdots, \mathbf{s}_n \in D$ as $z(\mathbf{s}_1), \cdots, z(\mathbf{s}_n)$. Then, the random field Z has intrinsic stationary, for any location $\mathbf{s}_1, \mathbf{s}_2 \in D$,

$$\begin{aligned} &E[Z(\mathbf{s}_1) - Z(\mathbf{s}_2)] = 0 \\ &Var[Z(\mathbf{s}_1) - Z(\mathbf{s}_2)] = 2\gamma(\mathbf{s}_1 - \mathbf{s}_2) \end{aligned} \tag{1}$$

where, $E[\square]$ is expected value, $Var[\square]$ represents dispersion.

For rainfall estimation, the method becomes as the following.

$D \subset \mathbf{R}^2$	Area for estimating rainfall
$\mathbf{s}_i = (x_i, y_i)\ (i = 1, \cdots, n)$	Location of setting rainfall radar
$z(\mathbf{s}_i)\ (i = 1, \cdots, n)$	Observed rainfall data at location $\mathbf{s}_i$

If the intrinsic stationary exists, then for any two locations (locations have to be in D, not have to be observation ones) $\mathbf{s}_i = (x_i, y_i), \mathbf{s}_j = (x_j, y_j) (i \neq j)$,

$$\begin{aligned} &E[Z(\mathbf{s}_i) - Z(\mathbf{s}_j)] = 0 \\ &Var[Z(\mathbf{s}_i) - Z(\mathbf{s}_i)] = 2\gamma(\mathbf{s}_i - \mathbf{s}_j) \end{aligned} \tag{2}$$

The semivariogram γ does not depend on position.

The intrinsic stationary assumed that the semivariogram does not depend on location, however, is a function of vector's difference with anisotropy. Here, change the assume below with isotropy,

$$\begin{aligned} &\gamma(\mathbf{s}_i - \mathbf{s}_j) = \gamma(h) \\ &h = \| \mathbf{s}_i - \mathbf{s}_j \| \end{aligned} \tag{3}$$

then, the value of semivariogram can be estimated by:

$$\hat{\gamma}(h) = \frac{1}{2|N(h)|} \sum_{N(h)} (z(\mathbf{s}_i) - z(\mathbf{s}_j))^2 \tag{4}$$

where, $N(h) = \{(i, j); \| \mathbf{s}_i - \mathbf{s}_j \| = h\}$. In other words, the distance between $\mathbf{s}_i, \mathbf{s}_j$ is h, as set of all groups of (i, j). In addition, $|N(h)|$ is the elements number of $N(h)$. However, $N(h)$ cannot be generated if h is fixed。 Then, h is divided to classes with same spaces to generate the semivariogram within the class. This is the said empirical semivariogram.

Empirical Semivariogram is a discrete value generated from each class, and a statistic with bias error. Where, $\gamma(h)$ is adapted to parameter model. The parameter model being used in Kriging method contains the nugget effect, linearity, power, spheric, exponential, and Gaussian models. For example, the function of most used Gaussian model is as follows:

$$\gamma(h) = \begin{cases} \theta_0 + \theta_1 \{1 - \exp(-(\frac{h}{\theta_2})^2)\} & (h > 0) \\ 0 \quad (h = 0) \end{cases} \tag{5}$$

$(\theta_0, \theta_1, \theta_2)$ is determined from measured value by least squares method.
It uses semivariogram coefficient $\gamma(h)$ to forecast the response $Z(\mathbf{s}_0)$ that to any point $\mathbf{s}_0$ in the area D. The forecasted value $\hat{Z}(\mathbf{s}_0)$ of $Z(\mathbf{s}_0)$ is the linear sum of weighted vector $\mathbf{w} = (w_1, \cdots, w_n)'$, which is generated by

$$\hat{Z}(\mathbf{s}_0) = \mathbf{w}'\mathbf{z} \tag{6}$$

However, $\mathbf{z} = (z(\mathbf{s}_1), \cdots, z(\mathbf{s}_n))'$.

If $\hat{Z}$ has the unbiasedness, because $E[\hat{Z}(\mathbf{s}_0)] = E[Z(\mathbf{s})] = \mu$, then must $\sum_{i=1}^{n} w_i = 1$.

In addition, the mean-square error of prediction is

$$\sigma^2(\mathbf{s}_0) = E[\{Z(\mathbf{s}_0) - Z(\mathbf{s}_0)\}^2] = -\mathbf{w}'\Gamma\mathbf{w} + 2\mathbf{w}'\boldsymbol{\gamma}_0 \tag{7}$$

$$\boldsymbol{\gamma}_0 = \begin{bmatrix} \gamma(\mathbf{s}_1 - \mathbf{s}_0) \\ \vdots \\ \gamma(\mathbf{s}_n - \mathbf{s}_0) \end{bmatrix}, \quad \Gamma = \left[\gamma(\mathbf{s}_i - \mathbf{s}_j)\right]_{ij} = \begin{bmatrix} \gamma(\mathbf{s}_1 - \mathbf{s}_1) & \cdots & \gamma(\mathbf{s}_1 - \mathbf{s}_n) \\ \vdots & \ddots & \vdots \\ sym & \cdots & \gamma(\mathbf{s}_n - \mathbf{s}_n) \end{bmatrix}$$

Therefore, this is a question of how to generate $\mathbf{w} = (w_1, \cdots, w_n)'$ by minimizing $\sigma^2(\mathbf{s}_0)$ under the limiting factor $\sum_{i=1}^{n} w_i = 1$. If applying this to method of Lagrange multipliers, it becomes:

$$\mathbf{w} = \Gamma^{-1}\boldsymbol{\gamma}_0 + \left(\frac{1 - \mathbf{1}'\Gamma^{-1}\boldsymbol{\gamma}_0}{\mathbf{1}'\Gamma^{-1}\mathbf{1}}\right)\Gamma^{-1}\mathbf{1} \qquad (8)$$

$$\mathbf{1} = (1, \cdots, 1)'$$

$\hat{Z}(\mathbf{s}_0)$, the position $\mathbf{s}_0$ where Z value is located in the generated weight $\mathbf{w}$,can be estimated from equation(6).

<Algorithm>

Step1 Importing the location data (Latitude, Longitude) and rainfall data that at a given time from CSV files. Displayed as x_i, y_i, z_i (Latitude, Longitude, and rainfall).

Step2 Generating the distance $h_k = \sqrt{(x_i - x_j)^2 + (y_i - y_j)^2}$ and semivariogram $z_k = \frac{1}{2}(z_i - z_j)^2$.

$$i = 1, 2, \cdots, n-1;\ j = i+1, \cdots, n;\ k = (i-1)n + j,\ k = 1, \cdots, \frac{(n-1)(n-2)}{2}$$

Step3 Generating the empirical semivaiogram and estimating the division number from exported result

Step4 Estimating the coefficient $(\theta_0, \theta_1, \theta_2)$ of Gaussian model by the least squares method. Different from the use of the least squares method in estimating polynomial function, because of the unlimited non-linear optimization, the system finally chose conjugate gradient method for estimation.

Step5 Generating weighted vector $\mathbf{w}$ by equation (8).

Step6 Generating the grid point $\hat{Z}$ within area D by equation (6).

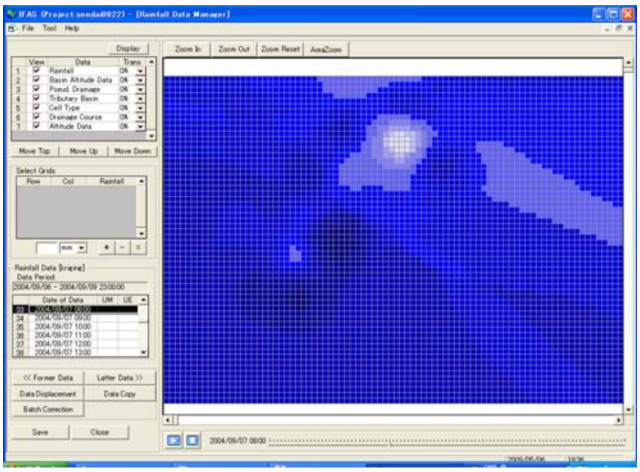
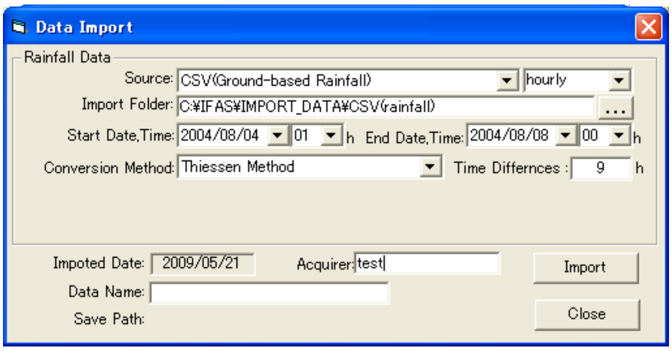


Fig. 6.27 Area rainfall with Kriging method

[Adjustment of time difference]



In order to apply GMT to present data and time and overlap data of WISEF and IFAS format by JMT as well as calculation, time difference should be input to "Time Difference" label. If time and data is later than GMT, signal of "-"should be added.

For example, file of 8/4 1:00 is recorded as file of 8/4 10:00.

6.3.5 CSV rainfall data (site rainfall data)

6.3.5.1 Features

Rainfall data file (CSV file) defined as rainfall along with site can be treated in the IFAS.

6.3.5.2 Data format

Rainfall data defined by the IFAS is text data composed of parts of head and data and rainfall data within any time unit can be recorded. Data is recorded as CSV file.

CSV data format defined by IFAS has the following kinds.

YYYY/MM/DD HH:MM reflects time of precipitation

Observation Spot Name1, Observation Spot Name2・・・・Observation Spot Name n
"Latitude", Latitude1, Latitude2, ・・・・Latitude n
"Longitude", Longitude1, Longitude2, ・・・・Longitude n
YYYY/MM/DD HH:MM Rainfall data1, Rainfall data 2・・・・Rainfall data n
YYYY/MM/DD HH:MM Rainfall data1, Rainfall data 2・・・・Rainfall data n
～
YYYY/MM/DD HH:MM Rainfall data1, Rainfall data2・・・・Rainfall data n
YYYY/MM/DD HH:MM Rainfall data1, Rainfall data2・・・・Rainfall data n

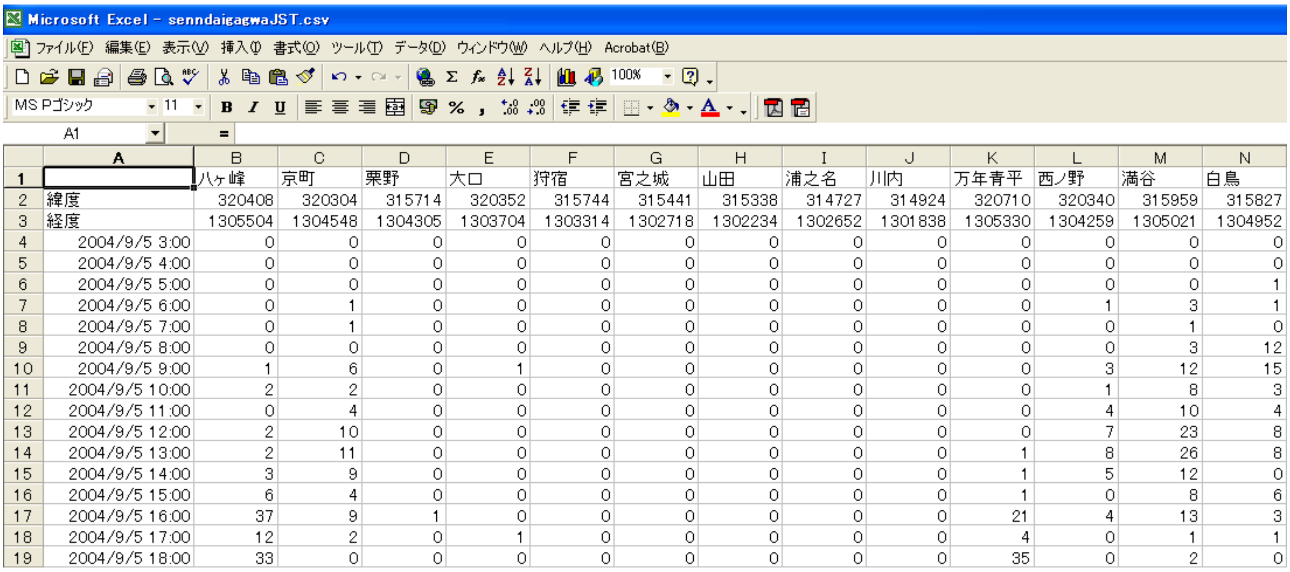
Fig. 6.28 IFAS rainfall data format

6.3.5.3 How to import

a) Preparation

Before starting system, original CSV rainfall data which could be treated by the IFAS should be saved.

Data from Hydrology and Water Quality Database of Ministry of Land, Infrastructure and Transport and observation data are combined to text file with IFAS format. Rainfall data with IFAS format in this manual adopts data 9 precipitation observation spots extracted from Hydrology and Water Quality Database of Ministry of Land, Infrastructure and Transport.



	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1		八ヶ峰	京町	栗野	大口	狩宿	宮之城	山田	浦之名	川内	万年青平	西ノ野	満谷	白鳥
2	緯度	320408	320304	315714	320352	315744	315441	315338	314727	314924	320710	320340	315959	315827
3	経度	1305504	1304548	1304305	1303704	1303314	1302718	1302234	1302652	1301838	1305330	1304259	1305021	1304952
4	2004/9/5 3:00	0	0	0	0	0	0	0	0	0	0	0	0	0
5	2004/9/5 4:00	0	0	0	0	0	0	0	0	0	0	0	0	0
6	2004/9/5 5:00	0	0	0	0	0	0	0	0	0	0	0	0	1
7	2004/9/5 6:00	0	1	0	0	0	0	0	0	0	0	1	3	1
8	2004/9/5 7:00	0	1	0	0	0	0	0	0	0	0	0	1	0
9	2004/9/5 8:00	0	0	0	0	0	0	0	0	0	0	0	3	12
10	2004/9/5 9:00	1	6	0	1	0	0	0	0	0	0	3	12	15
11	2004/9/5 10:00	2	2	0	0	0	0	0	0	0	0	1	8	3
12	2004/9/5 11:00	0	4	0	0	0	0	0	0	0	0	4	10	4
13	2004/9/5 12:00	2	10	0	0	0	0	0	0	0	0	7	23	8
14	2004/9/5 13:00	2	11	0	0	0	0	0	0	0	1	8	26	8
15	2004/9/5 14:00	3	9	0	0	0	0	0	0	0	1	5	12	0
16	2004/9/5 15:00	6	4	0	0	0	0	0	0	0	1	0	8	6
17	2004/9/5 16:00	37	9	1	0	0	0	0	0	0	21	4	13	3
18	2004/9/5 17:00	12	2	0	1	0	0	0	0	0	4	0	1	1
19	2004/9/5 18:00	33	0	0	0	0	0	0	0	0	35	0	2	0

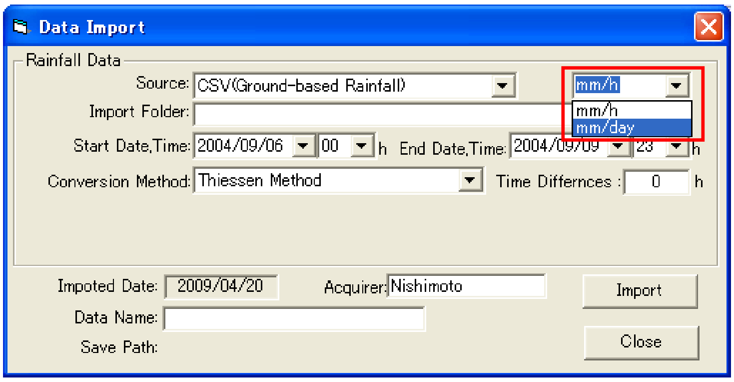
Fig. 6.29 IFAS rainfall data (senndaigagwaJST.csv)

b) Operation

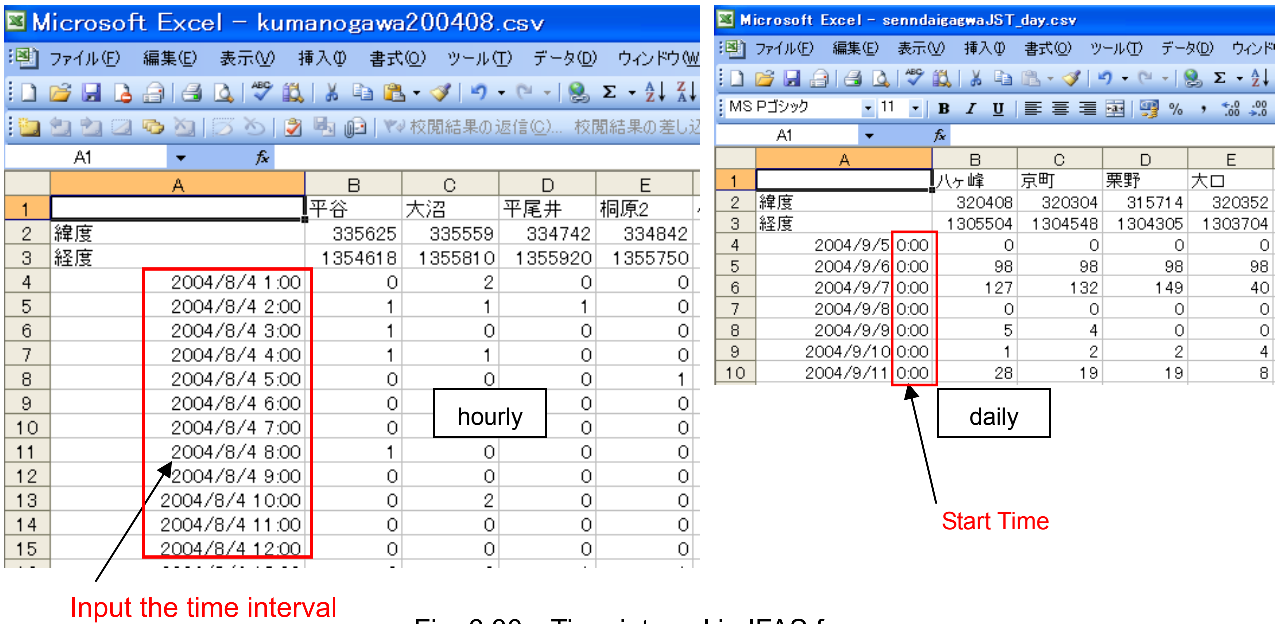
Basic operation is the same as the one of satellite rainfall and WISEF file.

However, data obtaining period should be input with CSV file recorded time unit within subject period of project. Folder in which observation rainfall data file is imported previously should exist.

In addition, the data file can be treated as hourly (mm/h) and daily (mm/day) rainfall files.



The time of daily rainfall data file is created as the start time of calculation period.



	A	B	C	D	E
1		平谷	大沼	平尾井	桐原2
2	緯度	335625	335559	334742	334842
3	経度	1354618	1355810	1355920	1355750
4	2004/8/4 1:00	0	2	0	0
5	2004/8/4 2:00	1	1	1	0
6	2004/8/4 3:00	1	0	0	0
7	2004/8/4 4:00	1	1	0	0
8	2004/8/4 5:00	0	0	0	1
9	2004/8/4 6:00	0		0	0
10	2004/8/4 7:00	0		0	0
11	2004/8/4 8:00	1	0	0	0
12	2004/8/4 9:00	0	0	0	0
13	2004/8/4 10:00	0	2	0	0
14	2004/8/4 11:00	0	0	0	0
15	2004/8/4 12:00	0	0	0	0

	A	B	C	D	E
1		八ヶ峰	京町	栗野	大口
2	緯度	320408	320304	315714	320352
3	経度	1305504	1304548	1304305	1303704
4	2004/9/5 0:00	0	0	0	0
5	2004/9/6 0:00	98	98	98	98
6	2004/9/7 0:00	127	132	149	40
7	2004/9/8 0:00	0	0	0	0
8	2004/9/9 0:00	5	4	0	0
9	2004/9/10 0:00	1	2	2	4
10	2004/9/11 0:00	28	19	19	8

Fig. 6.30 Time interval in IFAS form

6.3.6 Forecast rainfall

6.3.6.1 Feature

The IFAS can import the forecast rainfall data which is extracted from numerical forecast data (GPV: Grid Point Value) provided by meteorological agency.

Interval of provided data: 6 hours Mesh sizeL: 1.25°≒125 km Observation area: global Physical parameters Ground: corrected sea-level air pressure, east-west wind (10 m), south-north wind (10 m), temperature (1.5 m), relative moisture (1.5 m), accumulate precipitation, and air pressure. Atmosphere layer: 16 layers ... altitude, east-west wind, south-north wind, temperature. 7 layers ... relative moisture, upward flow. Among which, the accumulate precipitation is used. Data provided at URL : GPV: http://database.rish.kyoto-u.ac.jp/arch/jmadata/data/gpv/original/

6.3.6.2 Data format

Data format: GRIB2

File name: o Z__C_RJTD_yyyymmddhh0000_GSM_GPV_Rgl_FDtttt_grib2.bin

yyyymmddhh ... Initial time(UTC), hh=00,06,12,18
tttt ... 0000: Forecast time 000h (=Initial value)
0006: Forecast time 006h
0012: Forecast time 012h
・
・
・
0306: Forecast time 078h
0312: Forecast time 084h

6.3.6.3 Import method

Select the “GPV” item from “Source” menu to import the data, which is as same as importing other satellite rainfall.

Extract the rainfall data from GRIB2 and create that as 0.1-degree grid (the same format as GSMap). Then import the data as the same as GSMaP. This function is designed for creating rainfall data in case of combined with GSMaP.

The content of processing is as follows.

①The GPV data is an integrated value for six hours. And, six capitation of the data. The space is interpolated, and 0.1deg lattice data is made.

The above-mentioned processing twice when the downloaded forecast rainfalls are 12 hours, and The above-mentioned processing 14 times for 84 hours.

②Import within the range of the object is done from 0.1deg made lattice data.

③The import of GSMaP_NRT at the period covered is done.

When the import is done, the GPV data has already overwrited GSMaP_NRT.

12 hours and 84 hours can be selected at the forecast time (Default : for 12 hours).

Note) A lot of processing time is necessary if there is no memory of 4GB in PC when 84 hours are selected.

＜Reference＞ Precision of the forecast rainfall data

According to some researches, the precision of forecast rainfall(GSM) seems to lower, when the forecast time is over 12 hours.When the forecast rainfall is used, it is necessary to note it's precision.

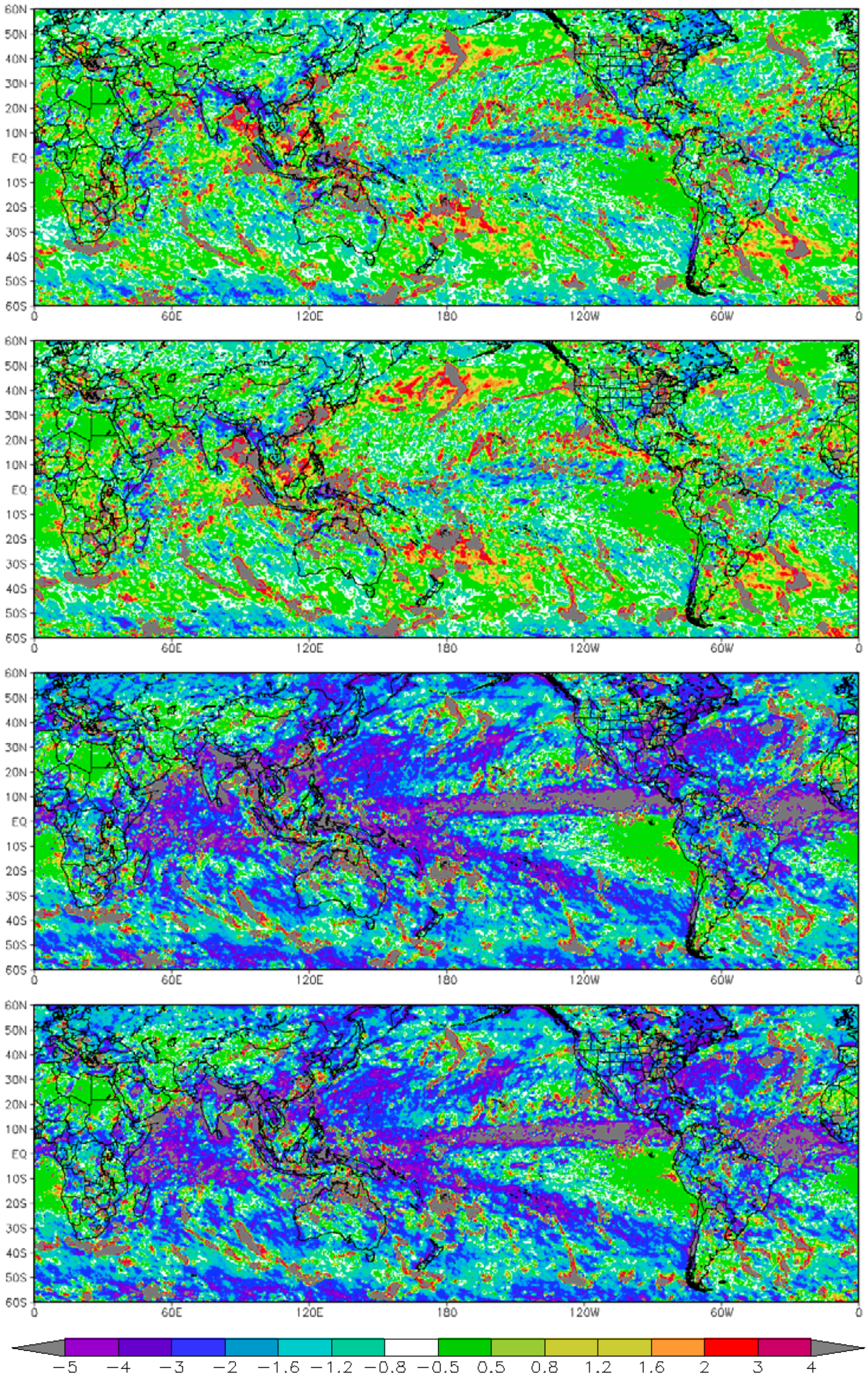
Data source: 2008 "A report on business in improving the function of flood forecast program for developing countries"

forecast time 0-6 hourdle

forecast time 6-12 hourdle

forecast time 12-18 hourdle

forecast time 18-24 hourdle



Comparison of GSMaP and GSM (difference of the two)

(2008/6/1～2008/12/31) mean precipitation density (mm/6hr)

6.4 Downloading rainfall data

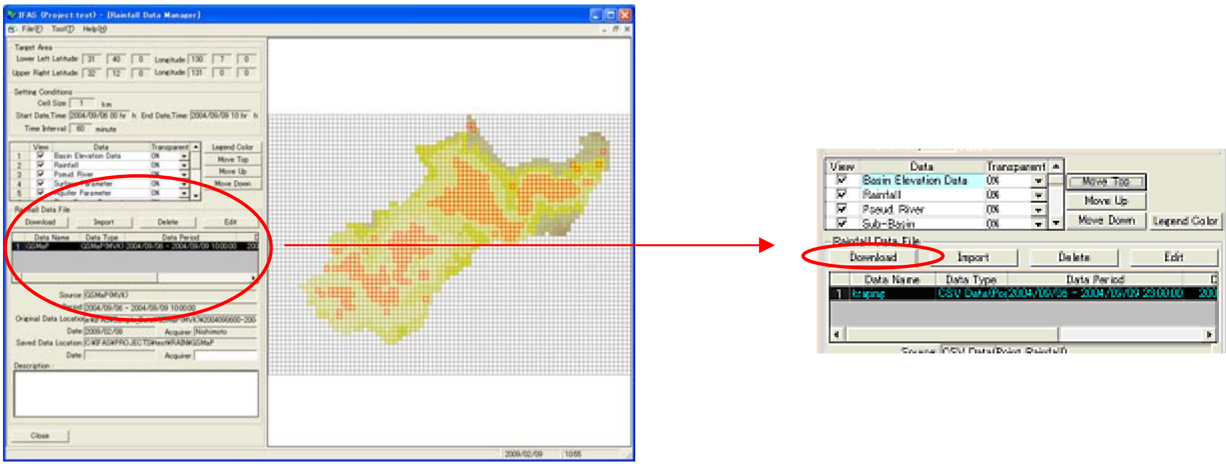
6.4.1 Downloading 3B42RT data

6.4.1.1 How to download

Download rainfall data from the website of 3B42RT. Create a folder named by the starting year/month/data---finishing year/month/data to IMPOTRT_DATA folder. Extract the downloaded files and save them the created folder.

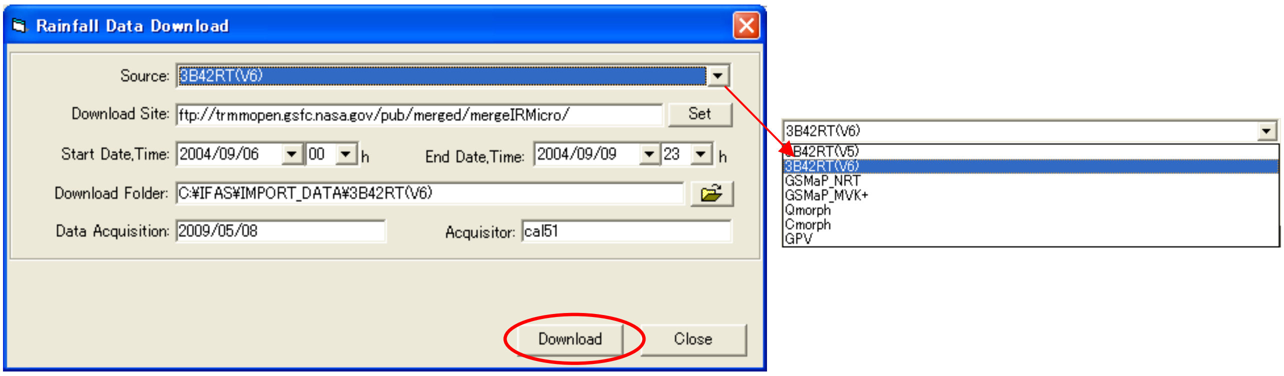
Internet should be connected for downloading.

The 3B2RT has two kinds of data, V5 and V6. Here, we describe how to download the V6 as an example.



① Select the Manu “Rainfall Data Manager” from “Tool” menu.

② Click the “Download” button from the Rainfall Data Manager window.



③ Click “3B42RT(v6)” on the full down menu of “Source”

④ Period of downloading data is set by default by project setting. The period can be changed optionally.

⑤ Click “Download” button to start downloading.

(Remark)Time for downloading is different depending on data’s size and internet environment.

6.4.2 Downloading of other satellite rainfall data (GSMaP, Cmorph, Qmorph, and GPV)

6.4.2.1 How to download

The method to download other satellite rainfall is the same as 3B42RT.

Click target data on the pull down menu of “Source”

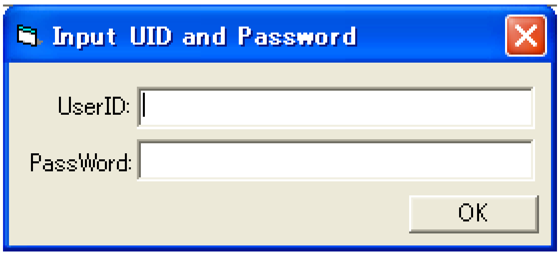
Notes) It is necessary to input to ..download.. doing of GSMaP_NRT doing user ID and the password of the user's registration.

6.4.2.2 How to download GSMaP_NRT

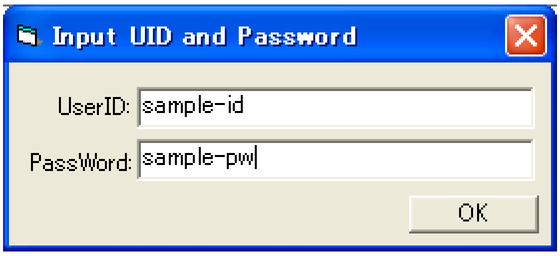
To download GSMaP_NRT, the user ID and password are necessary. User has to registry and/or inputs them for downloading (please registry when downloading it at first time).

To get the user ID and password, please check the website of GSMaP, which is http://sharaku.eorc.jaxa.jp/GSMaP/index_j.htm..

① For first downloading, because the user ID and/or password has not been registered, it will display as follows.



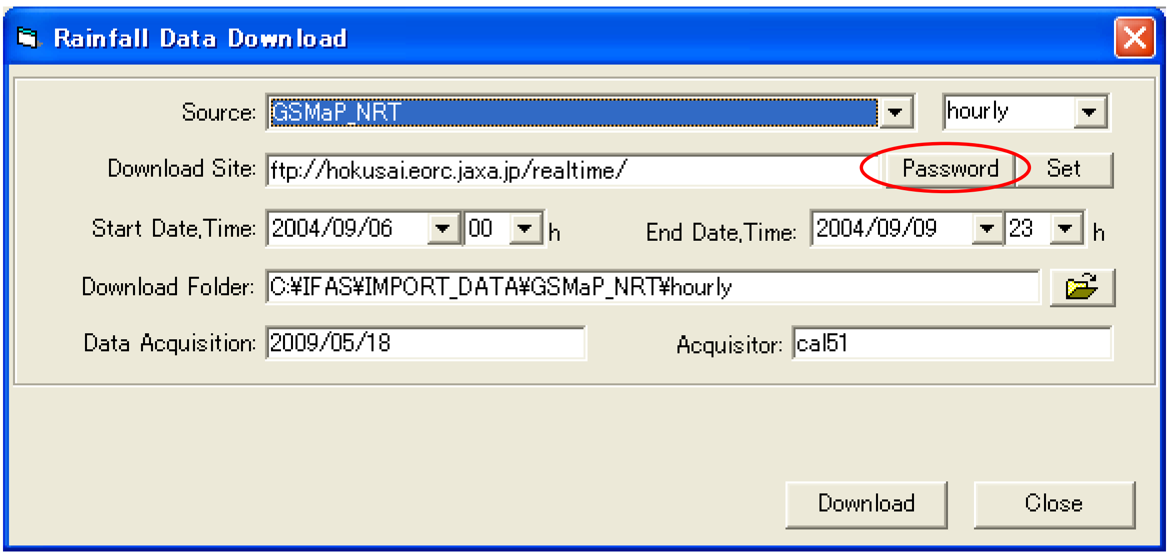
② Type the user ID and password and click “OK” to start downloading.



③ If the user ID and/or password is wrong, the following message will be displayed.

Notes) a wrong user ID and/or password also enable the system to search files, it will not stop until the message box is displayed.

④ To retype the user ID and password, click “Password” button and the window will return to ②.



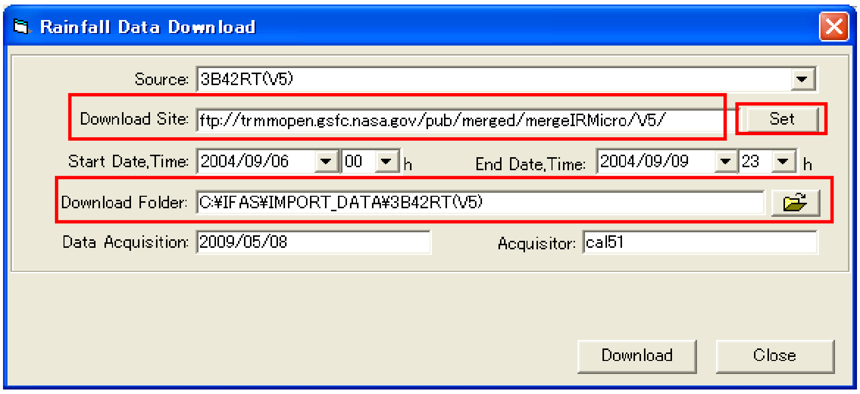
6. 4. 3 The storage folder for each satellite rainfall data

The storage folders for each downloaded data are as follows

Data Name		Folder Name
Products	Source	\IFAS\IMPORT_DATA
3B42RT	V5	\3B42RT(V5)\yyyy
	V6	\3B42RT(V6)\yyyy
GSMaP	MVK+(hourly)	\GSMaP_MVK+\hourly\yyyymm
	MVK+(daily)	\GSMaP_MVK+\daily\yyyymm
	NRT(hourly)	\GSMaP_NRT\hourly\yyyy\mm\dd
	NRT(daily：0-23)	\GSMaP_NRT\daily(0-23)\yyyymm
	NRT(daily：12-11)	\GSMaP_NRT\daily(12-11)\yyyymm
Qmorph	30min_8km	\Qmorph
Cmorph	30min_8km	\Cmorph
GPV	GSM_GPV	\GPV

6.4.4 How to reset the download site and download folder

User can reset the URL in the “Download Site” label.



The reset site will be registered and effective in later operation after clicking the “Set” button.

In addition, if the download folder changed, click the button to find the new one.

However, the new storage folder should have been created.

The default setting of download site

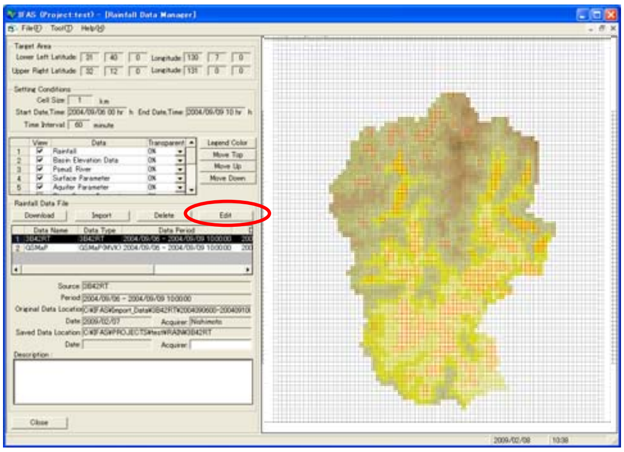
Products	Download site（URL）
3B42RT(V5)	ftp://trmmopen.gsfc.nasa.gov/pub/merged/mergeIRMicro/V5/
3B42RT(V6)	ftp://trmmopen.gsfc.nasa.gov/pub/merged/mergeIRMicro/
GSMaP_NRT	ftp://hokusai.eorc.jaxa.jp/realtime/
GSMaP_MVK+	ftp://hokusai.eorc.jaxa.jp/pub/gsmap_crest/MVK+/
Qmorph	ftp://ftp.cpc.ncep.noaa.gov/precip/qmorph/30min_8km/
Cmorph	ftp://ftp.cpc.ncep.noaa.gov/precip/global_CMORPH/30min_8km/
GPV	http://database.rish.kyoto-u.ac.jp/arch/jmadata/data/gpv/original/

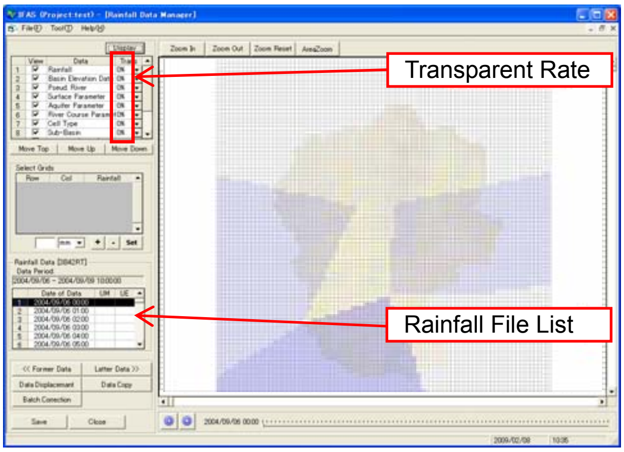
6.5 Rainfall data editing

6.5.1 Display of rainfall data

6.5.1.1 Display

Imported rainfall data can be presented by editing graph of IFAS rainfall data.

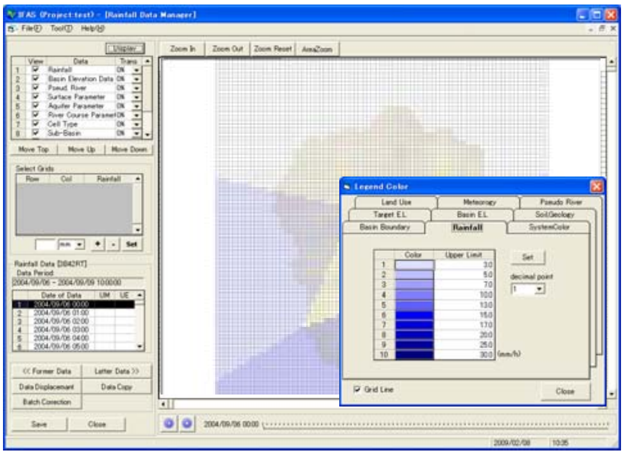


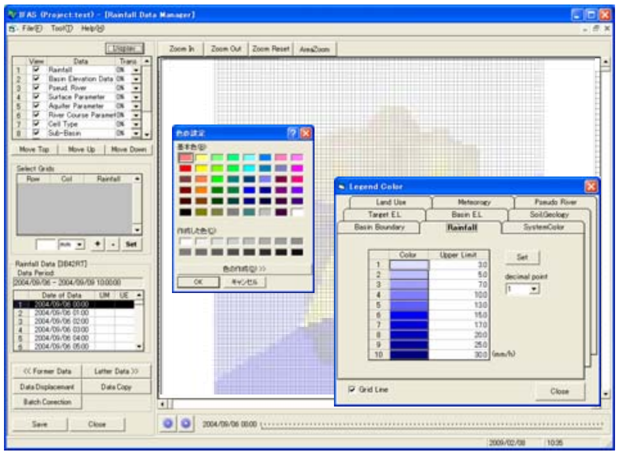


① Click on button “Edit” at graph of rainfall data creation.

If there are multiple rainfall data (folder), click on button of “Edit” from folder you want to present.

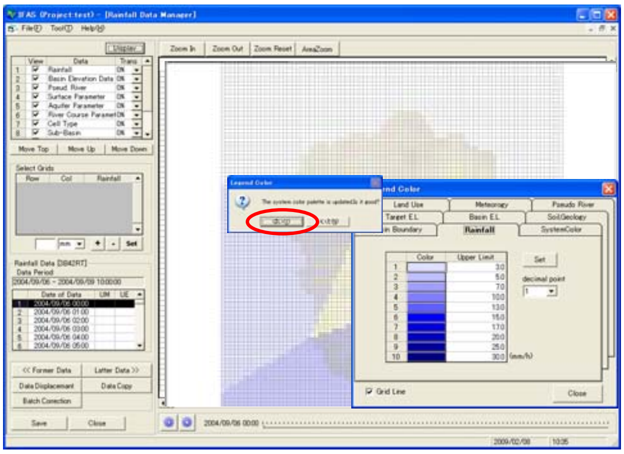
② Select rainfall data (file) you want to present from list, selected rainfall data shown in graph area. Through rainfall data, rainfall condition of overlapped river basin can be seen.

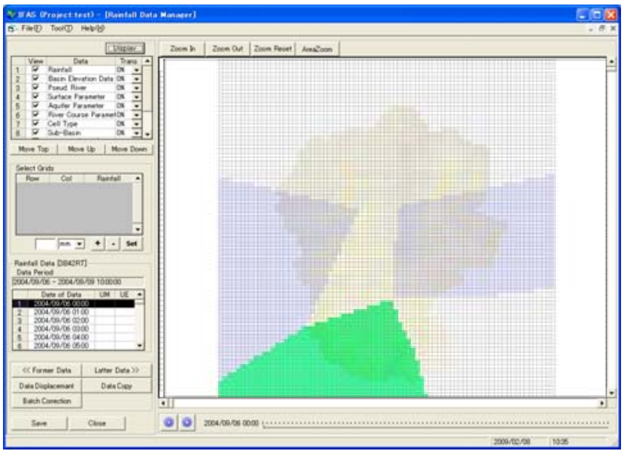




③ Click on button “Legend Color” and legend editing picture is present, display setting can be changed optionally.

④ Select “Rainfall” from displayed type in ColorBar and color in color pallet can be changed by clicking spot color you want to change. Value of legend and digit after decimal point also can be changed. Presented value of legend means the maximum.



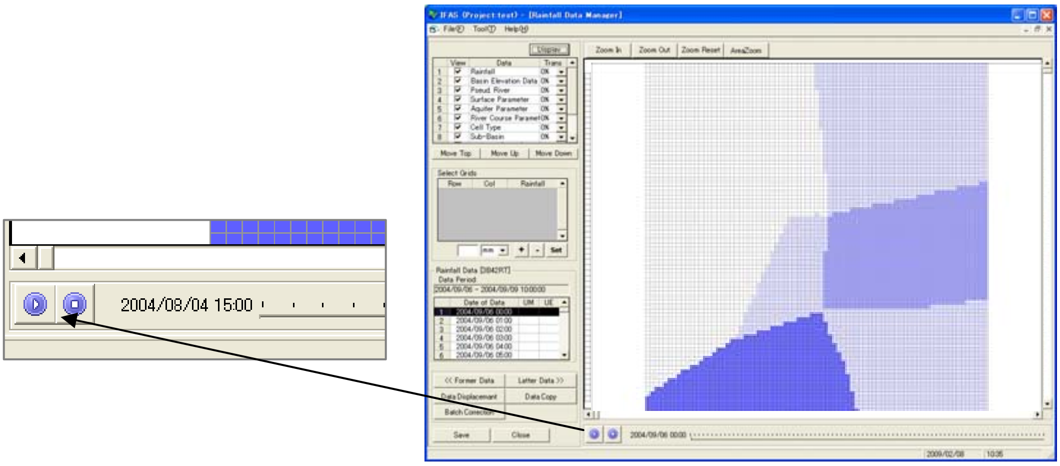


⑤ Click on button “Set” of ColorBar, confirmed picture is presented. Click on “Yes” if changed content is correct.

⑥ Click on button “Close” of ColorBar and changed content is reflected.

6.5.1.2 Animation presentation

Imported rainfall data can be presented in animation by time controller.



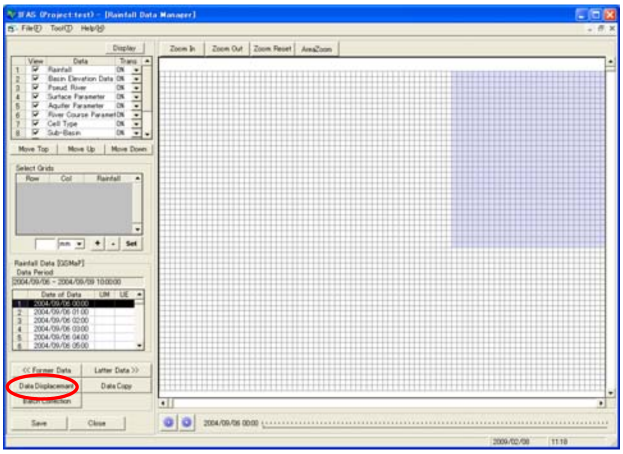
① When click the start button , animation begins and rainfall data file is shown in the order of date and time. In addition, movement of rainfall condition can be seen.

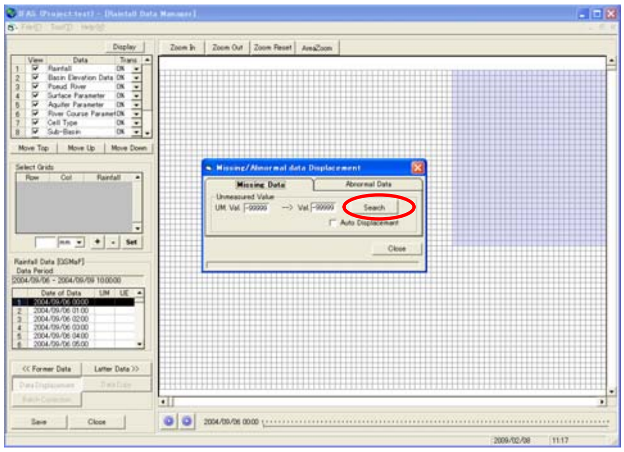
② Rainfall data file animation is stopped when clicking button stop .

6.5.2 Searching and replace of unmeasured data

6.5.2.1 Searching

IFAS is capable of searching unmeasured data of imported rainfall data and retrieving the value.





① Click button of “Data Displacement”.

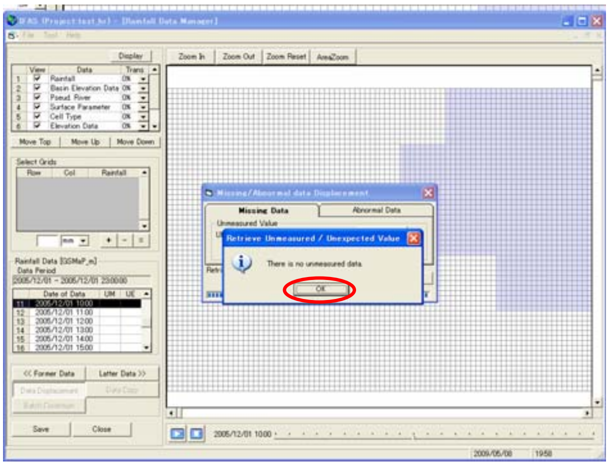
② Select tag of unmeasured data searching (“Missing Data” is displayed by default).

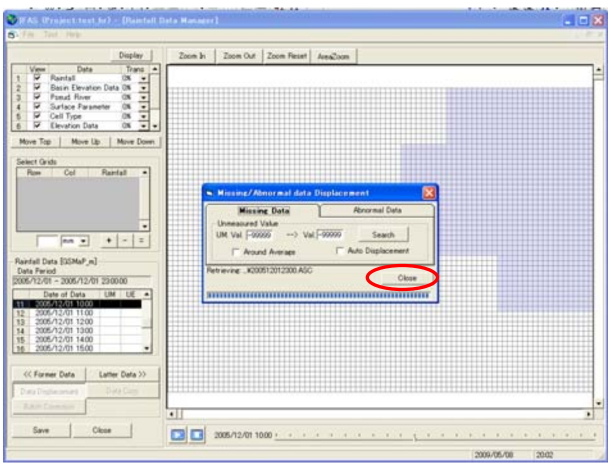
Click button “Search” to confirm unmeasured value.

Unmeasured value of rainfall data types are shown as follows:

3B42RT･･･”-99999” GSMaP･･･”-99999” Qmorph,Cmorph･･”255” WISEF･･･”-9999”

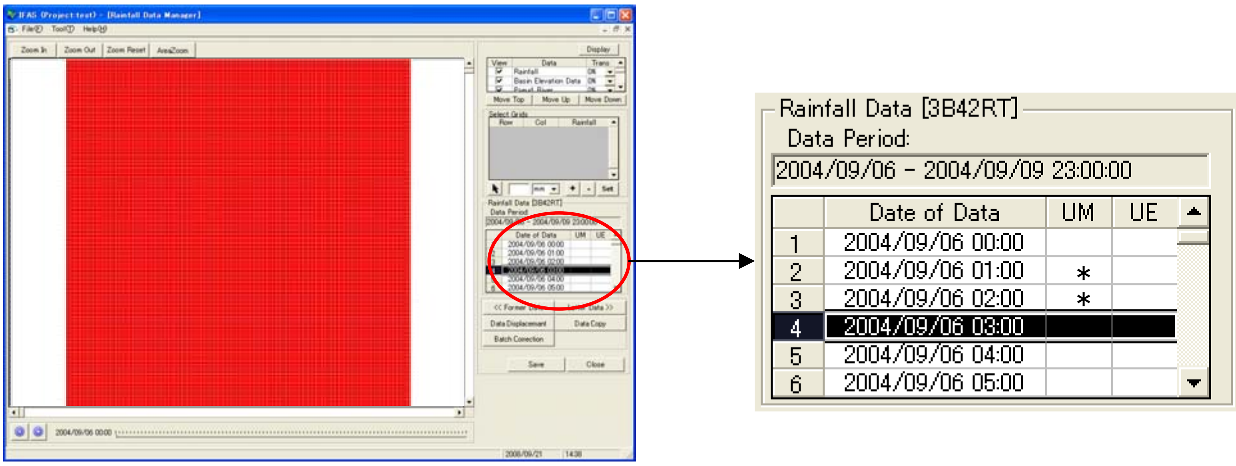
Negative values other than these are replaced with "-99999" at import.





③ Click button “OK” to confirm whether unmeasured value exits or not.

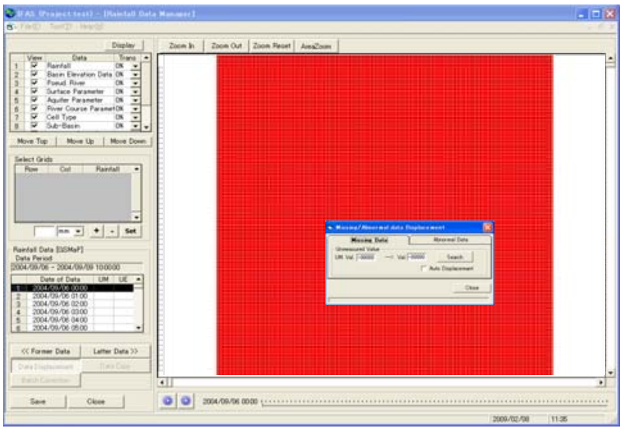
④ Click button of “Close”.

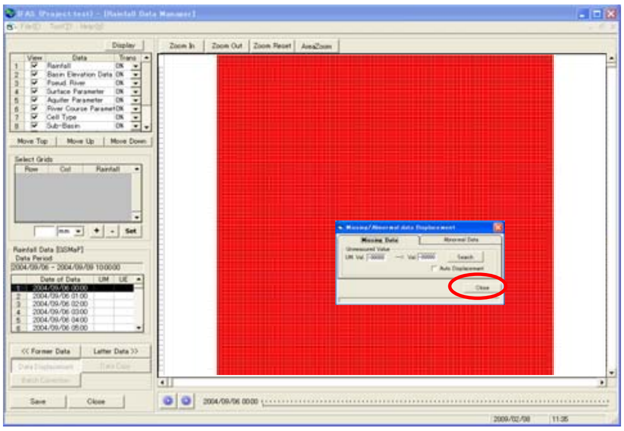


⑤ Unmeasured value is displayed as "＊" in list of found file and cell containing missing value is presented in red. In above picture, the whole file is occupied by unmeasured data.

6.5.2.2 Replace

By replace function of IFAS, unmeasured values which have been found can be edited in any rainfall data.

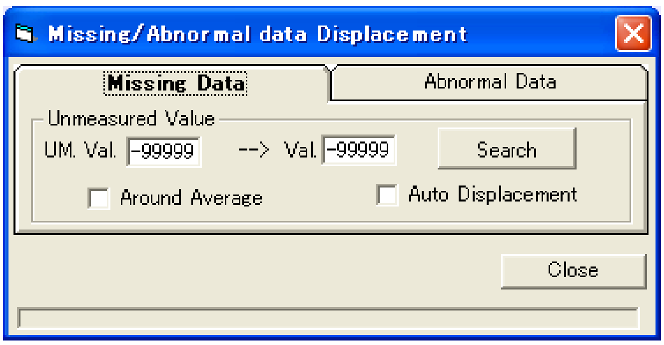


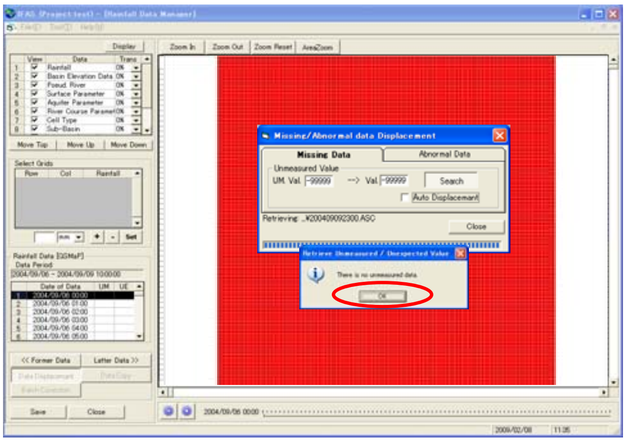


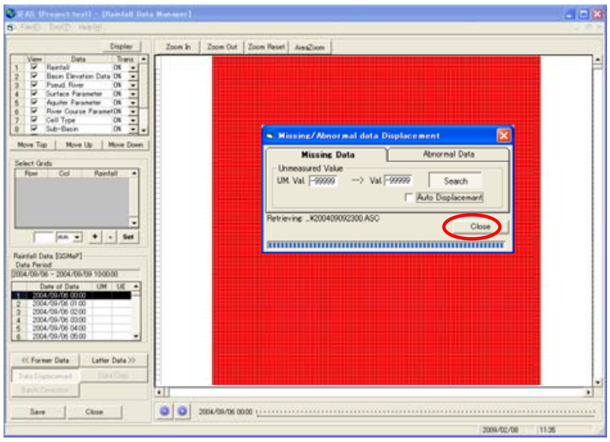
① Click button "Missing/Abnormal data Displacement" and the "Missing Data/ Abnormal Data" window is displayed.

② Input value of precipitation which needs changing in "Revision Value" column and click check box "Auto Displacement". Then, confirm marked check box and click button "Search".

When check the box "Around Average" and click the "Search" button, the system will search the cells located on top, bottom, left, right, and diagonal and calculate an average value of them for the target cell.

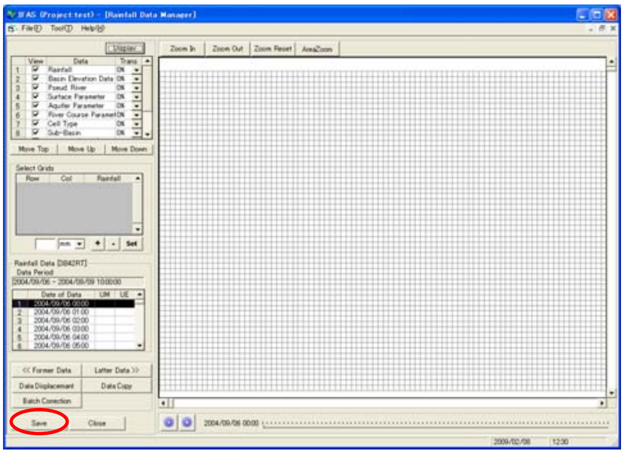


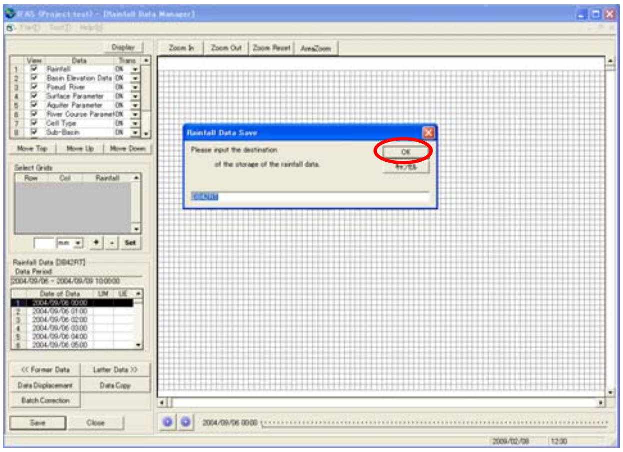




③ Click “Ok” to confirm revision of file.

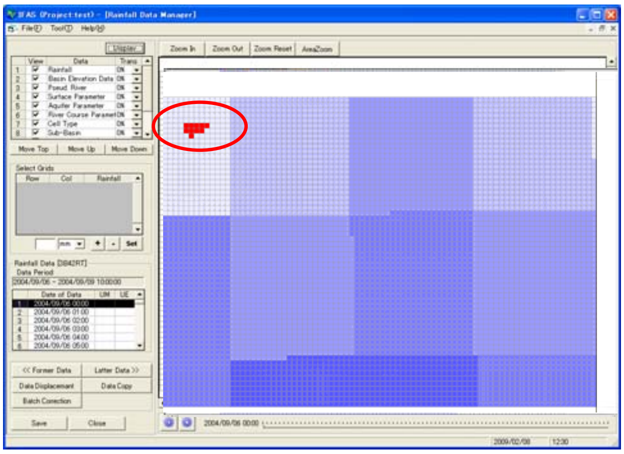
④ Click “Close” of window “Missing/unexpected Value Search”





⑤ Click button “Save”

⑥ Input folder name to edited rainfall data to save and click button “OK”. Click “Close” after saving.

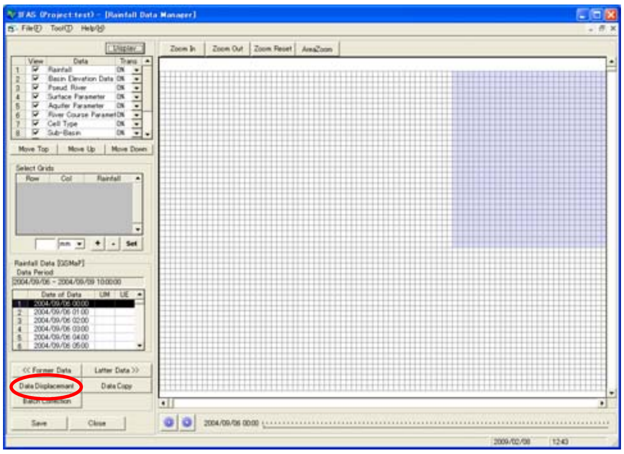


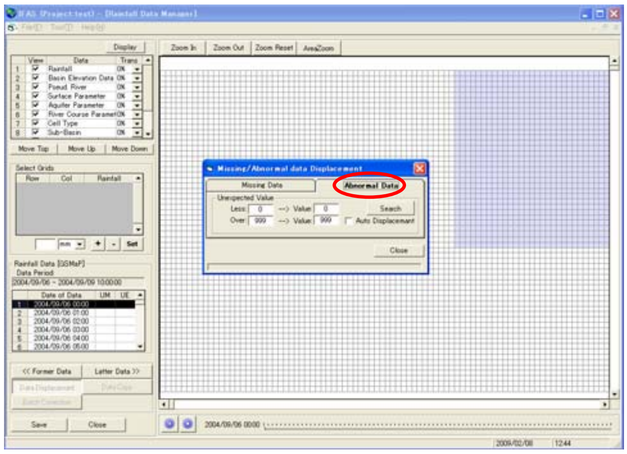
⑦ The mentioned retrieving will change the entire data although the unmeasured data is only a part of that as showed in above picture. In this case, edit the said data part individually and then retrieve all at once. Changed cell is shown in red frame.

6.5.3 Searching and replace for data with unexpected value

6.5.3.1 Searching

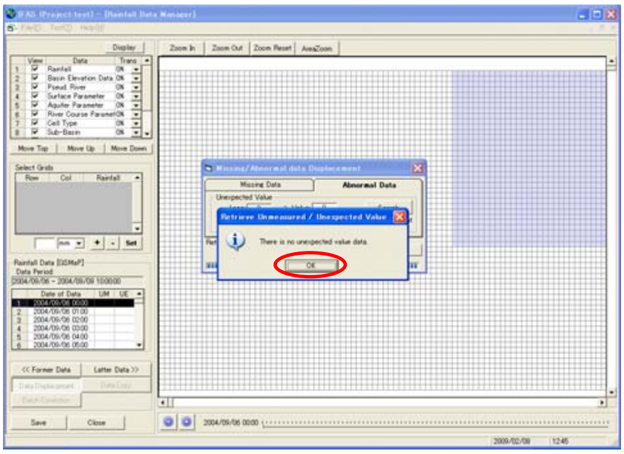
IFAS is capable search imported data mixed with unexpected value of rainfall data.

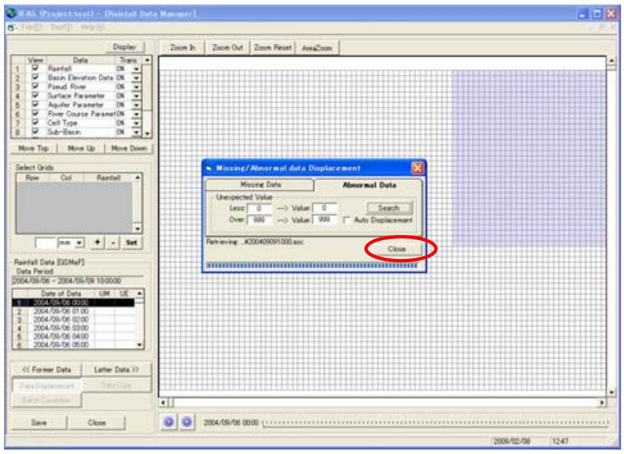




① Click button “Data Displacement”

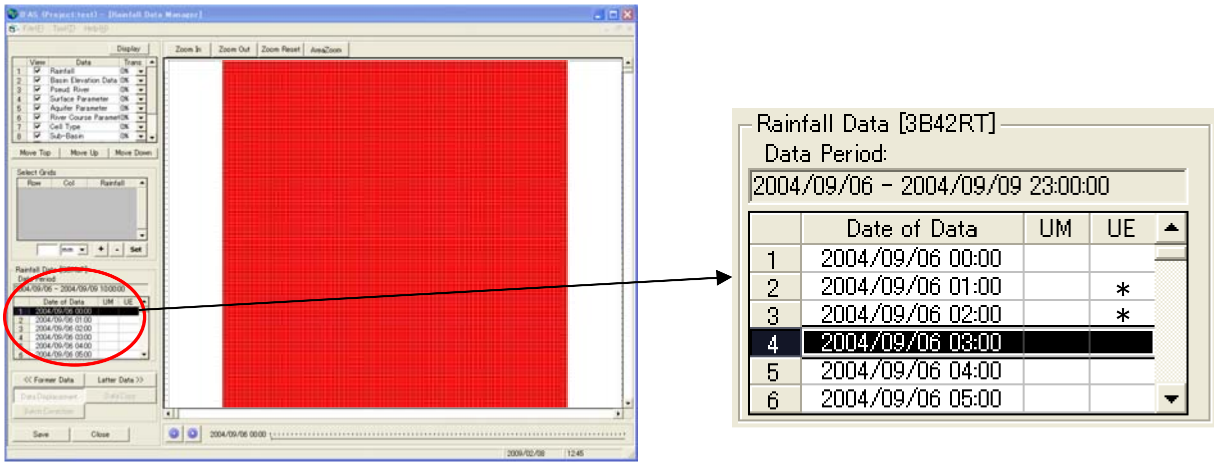
② Select abnormal data searching tag. Confirm setting of unexpected value and click button “Search”. Unexpected value setting is presented by default with value of precipitation below 0 mm and above 999 mm and value can be set optionally.





③ Click button “OK” to confirm whether unexpected value exits or not.

④ Click button “Close”.

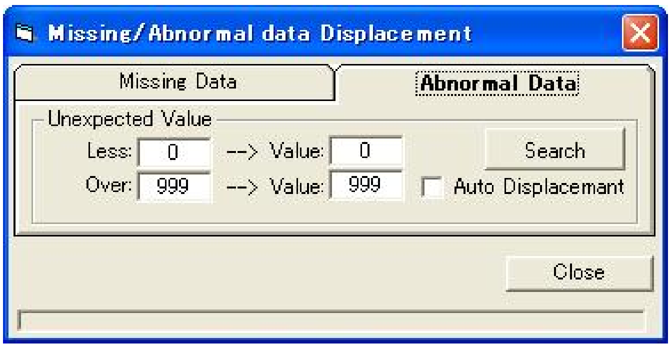


⑤ Unexpected value is displayed as "＊" in found file and unexpected cell is shown in red. Above picture presents the whole file is occupied by unexpected data.

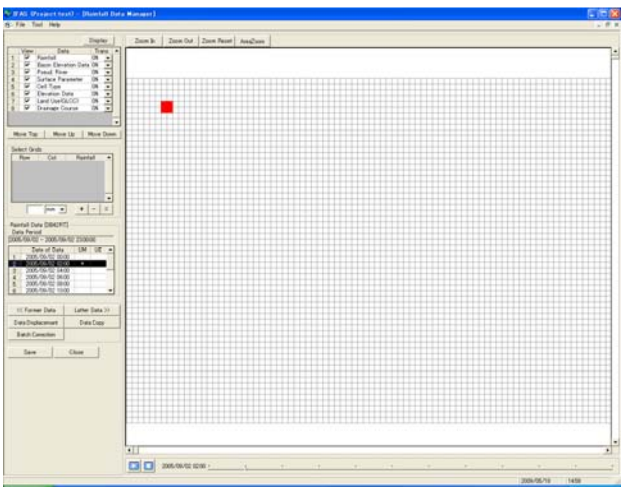
6.5.3.2 Replace

Discovered unexpected value can be edited with replace function of IFAS in any rainfall data. Operation is the same as retrieving of unmeasured value: in picture of "Unexpected Data Search", input value of precipitation which needs changing in column of "Completed Value" and click check box of "Auto Displacement". Then, data have been saved after retrieving.

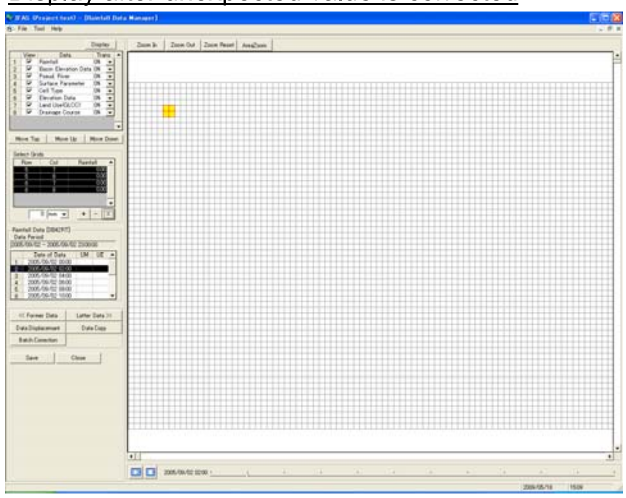
Changed cell is shown in red frame.



Display when unexpected value is discovered



Display after unexpected value is corrected

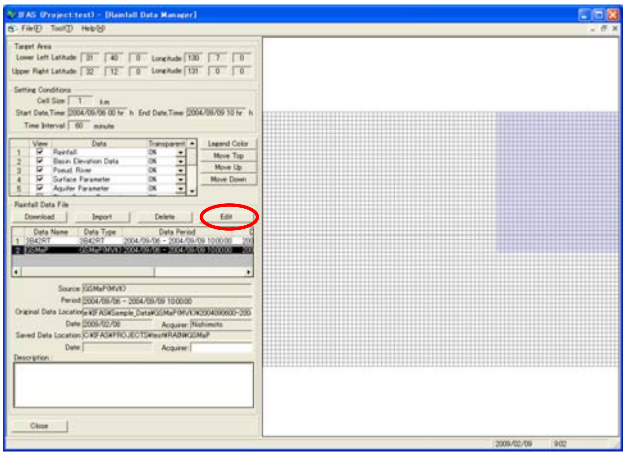


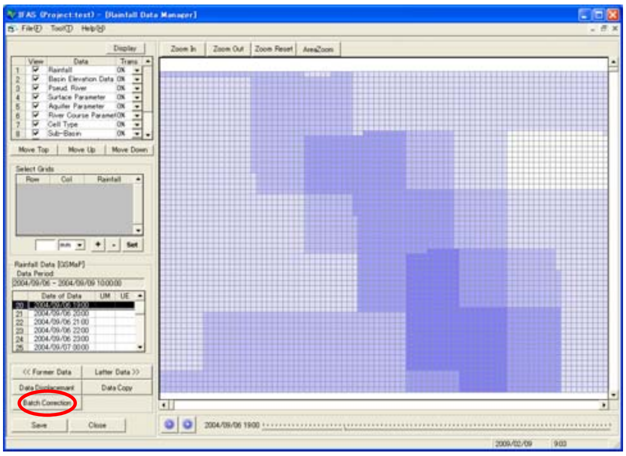
6.5.4 Searching and replace for data with unexpected value

6.5.4.1 Entire retrieving

In IFAS, imported rainfall data can be edited entirely.

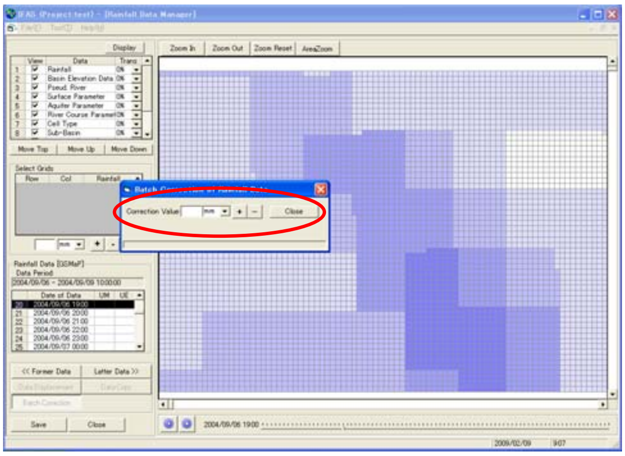
The “entire” being discussed here is not only the rainfall data file presented in graph but the overall rainfall data file involved in selected folder. Therefore, any editing of individual rainfall data file should use the “Individual retrieving” function explained in 6.5.4.2.





① Select rainfall data folder which needs editing from list and click button “Edit”

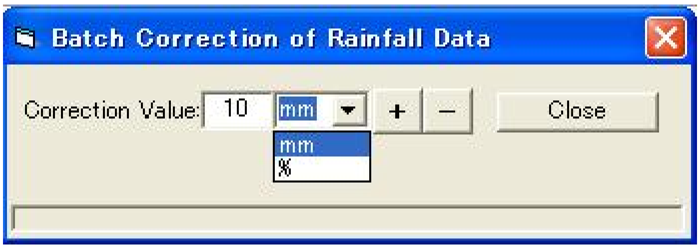
② Click bottom of “Batch Correction”



③ Input value to the field “Correction Value” and conduct entire editing of rainfall data by clicking “+” and “-” from pull down menu.

However, when edited precipitation becomes minus value, it is edited as precipitation “0” automatically.

【Case of precipitation increased by 10 mm】

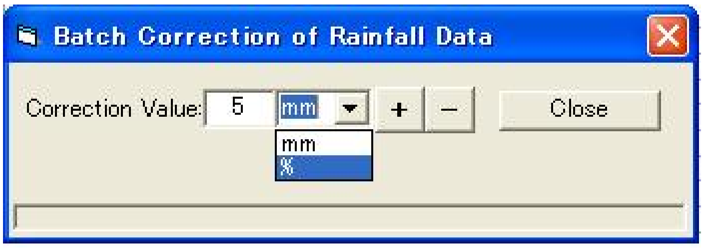


--- “10” is input in “Completation Value”

--- Select “mm” from pull down menu

--- Click “+”

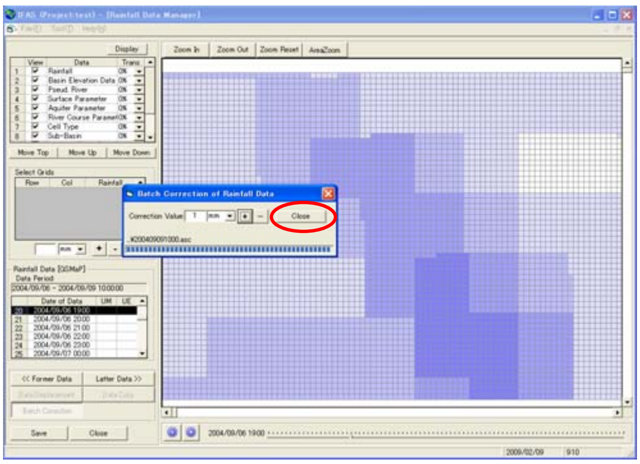
【Case of precipitation increased by 5%】



--- Input “5” in “Completation Value”

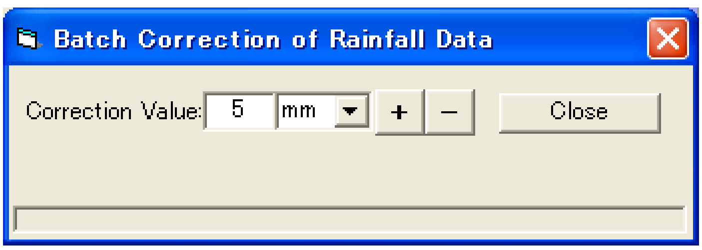
--- Select “%”from pulldown menu

--- Click “+”



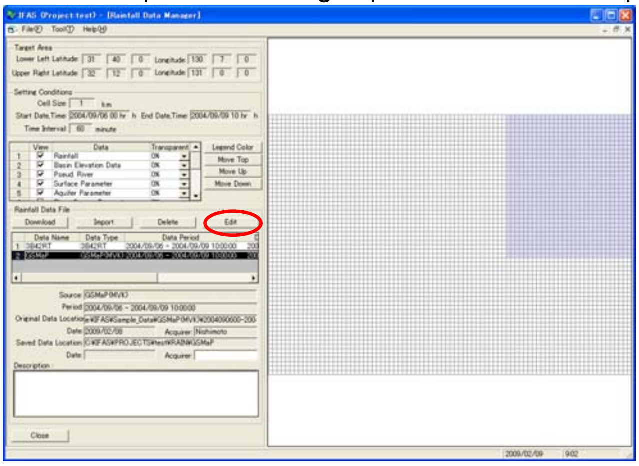
④ Click “Close”

The following operations are the same as so far discussed ones. To save data, please press “Save” button.



6.5.4.2 Individual retrieving

IFAS is capable of editing imported rainfall data optionally at a cell unit.



① Select rainfall data folder which needs editing from list and click the button “Edit”

② Click select the cell which needs editing.

There are two selection methods: one is to select by clicking cell individually and the other way is to select by dragging mouse at rectangle area.

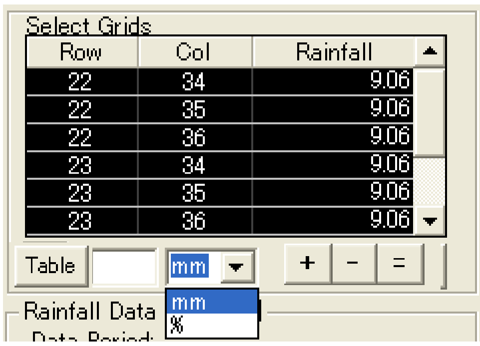
③ Input value in “Retrieving Value” column, select unit from pulldown menu, and edit rainfall data of selected cell by clicking “+” and “-” buttons. Further, by using button “Set”, direct value can be changed.

【 Case that precipitation increased by 10mm】

--- Input “10” in “Retrieving Value”

--- Select “mm” from pulldown menu

--- Click “+”

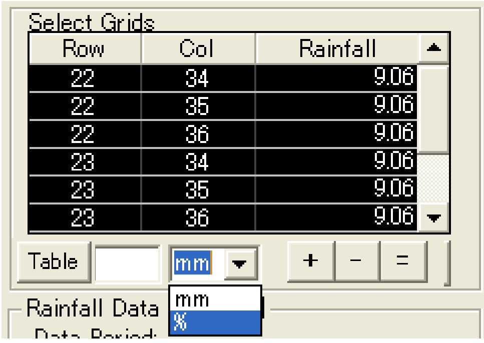


【Case that precipitation Increased by 20%】

--- Input “20” in “Retrieving Value”

--- Select “%” from pulldown menu

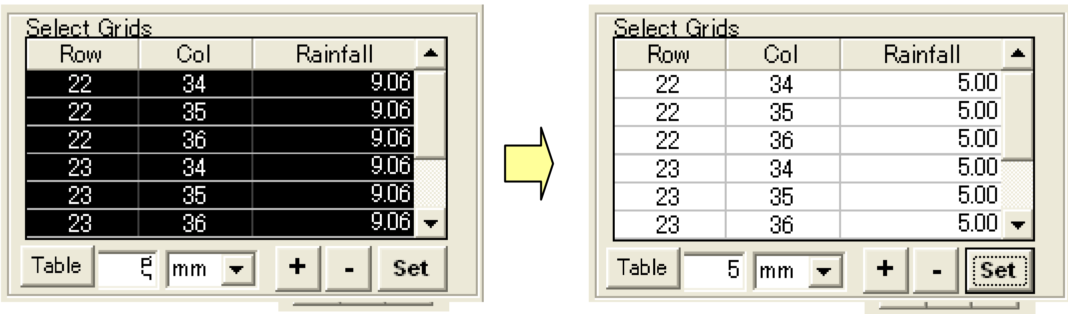
--- Click “+”

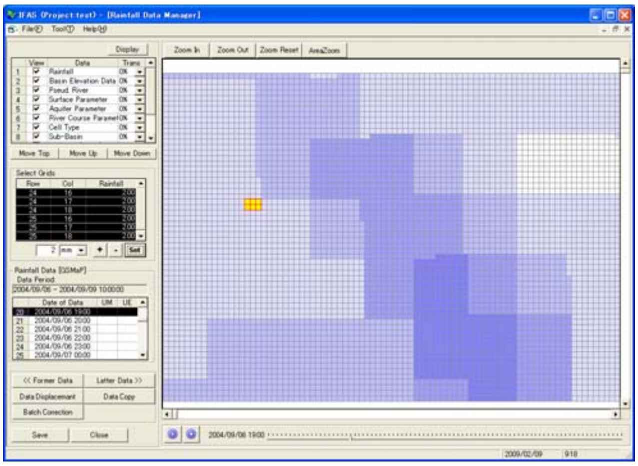


【Case at precipitation changed by 5mm】

--- Input “5” in “Retrieving Value”

--- Click the button “Set”





④ Changed cell is shown in red frame. Hereafter, “Save” is the same as “entire retrieving”.

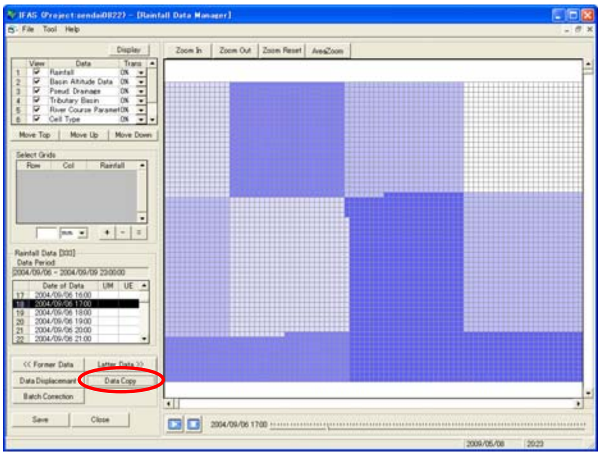
6.5.5 Alternation of Rainfall Data by Table Edit function

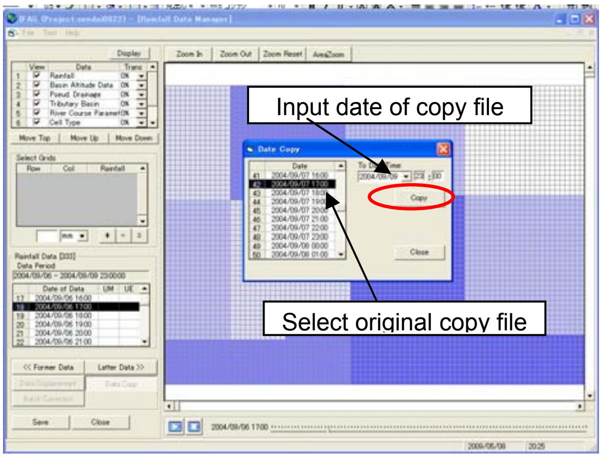
The rainfall data can be edited by using “Table Edit” as well as 5.3.4 Alternation of elevation by Table Edit function.

6.5.6 Copying of rainfall data (file)

IFAS is applicable to copy and delete rainfall data file in data folder. But, varied rainfall data folder cannot be copied.

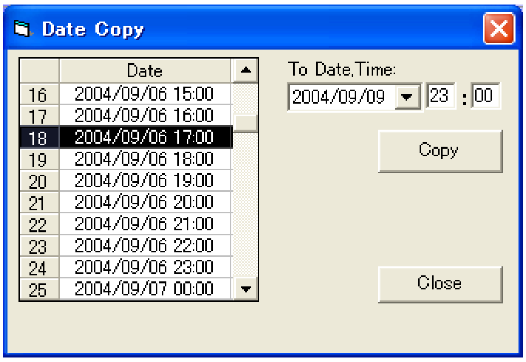
6.5.6.1 Copying





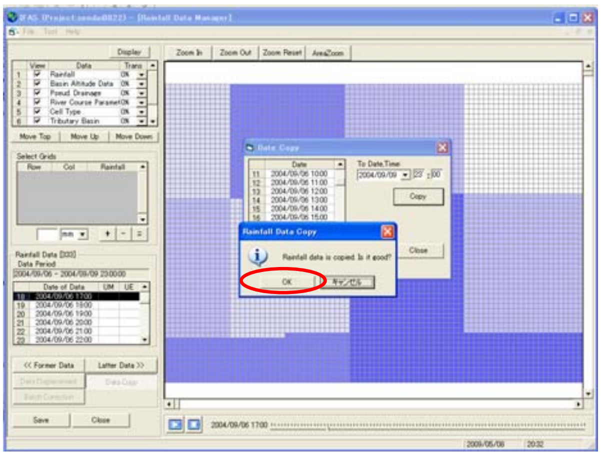
① Click button "Data Copy"

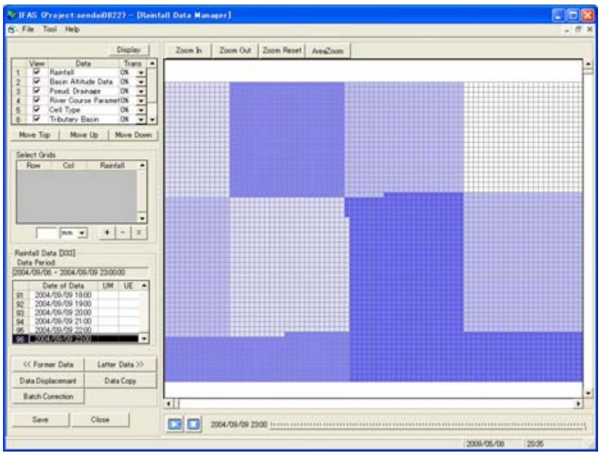
② Select original file to be copied and input data and time into newly copied file in the field "Copied Data Date and Time". However, it is not available for the file that exceeds object period of project.



③ For example, file of 2004/09/29 00:00 is created by copying file of 2004/9/28 23:00 and file 2004/9/29 11:00 is created by copying file of 2004/09/29 10:00.

Click button "Copy".





④ Click button "OK". Click button "Close" of window "Rainfall Data Copy". Hereafter, Save is the same as other function earlier mentioned.

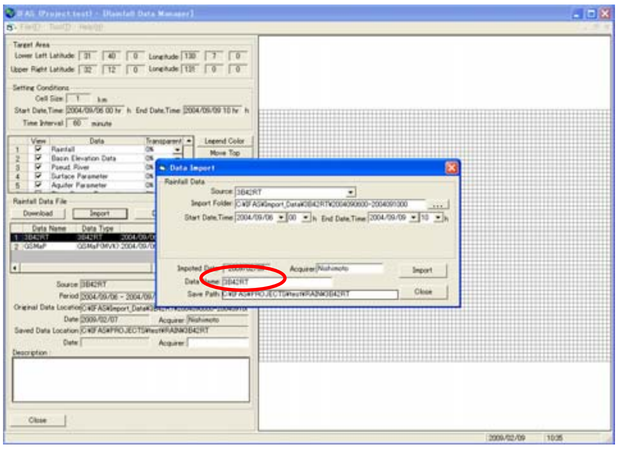
6.5.7 Saving and deletion of rainfall data (folder)

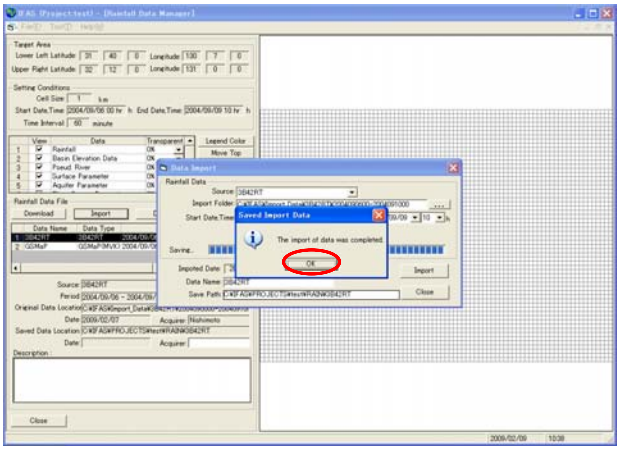
Rainfall data can be saved and deleted with unit of folder.

6.5.7.1 Saving

Newly operated rainfall data, from rainfall data import window, can be saved with folder name from edited rainfall data of rainfall data saving window.

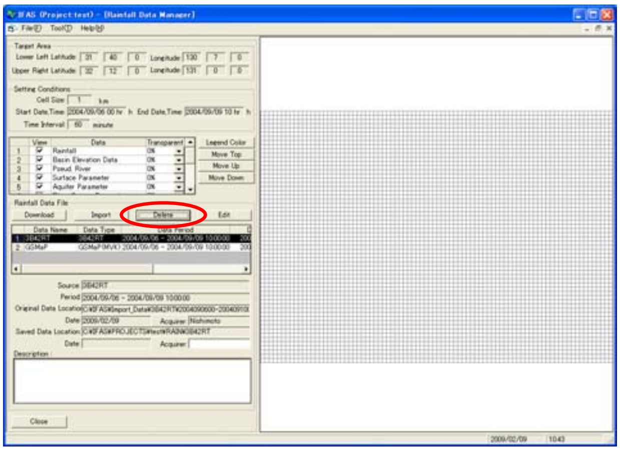
Saved rainfall data folder is presented in list of rainfall data creation window.

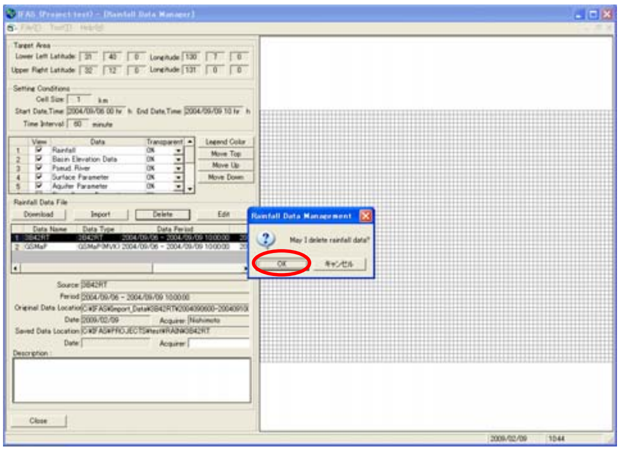




6.5.7.2 Deletion

Rainfall data (folder) displayed in list can be deleted.

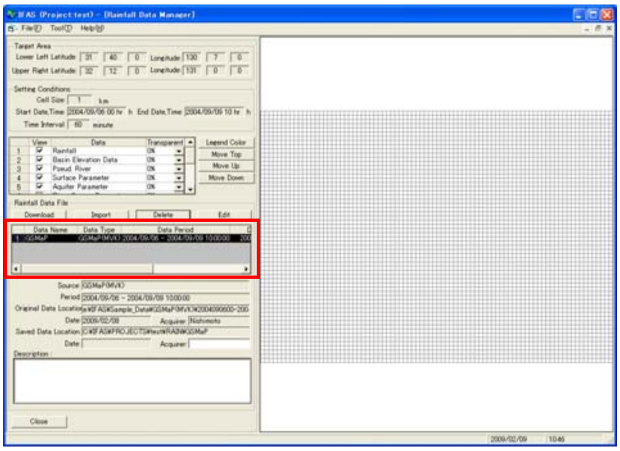




① Select rainfall data folder which needs deleting and click button “Delete”.

② Click button “OK”

③ Deleted rainfall data folder disappears from list.



7 Setting parameters（Parameter Manager）

7.1 Outline of setting parameter

User has to set the parameters of surface, aquifer and river course for runoff simulation calculation in the IFAS. The parameters contain maximum collection volume and runoff coefficient for surface and aquifer, roughness and runoff coefficient for river course.

The IFAS uses the approximate values that are pre-set. All the parameters can be reset automatically and manually.

7.2 Item of parameters

In IFAS it is necessary to set the runoff analysis model by way of the following parameters.

Notes) Refer to the reference for the content of the parameter.

① Surface parameters

Table 7.1 Surface parameters

Symbol	Notation	Unit	Explanation
Sf2	HFMXD	m	Surface's maximum collection volume Estimation of maximum collection volume of ground surface's A0 layer An estimation of 10-40mm is good
Sf1	HFMND	m	The height of a fast outward flow An estimation of 5-10mm is good
Sf0	HFOD	m	The height of deep percolation An estimated value of 5mm is good Sf1≧Sf0 condition is required
f0	SKF	cm/s	Final infiltration rate
Ari	FALFX	Non-dimensional	Stipulating factor for the outflow of the fast interflow fo･αri becomes the maximum outflow. αri becomes the same level as primary run-off ratio and impervious surface ratio.
N	SNF	m-1/3s-1	The ground surface roughness coefficient. It is the actual slope roughness coefficient, and it becomes a value less than the N value of the equivalent roughness method. When the final infiltration capacity is set larger than the rainfall intensity, without overland flow occurring, the N value becomes unrelated to outward flow.
	HIFD	m	Initial value for calculation

② Aquifer parameters

Table 7.2 Aquifer parameters

Symbol	Notation	Unit	Explanation
sg	HCGD	m	Unconfined ground-water outflow retention amount
Au	AUD	(1/mm/day)^1/2	Unconfined ground-water runoff coefficient. Do not confuse with Au2
Ag	AGD	1/day	Confined groundwater run-off coefficient
	HIGD	m	Initial value for calculation

③ River channel parameters

Table 7.3 River channel parameters

Symbol	Notation	Unit	Explanation
c	RBW		Coefficient.　Set using actual width of river The units are m for width of river, and km2 for basin area
s	RBS	Non-dimensional	Coefficient. The amount is 0.3～0.5
n	RNS	m-1/3s-1	Manning's roughness coefficient
	RRID	m	Initial value for calculation
	RGWD	1/day	Coefficient of infiltration from river course to the underground water tank Discharge of surface tank and unsaturated zone tank is available in inflow tank.　A mountain watershed is not considered to be particularly necessary
	RHW	—	Water level responding to the rate of flow of a flood through a major river bed is calculated as hc=RHW・ARHS
	RHS	—	Refer to RHW
	RBH	Non-dimensional	Flood channel width/low-flow channel width
	RBET	Non-dimensional	Flood channel slope
	RLCOF	Non-dimensional	River course length calibration coefficient

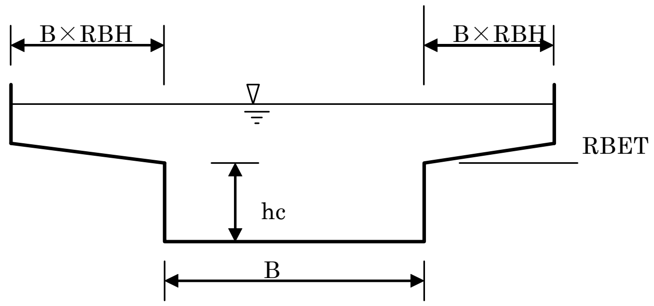


Fig. 7.1 Auxiliary channel cross-section of river course parameters

7.3 The method of setting parameter

It is necessary to set the parameter of all cells in IFAS. A few divisions will be classified so that the parameter table of each of the parameters of surface, aquifer and river course which were mentioned above can be shown, and setting is carried out by assigning the patition to each cell. Moreover, the value that becomes a standard set beforehand can be used, and the method is shown here below though setting the value of the parameter to each classification is necessary.

There are three main ways to set the parameter.

1) Automatic configuration according to the explanatory notes sorting of the external data.

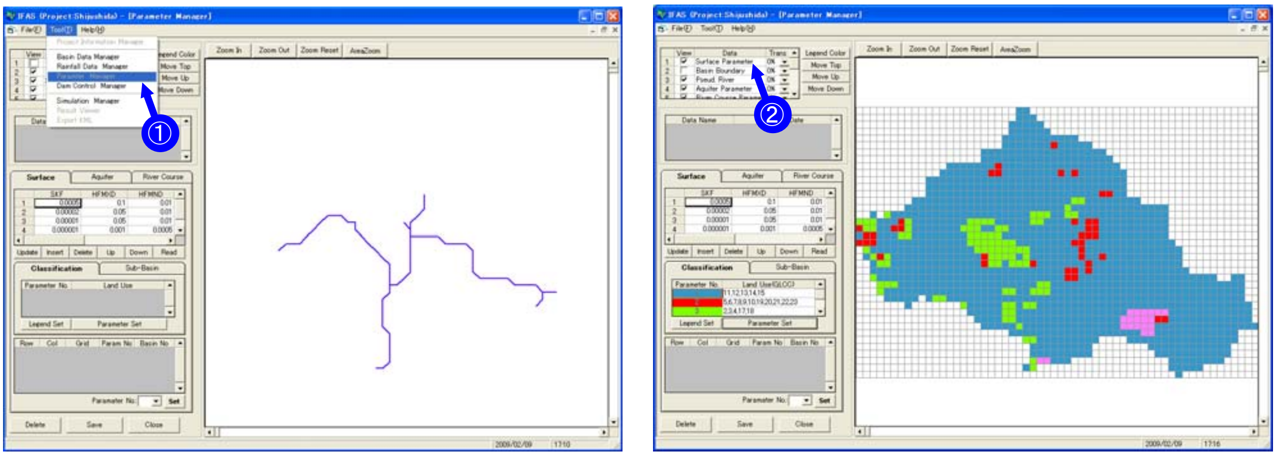
The parameter of each cell is automatically configured, based on the external data such as land use and soil division which were read.

2) Automatic configuration according to the tributary basin

Set the tributary basin parameters one by one.

3) Manual Setting

Users choose a cell and set the parameter voluntarily. Revision of the automatic configuration mentioned above can be performed in the same way.



① Select “Parameter Manager” menu from “Tool” menu, the parameter edition window will open.

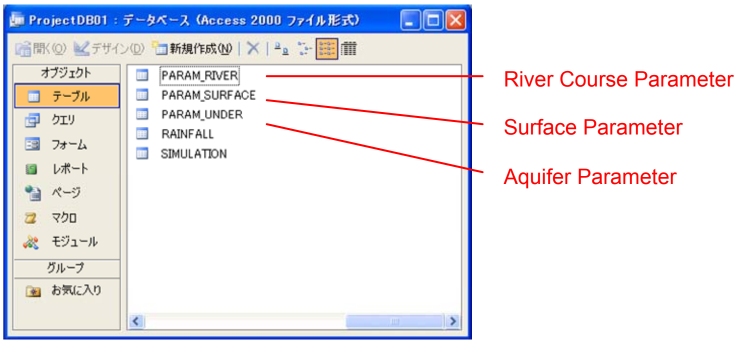
② The land use data etc used as a reference will be displayed at the parameter configuration.

7.3.1.1 Configuration of parameter table

First, perform the configuration of the parameter table.

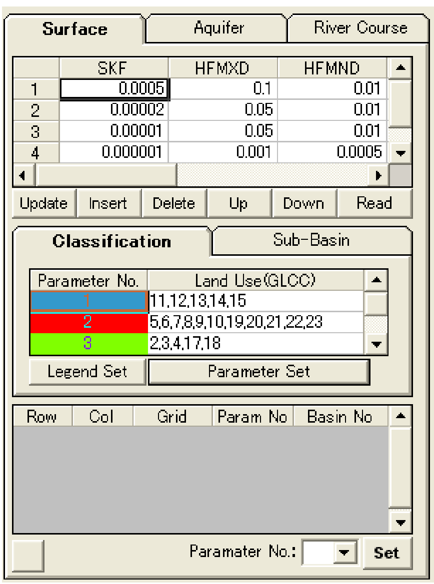
In IFAS, for the provided default parameter value, the surface parameter has 5 partitions, the aquifer parameter has 1 partition, and the river course parameter has 3 partitions. When the hydrology data etc. are not provided, uses can just use this value, however, follow the procedure below if values need to be changed. The values here are only approximate ones, user may have to do calibration based on the rainfall and observed runoff result of each river basin.

The default parameter value was set in the table in “\IFAS\DB\ProjectDB01.mdb” and the default value can be changed by changing the data of this table.



The parameters can be set as the partition as following

Parameter	Setting	
Surface	GLCC	Partition by land use information
	Sub Basin	Partition by sub basin
	Global Map	Partition by land cover, land use information
Aquifer	GLCC	Partition by land use information
	Sub Basin	Partition by sub basin
	Global Map	Partition by land cover, land use information
River Coerce	Upper Cell	Partition by total number of upper cells
	Sub Basin	Partition by sub basin

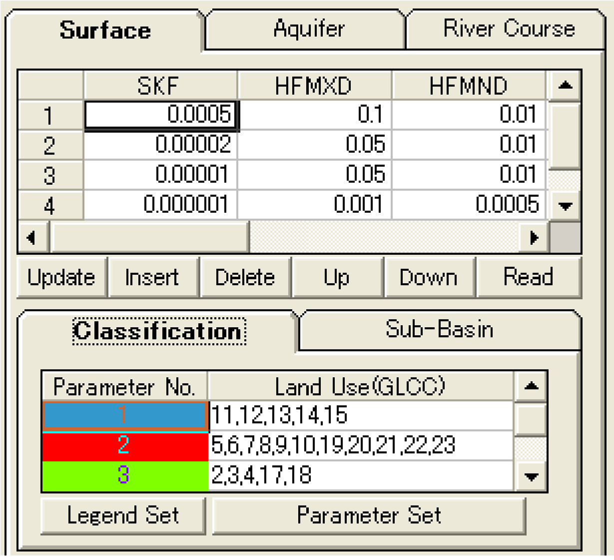


Button	Content
Update	Update the parameters
Insert	Insert a new partition of parameter Click the button to insert the new partition to end of the list, and input the value. Click “Update Table” to update the value.
Delete	Delete a existing parameter table row by row
Up	Move a parameter table in the list one position up
Down	Move a parameter table in the list one position down

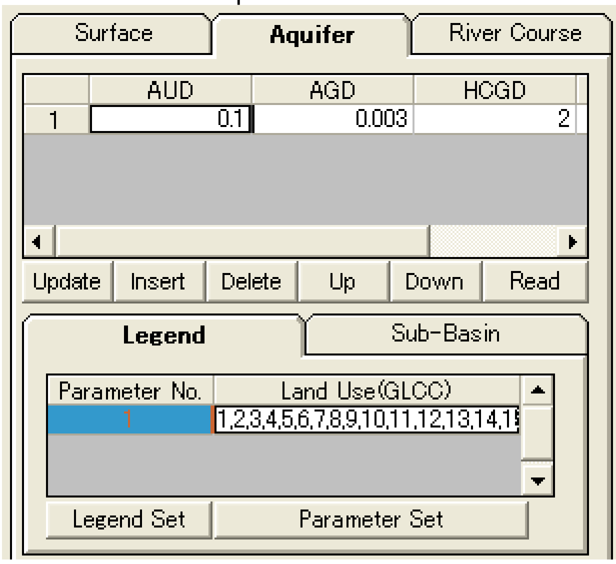
7.3.1.2 Configuration according to the explanatory notes partition of the external data

User can set parameters by partitioning them to legend division of external data.

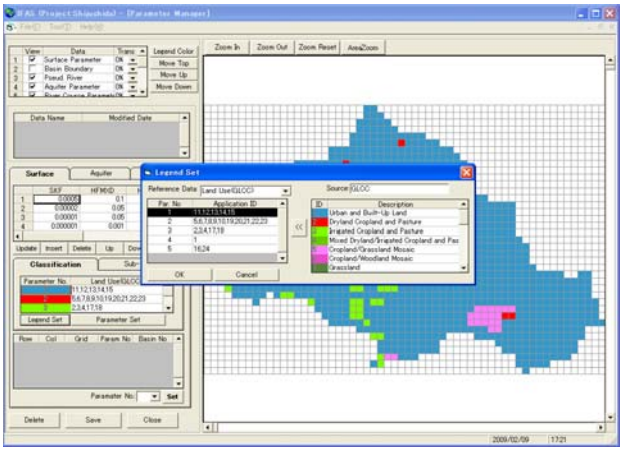
Surface Parameter

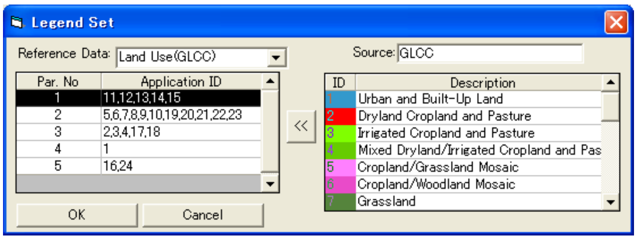


Aquifer Parameter



① A sample of setting parameters based on the surface GLCC.





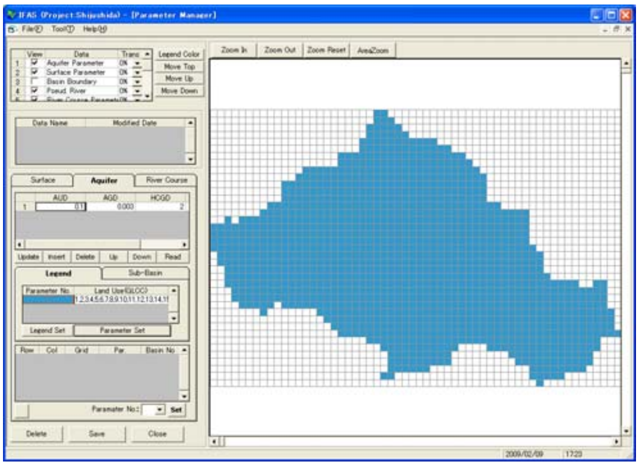
Configuration of surface parameter: Here the configuration is shown by GLCC. Click the “Legend Set” button, the window of the parameter table configuration will be displayed. After pointing at the Parameter No at the chart on the left hand side of the explanatory note configuration window, select the explanatory notes from “Description” at the right side and click the “<<” button. Then the explanatory note “ID” chosen will be displayed in the “Applying ID” column on the left side and assigned to Parameter No. Here, select land use partition corresponding to the parameter table and click the O.K. button, and the table will be displayed.

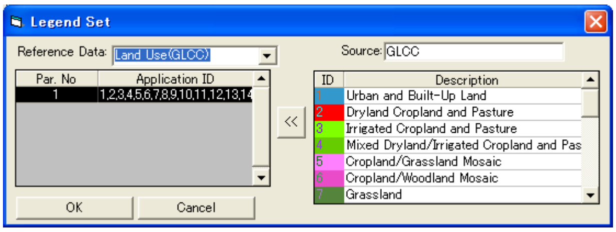
Based on the correspondence of explanatory notes here, automatic configuration will be performed.

Not only the GLCC, according to configurations of correspondence about the soil and geological feature data, it is also possible to configure the parameter in the say way.

② Configuration of the aquifer parameter: Here the configuration is shown by GLCC.

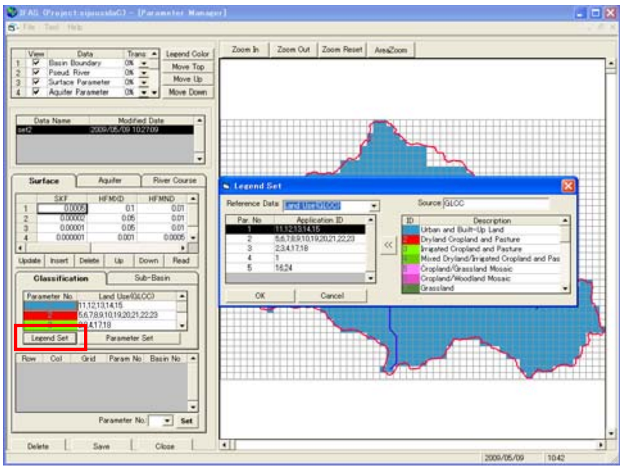
Because the aquifer parameter is regarded as only 1 partition, it is regarded as the same parameter for all land use.

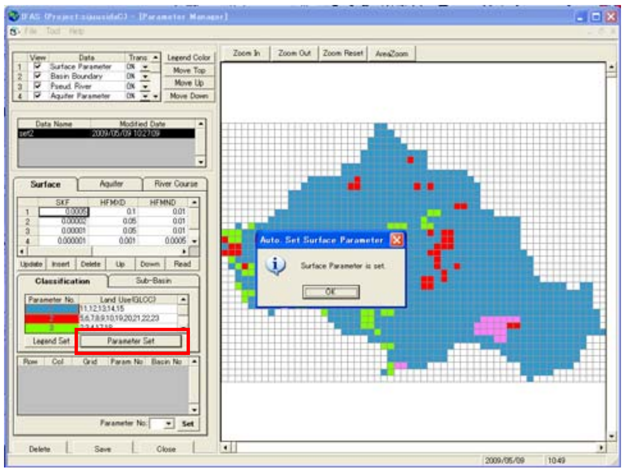




The set-up procedure is similar to the setting of the surface Parameter.

③ Automatic configuration according to the explanatory notes partition of the external data



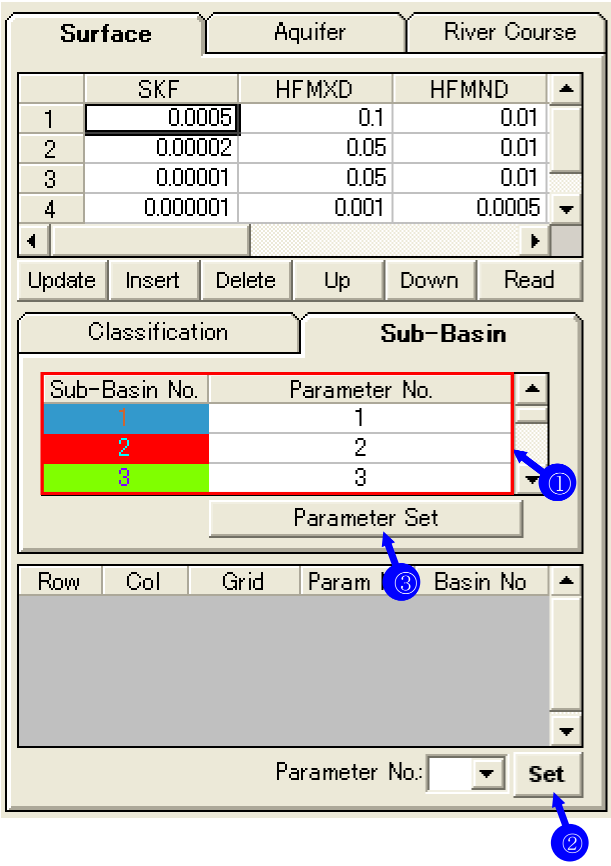


Click “Legend Set” button and confirm that the partition of the parameter is connected with the partition such as land use.

Click the “Parameter Set” button and carry out the configuration of each cell. In the same way, carry out the configuration of the aquifer parameter and the river course parameter.

7.3.1.3 Setting from sub-basin

User can set surface, aquifer, and river course parameters from sub-basin in “Basin Data Manager”.

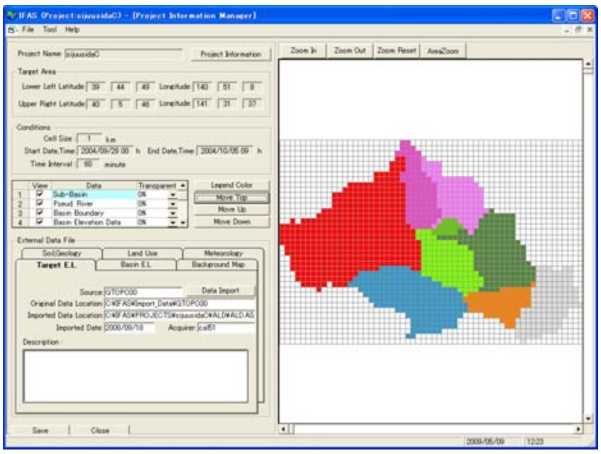


① When configure the parameter automatically according to the tributary basin, input the Parameter No assigned to the Tributary Basin No.

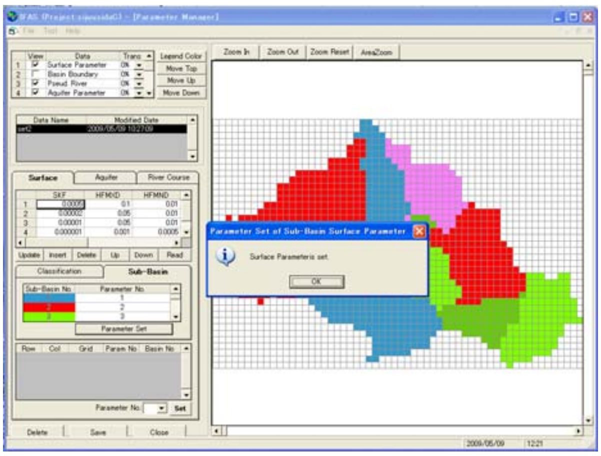
② Press the “Set” button of the explanatory notes

③ Click the “Parameter Set” button, follow the allotment configured, and the parameter in each cell can be set.

Display of creating sub-basin

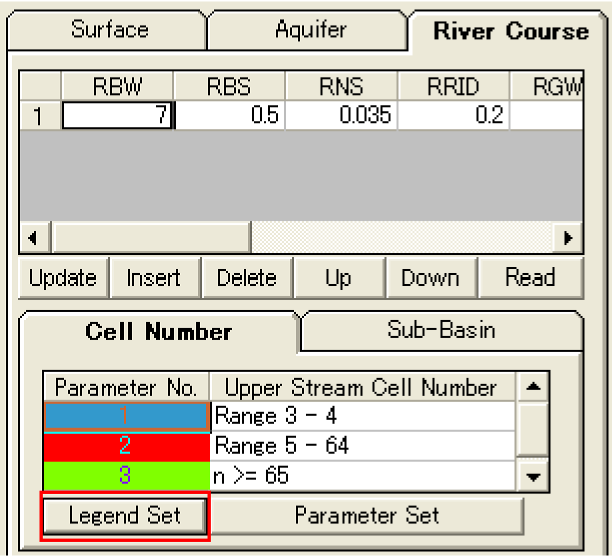


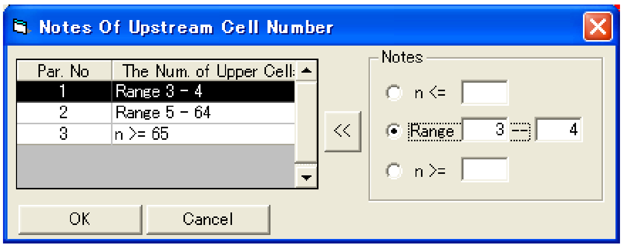
A sample of setting parameter due to sub-basin



7.3.1.4 Setting from the number of upstream cells

User can set the parameter from the partition of upstream cell number in river course option.





Click the “Parameter Manager” menu from the “Tool” of IFAS window and select river course parameter, the screen of parameter configuration will be displayed. Configure the parameter table using the mesh number of the river course. For the river course parameter, click the “Legend Set” button, the explanatory notes screen of the upper reach cell number will be displayed and the Parameter No will be assigned to the value of upper reach cell number. By doing that, parameter can be set automatically in each cell.

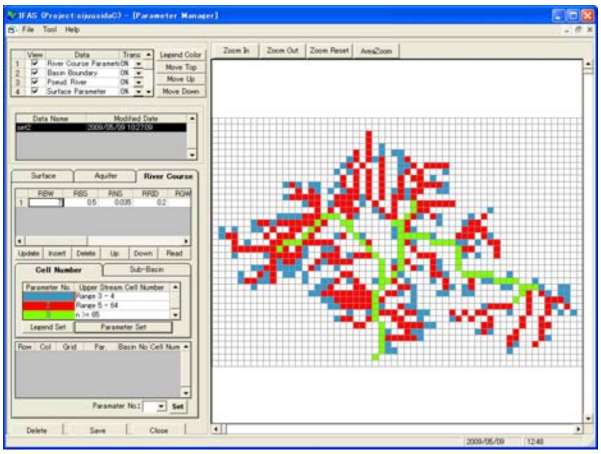
n＜＝ⓧ・・・when the value of the upper reach cell number is less than x or equal

Rangeⓧ--ⓨ・・・ when the value of the upper reach cell number is more than x but less than y

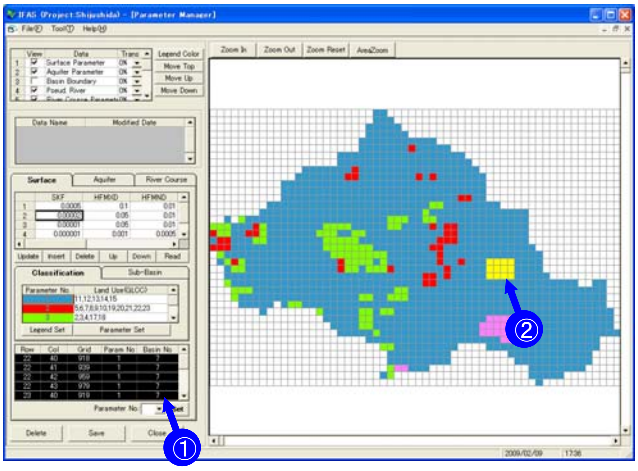
n＞＝ⓧ・・・ when the value of the upper reach cell number is more than x or equal

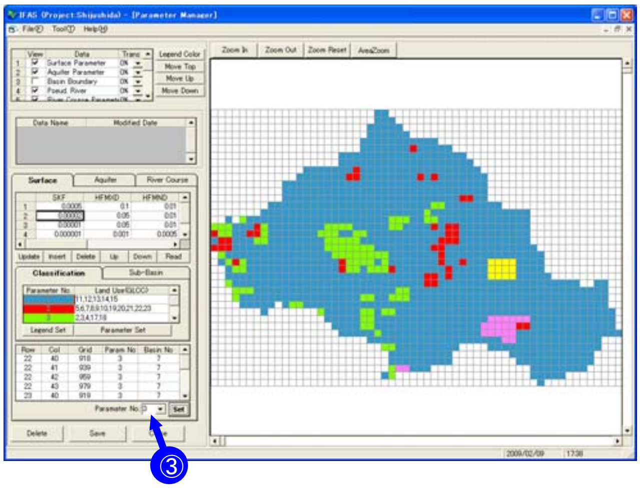
The system set the partitioned value of cell types that set by “Basin Data Manager” as default.

A sample of setting parameter from upstream cell number



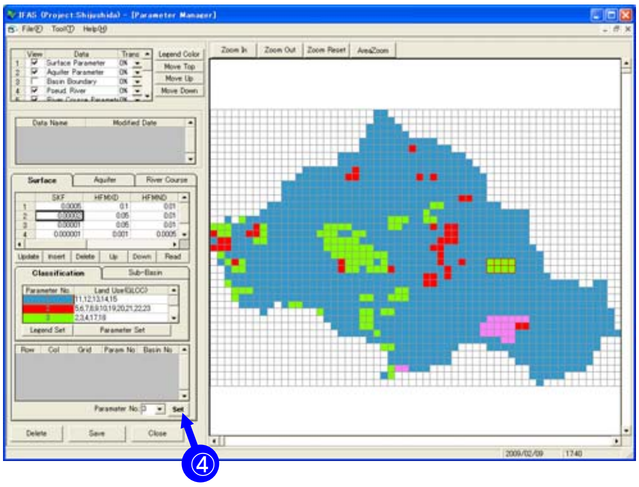
7.3.1.5 Manual Configuration (Change)





① ② Select the cell to be modified. The rows, columns, grids, parameter and the Tributary Basin No of the cell pointed will be displayed.

③ Input the parameter partition to be changed and the parameter partition to be configured in the parameter chart of the cell need to be modified.

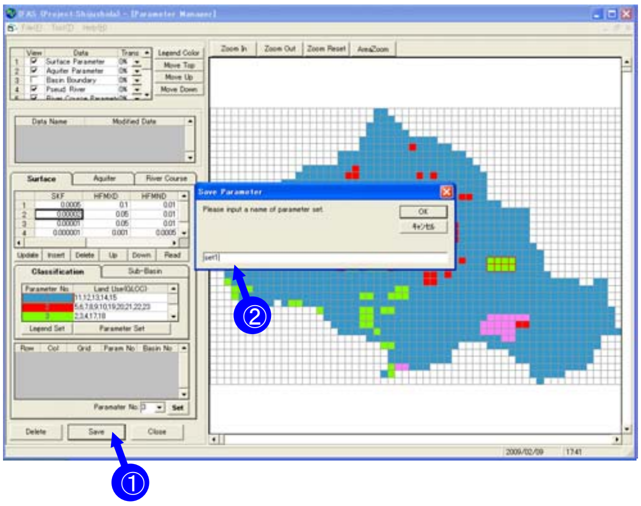


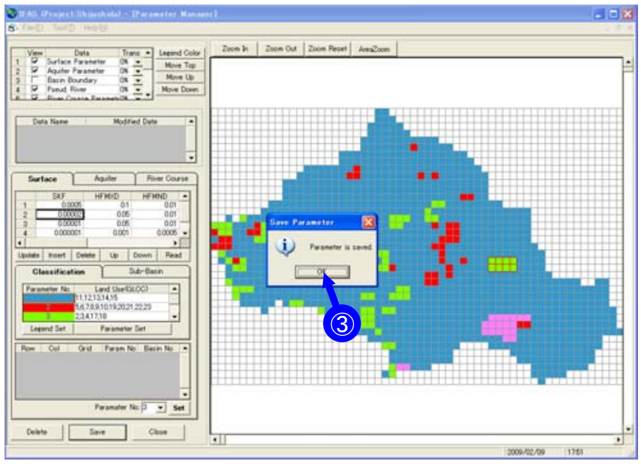
④ Save after modifying the parameter, the parameter modified will be displayed.

7.3.1.6 Alternation of Parameter by Table Edit function

The parameter can be edited by using “Table Edit” as well as 5.3.4 Alternation of elevation by Table Edit function.

7.3.1.7 Save the parameter configuration

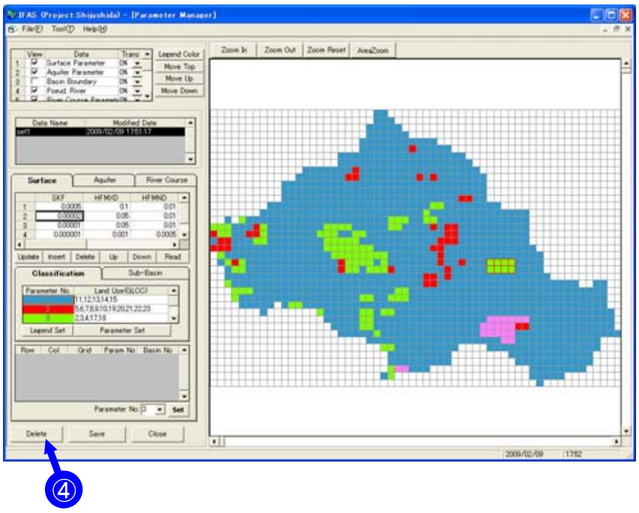




① Because after clicking save, the configuration file of the parameter will be displayed, ② input the file name of the parameter configuration file to be saved.

③ "OK" button is clicked, the parameter is preserved.

The parameter in which Save was done at the end can be displayed and be corrected.



④ When "Delete" button is clicked, the parameter setting that has been selected is deleted.

8. Creation of flood regulation function using a dam（Dam Control Manager）

8.1 Outline of setting flood regulation function using a dam

In IFAS, user can do calculation with considering flood regulation effect by dam in any location.

A maximum of 10 dam locations can be set in any cells.

There are four regulation methods, by fixed rate, fixed value, fixed rate + fixed value, and by capacity.

8.2 Dam regulation method

The dam regulation methods are the fours below.

i) Fixed Rate

This regulation method calculates the drainage flow as a fixed rate of outflow/inflow when it is over the set inflow.

For example, when control start discharge is set as 400 m^3/s and flood control rate is 40%, if the inflow is 500m^3/s, which is 100 m^3/s higher than the control start discharge, because 40% of the 100 m^3/s over flow will be drained, the drainage flow is calculated as (500-400) × 0.4 + 400 = 440 m^3/s.

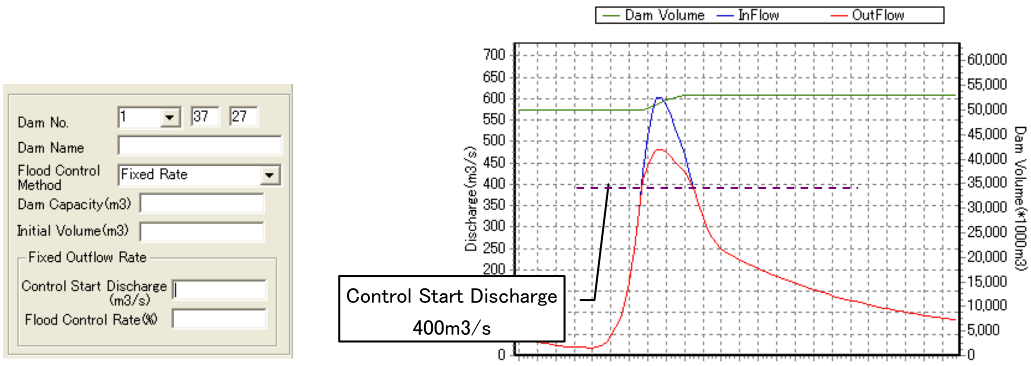


Fig.8.1 Sample of fixed rate

ii) Fixed Value

This regulation method calculates the drainage flow as a fixed value of inflow when it is over the set inflow.

For example, when control start discharge is set as 200 m^3/s, if inflow is lower than 200 m^3/s, then the drainage flow equal to inflow. If inflow is higher than 200 m^3/s, because the over flow will be stored in dam, the drainage flow is a constant as 200 m^3/s.

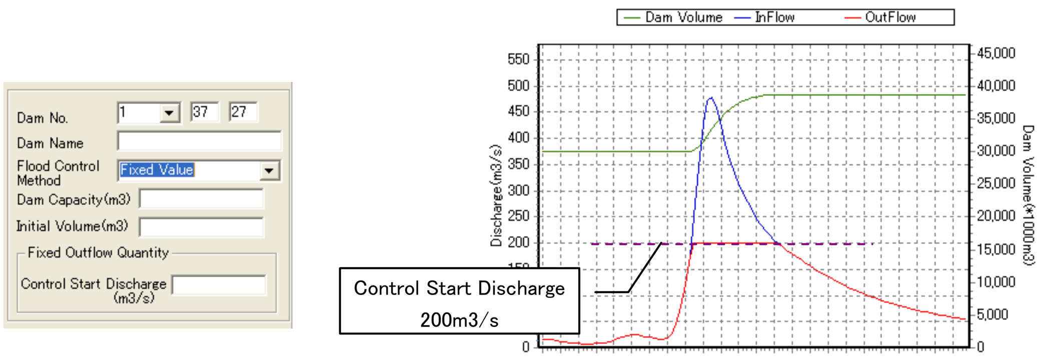


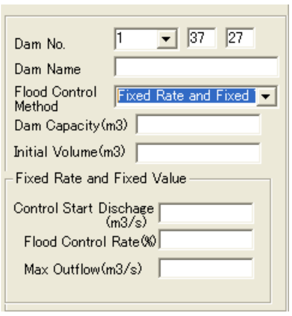
Fig.8.2 Sample of fixed value

iii) Fixed Rate and Fixed Value

This regulation method is an extension of fixed rate method, which calculates the drainage flow as a fixed value of inflow when it is over the max outflow.

For example, when control start discharge is set as 400 m^3/s, flood control rate is 40%, and max outflow is 600 m^3/s, if the inflow is lower than 400 m^3/s, then the drainage flow equal to inflow. If the inflow is higher than 400 m^3/s and lower than 900 m^3/s (when outflow is 600 m^3/s), because 40% of the 100 m^3/s over flow will be drained, the drainage flow is calculated as (500-400) × 0.4 + 400 = 440 m^3/s.

In addition, when the inflow is equal or higher than 900 m^3/s, because the over flow will be stored in dam, the outflow is calculated as 600 m^3/s.



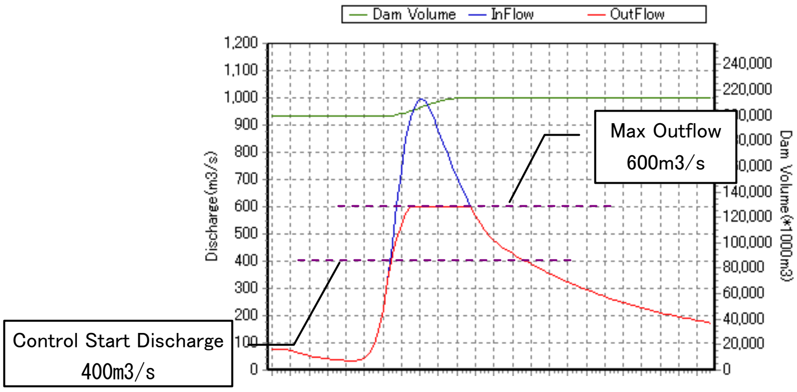
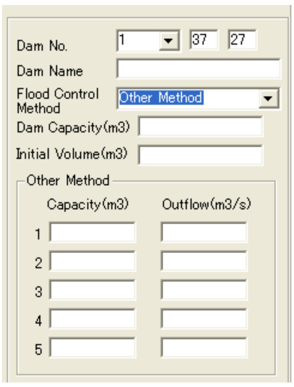


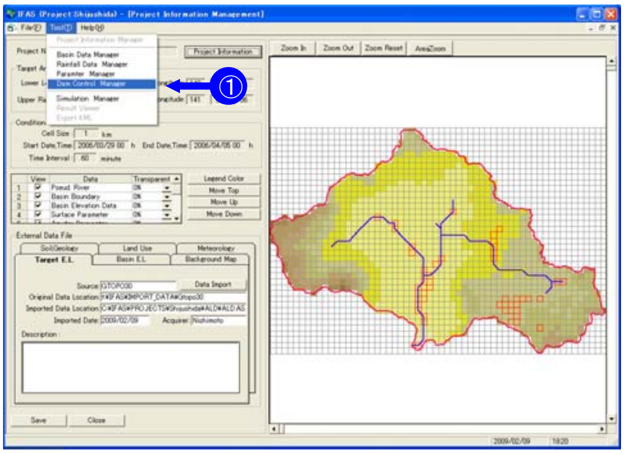
Fig.8.3 sample of fixed rate + fixed value

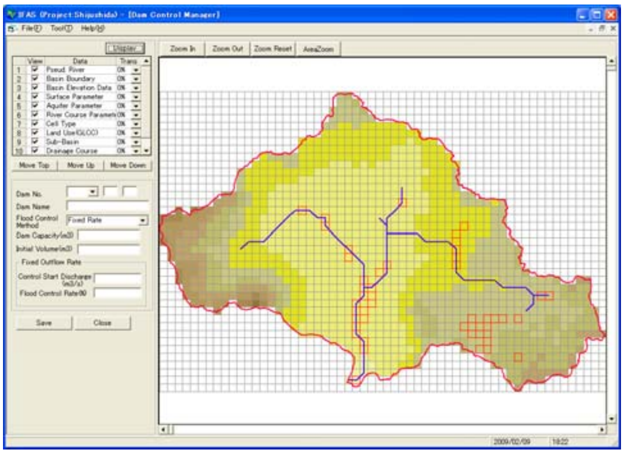
iv) Other Method

A method that sets the drainage flow according to dam capacity. The storage capacity can be set by five levels.

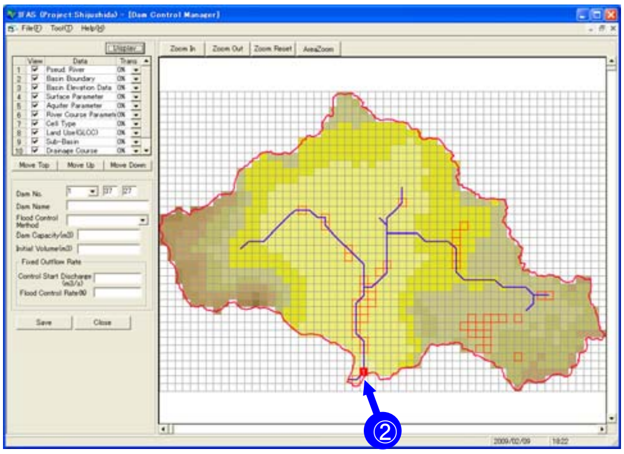


8.3 How to set flood regulation method by dam

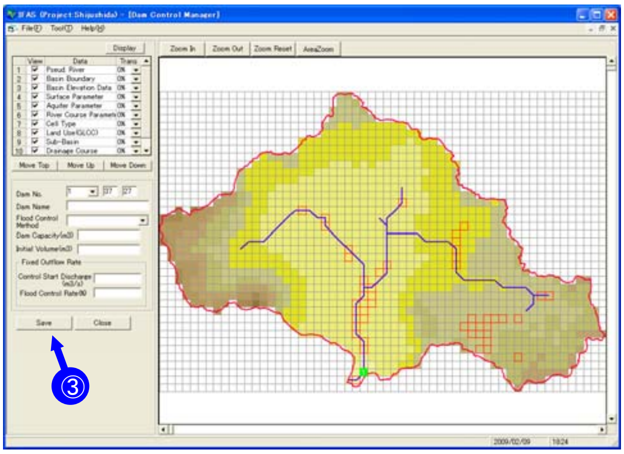


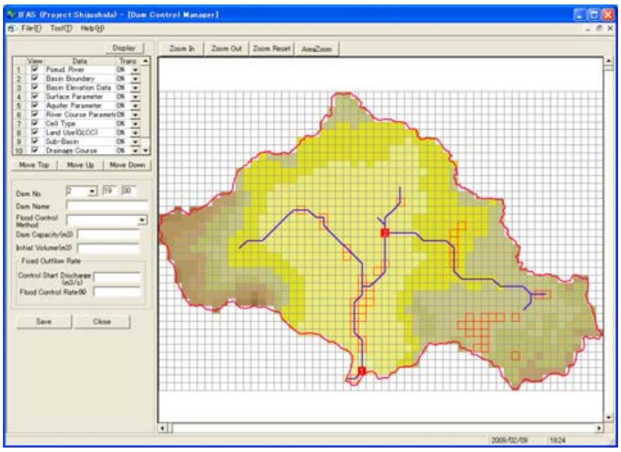


① From the “Tools” menu, select “Dam Control Manager”. The configuration window will be displayed.



② On the ground plan, double click the location of the dam to be configured. The selected cell will be coloured red and the dam number will be created. Enter the numerical values pertaining to the dam's flood regulation process. For the flood regulation process, select the fixed quantity formula, the fixed ratio formula, the fixed ratio and fixed quantity formula, or “other”, and enter the necessary conditions(Dam Name,DamCapacity,Initial Volume,other Method etc.). Here, “Other” formulae changes the outflow discharge depending on the reservoir capacity, and the user is required to enter the outflow discharge in response to capacity.





③ After entering the information, click “Save”.
For creating dams at multiple locations, repeat the above operation. The dam location and number will be displayed above the ground plan.

9. Calculation Implementation (Simulation Manager)

9.1 Outline of implementing calculation

Select the rainfall data and parameters in created model, check the data and conduct runoff simulation calculation.

9.1.1 Simulation concept

In IFAS, it is possible to manage “case” calculations with a combination of created rainfall data (Refer to '6. Rainfall data importing') and parameters (Refer to 7. Setting Parameter). The “case” is called “Simulation model”. An image of the simulation model is shown below.

From this, the rainfall data difference due to sensitivity analysis, and the parameter change due to operations such as reproducing calculations for the actual volume of flow, will become efficiently operable.

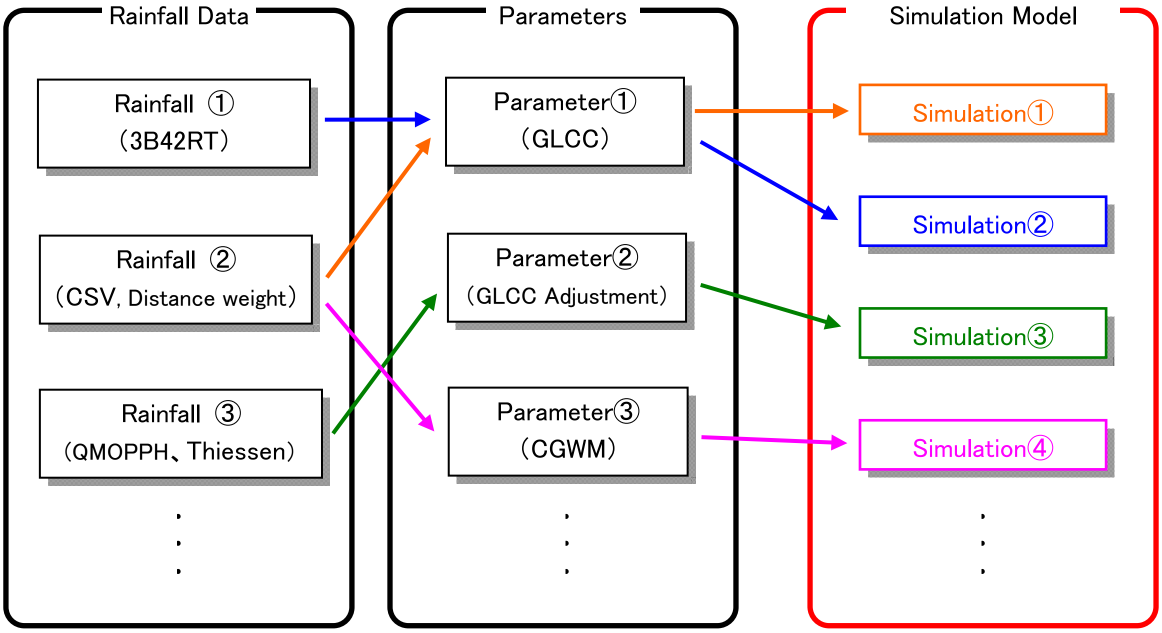


Fig. 9.1 Simulation concept

9.1.2 Calculation implementation

Run the simulation execution window from menu bar “Tool” → “Simulation Manager” (refer to Fig. 9.2).

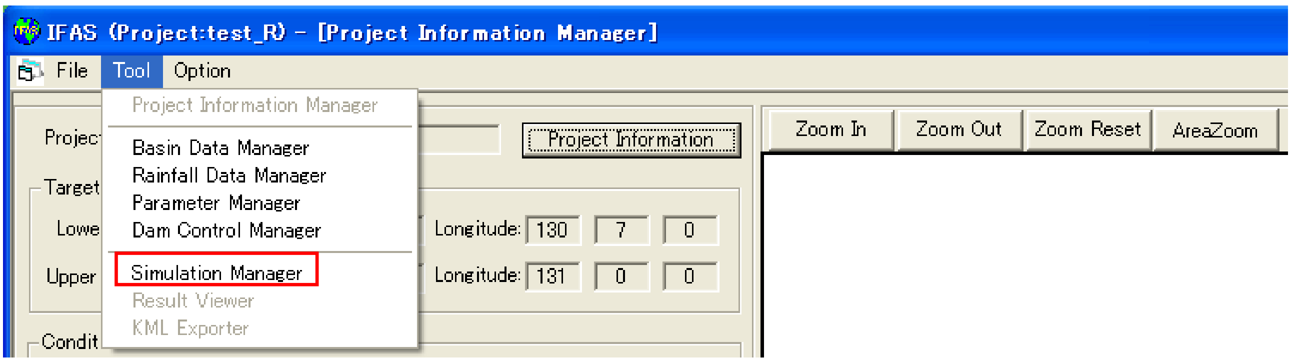


Fig. 9.2 Simulation execution window start-up

Select the rainfall data and parameters as explained in 9.1.1. Load the simulation model. Implement the calculation.

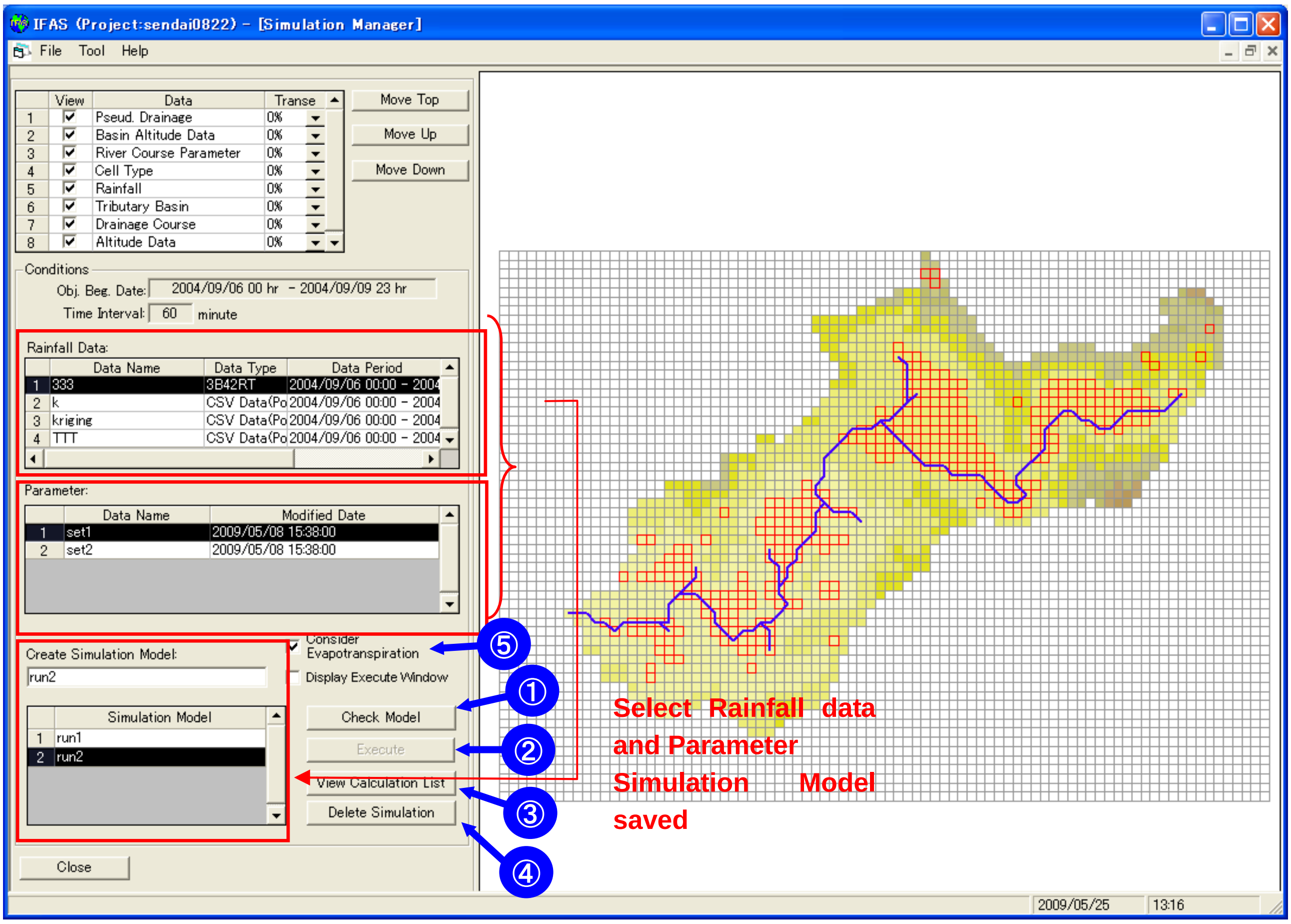


Fig. 9.3 Simulation execution window

① In order to execute the simulation, check whether or not the necessary data is sufficient.

② Execute the calculations. In addition, in the case that boxes in the “Display execute window” were checked and calculations executed, the command prompt window will launch and the progress of the calculations may be observed.

③ A summary of the parameters used in the calculations will be displayed.

④ From the list to the left of the buttons, select the simulation model and press the button to delete it.

⑤ Check “Consider Evapotranspiration” option to implement calculation considering with Notes) the evapotranspiration.

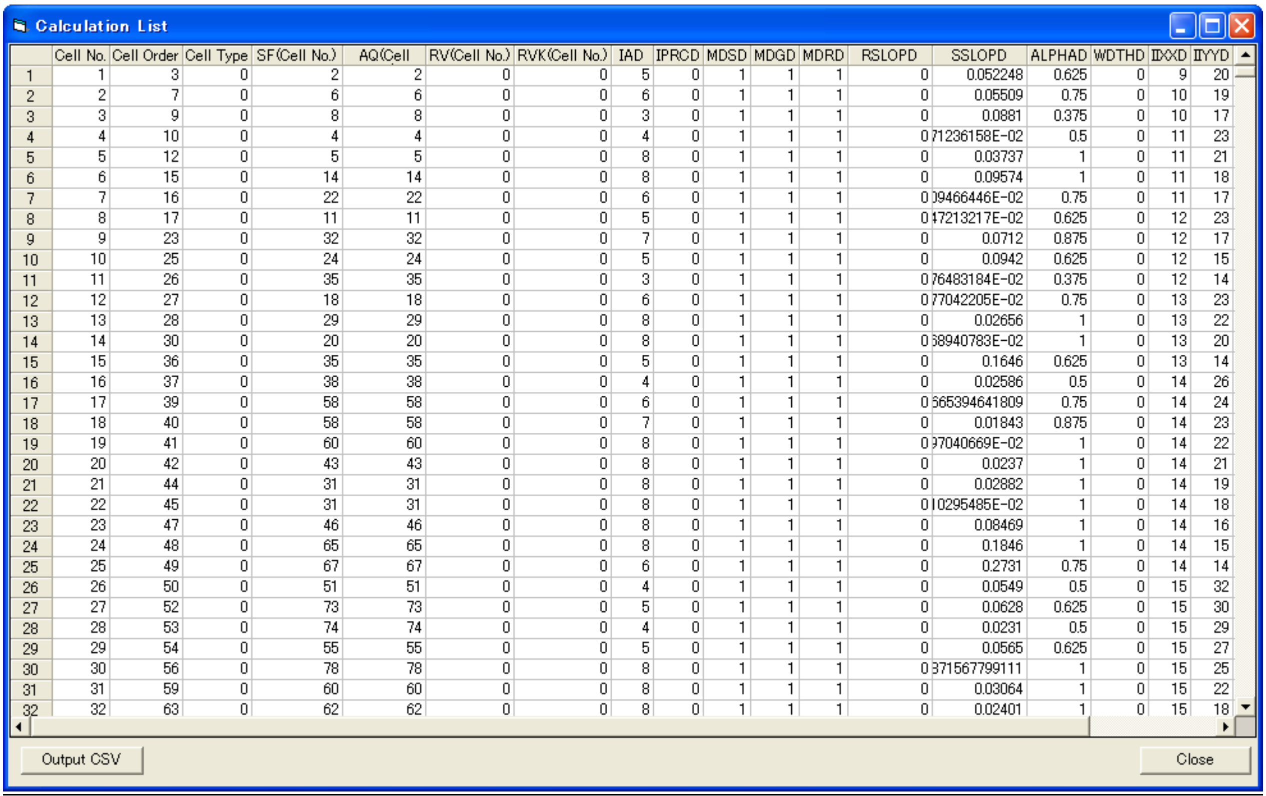
Notes) the evapotranspiration is set by 10 years mean reparse value of NCEP monthly. Details of the evapotranspiration are Information 5. Refer to the calculation of the evapotranspiration data.

(\IFAS\PROGRAMS\BIN\EVP\ eva_ave.dat).NECP_URL:http://database.rish.kyoto-u.ac.jp/arch/ncep/

The list of items that will be treated when implementing the check function

Item	Content
Get the import information	get and set the target area, target period, and cell information
Set the files being used	Set the path of files being used when calculating runoff
Create the export folder	Initialization and/or create the export folder
Parameter	Confirm the parameter setting file
Rainfall data	Confirm whether or not the rainfall data file exists
	Confirm whether or not the rainfall file is missing
	Confirm whether or not the start and finish files exist

A sample of parameter list



	Cell No.	Cell Order	Cell Type	SF(Cell No.)	AQ(Cell	RV(Cell No.)	RVK(Cell No.)	IAD	IPRCD	MDSD	MDGD	MDRD	RSLOPD	SSLOPD	ALPHAD	WDTHD	IIXXD	IIYYD
1	1	3	0	2	2	0	0	5	0	1	1	1	0	0.052248	0.625	0	9	20
2	2	7	0	6	6	0	0	6	0	1	1	1	0	0.05509	0.75	0	10	19
3	3	9	0	8	8	0	0	3	0	1	1	1	0	0.0881	0.375	0	10	17
4	4	10	0	4	4	0	0	4	0	1	1	1	0	71236158E-02	0.5	0	11	23
5	5	12	0	5	5	0	0	8	0	1	1	1	0	0.03737	1	0	11	21
6	6	15	0	14	14	0	0	8	0	1	1	1	0	0.09574	1	0	11	18
7	7	16	0	22	22	0	0	6	0	1	1	1	0	09466446E-02	0.75	0	11	17
8	8	17	0	11	11	0	0	5	0	1	1	1	0	47213217E-02	0.625	0	12	23
9	9	23	0	32	32	0	0	7	0	1	1	1	0	0.0712	0.875	0	12	17
10	10	25	0	24	24	0	0	5	0	1	1	1	0	0.0942	0.625	0	12	15
11	11	26	0	35	35	0	0	3	0	1	1	1	0	76483184E-02	0.375	0	12	14
12	12	27	0	18	18	0	0	6	0	1	1	1	0	77042205E-02	0.75	0	13	23
13	13	28	0	29	29	0	0	8	0	1	1	1	0	0.02656	1	0	13	22
14	14	30	0	20	20	0	0	8	0	1	1	1	0	68940783E-02	1	0	13	20
15	15	36	0	35	35	0	0	5	0	1	1	1	0	0.1646	0.625	0	13	14
16	16	37	0	38	38	0	0	4	0	1	1	1	0	0.02586	0.5	0	14	26
17	17	39	0	58	58	0	0	6	0	1	1	1	0	665394641809	0.75	0	14	24
18	18	40	0	58	58	0	0	7	0	1	1	1	0	0.01843	0.875	0	14	23
19	19	41	0	60	60	0	0	8	0	1	1	1	0	97040669E-02	1	0	14	22
20	20	42	0	43	43	0	0	8	0	1	1	1	0	0.0237	1	0	14	21
21	21	44	0	31	31	0	0	8	0	1	1	1	0	0.02882	1	0	14	19
22	22	45	0	31	31	0	0	8	0	1	1	1	0	10295485E-02	1	0	14	18
23	23	47	0	46	46	0	0	8	0	1	1	1	0	0.08469	1	0	14	16
24	24	48	0	65	65	0	0	8	0	1	1	1	0	0.1846	1	0	14	15
25	25	49	0	67	67	0	0	6	0	1	1	1	0	0.2731	0.75	0	14	14
26	26	50	0	51	51	0	0	4	0	1	1	1	0	0.0549	0.5	0	15	32
27	27	52	0	73	73	0	0	5	0	1	1	1	0	0.0628	0.625	0	15	30
28	28	53	0	74	74	0	0	4	0	1	1	1	0	0.0231	0.5	0	15	29
29	29	54	0	55	55	0	0	5	0	1	1	1	0	0.0565	0.625	0	15	27
30	30	56	0	78	78	0	0	8	0	1	1	1	0	371567799111	1	0	15	25
31	31	59	0	60	60	0	0	8	0	1	1	1	0	0.03064	1	0	15	22
32	32	63	0	62	62	0	0	8	0	1	1	1	0	0.02401	1	0	15	18

Cell No	: calculation step
Cell Order	: number of being calculated cell
Cell Type	: cell type
SF (Cell No)	: the No. of cell (where the water of Surface Tank flows to)
AQ (Cell No)	: the No. of cell (where the water of Aquifer Tank flows to)
RV (Cell No)	: the No. of cell (where the water of River course (Celltype2) flows to)
RVK (Cell No)	: the No. of cell (where the water of River course Tank (Celltype3) flows to)
IAD	: coefficient for estimating cell area
IPRCD	: No. of being used rainfall data (not used)
MDSD	: temporal location for storing water of Surface Tank when conducting calculation
MDGD	: temporal location for storing water of Aquifer Tank when conducting calculation
MDRD	: temporal location for storing water of River course Tank when conducting calculation
RSOLPD	: gradient of river course
SSLOPD	: gradient of slope
ALPHAD	: coefficient for estimating basin area
WDTHD	: river width (not used)
IIXXD	: location of cell (X axis)
IIYYD	: location of cell (Y axis)

Click the “Output CSV” button to export the displayed data as CSV format file.

The registered simulation model will be saved in the folder below.

Save location folder --->\IFAS\PROJECTS\PROJECT NAME\SIMU

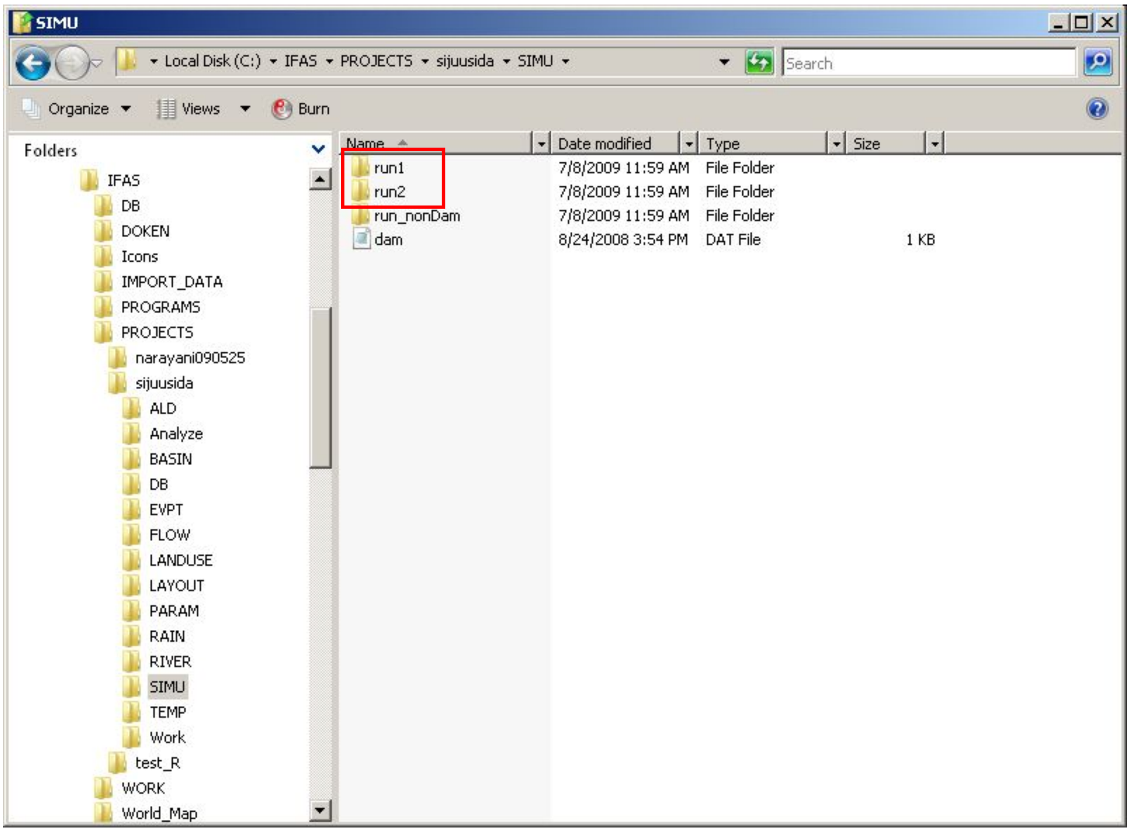


Fig. 9.4 Simulation model save location

10. Calculation results display (Result Viewer)

10.1 Outline of displaying calculation results

User can check the 1), elevation data for conducted runoff simulation calculation; 2), calculation conditions such as parameter and rainfall; and 3) calculation results such as tank water table and flow, by text display, plane distribution, and/or graphic display (i.e. hydro-graph).

Temporal data of plane distribution can be displayed by animation, and can be exported as text file from the list.

10.2Calculation results display function

In the simulation execution window select the simulation model for which the results are to be shown, select "Tool" from the menu → "Calculation results display". The simulation results display window will launch (refer to Fig. 10.1).

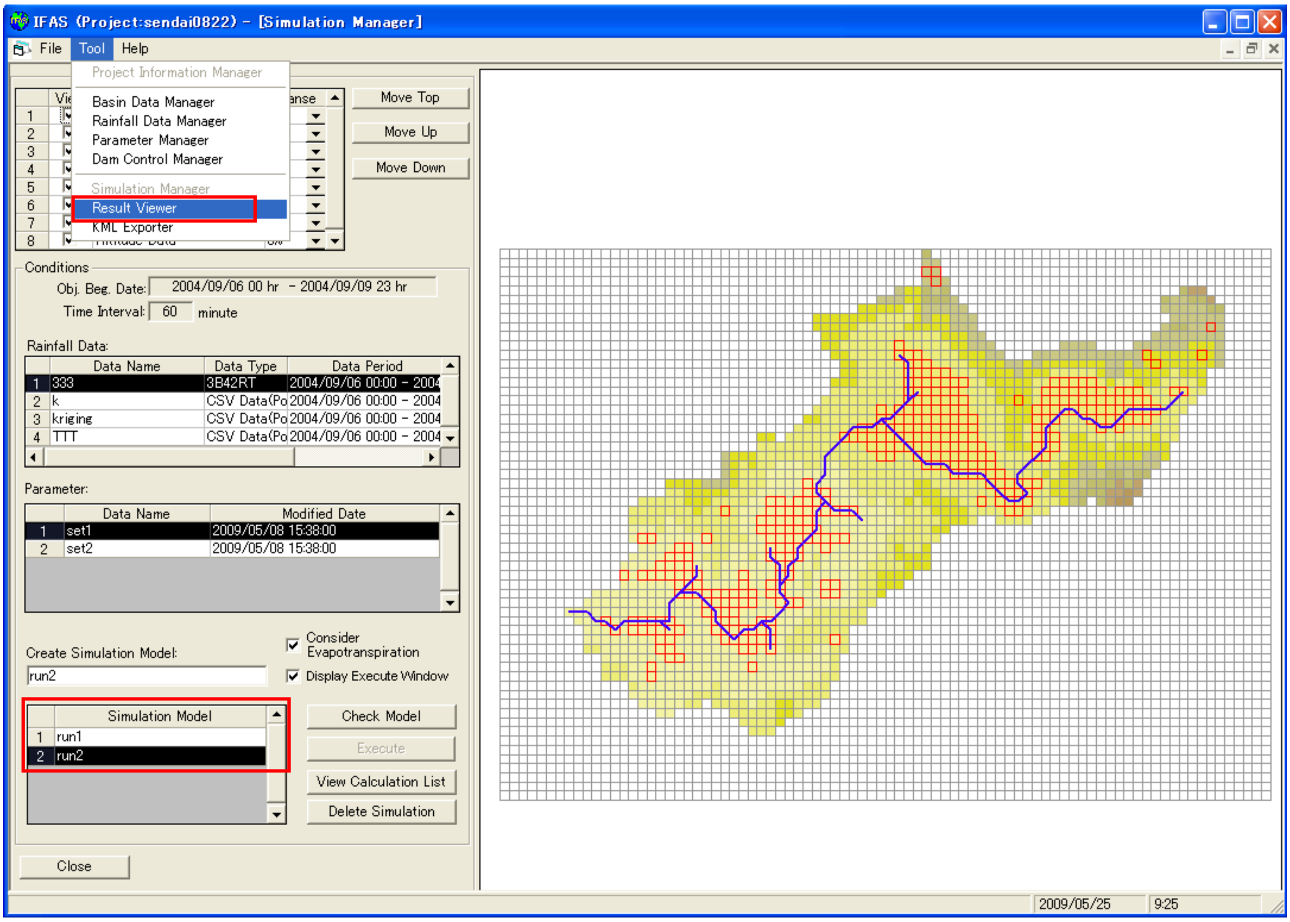


Fig. 10.1 Simulation results display window start-up

When it is launched, the ground plan of the basin in the basic window of the calculation results display will be displayed. In this ground plan, the basin used for the calculations and the river course conditions can be displayed. It is also possible to display such things as the hydrograph for a specified site and the fluctuation of the water level for river course cross-section.

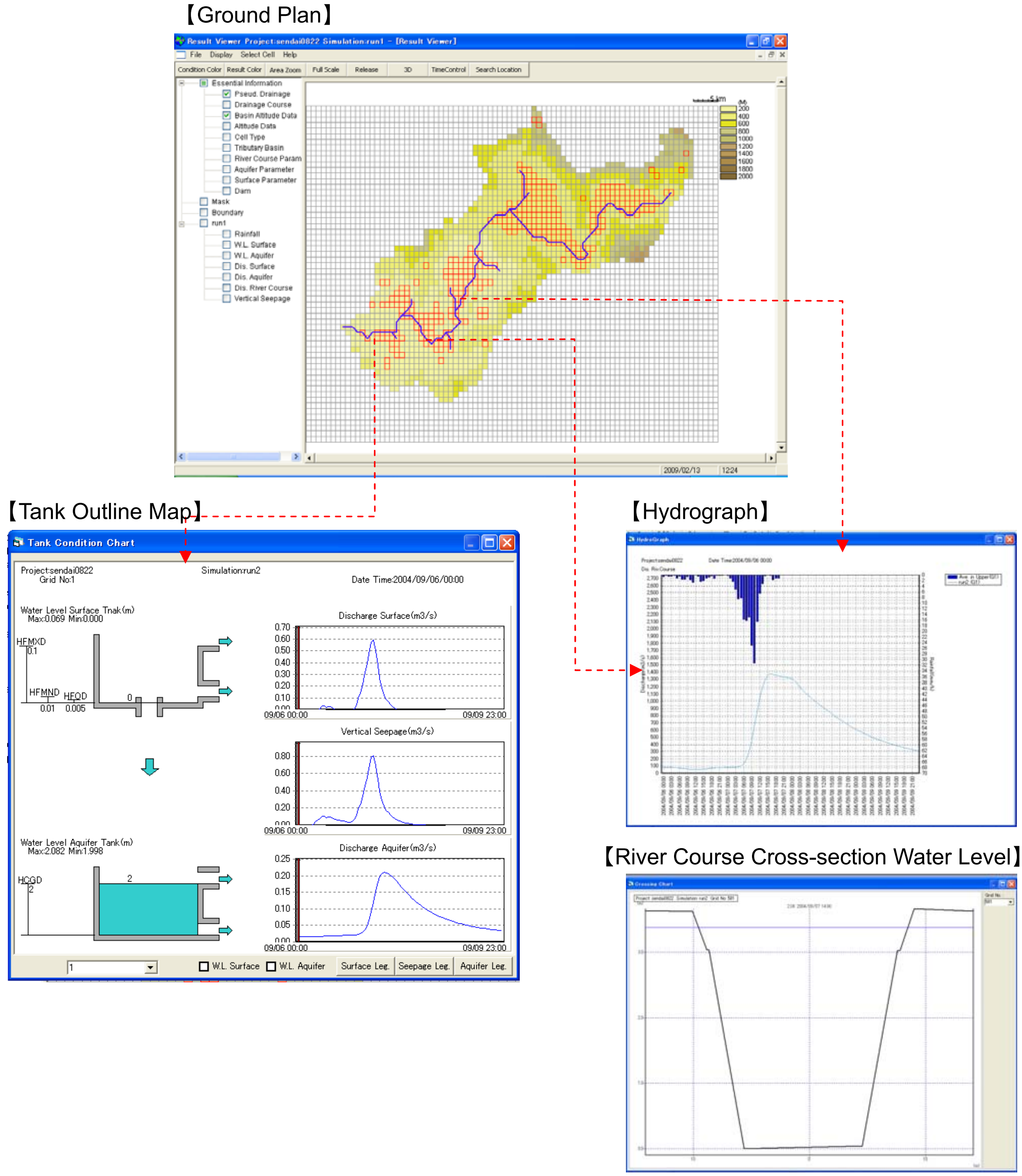


Fig. 10.2 Display window start-up for tank outline map and hydrograph from ground plan

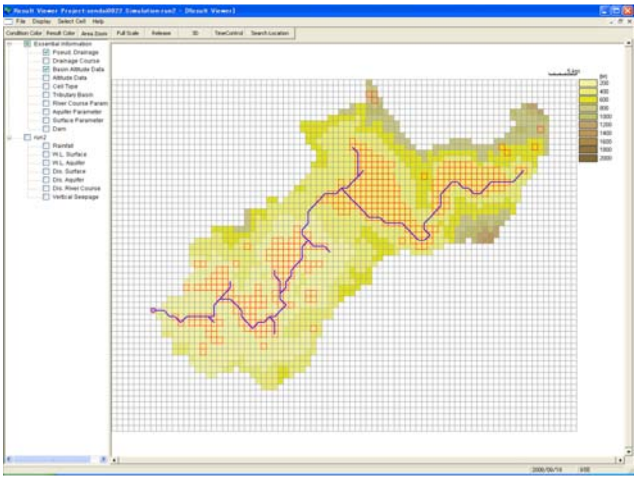
(1) Ground plan function

The ground plan shows the things selected from the “Essential information” and “Simulation model” menus located to the left of the screen.

“Essential information” is the basin elevation data that used calculations, as well as the calculation conditions for things such as the parameters.　“Simulation model” can display the calculation results for rainfall distribution and tank water level/river course flow volume, and it is possible for the simulation model to add several simulations.

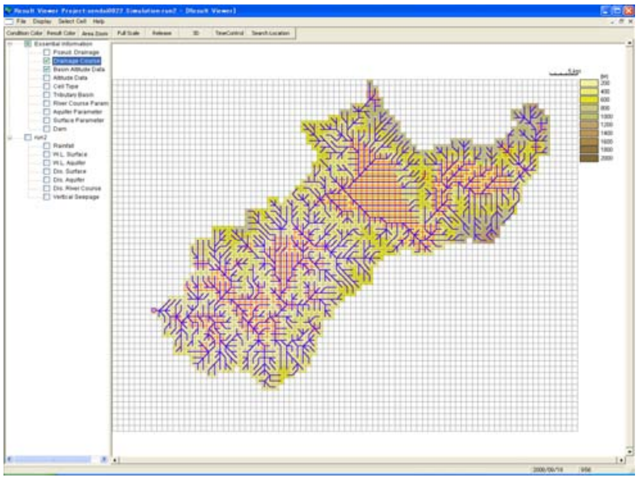
An image of the “Essential information” is shown below.

Pseudo river course basin elevation data



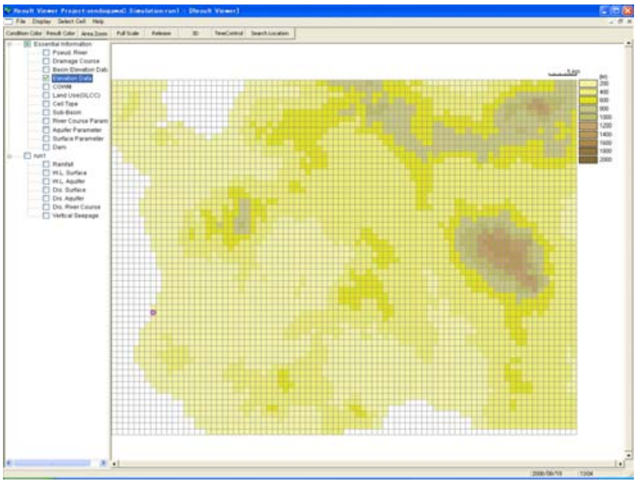
※ The pseudo river course cannot be shown as a separate element

Drainage course/ river basin elevation data



※ The drainage course cannot be shown as a separate element

Elevation data



Geological classification

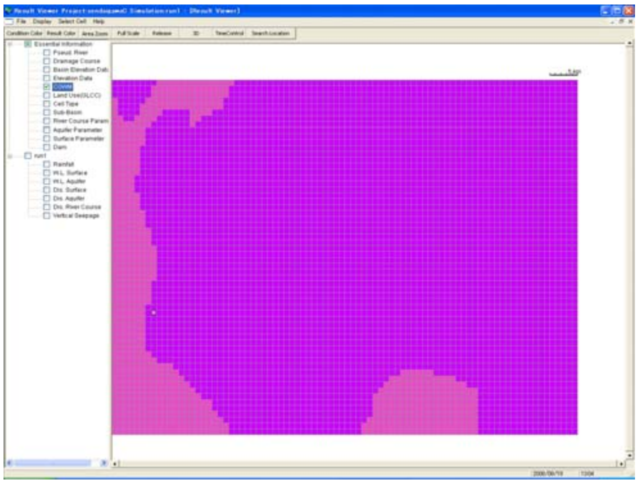


Fig. 10.3(1) “Essential Information” display image

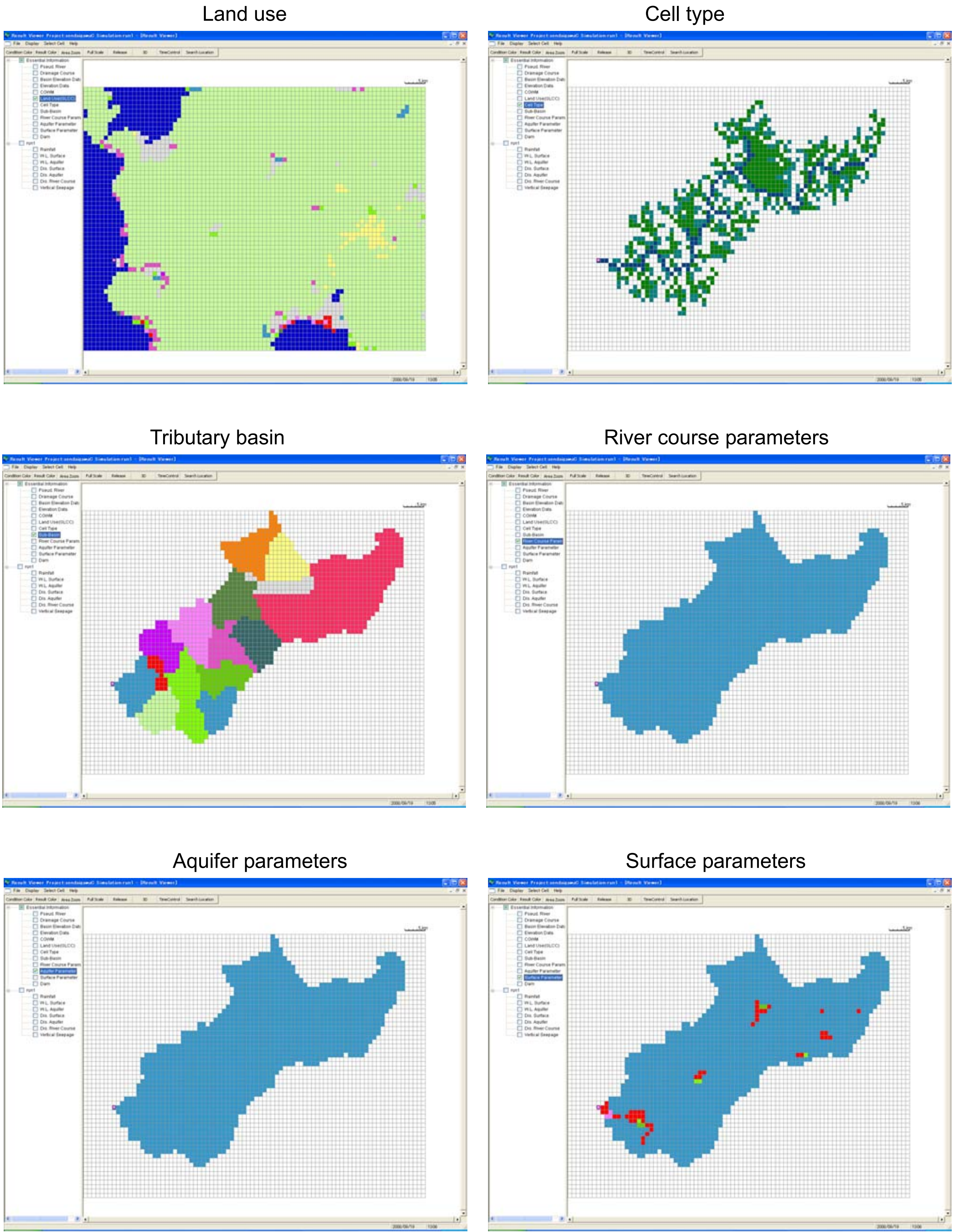


Fig. 10.3(2) “Essential Information” display image

Dam

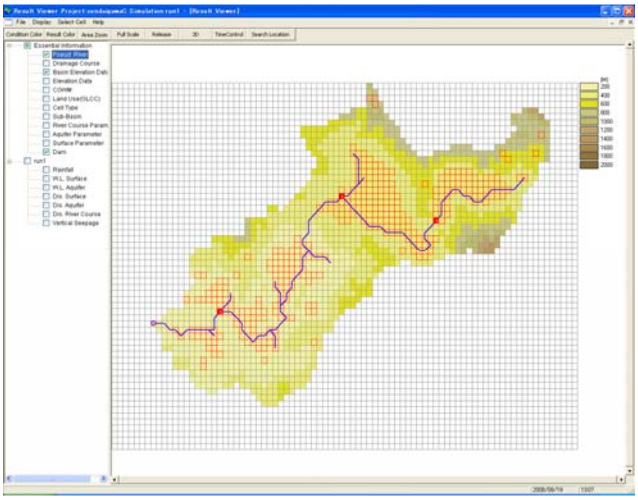


Fig. 10.3(3) “Essential Information” display image

Simulation model calculation results will all be saved in text format in the folder below and will be plotted and shown in the ground plan. Figure-10.4 shows the folder in which the results are stored, and an image of the calculation results display is shown in Figure-10.5.

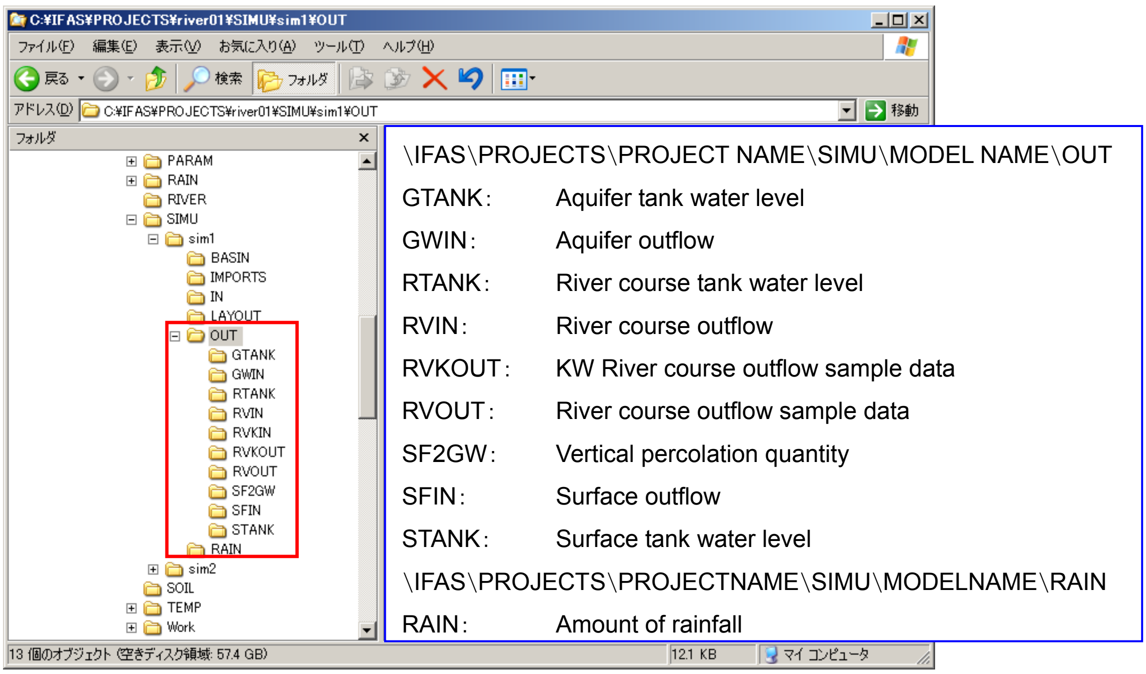
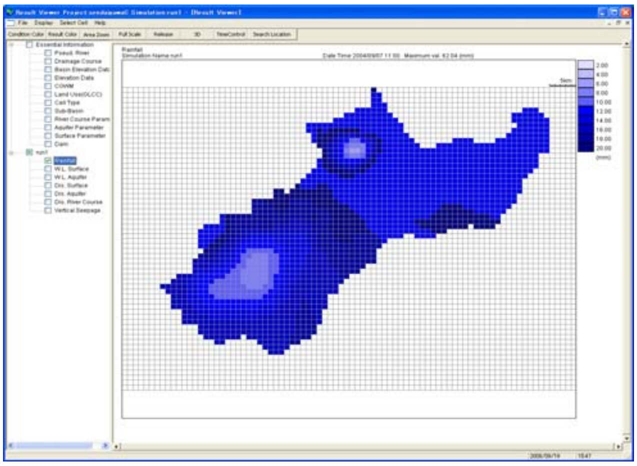
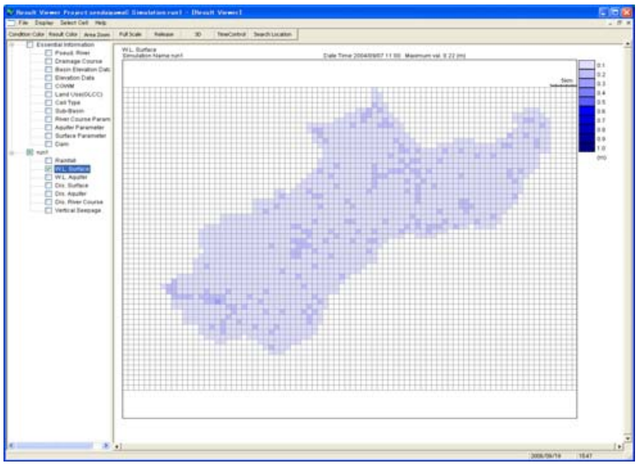


Fig. 10.4 Rainfall and calculation results save location

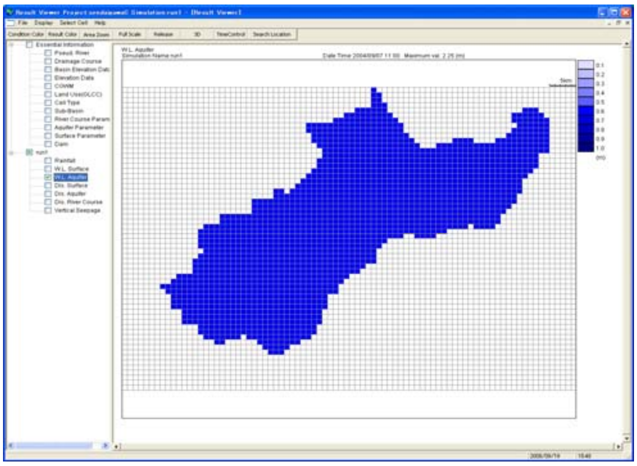
Rainfall distribution



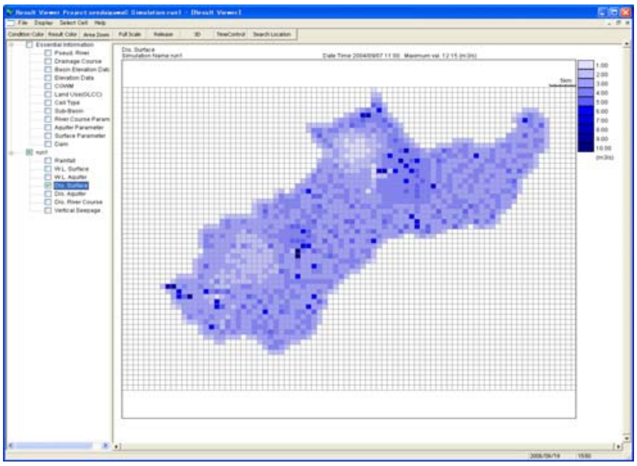
Surface tank water level



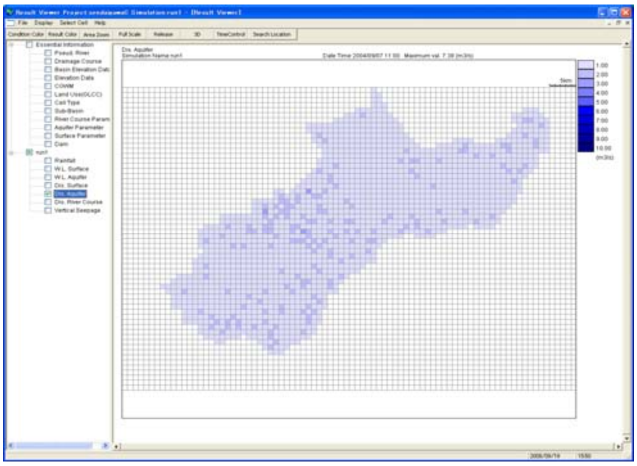
Aquifer tank water level



Surface tank volume of flow



Aquifer tank volume of flow



River course tank volume of flow

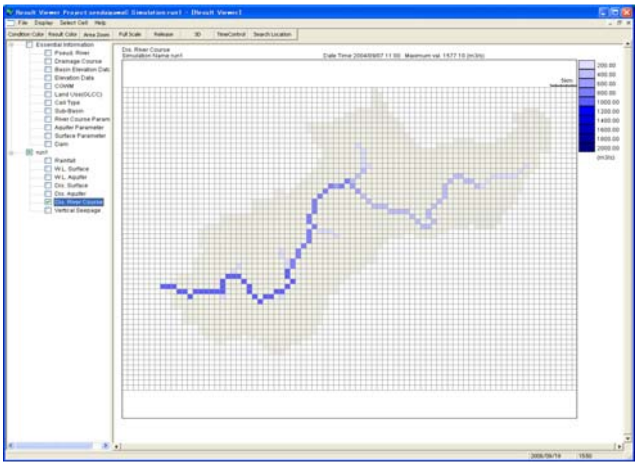


Fig. 10.5(1) “Simulation model” display image

Vertical percolation quantity

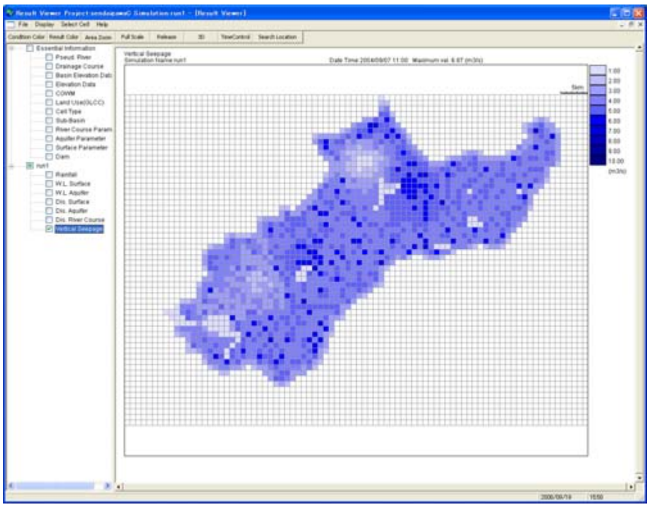


Fig. 10.5(2) "Simulation model" display image

(2) Display configuration

To change the display configuration, launch the Colour Bar from "Essential display" located in the menu and the display change will be performed.

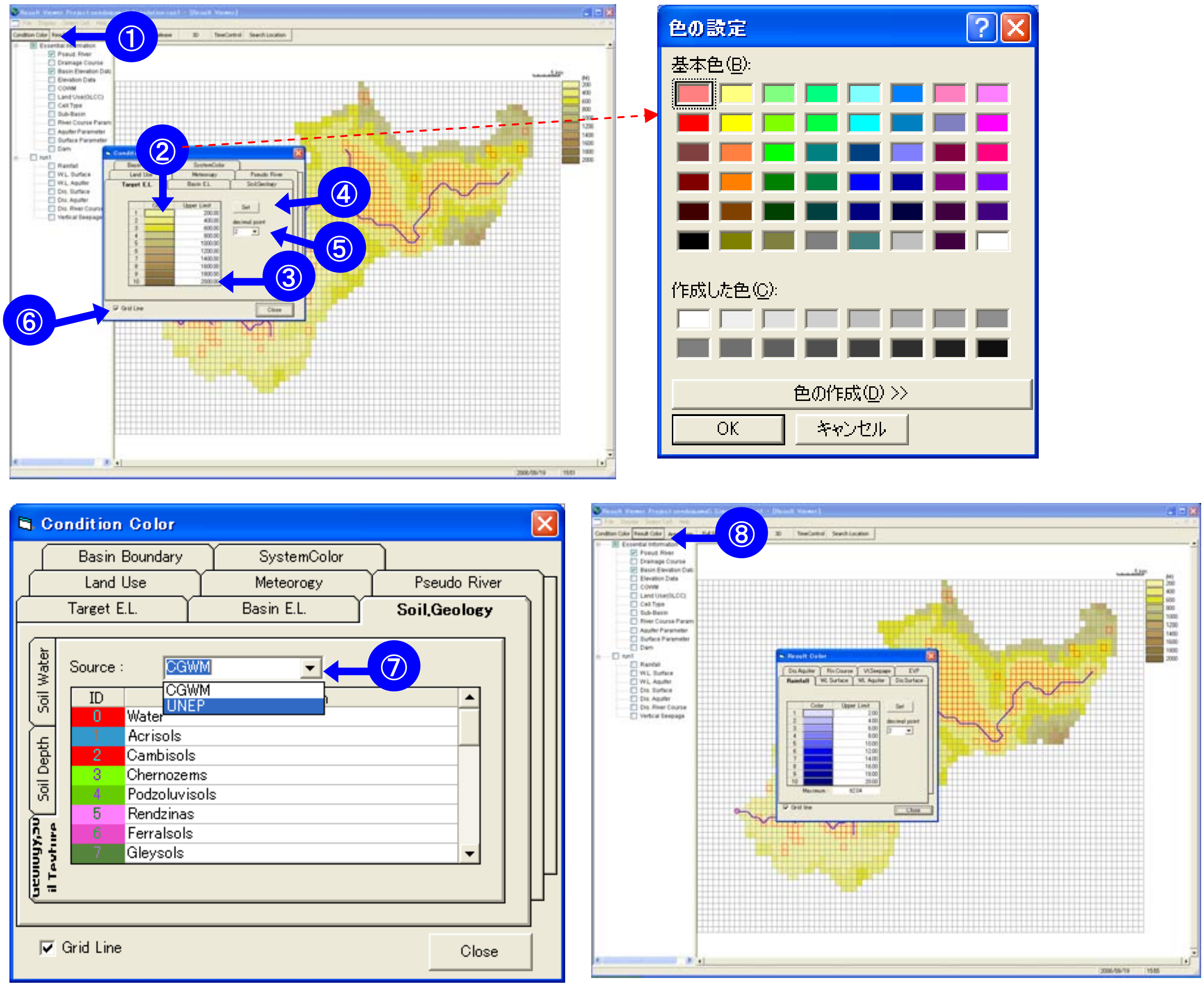


Fig. 10.6 Changing the display configuration

① When the “Condition Clolr” button is clicked the “Color Bar” window will be displayed. Here, the configuration outlined in the explanatory notes for the “Essential information” can be used.
② When a palette section is clicked, the “Color configuration” window will be displayed, and it can be changed to any color.
③ Click a numerical value section to be changed and the value can be changed.
④ If the color or value is changed, click “Set” and the settings will be changed.
⑤ Using “Decimal point”, configuration of the number of digits after the decimal point at a set point can be performed.
⑥ By selecting or deselecting “Grid Line”, the grid lines can be set to display or hide.
⑦ In “Soil/Geology”, explanatory notes for “CGWM” and “UNEP” can be viewed.
⑧ The basic operation of the “Plane display” is the same as the “Basic display” and can perform the display configuration for rainfall distribution and calculation results。

(3) Area zoom/Entire display

Ground plan magnification using “Area Zoom”, and display of the entire ground plan using “Full Scale”, is possible.

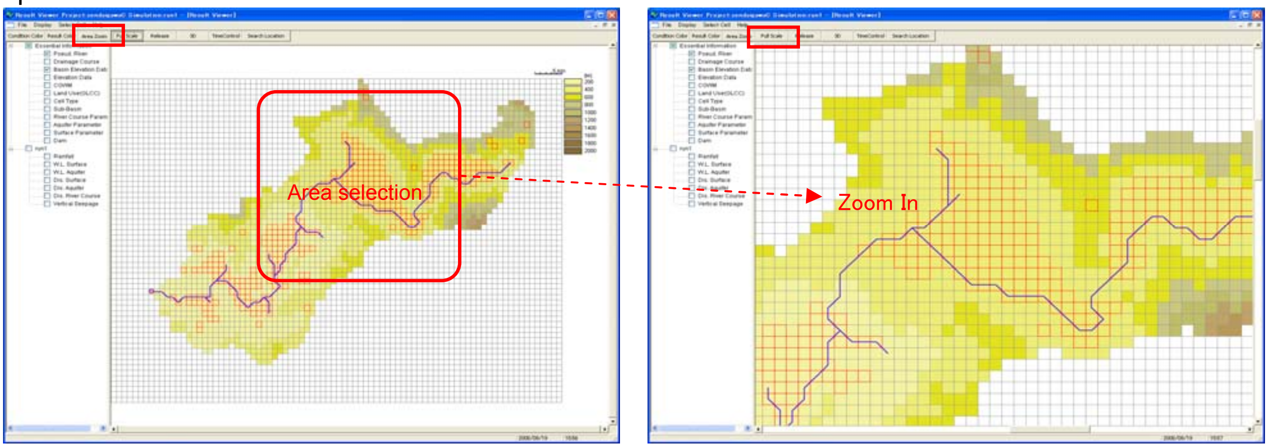


Fig. 10.7 Area zoom image

(4) Deselecting

In the ground plan, several grids displaying the hydrograph and river course cross section can be selected. To cancel these designated grids, click “Release” (express each grid selection as 9.2.3). In addition, for those deselected, the grids selected in the beginning will remain that way.

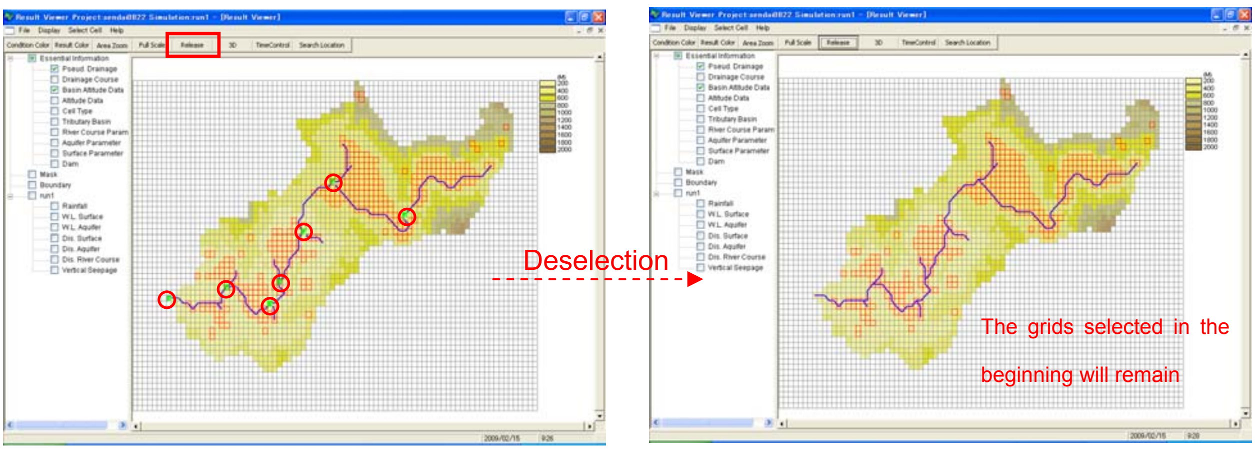


Fig. 10.8 Deselection image

(5) 3D

When the “3D” button is clicked, it is possible to view the ground plan changed into a three-dimensional state（Only the altitude）.

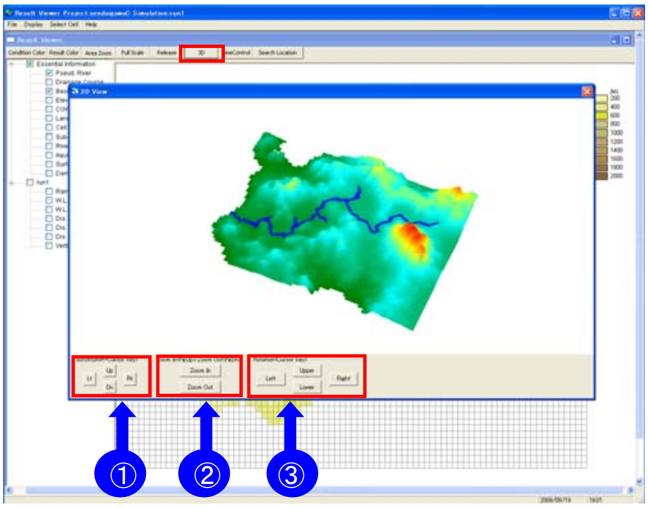


Fig. 10.8 3D Image

① Up — Moves the figure upwards
Dn — Moves the figure downwards
Lt — Moves the figure left
Rt — Moves the figure right

② Zoom in — Magnification
Zoom out — Reduction

③ Upper — Changes the figure's display angle in an upward direction
Lower — Changes the figure's display angle in a downward direction
Left — Changes the figure's display angle towards the left
Right — Changes the figure's display angle towards the right。

(6) Time control

When “Time Control” is clicked, the time controller will be displayed and the calculation results can be viewed as an animation. Furthermore, for the hydrograph and tank outline map to be displayed on-screen, run them together with the ground plan animation.

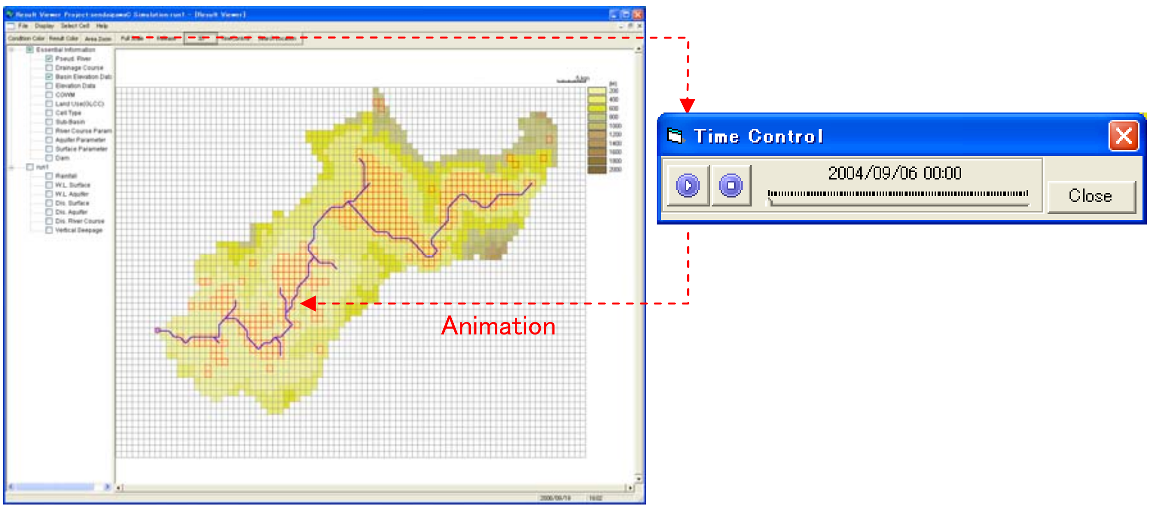


Fig. 10.10 Time control image

(7) Searching for a site

When the "Search Location" button is clicked, the "Search Location" window is displayed and when any latitude or longitude is entered, the prescribed grid above the ground plan can be retrieved.

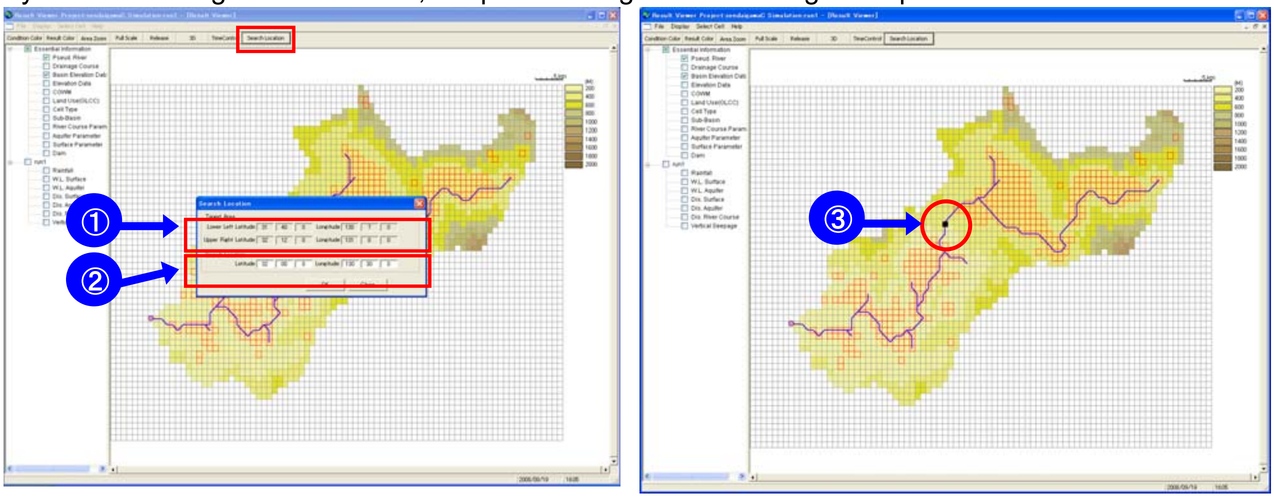


Fig.10.11 Site search image

① In "Taeget Area", the value range information for the project currently displayed will be displayed.

② In "Search Location", enter the site information (latitude/longitude) searched for (for default, the lower left latitude and longitude will be configured).

③ In "Search Location", enter any value and click "OK". The cell corresponding to the entered latitude and longitude will be displayed in black (when the "Close" button is clicked, it will return to the state prior to searching).

(8) Simulation summary display

When the simulation model is right clicked, the simulation calculation conditions/used data can be confirmed.

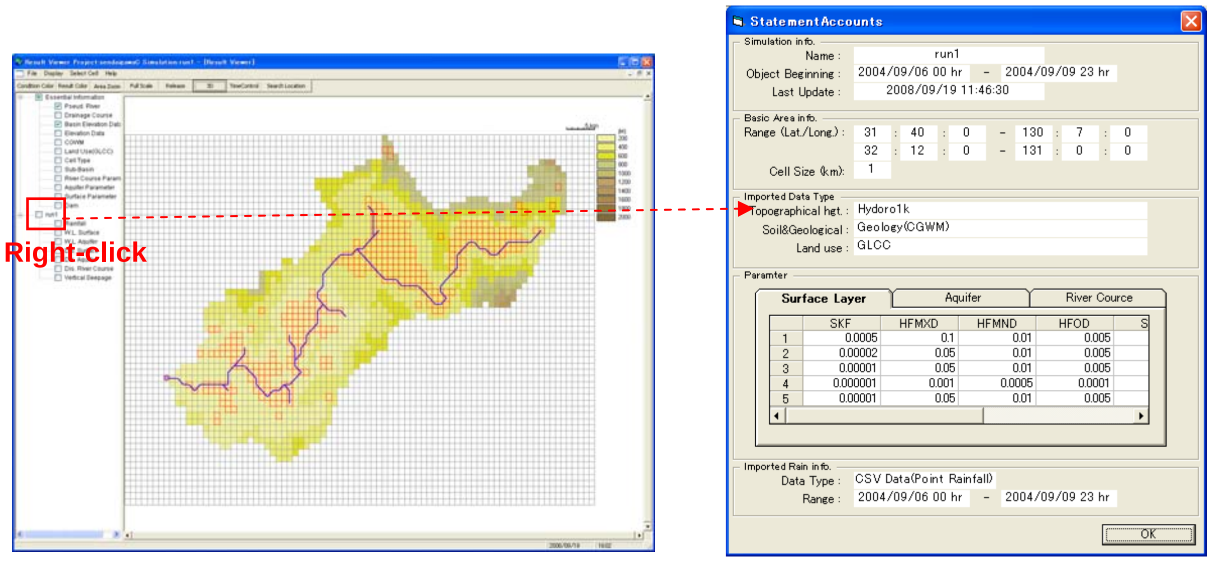
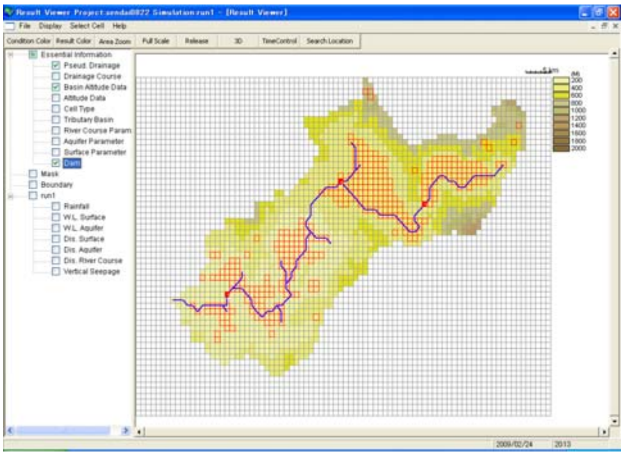
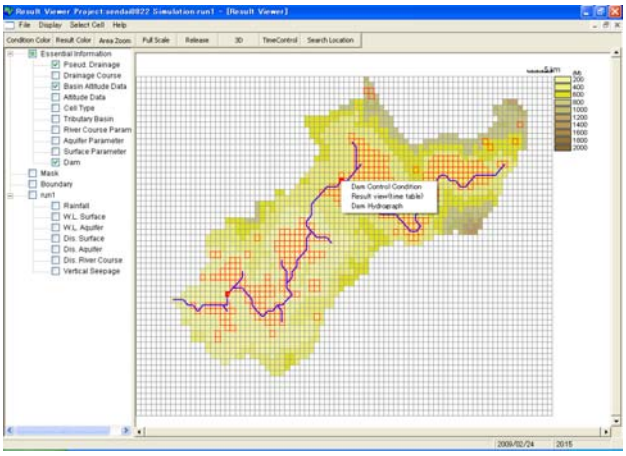


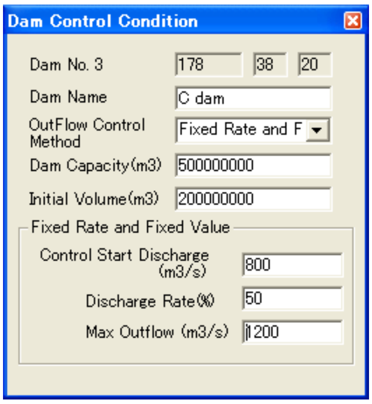
Fig. 10.12 Simulation summary display

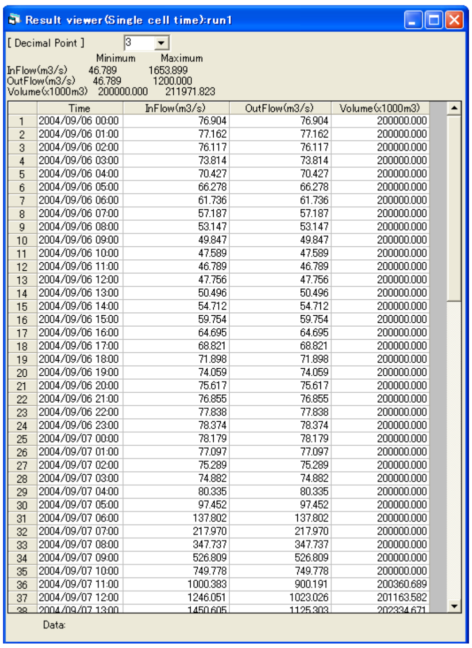
(9) Flood control display using a dam

From “Essential Information” select “Dam”, and right click the dam site above the ground plan. The “Dam Control Conditions”, “Result view(time table)”, and “Dam Hydrograph” menus will be displayed.

When each menu is selected, the following type of figures will be displayed.





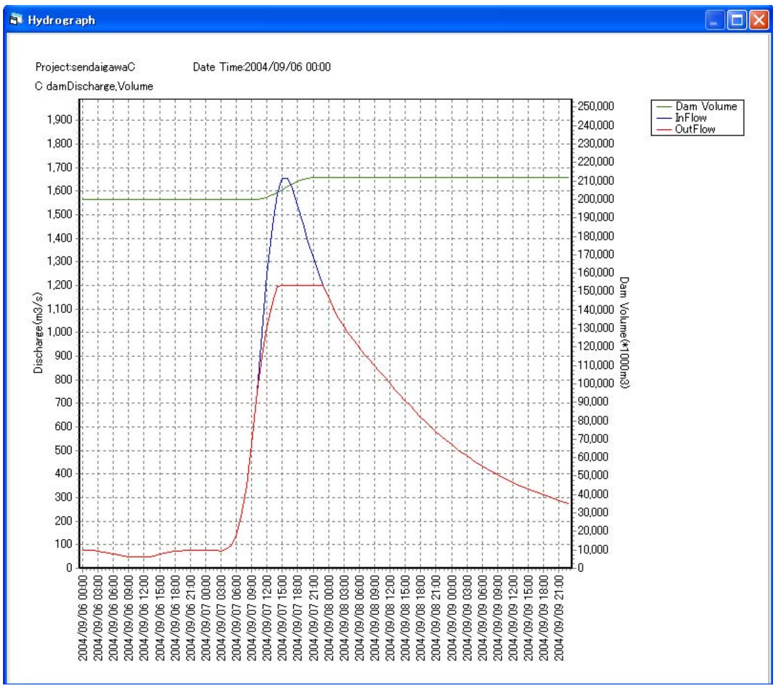
Result viewer(Single cell time):run1

[Decimal Point] 3

	Minimum	Maximum
InFlow(m3/s)	46.789	1653.899
OutFlow(m3/s)	46.789	1200.000
Volume(x1000m3)	200000.000	211971.823

	Time	InFlow(m3/s)	OutFlow(m3/s)	Volume(x1000m3)
1	2004/09/06 00:00	76.904	76.904	200000.000
2	2004/09/06 01:00	77.162	77.162	200000.000
3	2004/09/06 02:00	76.117	76.117	200000.000
4	2004/09/06 03:00	73.814	73.814	200000.000
5	2004/09/06 04:00	70.427	70.427	200000.000
6	2004/09/06 05:00	66.278	66.278	200000.000
7	2004/09/06 06:00	61.736	61.736	200000.000
8	2004/09/06 07:00	57.187	57.187	200000.000
9	2004/09/06 08:00	53.147	53.147	200000.000
10	2004/09/06 09:00	49.847	49.847	200000.000
11	2004/09/06 10:00	47.589	47.589	200000.000
12	2004/09/06 11:00	46.789	46.789	200000.000
13	2004/09/06 12:00	47.756	47.756	200000.000
14	2004/09/06 13:00	50.496	50.496	200000.000
15	2004/09/06 14:00	54.712	54.712	200000.000
16	2004/09/06 15:00	59.754	59.754	200000.000
17	2004/09/06 16:00	64.695	64.695	200000.000
18	2004/09/06 17:00	68.821	68.821	200000.000
19	2004/09/06 18:00	71.898	71.898	200000.000
20	2004/09/06 19:00	74.059	74.059	200000.000
21	2004/09/06 20:00	75.617	75.617	200000.000
22	2004/09/06 21:00	76.855	76.855	200000.000
23	2004/09/06 22:00	77.838	77.838	200000.000
24	2004/09/06 23:00	78.374	78.374	200000.000
25	2004/09/07 00:00	78.179	78.179	200000.000
26	2004/09/07 01:00	77.097	77.097	200000.000
27	2004/09/07 02:00	75.289	75.289	200000.000
28	2004/09/07 03:00	74.882	74.882	200000.000
29	2004/09/07 04:00	80.335	80.335	200000.000
30	2004/09/07 05:00	97.452	97.452	200000.000
31	2004/09/07 06:00	137.802	137.802	200000.000
32	2004/09/07 07:00	217.970	217.970	200000.000
33	2004/09/07 08:00	347.737	347.737	200000.000
34	2004/09/07 09:00	526.809	526.809	200000.000
35	2004/09/07 10:00	749.778	749.778	200000.000
36	2004/09/07 11:00	1000.383	900.191	200360.689
37	2004/09/07 12:00	1246.051	1023.026	201163.582
38	2004/09/07 13:00	1450.605	1125.303	202334.671

Data:



10.3 Simulation file addition and deletion

For the IFAS calculation results display, several simulations are read, and results from the hydrograph superposition can be viewed while comparing.

(1) Simulation file addition

“File” menu → from “Simulation file reading”, launch the simulation list, and the simulation will be added. From the simulation list select the simulation to be displayed, and when the “OK” button is clicked, the selected simulation will be added to the tree diagram on the left side of the screen.

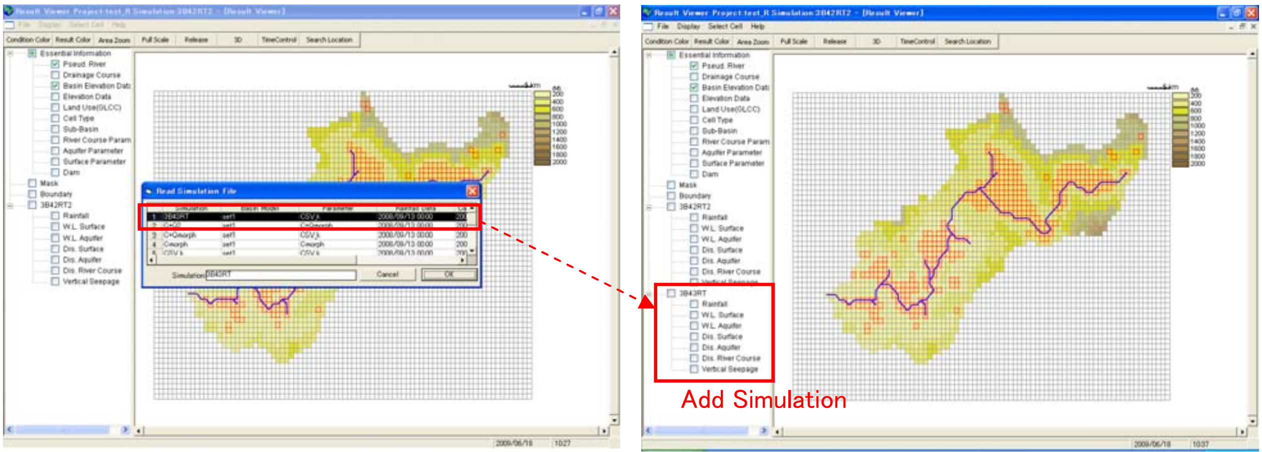


Fig. 10.13 Adding a simulation

(2) Simulation file deletion

“File” menu → from “Simulation file deletion”, launch the simulation list being read, and the simulation deletion will be performed (refer to the figure below on the left). In addition, the “Simulation deletion” here is not the deletion of the data itself, it is the deletion of the read simulation. To delete the actual data, select “Delete Simulation” from the simulation execution window (refer to the figure below on the right).

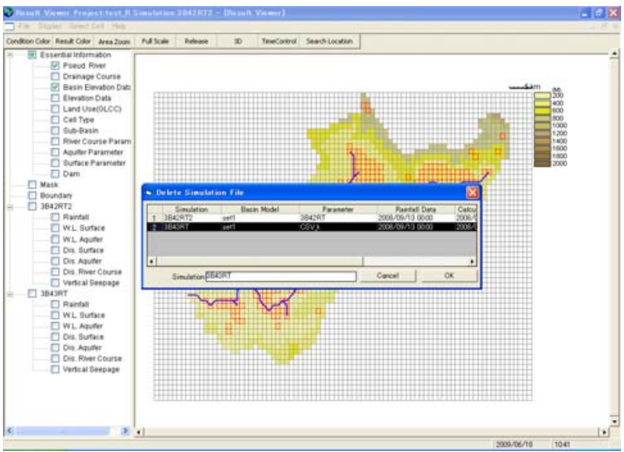


Fig.10.14 Simulation deletion from results window

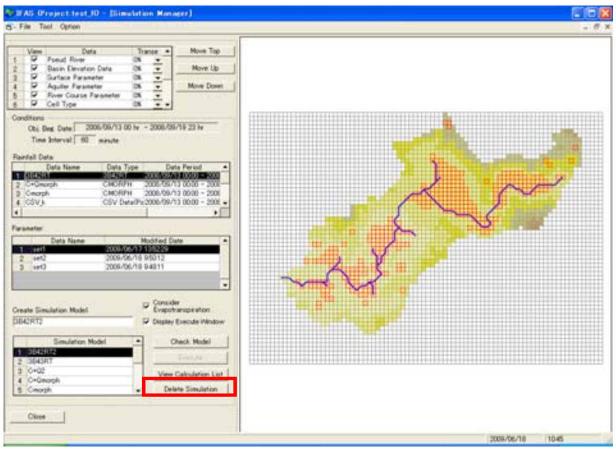


Fig.10.15 Simulation deletion

10.4 Grid selection

In order to display a specific grid's hydrograph and tank outline map, select the grid on the ground plan. Select the grid by moving the pink ball in the ground plan using the mouse.

In IFAS various selection options are available, and can be used by clicking “Grid Selection” from the menu.

(1) Single grid selection and multiple grid selection

To select one grid, use “Select Single Cell”.

Alternatively, for the superimposed multiple grid hydrograph, use “Select Plural Cell”. Multiple grid selection or unselection can be done by double clicking it while pushing the shift key any position above the ground plan.

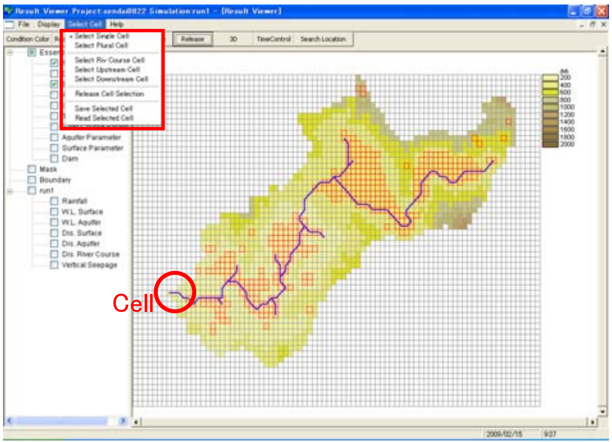


Fig. 10.16 Grid selection menu

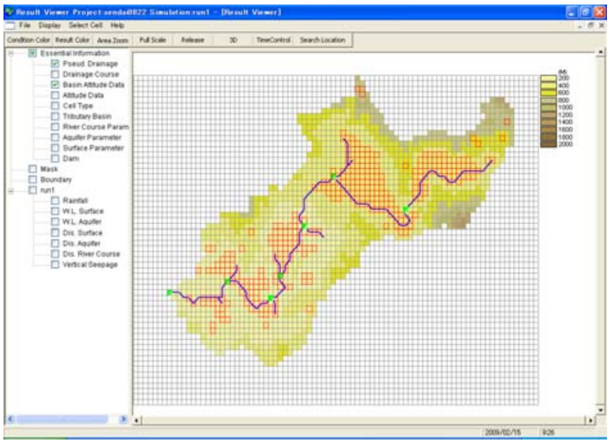


Fig. 10.17 Multiple grid selection

(2) River course grid selection

It is possible to select a pseudo river course using “Riv. Course Grid Selection”. For this type of selection, the selection grid color will be displayed as yellow.

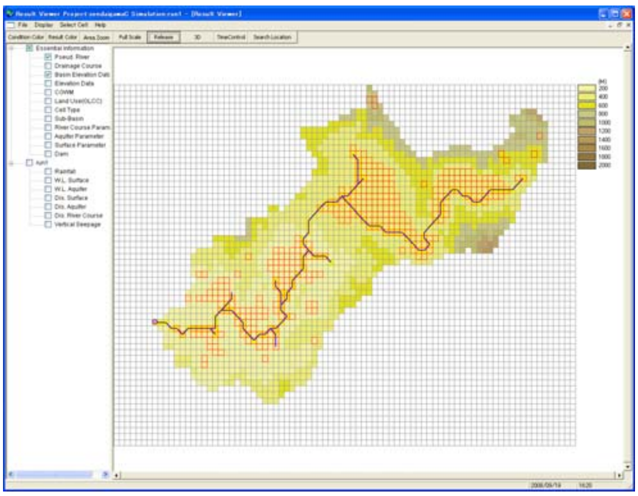


Fig.10.18 River course grid selection

(3) Upstream selection and downstream selection

Using “Select Upstream Cell”, rather than the selected grid, all of the parts situated upstream will be selected (refer to the figure below on the left).

Using “Select Downstream Cell”, rather than the selected grid, all of the river course parts situated downstream will be selected (refer to the figure below on the right).

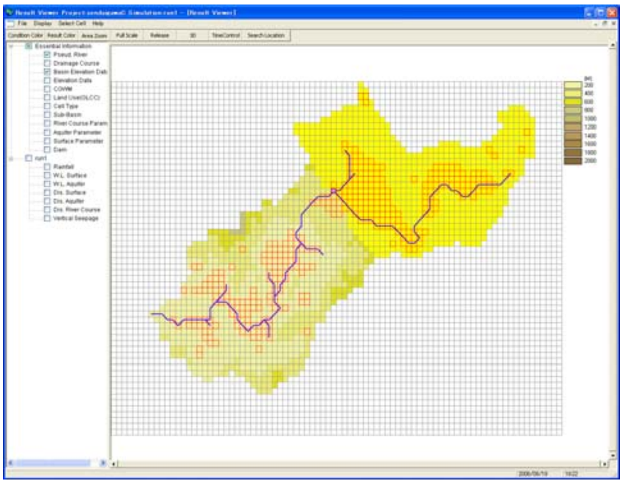


Fig. 10.19 Upstream grid selection

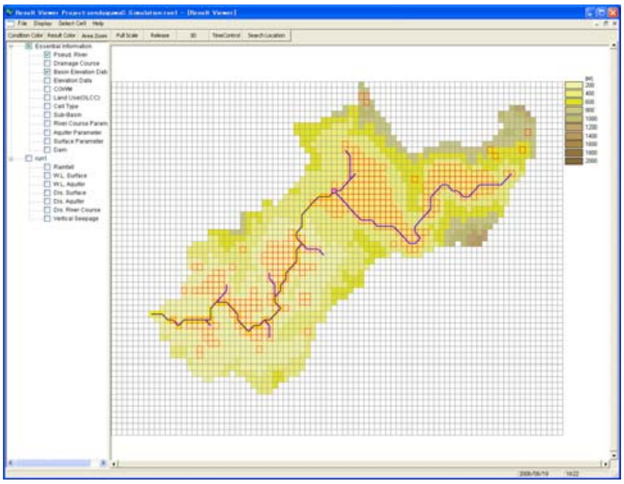


Fig. 10.20 Downstream grid selection

(4) Cancelling the selected grid

Using “Release Cell Selection”, multiple, river course, upstream, and downstream grid selected objects will be cancelled (however, from the initial state as a single grid, the existing grid will remain in that location).

(5) Saving the selected grid, reading the selected grid

Using “Save Selected Cell”, the selected grid number and location will be saved, and “Read Selected Cell” can display the saved data.

10.5 Display of all sorts of calculation result

The calculation results other than the plane figure can be displayed through clicking “Display”from the menu or right-button clicking on the Plane figure. The displaying types are the 9 types displayed in table 10.1.

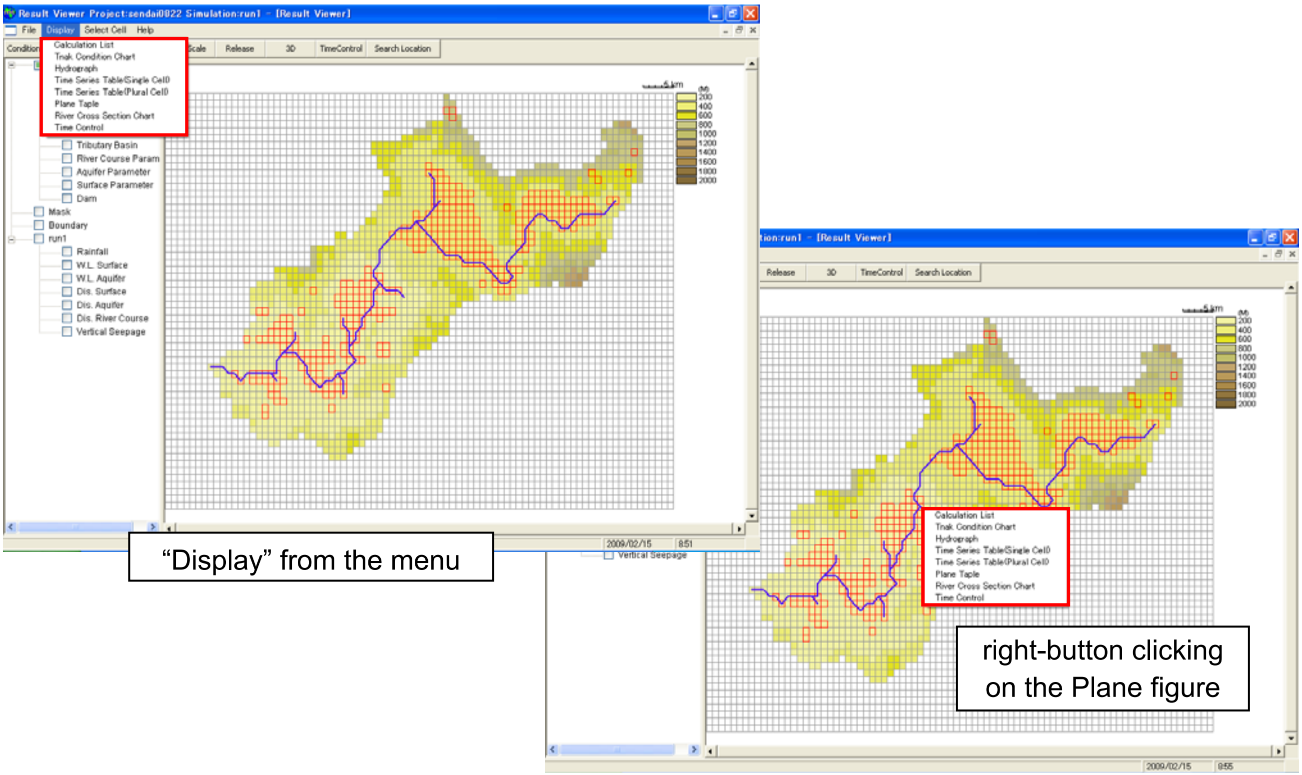


Fig. 10.21 The display menu

Table 10.1 Contents of the display menu

Type	Content
List of calculation conditions	List of data used for calculation
Tank outline map	schematic diagram of the surface tank at the grid / river course tank etc, and hydrograph
Hydrograph	Chronological order display of outflow and rainfall
result display (single grid chronological order)	table of rainfall / tank water level / tank outflow of the specific grid
result display (plural grid chronological order)	table of rainfall / tank water level / tank outflow of plural grids
result display (all grid plane)	plane expression of calculation conditions, and plane expression of calculation conditions at some stages
Cross section figure	Superposition display of the river course cross section and water levels at some stages
Time Control	Display of time control menu bar

(1) List of calculation conditions

The list of data used in simulation calculation is displayed. In addition, right click the screen, “save” and “Print” can be selected. By clicking “Save” the data can be saved in the CSV file.

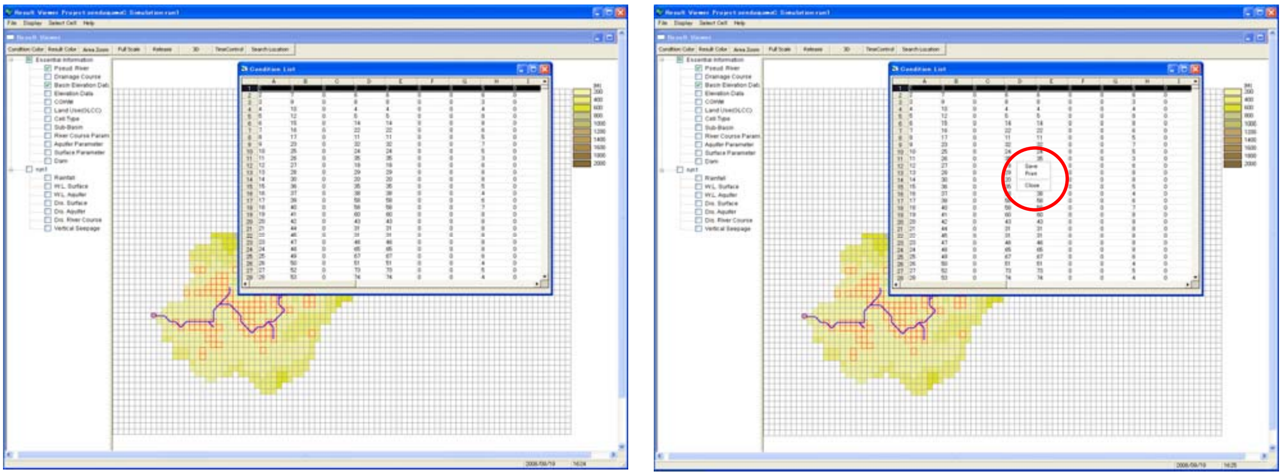


Fig. 10.22 List of calculation conditions

(2) Tank outline map

In the tank outline map, the “surface tank water level” , the “aquifer tank water level“, the “river course tank water level“, the “surface tank outflow“, the “aquifer tank outflow“, the “river course tank outflow“ and the “vertical percolation quantity“ of the selected grid position in the plane figure are displayed. In addition, animation can be performed using “Time Control“ together, and right click the screen, “Save“ and “Print“ can be carried out in the same way as “List of Calculation Condition“ above.

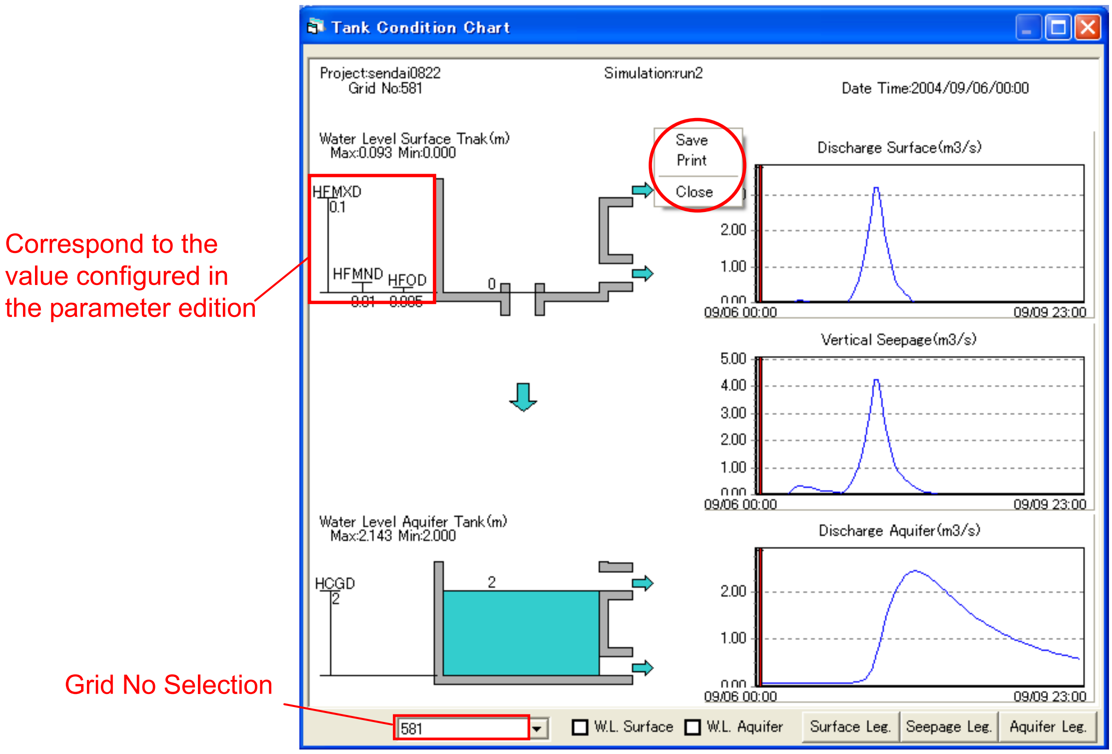


Fig. 10.23 Tank outline figure

(3) Hydrology graph

Select one place or plural grid where the hydrology graph of the plane figure needs to be displayed, the screen of Configuration Display can be started from “Display“→“Hydrograph“. In the Display Configuration, the hydrograph of the grid / the actual result data (quantity of flow observed and the other calculation result) can be stacked and displayed. In addition, considering about rainfall, the grid rainfall and the average rainfall of the upper reach grid can be displayed together with the hydrograph.

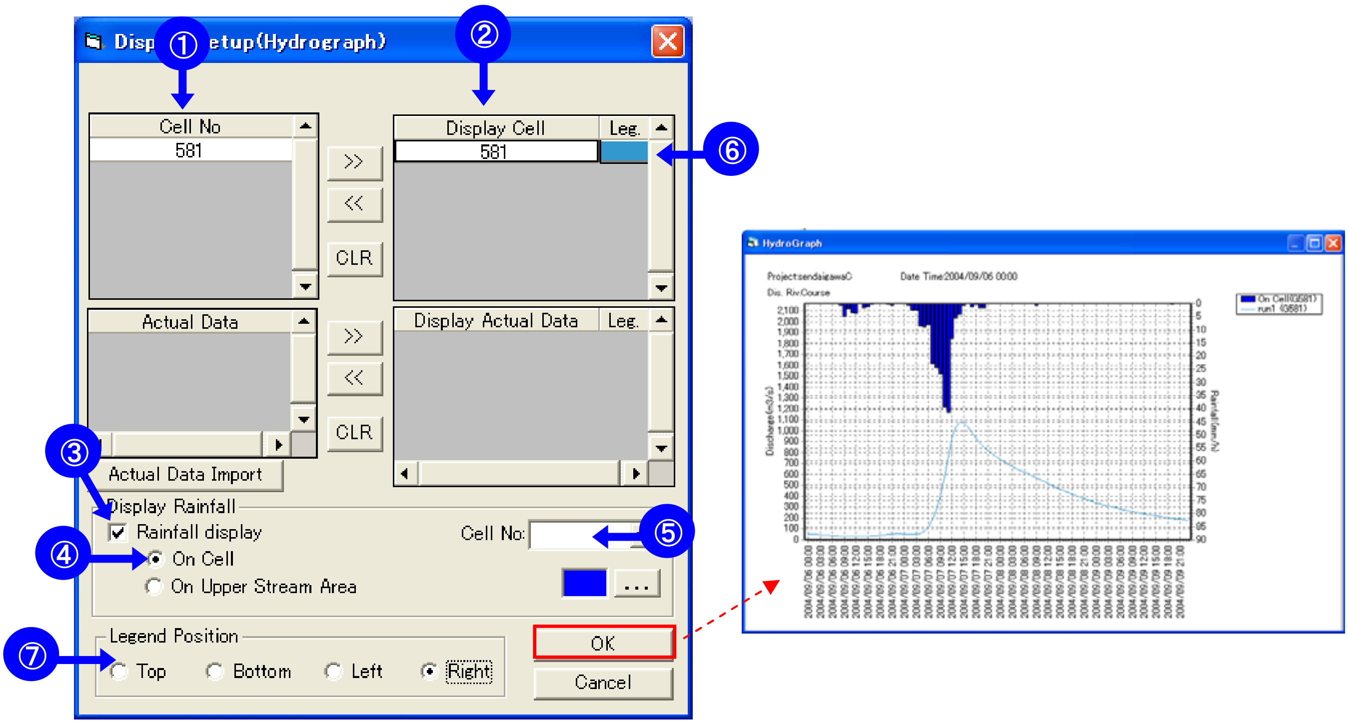


Fig. 10.24 Example of display configuration of hydrograph and hydrograph

① In the “GridNo“ list, the grid being selected currently is displayed. Select the grid where the hydrograph needs to be drawn and add it in “Display Grid“ at ②.

② This is the list of grids actually drawing the hydrograph. Select the grid and click “<<“, the grid can be deleted from the list. In addition, Click “CLR“ if all grids need to be deleted.

③ Tick the box “rainfall display“ if rainfall needs to be displayed.

④ To display the rainfall of the place of “Display Grid“ being selected, tick the “Grid Rainfall box“. To display the upper reach average rainfall from the place of “Display Grid“, tick the “Grid Upper Reach Average Rainfall“ box.

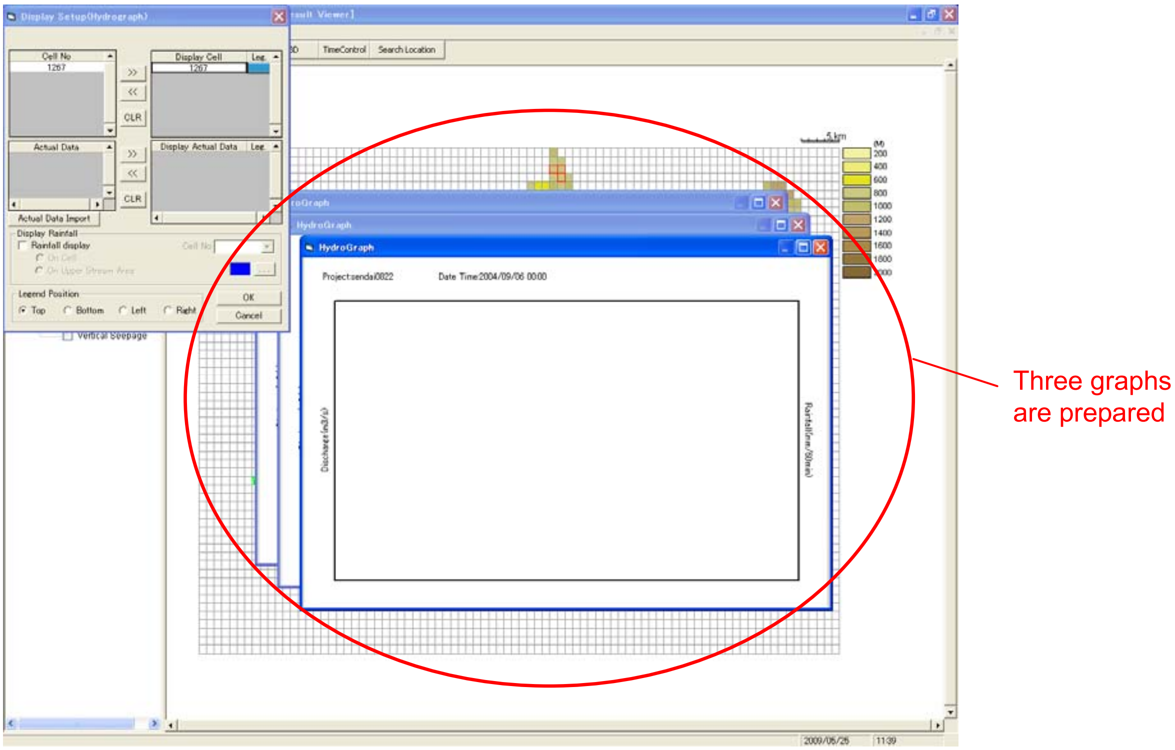
⑤ In the “Display Grid“ list if the “GridNo“ is set as plural, then choose one grid place making “Rainfall Display“ from the list (The rainfall display can only display rainfall of one place).

⑥ Because the “Explanatory Notes“ of the “Display Grid“ is corresponding to the “Calculation Quantity of Flow“, the color of the calculation quantity of flow in the graph will change if the explanatory notes change. Also the “Explanatory Notes“ of “Actual Result Data“ and “Grid Rainfall“ can be configured.

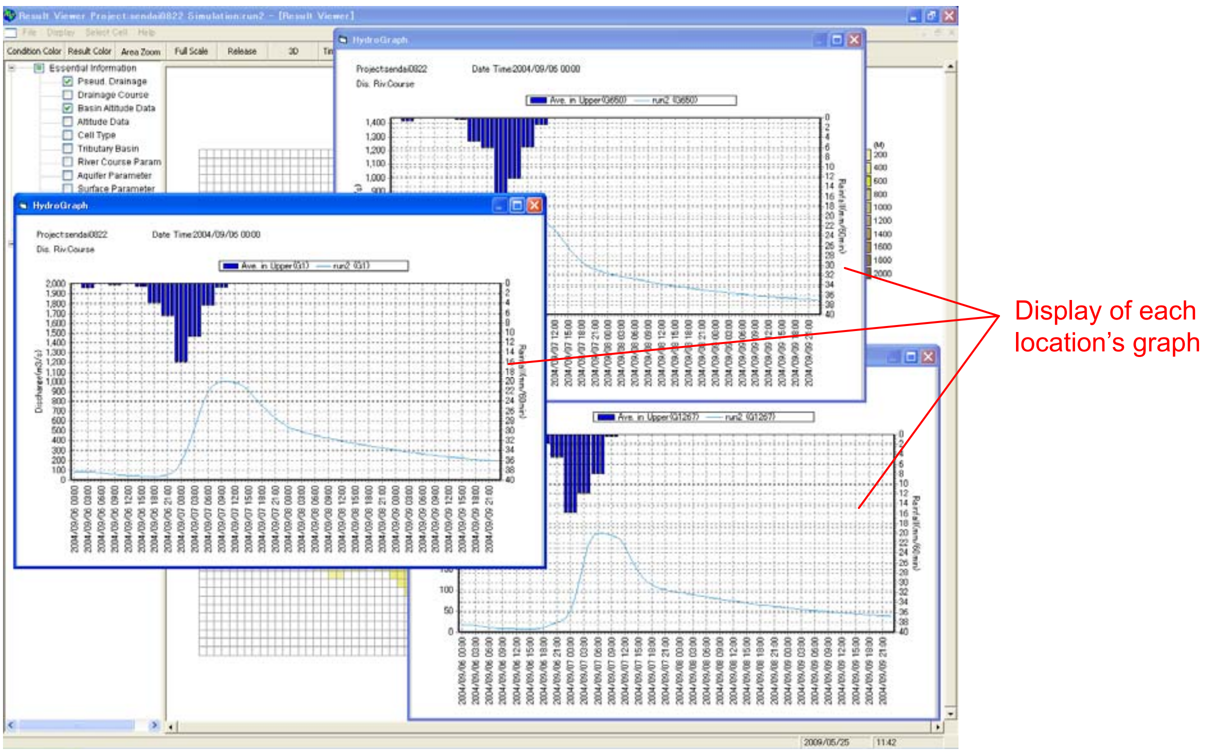
⑦ The display position of legend can be changed by clicking “Top”, “Bottom”, “Left”, and “Right” buttons.

For selecting multiple cells, when clicking the “Select Plural Cell” of “Select Cell”, the hydro-graphs in number of selected cells will be displayed. In addition, when clicking the “Select Plural Cell” of “Select Cell”, the runoff of multiple locations can be displayed in one hydro-graph. However, for rainfall data, only one cell can be selected.

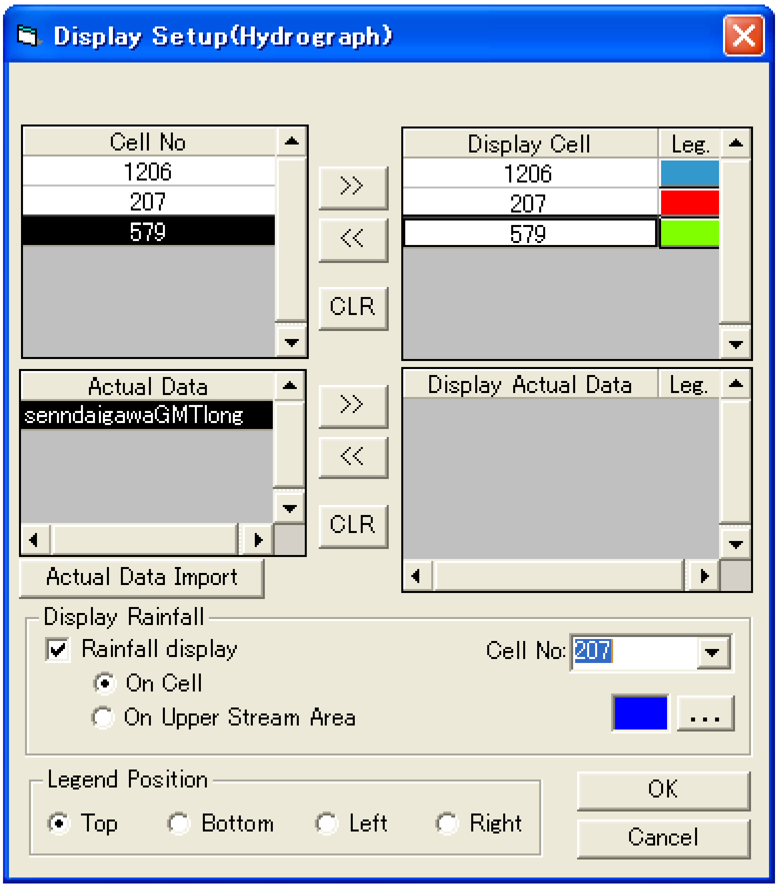
A sample of three locations' cells are selected and implemented



Input the parameter of each location



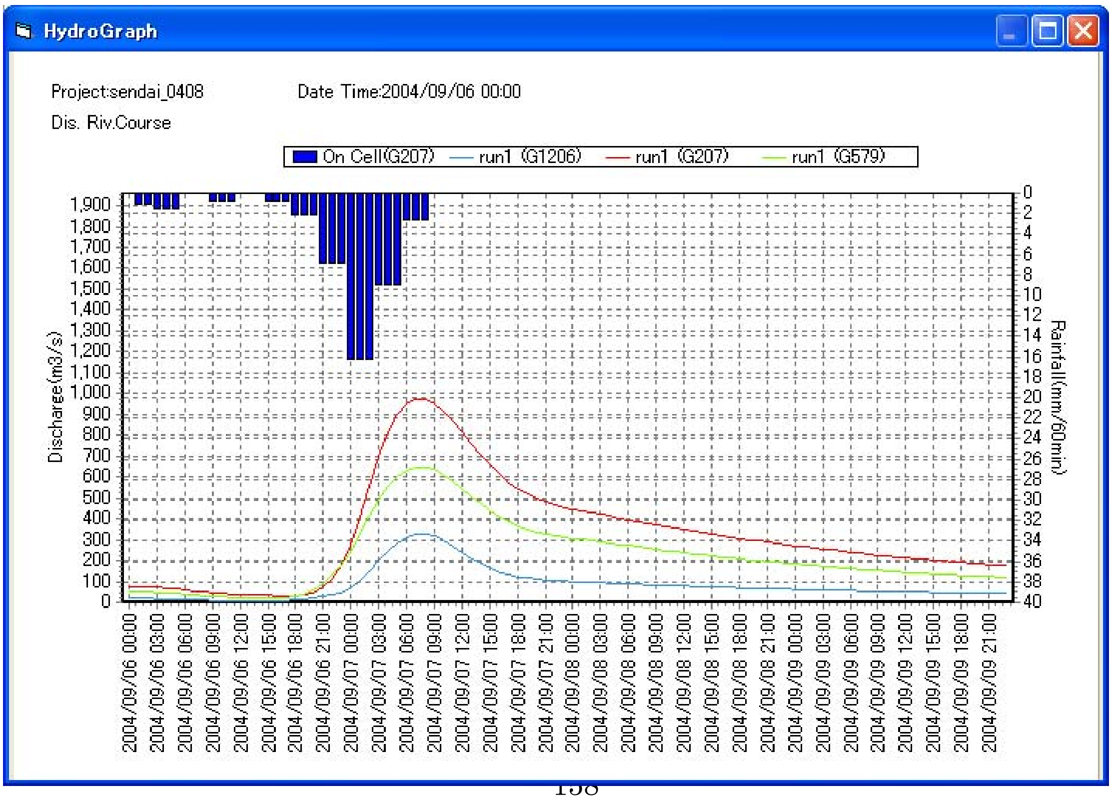
The “Select Cell” is the display of multiple “Select Single Cell”



When three locations’ cells are selected, the name of selected location is displayed.

However, for rainfall data, only one cell can be selected.

A display sample of hydro-graph when three locations are selected.



To display comparison between Actual Result Data and Calculation Quantity of Flow, first it is necessary to perform Actual Result Data import. The Actual Result Data is in CSV form, it needs to be prepared beforehand.

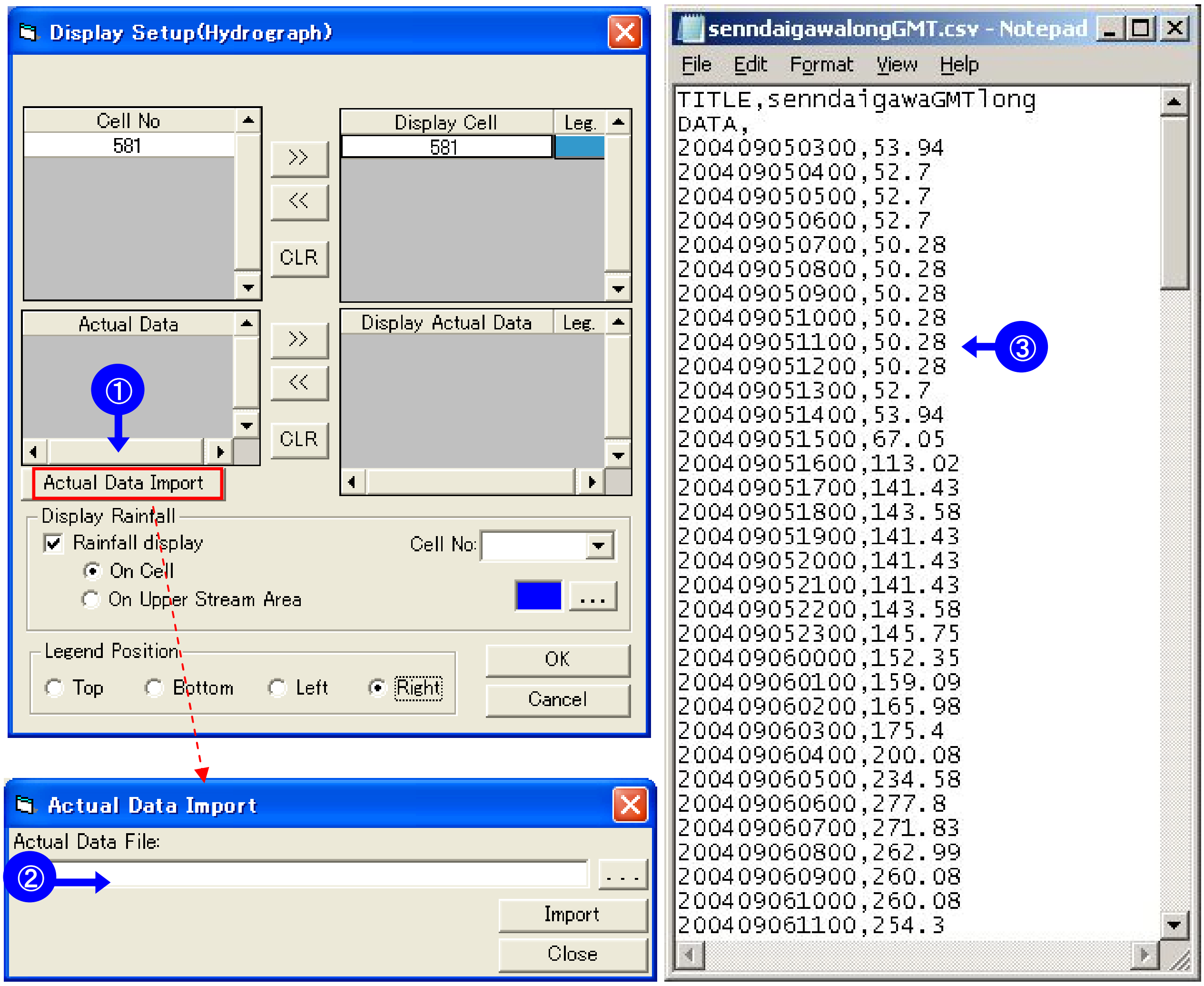


Fig. 10.25 Imports of actual result data

① Click the “Actual Result Data Import” if the actual result data need to be drawn as a hydrograph.

② After the screen of actual result data import is displayed, press the select button and select the data file from any of the folder (The files of actual result data are in the CSV form).

③ As the data of the CSV form shown in the figure above, click 「Import」 at the end, the data will be imported.

A sample for creation method of actual data（data format）

TITLE,senndaigawaGMTlong	Line 1	:TITLE(fixed), Text
DATA,	Line 2	:DATA(fixed),
200409050300,53.94	From Line 3	:YYYYMMDDHHmm, value,
200409050400,52.7		・
200409050500,52.7		・
200409050600,52.7		・
200409050700,50.28	・	
・		
・		
・		
・		
EOD,	The last line: EOD (fixed),	

In addition, right click at the top the hydrograph, “Explanatory Notes Configuration“ and “Display Configuration“ can be selected. By selecting “Display Configuration“, the Display Configuration screen mentioned above can be redisplayed, and the grid need to be make into figures can be selected. By selecting “Explanatory Notes Configuration“, the screen of the explanatory notes configuration can be displayed, and the configuration about hydrograph can be modified.

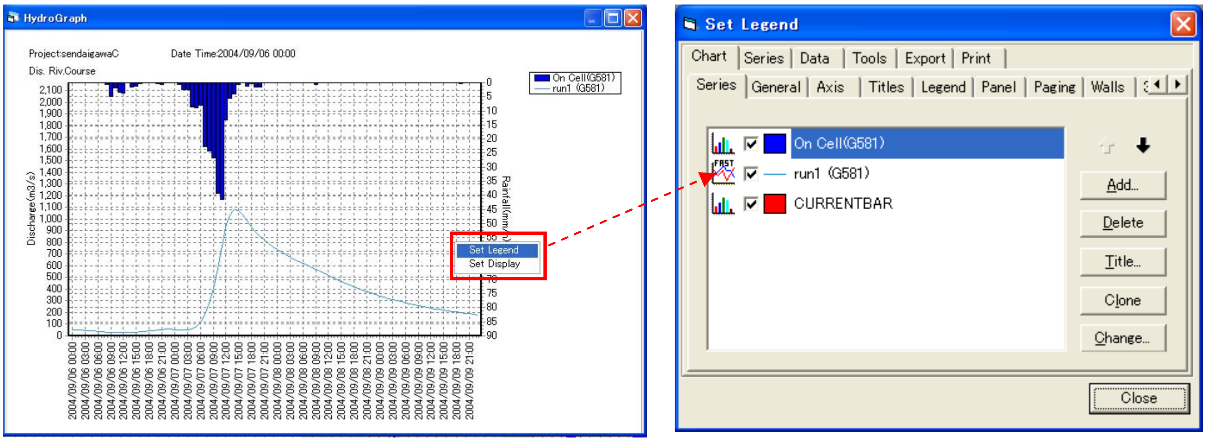


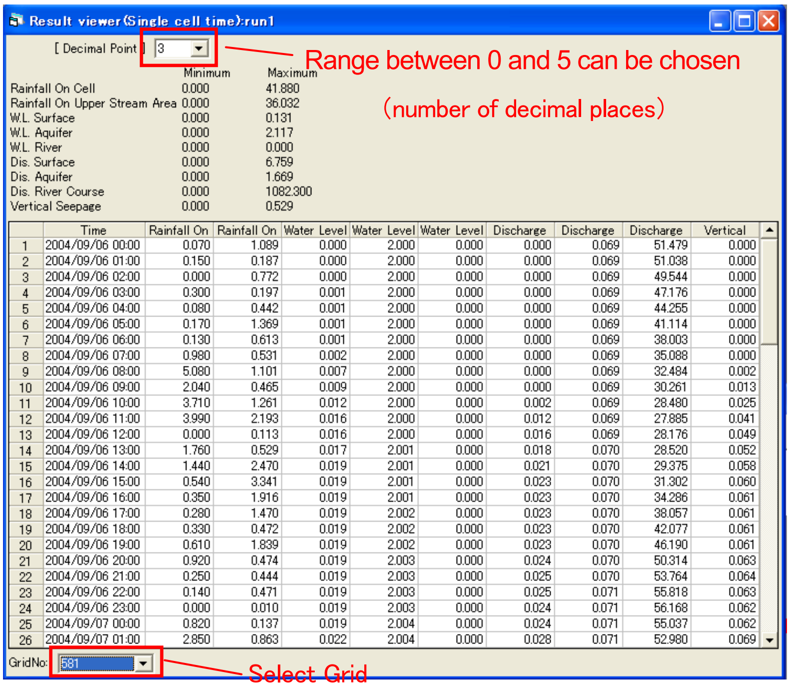
Fig. 10.26 Explanatory notes configuration of hydrograph

Items of setting legends

Item	Content
Chart	Chart information (category)
Series	To set the item series (color)
General	General (empty, preview)
Axis	To set the axis (scale, label, to display / not display)
Titles	To set the title (text)
Legend	To set the legend (display for, to display / not display
Panel	To set the panel (color)
Paging	To set the page
Wall	To set the wall (color)
3D	To set the display of three-dimension
Series	To set the series (style, marker)
Data	To display the data
Tools	To set the tool (option)
Export	To export the file (select by file category)
Print	Print

(4) Result display (Single grid chronological order)

In “Time Series Table(Single Cell) “, , “Rainfall“, “Water Level of surface“, “Water Level of Aquifer“, “Water Level of River“, “Discharge of Surface“, “Discharge of Aquifer」“, “Discharge of River“and“Vatical Seepage“ of the grid place selected can be displayed by the chronological order. In addition, right click above the table, “Save“ and “Print“ can be selected.



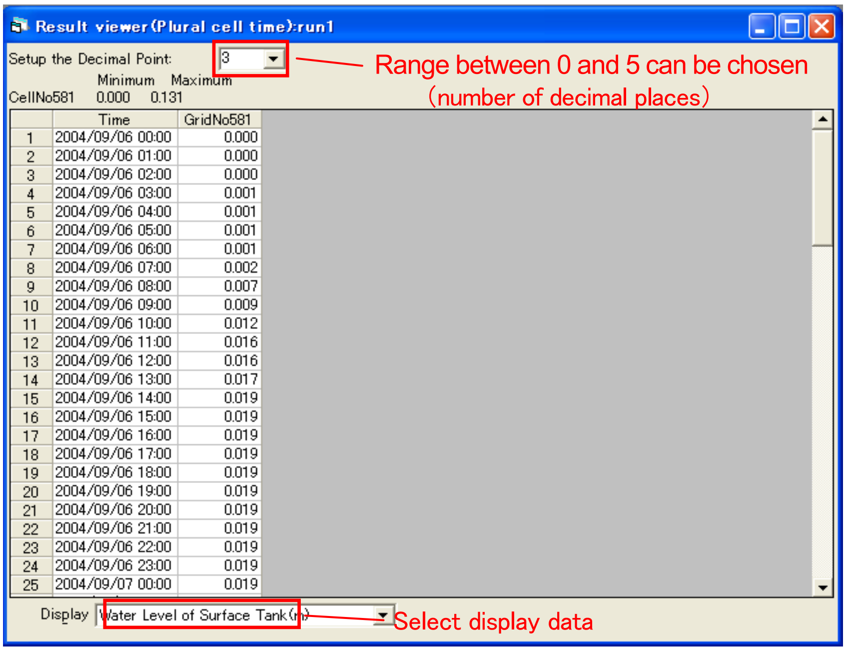
	Minimum	Maximum
Rainfall On Cell	0.000	41.880
Rainfall On Upper Stream Area	0.000	36.032
W.L. Surface	0.000	0.131
W.L. Aquifer	0.000	2.117
W.L. River	0.000	0.000
Dis. Surface	0.000	6.759
Dis. Aquifer	0.000	1.669
Dis. River Course	0.000	1082.300
Vertical Seepage	0.000	0.529

	Time	Rainfall On	Rainfall On	Water Level	Water Level	Water Level	Discharge	Discharge	Discharge	Vertical
1	2004/09/06 00:00	0.070	1.089	0.000	2.000	0.000	0.000	0.069	51.479	0.000
2	2004/09/06 01:00	0.150	0.187	0.000	2.000	0.000	0.000	0.069	51.038	0.000
3	2004/09/06 02:00	0.000	0.772	0.000	2.000	0.000	0.000	0.069	49.544	0.000
4	2004/09/06 03:00	0.300	0.197	0.001	2.000	0.000	0.000	0.069	47.176	0.000
5	2004/09/06 04:00	0.080	0.442	0.001	2.000	0.000	0.000	0.069	44.255	0.000
6	2004/09/06 05:00	0.170	1.369	0.001	2.000	0.000	0.000	0.069	41.114	0.000
7	2004/09/06 06:00	0.130	0.613	0.001	2.000	0.000	0.000	0.069	38.003	0.000
8	2004/09/06 07:00	0.980	0.531	0.002	2.000	0.000	0.000	0.069	35.088	0.000
9	2004/09/06 08:00	5.080	1.101	0.007	2.000	0.000	0.000	0.069	32.484	0.002
10	2004/09/06 09:00	2.040	0.465	0.009	2.000	0.000	0.000	0.069	30.261	0.013
11	2004/09/06 10:00	3.710	1.261	0.012	2.000	0.000	0.002	0.069	28.480	0.025
12	2004/09/06 11:00	3.990	2.193	0.016	2.000	0.000	0.012	0.069	27.885	0.041
13	2004/09/06 12:00	0.000	0.113	0.016	2.000	0.000	0.016	0.069	28.176	0.049
14	2004/09/06 13:00	1.760	0.529	0.017	2.001	0.000	0.018	0.070	28.520	0.052
15	2004/09/06 14:00	1.440	2.470	0.019	2.001	0.000	0.021	0.070	29.375	0.058
16	2004/09/06 15:00	0.540	3.341	0.019	2.001	0.000	0.023	0.070	31.302	0.060
17	2004/09/06 16:00	0.350	1.916	0.019	2.001	0.000	0.023	0.070	34.286	0.061
18	2004/09/06 17:00	0.280	1.470	0.019	2.002	0.000	0.023	0.070	38.057	0.061
19	2004/09/06 18:00	0.330	0.472	0.019	2.002	0.000	0.023	0.070	42.077	0.061
20	2004/09/06 19:00	0.610	1.839	0.019	2.002	0.000	0.023	0.070	46.190	0.061
21	2004/09/06 20:00	0.920	0.474	0.019	2.003	0.000	0.024	0.070	50.314	0.063
22	2004/09/06 21:00	0.250	0.444	0.019	2.003	0.000	0.025	0.070	53.764	0.064
23	2004/09/06 22:00	0.140	0.471	0.019	2.003	0.000	0.025	0.071	55.818	0.063
24	2004/09/06 23:00	0.000	0.010	0.019	2.003	0.000	0.024	0.071	56.168	0.062
25	2004/09/07 00:00	0.820	0.137	0.019	2.004	0.000	0.024	0.071	55.037	0.062
26	2004/09/07 01:00	2.850	0.863	0.022	2.004	0.000	0.028	0.071	52.980	0.069

Fig. 10.27 Result display (Single grid chronological order)

(5) Result display (Plural grid chronological order)

In “Time Series Table(Plural Cell) “, “Rainfall“, “Water Level of surface“, “Water Level of Aquifer“, “Water Level of River“, “Discharge of Surface“, “Discharge of Aquifer」“, “Discharge of River“and“Vatical Seepage“of the plural grid can be displayed by the chronological order. In addition, right click the top of the table, “Save“ and “Print“ can be selected.



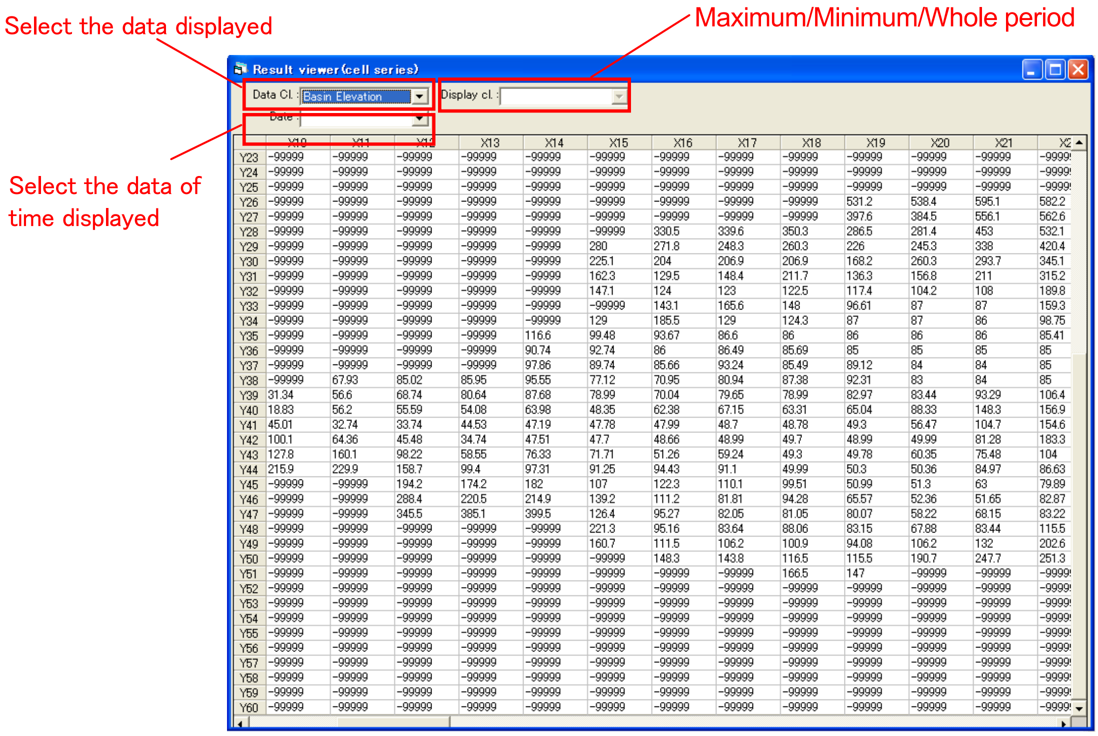
	Minimum	Maximum
CellNo581	0.000	0.131

	Time	GridNo581
1	2004/09/06 00:00	0.000
2	2004/09/06 01:00	0.000
3	2004/09/06 02:00	0.000
4	2004/09/06 03:00	0.001
5	2004/09/06 04:00	0.001
6	2004/09/06 05:00	0.001
7	2004/09/06 06:00	0.001
8	2004/09/06 07:00	0.002
9	2004/09/06 08:00	0.007
10	2004/09/06 09:00	0.009
11	2004/09/06 10:00	0.012
12	2004/09/06 11:00	0.016
13	2004/09/06 12:00	0.016
14	2004/09/06 13:00	0.017
15	2004/09/06 14:00	0.019
16	2004/09/06 15:00	0.019
17	2004/09/06 16:00	0.019
18	2004/09/06 17:00	0.019
19	2004/09/06 18:00	0.019
20	2004/09/06 19:00	0.019
21	2004/09/06 20:00	0.019
22	2004/09/06 21:00	0.019
23	2004/09/06 22:00	0.019
24	2004/09/06 23:00	0.019
25	2004/09/07 00:00	0.019

Fig. 10.28 Result display (Plural grid chronological order)

(6) Result display (All grid plan)

In “Result Display“, all data of “Essential Information“ and “Simulation Result“ can be displayed. In addition, right click the top of the table, “Save“ and “Print“ can be selected.

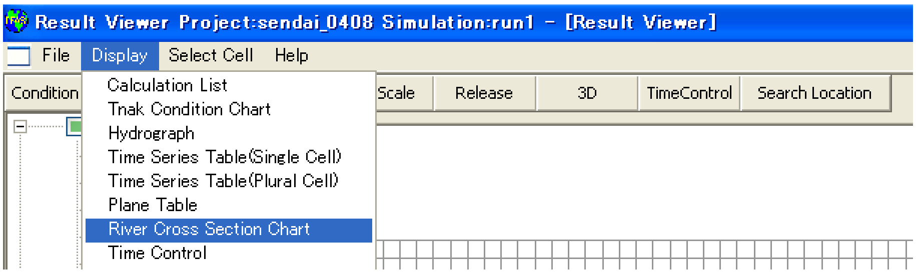


	X10	X11	X12	X13	X14	X15	X16	X17	X18	X19	X20	X21	X2
Y23	-99999	-99999	-99999	-99999	-99999	-99999	-99999	-99999	-99999	-99999	-99999	-99999	-9999
Y24	-99999	-99999	-99999	-99999	-99999	-99999	-99999	-99999	-99999	-99999	-99999	-99999	-9999
Y25	-99999	-99999	-99999	-99999	-99999	-99999	-99999	-99999	-99999	-99999	-99999	-99999	-9999
Y26	-99999	-99999	-99999	-99999	-99999	-99999	-99999	-99999	-99999	531.2	538.4	595.1	582.2
Y27	-99999	-99999	-99999	-99999	-99999	-99999	-99999	-99999	-99999	397.6	384.5	556.1	562.6
Y28	-99999	-99999	-99999	-99999	-99999	-99999	330.5	339.6	350.3	286.5	281.4	453	532.1
Y29	-99999	-99999	-99999	-99999	-99999	280	271.8	248.3	260.3	226	245.3	338	420.4
Y30	-99999	-99999	-99999	-99999	-99999	225.1	204	206.9	206.9	168.2	260.3	293.7	345.1
Y31	-99999	-99999	-99999	-99999	-99999	162.3	129.5	148.4	211.7	136.3	156.8	211	315.2
Y32	-99999	-99999	-99999	-99999	-99999	147.1	124	123	122.5	117.4	104.2	108	189.8
Y33	-99999	-99999	-99999	-99999	-99999	-99999	143.1	165.6	148	96.61	87	87	159.3
Y34	-99999	-99999	-99999	-99999	-99999	129	185.5	129	124.3	87	87	86	98.75
Y35	-99999	-99999	-99999	-99999	116.6	99.48	93.67	86.6	86	86	86	86	85.41
Y36	-99999	-99999	-99999	-99999	90.74	92.74	86	86.49	85.69	85	85	85	85
Y37	-99999	-99999	-99999	-99999	97.86	89.74	85.66	93.24	85.49	89.12	84	84	85
Y38	-99999	67.93	85.02	85.95	95.55	77.12	70.95	80.94	87.38	92.31	83	84	85
Y39	31.34	56.6	68.74	80.64	87.68	78.99	70.04	79.65	78.99	82.97	83.44	93.29	106.4
Y40	18.83	56.2	55.59	54.08	63.98	48.35	62.38	67.15	63.31	65.04	88.33	148.3	156.9
Y41	45.01	32.74	33.74	44.53	47.19	47.78	47.99	48.7	48.78	49.3	56.47	104.7	154.6
Y42	100.1	64.36	45.48	34.74	47.51	47.7	48.66	48.99	49.7	48.99	49.99	81.28	183.3
Y43	127.8	160.1	98.22	58.55	76.33	71.71	51.26	59.24	49.3	49.78	60.35	75.48	104
Y44	215.9	229.9	158.7	99.4	97.31	91.25	94.43	91.1	49.99	50.3	50.36	84.97	86.63
Y45	-99999	-99999	194.2	174.2	182	107	122.3	110.1	99.51	50.99	51.3	63	79.89
Y46	-99999	-99999	288.4	220.5	214.9	139.2	111.2	81.81	94.28	65.57	52.36	51.65	82.87
Y47	-99999	-99999	345.5	385.1	399.5	126.4	95.27	82.05	81.05	80.07	58.22	68.15	83.22
Y48	-99999	-99999	-99999	-99999	-99999	221.3	95.16	83.64	88.06	83.15	67.88	83.44	115.5
Y49	-99999	-99999	-99999	-99999	-99999	160.7	111.5	106.2	100.9	94.08	106.2	132	202.6
Y50	-99999	-99999	-99999	-99999	-99999	-99999	148.3	143.8	116.5	115.5	190.7	247.7	251.3
Y51	-99999	-99999	-99999	-99999	-99999	-99999	-99999	-99999	166.5	147	-99999	-99999	-9999
Y52	-99999	-99999	-99999	-99999	-99999	-99999	-99999	-99999	-99999	-99999	-99999	-99999	-9999
Y53	-99999	-99999	-99999	-99999	-99999	-99999	-99999	-99999	-99999	-99999	-99999	-99999	-9999
Y54	-99999	-99999	-99999	-99999	-99999	-99999	-99999	-99999	-99999	-99999	-99999	-99999	-9999
Y55	-99999	-99999	-99999	-99999	-99999	-99999	-99999	-99999	-99999	-99999	-99999	-99999	-9999
Y56	-99999	-99999	-99999	-99999	-99999	-99999	-99999	-99999	-99999	-99999	-99999	-99999	-9999
Y57	-99999	-99999	-99999	-99999	-99999	-99999	-99999	-99999	-99999	-99999	-99999	-99999	-9999
Y58	-99999	-99999	-99999	-99999	-99999	-99999	-99999	-99999	-99999	-99999	-99999	-99999	-9999
Y59	-99999	-99999	-99999	-99999	-99999	-99999	-99999	-99999	-99999	-99999	-99999	-99999	-9999
Y60	-99999	-99999	-99999	-99999	-99999	-99999	-99999	-99999	-99999	-99999	-99999	-99999	-9999

Fig. 10.29 Result display (All grid plan)

(7) Cross section figure

In “Cross Section chart“, the water course water level and the cross section figure of the river course grid can be stacked and displayed. In addition, animation can be displayed by using “Time Control” together.



Click the “River Cross Section Chart” option from the “Tool” menu or from the pop-up menu as shown to display file open dialog.

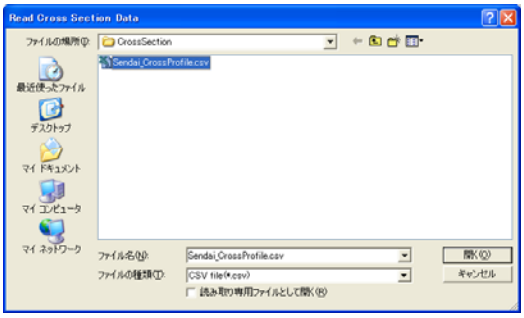
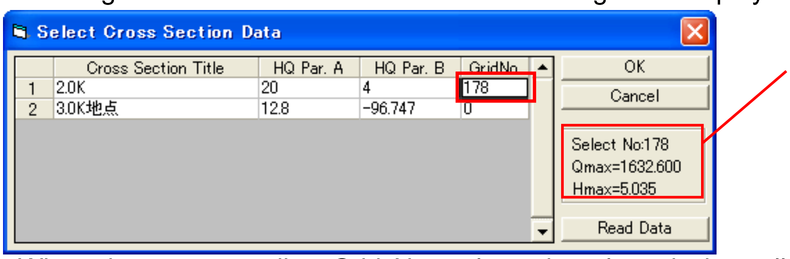
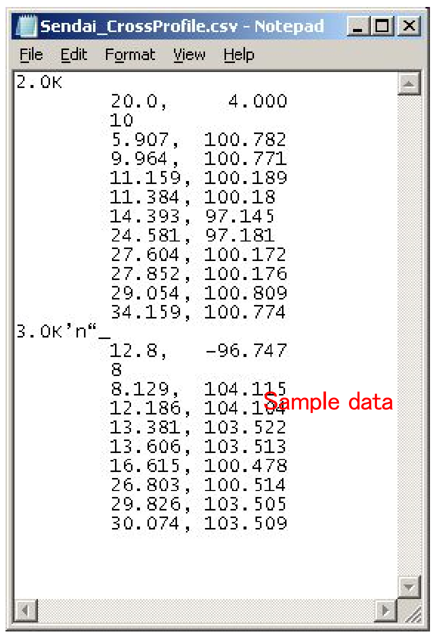


Fig. 10.30 Function of cross section figure screen

Reading of the selection of the file for the crossing chart display is done.





When the corresponding Grid No. column is selected, the cell number been selected by the cell is input. “OK" When the button is clicked, the cell number is registered. “Cancel" The dialog is shut without registering when the button is clicked.

An additional reading of the section data can be done with the Read button.

Here, the parameters a and b for H-Q equation can be changed

$$H = \sqrt{a \div Q} - b$$

Water depth at the max flow of calculation result is displayed.

If there is no appropriate data to be displayed in the list, by “Cross Section Data Reading“, files can be read from any of the folder (The files of the cross section figure data are in CSV form). Select the data file which needs to be displayed and click “Open“, the list of “Cross section data selection“ can be added.

Creation sample of cross section data (CSV file: coma delimited text data)

Line 1: Label（place name etc.）	Location name, any text distance mark
Line 2: coefficient a, b	Coefficient of H-Q equation
Line 3: number of cross sections	Number of cross section's coordinatitions (intergal value）
Line 4: X Coordinates (1), Y Coordinates (1) Line 5: X Coordinates (2), Y Coordinates (2) Line 6: X Coordinates (2), Y Coordinates (2) . . . Line n+3: X Coordinates (n), Y Coordinates (n)	Grid data of cross section（number of lines = number of grids） X Coordinates (horizontal distance), Y Coordinates (elevation)

Notes) the system repeats the data in same style to create multiple cross sections

Right click on the screen. The menu about cross section figure display will appear. In "Display Configuration", "Cross Section Figure Configuration", "Axial Presence", "Grid Presence" and "Scale Presence" can be configured.

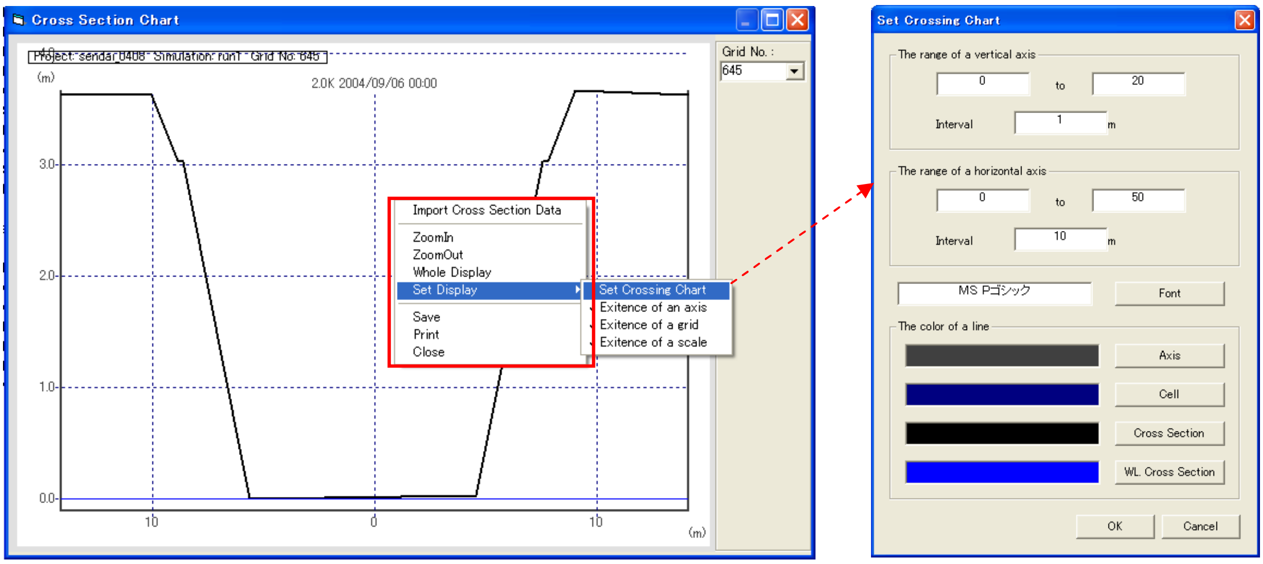


Fig.10.32　Feature of cross section graph

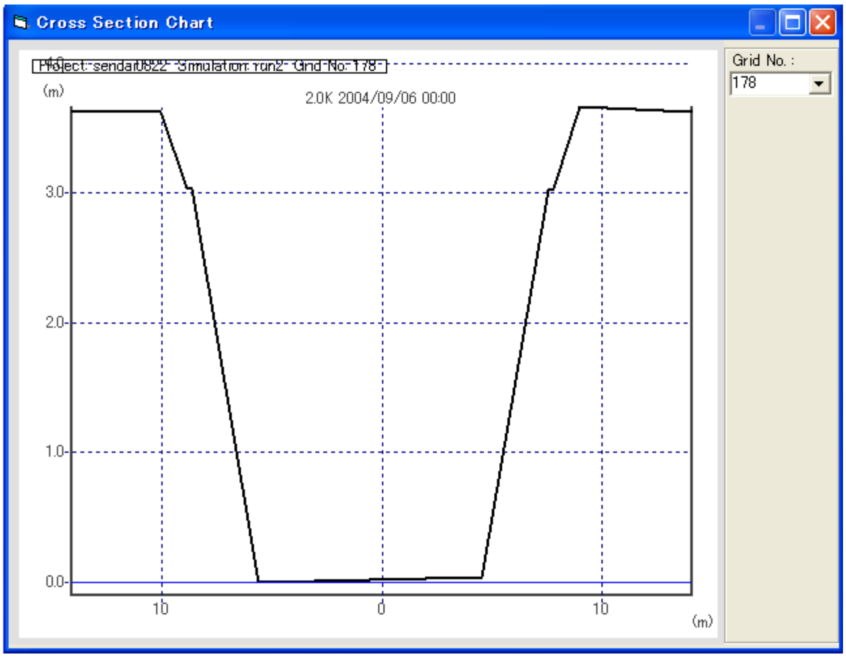


Fig.10.33 Display sample of cross section

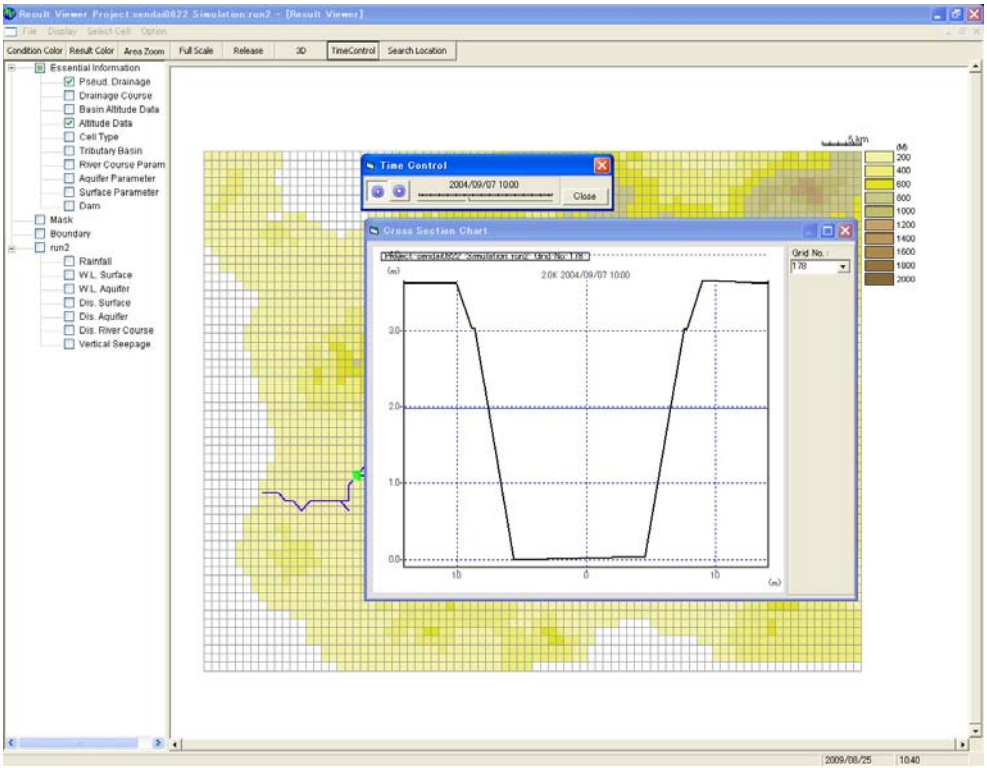
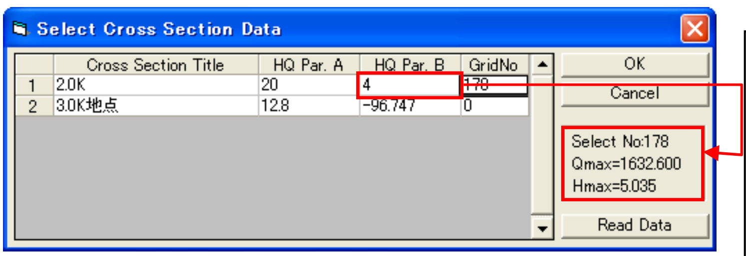


Fig.10.34 Animation display of cross section



The value of water table changes with the initial value, which is determined by B value of H-Q equation.
Qmax:max flow of calculated result (m^3/s)
Hmax: calculated water table by H-Q equation

Fig.10.35 Display of setting water table

10.6 Window layout/entire window layout

If the recurring calculations of the flood results are being performed while carrying out the repeating calculations which change the parameters and rainfall, every time a calculation is carried out the grid calculation results and superimposed hydrograph display performance will be very poor. In this kind of situation, the “window layout” function, which saves the display window for the last session, is useful.

“Save Window Layout” can record the currently displayed window state, and “Read Window Layout” can display the same window's state again.

The window layout function has the two functions “Save Window Layout” which records every grid, and “Save All Window Layouts” which records all window states shown in simulation displays, and the saved window layout can restore the layout from each menu read.

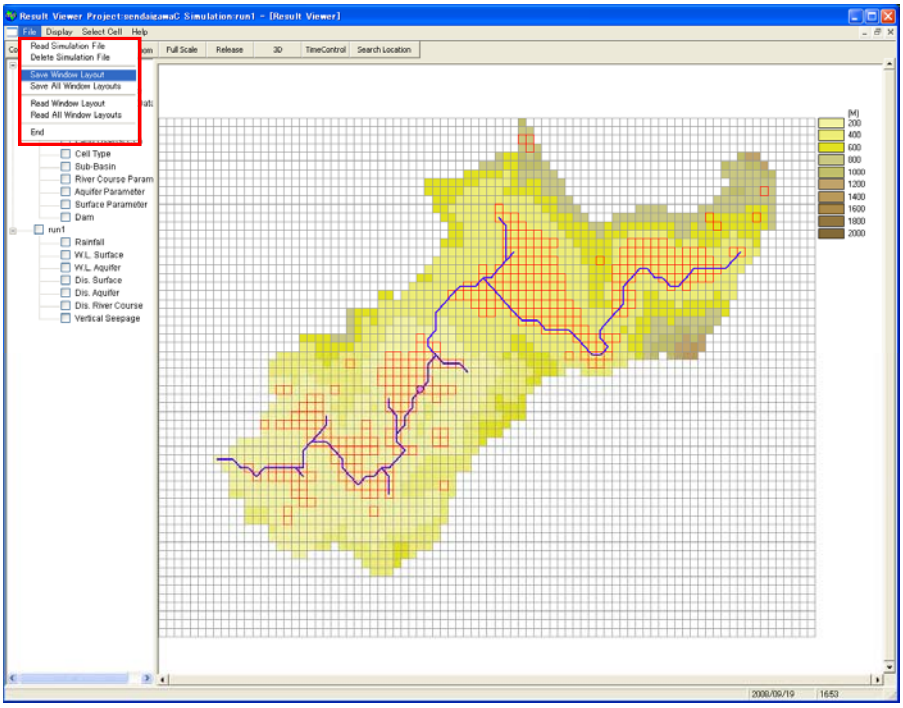


Fig.10.36 Window layout menu

When the “Save Window Layout” menu is selected, the save layout confirmation screen will be displayed. Click the “OK” button and the recently displayed grid and calculation display entries, as well as the window size and position will be recorded.

When “Read Window Layout” is selected from the menu, the layout information management window and the recorded grid summary will be displayed. Select the grid to be displayed, and when the “OK” button is clicked, the recorded layout will be restored.

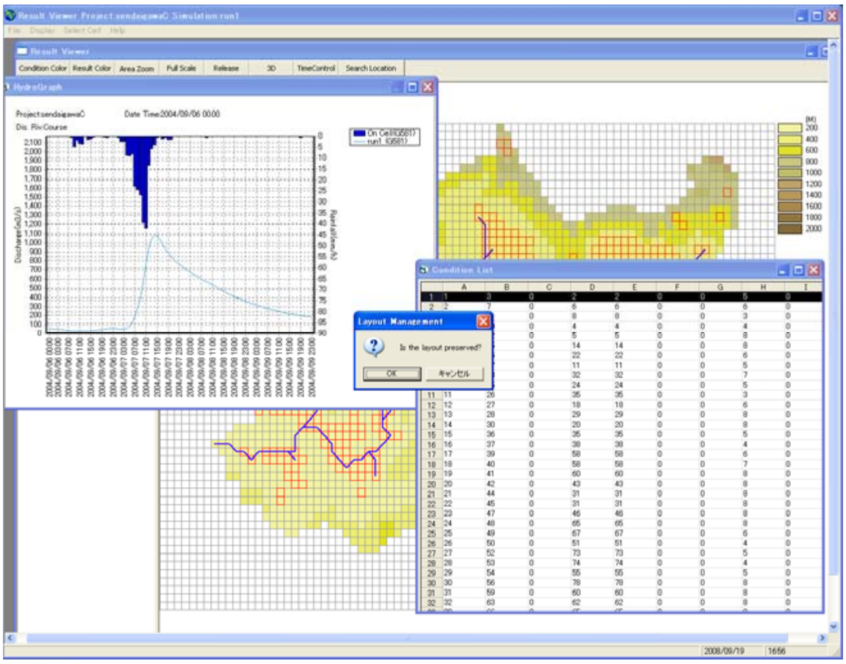


Fig. 10.37 Saving and reading the window layout

When “Save all window layouts” is selected from the menu, the save all window layouts confirmation screen will be displayed. Click the “OK” button and all the simulation grids, results windows, entry types, locations and sizes being displayed, will be recorded. Select “Read All Window Layouts” from the menu and the recorded layouts can be restored.

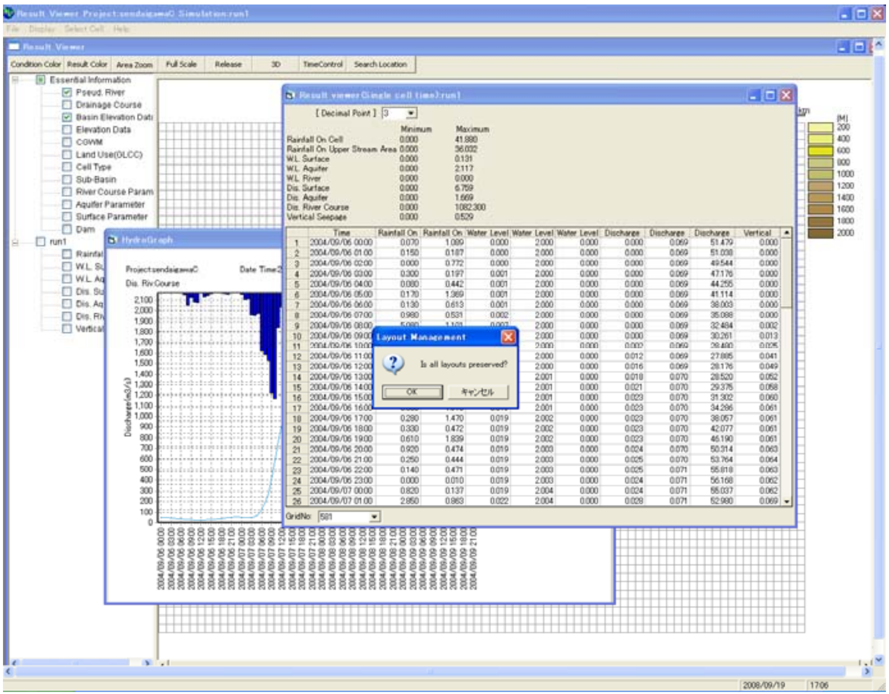


Fig. 10.38 Saving all window layouts

11.Export of general geographical information system (KML Exporter)

Calculation result (river flow) and calculation parameter (rainfall) can be displayed on Google Earth after exported by the KML file. Temporal data of river flow and rainfall can be displayed on Google Earth by animation in each's time series.

User can set the maximum and minimum values of each exported item, and display them as a gradation from minimum to maximum values. User can also select the resolution for exported image file. The higher resolution value, the clearer image; however, if the size of image file is too big, the animation display on Google Earth may become very slow.

11.1 Outline of the KML file

KML is a file format used to display geographic data in an Earth browser such as Google Earth. It uses a tag-based structure with nested elements and attributes and is based on the XML standard.

In the IFAS, calculation condition and result data file in format of ESRIASCII (plane distribution) are created as an image file in format of .png. The spatial and temporal information of plane are displayed in .xml format. In addition, it records the legend and logo, and the river basin boundary as line segment.

The addressed display image files above have to be stored to a same folder under the KML file. This folder will be compressed as a zip file, if the extension of zip file is set as KMZ, we call it KMZ file. The KMZ file is also such a file format used in Google Earth, one KMZ file represents the same content as KML file.

A sample of KML file

11.2 Exporting items

The items that can be export as KML file are listed as follows.

- Rainfall
- W.L.Surface
- W.L.Aquifer
- Dis.Surface
- Dis.Aquifer
- Dis.River Couese
- Vertical Seepage

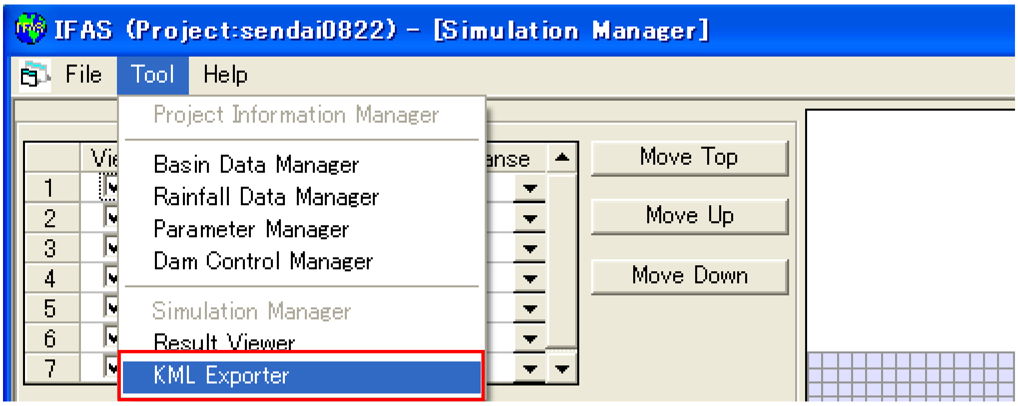
11.3 Setting items

The items that can be set when exporting KML file are listed as follows.

- The maximum and minimum value of export items
- The resolution of export image files
- Whether to display the legend
- Whether to display the ICHARM logo

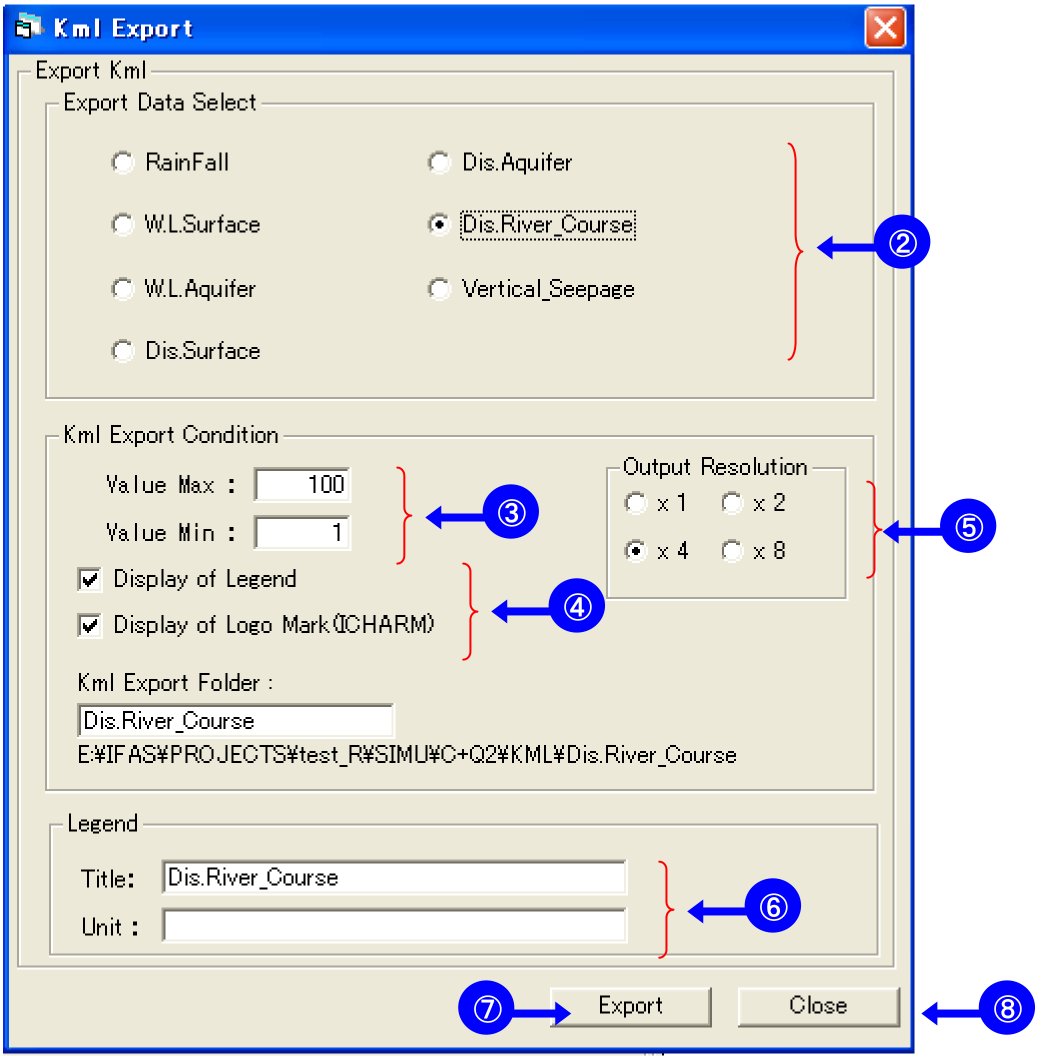
11.4 Export method

(1) Operation



① Select the “ExportKML” menu from “Tool”.

The dialog KML import will be displayed.



② Select the export project.

③ Set the maximum and minimum value (the minimum value is colorless and cannot be displayed on Google Earth)

User may set an appropriate value here.

The set minimum value is displayed colorlessly.

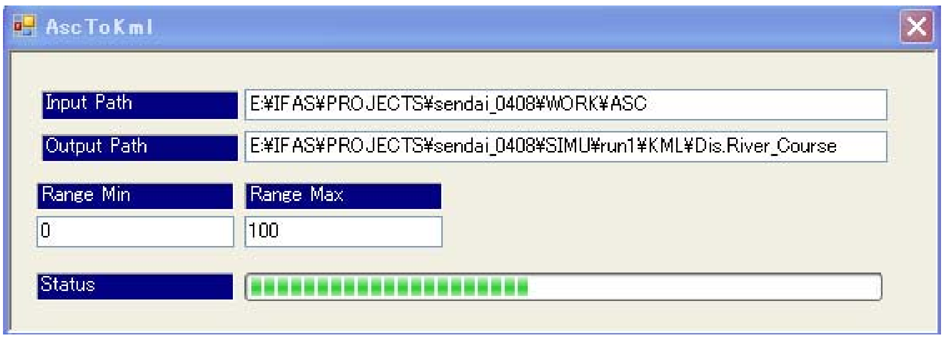
④ Select whether or not to display the legend and logo mark.

⑤ Select the resolution of export.

⑥ The title and the unit are input.

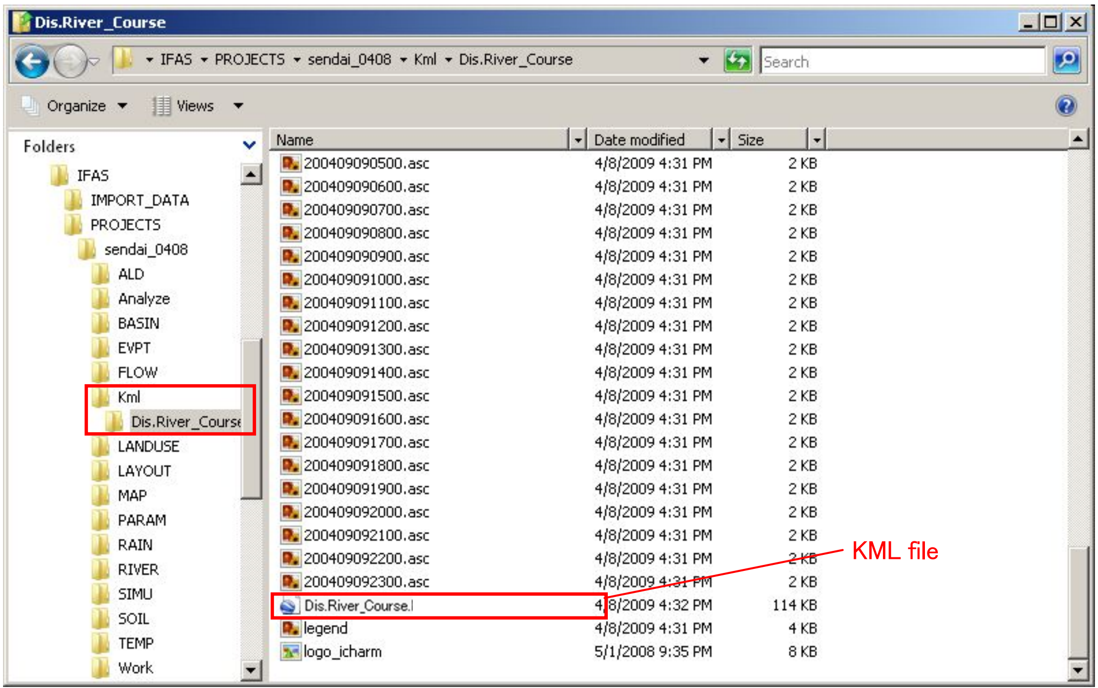
⑦ Click the “Export” button.

A sample of exporting KML file

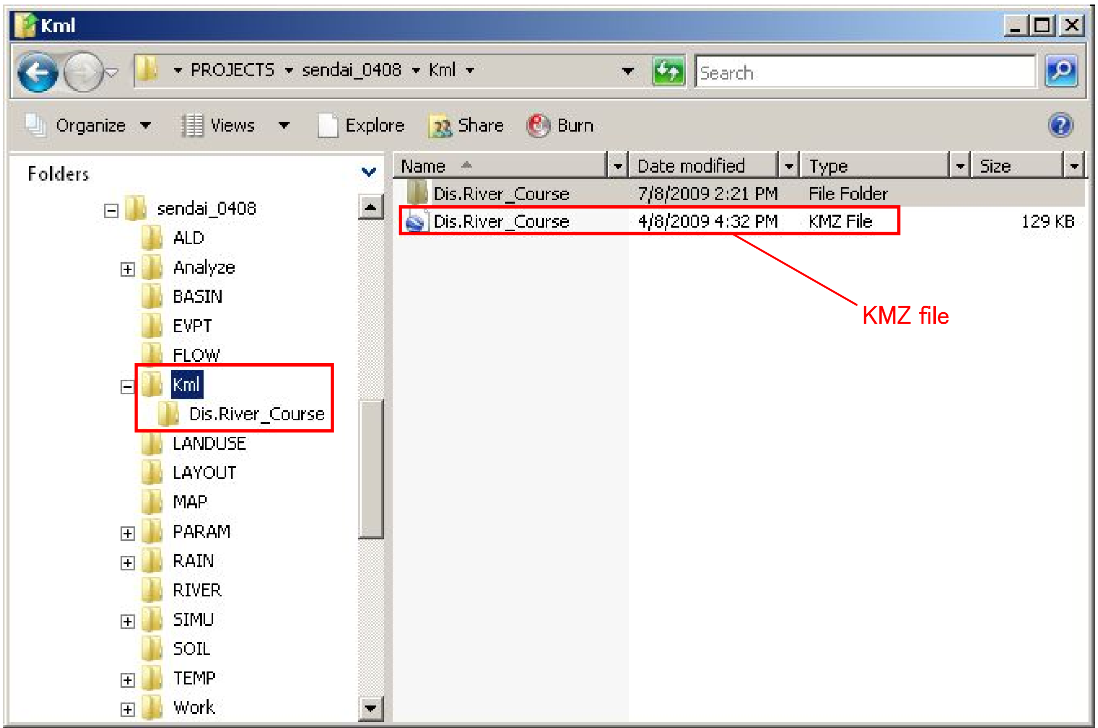


⑧ Click the “Close” button to close the dialog.

Export folder of KMZ file



Export folder of KMZ file

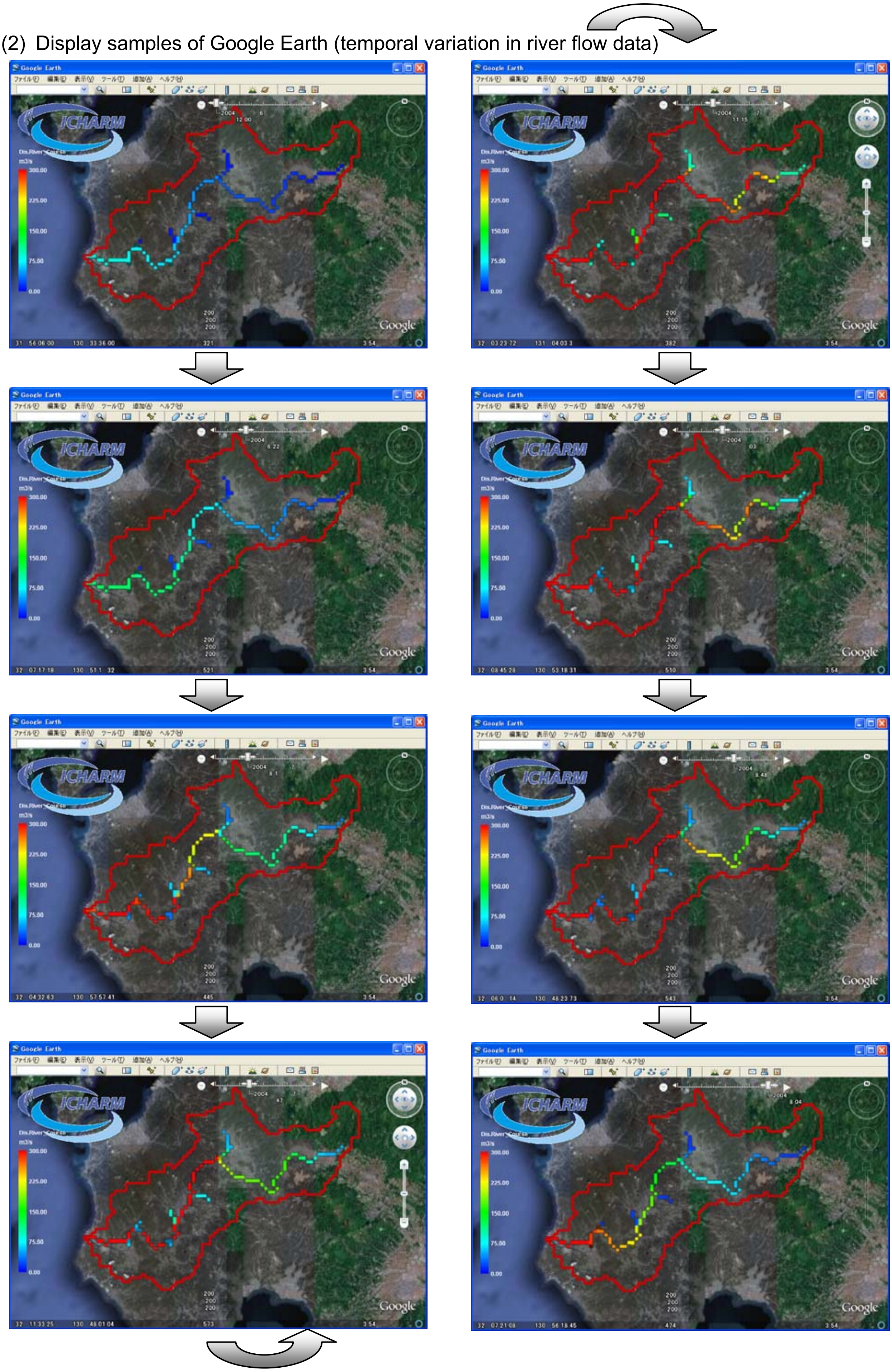


The KML file (Output item name.kml) is saved to "\PROJECTS\PROJECT_NAME\SIMU\SIMULATION NAME\KML\EXPORT_PROJECT_NAME" folder and KMZ file (EXPORT_PROJECT_NAME.KMZ) is saved to "\PROJECTS\PROJECT NAME\SIMU\SIMULATION NAME\KML" folder, respectively.

Double click the KLM, KMZ files or open them from Google Earth, the export results will be displayed on Google Earth.

However, the Google Earth has to be installed firstly.

(2) Display samples of Google Earth (temporal variation in river flow data)



References

Information1, File used with IFAS

(1) File creation time

The file creation time (when create each file during operating) is shown in Fig.1 (1) - Fig.1 (3).
The file read time is shown in Fig.2 (1) - Fig.2 (2).

Fig.1 (1)　File creation time

form	control	input files/folder	file	database	note
dlgProjectFolder	OKButton		＊(File name)		
Project Manager (dlgNewProject)	OKButton		1.LayOut 2. Work-Backup－ALD、BASIN、LANDUSE、MAP、SOIL、WORLDCLIM、projectDB01.MDB 3. DrawLayer.cntl 4. ProjectDB01.MDB 5. *.ifasproj		
Project Manager (dlgProjectConditional)	OKCancelButton		1. Import.ini		
Project Manager (dlgDataImport)	ImportButtom	Hydro1k/GOTOP30	1. Work-ALD-ALD.Asc 2. ALD-ALD.ASC	DL_LayerControl & DL_ALD	frmProjectInfo-SSTab1-Target E..L.
		CGWM/UNEP/PROFDEP/ SOILWATER	1. Work-SOIL-soil1.Asc 2. SOIL-soil1.ASC	DL_LayerControl & DL_SOIL1	frmProjectInfo-SSTab1-Soil,Geoligy.
		GLcc	1. Work-LANDUSE-LAND.Asc 2. LANDUSE-LAND.Asc	DL_LayerControl & DL_LANDUSE	frmProjectInfo-SSTab1-Land Use
	CancelButton				
Project Manager (frmProjectInfo)	cmdSave		1. Work-Backup－ALD-ImportData.Log 2. ALD-ImportData.Log/SOIL-ImportData.Log /LANDUSE-ImportData.Log		
	Command4				start dlgDataImport
Main Menu (frmMain)	mnuToolsCretaeBasin		1. BASIN 2. FLOW 3. RIVER 4. TEMP		
Basin Data Manager (frmMap)	ToggleButton2(0)	ALD.ASC	1. TEMP-BASIN-BASIN.asc、Flw.asc、SAGARIVER.asc、SUBBASINS.asc		
	ToggleButton2(1)	basin.asc	1. BASIN-BASIN.asc 2. TEMP-BASIN-Result.txt		
Basin Data Manager (frmCreateBasin)	ToggleButton2(0)		1. Analyze-In、OUT-GTANK、Gwin、RTANK、RVin、RVKin、SF2GW、SFin、STANK 2. DB-TASK3.MDB 3. Work-BASIN、FLOW、OUT、RAIN、RIVER、RIVER2、UND、UNI	DL_LayerControl & DL_BASINALD	start　frmMap v
	ToggleButton2(1)	BasicBoundary		DL_LayerControl & DL_BASINBORDER	
	ToggleButton2(2)	basin.asc	1. Work-Backup-DB-TASK3.MDB 2. BASIN-CELLID.ASC 3. FLOW- CalcOrder.csv、CellArea.csv、CellID.csv、CellType.csv、EDITEDALD.ASC、EditedALD.csv、 FLOW.ASC、FlowDirection.csv、GWto.csv、InflowArea8.csv、InflowCells.csv、RSlop.csv、RVKto.csv、RVto.csv、SFto.csv、SSlop.csv、Termnus.csv 4. RIVER-CCELLS.ASC、CELLTYPE.ASC、FLOW.asc、FLOW_1.asc、FLOWV.asc	DL_LayerControl & DL_FLOW DL_LayerControl & DL_FLOW1	Pseudoriver course making
	ToggleButton2(4)	RIVER\CCELLS.asc and FLOW\FLOW.asc	1. RIVER-FLW.csv、RIV.csv、SUBBASIN.asc、SUBBASIN.csv	DL_LayerControl & DL_SUBBASIN	Display of River course・Sub-Basin
	Command7				Update Import.ini

Fig.1 (2)　File creation time

form	control	input files/folder	file	database	note
Basin Data Manager (frmCreateBasin)	cmdSave		1. Work-Backup-FLOW- CalcOrder.csv、CellArea.csv、CellID.csv、CellType.csv、EDITEDALD.ASC、EditedALD.csv、 FLOW.ASC、FlowDirection.csv、GWto.csv、InflowArea8.csv、InflowCells.csv、RSlop.csv、RVKto.csv、RVto.csv、SFto.csv、SSlop.csv、Termnus.csv 2. Work-Backup-RIVER-CCELLS.ASC、CELLTYPE.ASC、FLOW.asc、FLOW_1.asc 3. Work-Backup-RIVER-FLW.csv、RIV.csv、SUBBASIN.asc、SUBBASIN.csv 4. Work-Backup-BASIN-BASIN.asc、CELLID.ASC		Saved Pseudoriver course making and Pseudoriver course making
Main Menu (frmMain)	mnuToolsEditParam		1. PARAM 2. Work-PARAM		
Rainfall Data Manager (frmRainImport)	ImportButtom			DL_LayerControl & DL_RAIN	start dlgRainImport
Rainfall Data Manager (dlgRainImport)	ImportButtom	3B42RT/GSMaP_NRT/GSMaP(MVK)/Qmorph/Cmorph/Tijouuryou	1. Work-Rain-*.asc 2. RAIN-(data storage destination)-*.asc 3. Work-Rain-ImportData.Log 4. RAIN-ImportData.Log 5.RAIN--(data storage destination)-*.txt		
Parameter Manager (frmSetParamater)	Command5(1)		1. Work-PARAM-PARAFACE.ASC	DL_LayerControl & DL_PARAFACE	Surface Parameter'(SSTab1)+SubBasin(SSTab2)
	Command5(11)		1. Work-PARAM-PARAUNDER.ASC	DL_LayerControl & DL_PARAUNDER	Aquifer Parameter'(SSTab1)+ SubBasin (SSTab2)
	Command5(21)		1. Work-PARAM-PARARIVER.ASC	DL_LayerControl & DL_PARARIVER	Rivercourse Parameter'(SSTab1)+ SubBasin (SSTab2)
	Command1(11)		1. PARAM-CalParameter.csv、PARAFACE.ASC、PARAUNDER.ASC、PARARIVER.ASC		

Fig.1 (3)　File creation time

form	control	input files/folder	file	database	note
Simulation Manager （frmSimulation）	Command4(3)		1. Work-SIM_TEMP-BASIN、IMPORTS、IN-（Fnames.tct、GHT.txt、MD.txt MP.txt、RGD.txt、TID.txt）、LAYOUT、OUT-(DQIN、DQOUT、DTOTAL、GTANK、GWIN、RTANK、RVIN、RVKIN、RVKOUT、RVOUT、SF2GW、SFIN、STANK)、RAIN-(*.asc)		
	Command4(4)		1. SIMU-[Simulation Model]-BASIN-(CELLTYPE.ASC、RIVER.ASC)、IMPORTS、IN-（dam.txt、Fnames.tct、GHT.txt、MD.txt、MP.txt、RGD.txt、TID.txt）、LAYOUT、OUT-(DQIN、DQOUT、DTOTAL、GTANK、GWIN、RTANK、RVIN、RVKIN、RVKOUT、RVOUT、SF2GW、SFin、STANK、AR.txt)、RAIN-(*.asc)、Simulation.INI、TASK4.MDB 2. SIMU-[Simulation Model]-OUT-DQIN-(*.asc) 3. SIMU-[Simulation Model]-OUT-DQOUT-(*.asc) 4. SIMU-[Simulation Model]-OUT-DTOTAL-(*.asc) 5. SIMU-[Simulation Model]-OUT-GTANK-(*.asc) 6. SIMU-[Simulation Model]-OUT-GWIN-(*.asc) 7. SIMU-[Simulation Model]-OUT-RTANK-(*.asc) 8. SIMU-[Simulation Model]-OUT-RVIN-(*.asc) 9. SIMU-[Simulation Model]-OUT-RVKIN-(*.asc) 10. SIMU-[Simulation Model]-OUT-RVKOUT-(*.asc) 11. SIMU-[Simulation Model]-OUT-RVOUT-(*.asc) 12. SIMU-[Simulation Model]-OUT-SF2GW-(*.asc) 13. SIMU-[Simulation Model]-OUT-SFin-(*.asc) 14. SIMU-[Simulation Model]-OUT-STANK-(*.asc)		

Fig.2 (1)　File import time

File Name	Form	Control（Button　etc.）
IFAS.ini	Start（Form load）	
\ProjectName\ProjectName.ifasproj	Project Manager	OK(Buttom)
\ProjectName\Import.ini	Project Information Manager	Form_load
\ProjectName\ALD\ImportData.Log		
\ProjectName\LANDUSE\ImportData.Log		
\ProjectName\SOIL\ImportData.Log		
\ProjectName\MAP\ImportData.Log		
\ProjectName\Import.ini	Basin Data Manager	Form_load
\ProjectName\BASIN\BASINBORDER.CSV		Import Basin Boundary(Buttom)
\ProjectName\BASIN\ImportData.Log		
\ProjectName\FLOW\FLOW.asc		Create Pseudo River(Buttom)
\ProjectName\FLOW\EDITEDALD.asc		
\ProjectName\RIVER\CCELLS.asc,		
\ProjectName\RIVER\CELLTYPE.asc		
\ProjectName\RIVER\FLOW.asc		
\ProjectName\RIVER\FLOW.asc		Create Sub-Basin(Buttom)
\ProjectName\FLOW\FLOW.asc		
\ProjectName\ALD\ALD.asc	Create Basin Area	Create Primary Basin Boundary (Buttom)
\ProjectName\TEMP\BASIN\SUBBASINS.asc		
\ProjectName\TEMP\BASIN\BASIN.asc		
\ProjectName\TEMP\BASIN\FLOW.asc		
\ProjectName\TEMP\BASIN\SAGARIVER.asc		
\ProjectName\TEMP\BASIN\SUBBASINS.asc		At the display click
\ProjectName\Import.ini	Rainfall Data Manager	Form_load
\ProjectName\RAIN\ + “Selected File”		At the list click
\ProjectName\Work\RAIN\+ “Selected File”	Rainfall Data Edit	Form_load
\ProjectName\Import.ini	Parameter Manager	Form_load
\ProjectName\WORK\PARAM¥Legend1.ini		
\ProjectName\PARAM\PARARIVER.ASC		
\ProjectName\PARAM\PARAUNDER.ASC		
\ProjectName\PARAM\PARAFACE.ASC		
\ProjectName\WORK\PARAM\PARARIVER.ASC		Parameter Set（Buttom）
\ProjectName\WORK\PARAM\PARAUNDER.ASC		
\ProjectName\WORK\PARAM\PARAFACE.ASC		
\ProjectName\BASIN\BASIN.ASC		

Fig.2 (2) File import time

File Name	Form	Control(Button etc.)
\ProjectName\Import.ini	Rainfall Data Manager	Form_load
\ProjectName\RAIN\ + "Selected File"		At the list click
\ProjectName\Work\RAIN\+ "Selected File"	Rainfall Data Edit	Form_load
\ProjectName\Import.ini	Parameter Manager	Form_load
\ProjectName\WORK\PARAM\Legend1.ini		
\ProjectName\PARAM\PARARIVER.ASC		
\ProjectName\PARAM\PARAUNDER.ASC		
\ProjectName\PARAM\PARAFACE.ASC		
\ProjectName\WORK\PARAM\PARARIVER.ASC		Parameter Set(Buttom)
\ProjectName\WORK\PARAM\PARAUNDER.ASC		
\ProjectName\WORK\PARAM\PARAFACE.ASC		
\ProjectName\BASIN\BASIN.ASC		
\ProjectName\LANDUSE\LAND.ASC		
\ProjectName\SOIL\SOIL.ASC		
\ProjectName\RIVER\CCELLS.ASC		
\ProjectName\RIVER\SUBBASIN.asc		
\ProjectName\SIMU\dam.dat	Dam Control Manager	Form_load
\ProjectName\SIMU\SimulationName\Simulation.INI	frmSimulation	Form_load
\ProjectName\Import.ini		Check Model(Buttom)
\ProjectName\BASIN\BASIN.ASC		
\ProjectName\PARAM\PARARIVER.ASC		
\ProjectName\PARAM\PARAUNDER.ASC		
\ProjectName\PARAM\PARAFACE.ASC		
\ProjectName\RAIN\ + "Selected File"		
\ProjectName\BASIN\BASIN.ASC		Execute(Buttom)
\ProjectName\PARAM\PARARIVER.ASC		
\ProjectName\PARAM\PARAUNDER.ASC		
\ProjectName\PARAM\PARAFACE.ASC		
\ProjectName\RAIN\ + "Selected File"		
\ProjectName\RIVER\CELLTYPE.ASC		
\ProjectName\RIVER\CCELLS.ASC		
\ProjectName\SIMU\SimulationName\IN¥Fnames.txt,		
\ProjectName\SIMU\SimulationName\IN\MD.txt		View Calculation List(Buttom)

(2) Flow of rainfall data file creation

The flow of rainfall data file creation (when importing rainfall data) is shown as each item below.

a. 3B42RT_V5 and V6 (three hourly)

File Decompress (Extract file to 3B42RT.YYYYMMDDHH.bin)

【Content】

Directly extract the downloaded file to \work folder.

【Before extraction】 IFAS\IMPORTDATA\3B42RT(V5/V6)\YYYY\3B42RT.YYYYMMDDHH.bin.gz (about 100 kB)

【After extraction】 IFAS\WORK\3B42RT.YYYYMMDDHH.bin (3378 kB)

↓

clipping (Create YYYYMMDDHH.txt)

【Content】

Import extracted file, cut the target area data, and create the file by interpolating to cell size data.

(External module: “3B42Finder.exe”, “3B42RT2grid.exe”)

【Export file】

IFAS\PROJECTS\Work\Rain\YYYYMMDDHH.txt (three hourly)

↓

Creating of hourly data (Create YYYYMMDDHH.ASC)

【Content】

Because the 3B42RT is three hourly data (at 0:00, 3:00, 6:00, 9:00, 12:00, 15:00, 18:00, 21:00), to create hourly data, the system copys a data and pastes it to front and back of the data itself.

【Export file】

IFAS\PROJECTS\Work\Rain\YYYYMMDDHH.ASC (hourly)

↓

Creation of time interval file (Create YYYYMMDDHH.ASC for calculation use)

【Content】

Create the time interval file from the sum of hourly data cell according to calculation time interval.

(A sample) If the start time: 3:00, calculation time interval: three hours, then the data for 3:00 is the sum of rainfall at 3:00, 4:00, and 5:00.

【Export file】

IFAS\PROJECTS\PROJECT NAME\INPUT NAME\YYYYMMDDHH.ASC

The 3B42RT creates the rainfall data of set time interval from the discussed three hourly data. The follows are two sample of creating rainfall data (one and two hourly)

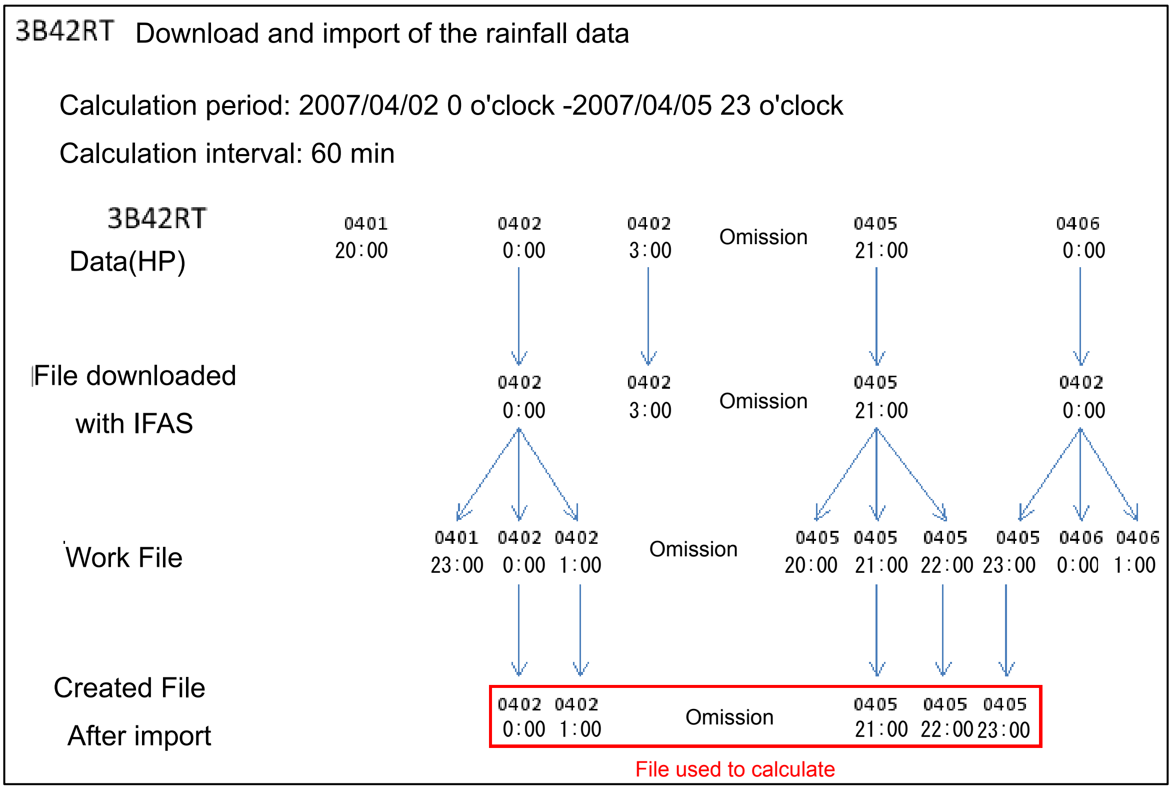


Image of importing hourly data

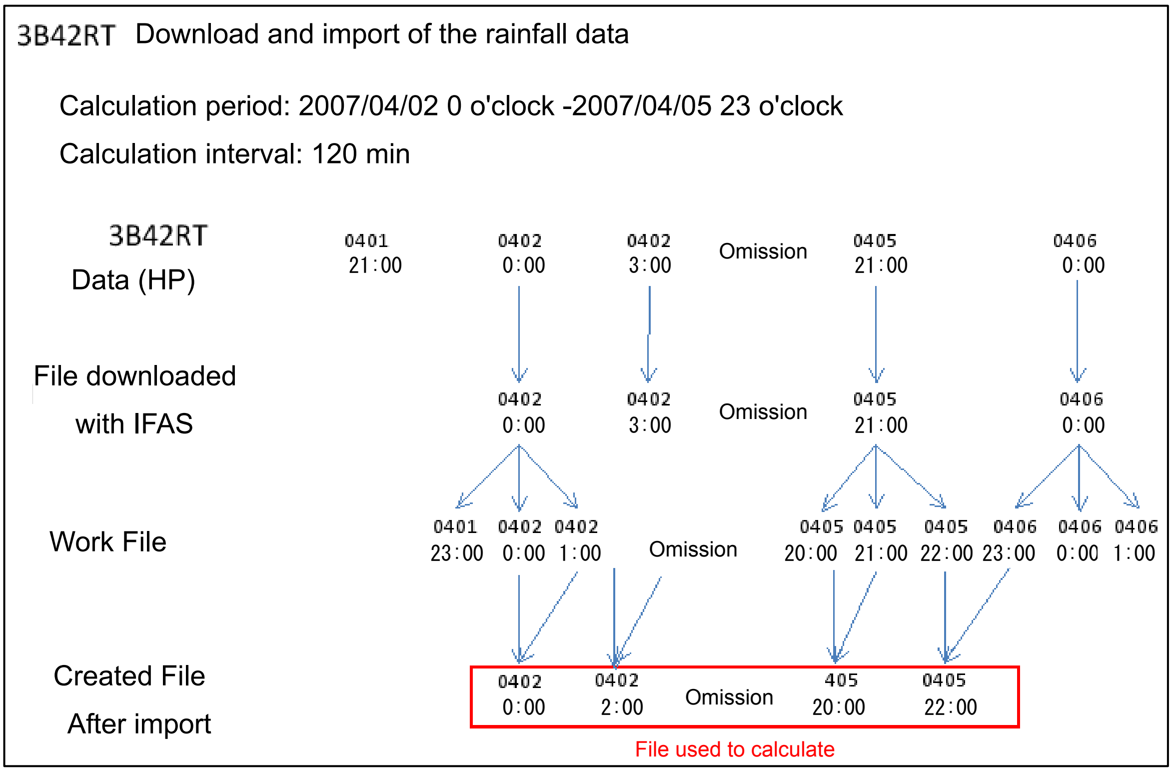


Image of importing two hourly data

b. GSMaP_NRT(hourly)

File Decompress (Extract to gsmap_nrt. YYYYMMDD.HH00.dat)

【Content】

Directly extract the downloaded file to \work folder.

【Before extraction】

IFAS\IMPORTDATA\GSMaP_NRT\hourly\gsmap_nrt. YYYYMMDD.HH00.dat.gz (about 900 kB)

【After extraction】

IFAS\WORK\gsmap_nrt. YYYYMMDD.HH00.dat (about 16875kB)

Clipping (Create YYYYMMDDHH.ASC)

【Content】

Import extracted file, cut the target area data, and create the file by interpolating to cell size data.

(External module “impgsmap.exe”: with correction, Type1”

“impgsmap2.exe”: Type2,Type3”） *1 Correction method

【Export file】

IFAS\PROJECTS\Work\Rain\YYYYMMDDHH.ASC (hourly)

Creation of time interval file (Create YYYYMMDDHH.ASC for calculation use)

【Content】

Create the time interval file from the sum of hourly data cell according to calculation time interval. (Treatment is the same as 3B42RT)

【Export file】

IFAS\PROJECTS\PROJECT NAME\INPUT NAME\YYYYMMDDHH.ASC

*1 Correction method

Without correction: observation value

Type1: considering the movement of rain area (three hours accumulated value)

Type2: considering the movement of rain area and mean ground rainfall (three hours accumulated value and mean rainfall of river basin)

Type3: considering the movement of rain area and mean ground rainfall (three hours accumulated value and rainfall of each cell)

c. GSMaP_NRT (Daily)

File Decompress (Extract to gsmap_nrt. YYYYMMDD.HH00.dat)

【Content】

Directly extract the downloaded file to \work folder.

【Before extraction】

IFAS\IMPORTDATA\GSMaP_NRT\daily(0-23)\YYYYMM\gsmap_nrt. YYYYMMDD.HH00.dat.gz (about 900 kB)

IFAS\IMPORTDATA\GSMaP_NRT\daily(12-11) \YYYYMM \gsmap_nrt. YYYYMMDD.HH00.dat.gz (about 900 kB)

【After extraction】

IFAS\WORK\gsmap_nrt. YYYYMMDD.HH00.dat (about 16875 kB)

Clipping (Create YYYYMMDDHH.ASC)

【Content】

Import extracted file, cut the target area data, and create the file by interpolating to cell size data.

(External module: “impgsmap025.exe”)

【Export file】

IFAS\PROJECTS\Work\Rain\YYYYMMDDHH.ASC (hourly)

Creation of time interval file (Create YYYYMMDDHH.ASC for calculation use)

【Content】

Create the time interval file from the sum of hourly data cell according to calculation time interval. (Treatment is the same as 3B42RT)

【Export file】

IFAS\PROJECTS\ PROJECT NAME\INPUT NAME \YYYYMMDDHH.ASC

d. GSMaP_MVK+ (hourly)

File Decompress (Extract to GSMaP_MVK+.YYYYMMDD.HH.0.1deg.hourly.v484)

【Content】

Directly extract the downloaded file to \work folder.

【Before extraction】

IFAS\IMPORTDATA\GSMaP_MVK+\hourly\YYYYMM.tar.gz (about 650 MB)

【After extraction】

IFAS\WORK\GSMaP_MVK+.YYYYMMDD.HH.0.1deg.hourly.v484 (about 16875 kB)

The GSMaP_MVK+ before extraction is monthly data.

Extraction to use data file (temporal) needs three times

Clipping (Create YYYYMMDDHH.ASC)

【Content】

Import extracted file, cut the target area data, and create the file by interpolating to cell size data.

(External module “impgsmap.exe”: with correction, Type1”

“impgsmap2.exe”: Type2,Type3”) *1 Correction method

【Export file】

IFAS\PROJECTS\Work\Rain\YYYYMMDDHH.ASC (hourly)

Creation of time interval file (Create YYYYMMDDHH.ASC for calculation use)

【Content】

Create the time interval file from the sum of hourly data cell according to calculation time interval. (Treatment is the same as 3B42RT)

【Export file】

IFAS\PROJECTS\ PROJECT NAME\INPUT NAME \YYYYMMDDHH.ASC

e. GSMaP_MVK+ (daily)

File Decompress (Extract to GSMaP_MVK+.YYYYMMDD.HH.0.1deg.daily.v484)

【Content】

Directly extract the downloaded file to \work folder.

【Before extraction】

IFAS\IMPORTDATA\GSMaP_MVK+\daily\YYYYMM.tar.gz (about 650 MB)

【After extraction】

IFAS\WORK\GSMaP_MVK+.YYYYMMDD.HH.0.1deg.daily.v484 (about 16875 kB)

The GSMaP_MVK+ before extraction is monthly data.

Extraction to use data file (temporal) needs three times

Clipping (Create YYYYMMDDHH.ASC)

【Content】

Import extracted file, cut the target area data, and create the file by interpolating to cell size data.

(External module: “impgsmap.exe”)

【Export file】

IFAS\PROJECTS\Work\Rain\YYYYMMDDHH.ASC (hourly)

Creation of time interval file (Create YYYYMMDDHH.ASC for calculation use)

【Content】

Create the time interval file from the sum of hourly data cell according to calculation time interval. (Treatment is the same as 3B42RT)

【Export file】

IFAS\PROJECTS\ PROJECT NAME\INPUT NAME \YYYYMMDDHH.ASC

f. Qmorph

File Decompress (Extract to QMORPH_8km_ YYYYMMDDHH)

【Content】

Directly extract the downloaded file to \work folder.

【Before extraction】

IFAS\IMPORTDATA\Qmorph\QMORPH_8km_YYYYMMDDHH.Z (about 1000kB)

【After extraction】

IFAS\WORK\QMORPH_8km_ YYYYMMDDHH (about 48MB)

Clipping (Create YYYYMMDDHH.ASC)

【Content】

Import extracted file, cut the target area data, and create the file by interpolating to cell size data.

(External module: “qm2gr.exe”)

【Export file】

IFAS\PROJECTS\Work\Rain\YYYYMMDDHH.ASC (hourly)

Creation of time interval file (Create YYYYMMDDHH.ASC for calculation use)

【Content】

Create the time interval file from the sum of hourly data cell according to calculation time interval. (Treatment is the same as 3B42RT)

【Export file】

IFAS\PROJECTS\ PROJECT NAME\INPUT NAME \YYYYMMDDHH.ASC

g. Cmorph

File Decompress (Extract toadvt-8km-interp-prim-sat-spat-2lag-2.5+5dovlp8kmIR-YYYYMMDDHH)

【Content】

Directly extract the downloaded file to \work folder.

【Before extraction】

IFAS\IMPORTDATA\Cmorph\advt-8km-interp-prim-sat-spat-2lag-2.5+5dovlp8kmIR-YYYYMMDDHH.Z

(about 1000 kB)

【After extraction】

IFAS\IMPORTDATA\Cmorph\advt-8km-interp-prim-sat-spat-2lag-2.5+5dovlp8kmIR-YYYYMMDDHH

(about 48 MB)

Clipping (Create YYYYMMDDHH.ASC)

【Content】

Import extracted file, cut the target area data, and create the file by interpolating to cell size data.

(External module: “qm2gr.exe”)

【Export file】

IFAS\PROJECTS\Work\Rain\YYYYMMDDHH.ASC (hourly)

Creation of time interval file (Create YYYYMMDDHH.ASC for calculation use)

【Content】

Create the time interval file from the sum of hourly data cell according to calculation time interval. (Treatment is the same as 3B42RT)

【Export file】

IFAS\PROJECTS\ PROJECT NAME\INPUT NAME \YYYYMMDDHH.ASC

h. Ground based Rainfall（CSV）

Import observation data (Import CSV file)

【Content】

Import the observation data prepared by user.

【Import file】

IFAS\IMPORTDATA\CSV(rainfall)\FILENAME.CSV (FILENAME is optional)

Interpolation (Create YYYYMMDDHH.ASC)

【Content】

Create files in the same format with satellite rainfall data by interpolating the observed value to each cell with correction methods.

Interpolate the observed value temporally to create time files.

There are three correction methods: Inversed Distance Weighted, Thiessen Tessellation, and Kriging Method.

(External module “IDW.exe”: Inversed Distance Weighted Method

“kriging.exe”: Kriging Method)

【Export file】

IFAS\PROJECTS\Work\Rain\YYYYMMDDHH.ASC (hourly)

Creation of time interval file (Create YYYYMMDDHH.ASC for calculation use)

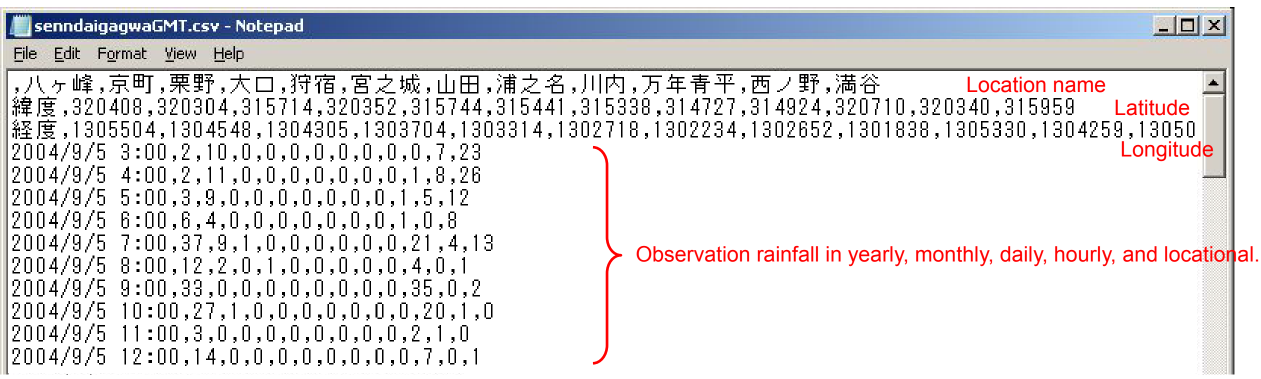
【Content】

Create the time interval file from the sum of hourly data cell according to calculation time interval. (Treatment is the same as 3B42RT)

【Export file】

IFAS\PROJECTS\ PROJECT NAME\INPUT NAME \YYYYMMDDHH.ASC

Sample of data file CSV (see detailed description in section (3), data file sample)



i. Forecast rainfall (GPV)

Data extraction, creation (Create file in GSMaP format)

【Content】

Extract the rainfall data from downloaded files and create the same format file as GSMaP.

【Before treatment】

IFAS\IMPORTDATA\GPV\Z__C_RJTD_YYYYMMDDHH0006_GSM_GPV_Rgl_FD0006_grib2.bin (about 32 MB) - - - (14 files)

【After treatment】

IFAS\WORK\GSMaP.YYYYMMDD.HH.dat (about 16875 kB)

Because the GPV file is stored as a forecast sum of six hours rainfall, six one-hourly files in GSMaP format can be created from the said one file.

Create 84 hours' file from the files.

(External module "grib2_dec_gpv_tpr.exe": extraction of rainfall data
"akmid.exe", "time_interp.exe": creation of files in GSMaP format)

Clipping (Create YYYYMMDDHH.ASC)

【Content】

Import extracted file, cut the target area data, and create the file by interpolating to cell size data.

(External module: "impgsmap.exe")

【Export file】

IFAS\PROJECTS\Work\Rain\YYYYMMDDHH.ASC (hourly)

Creation of time interval file (Create YYYYMMDDHH.ASC for calculation use)

【Content】

Create the time interval file from the sum of hourly data cell according to calculation time interval. (Treatment is the same as 3B42RT)

【Export file】

IFAS\PROJECTS\ PROJECT NAME\INPUT NAME \YYYYMMDDHH.ASC

(3) Sample of data file

The saved files when downloading the external and rainfall data are shown as follows.

a. GTOPO30（Altitude data）

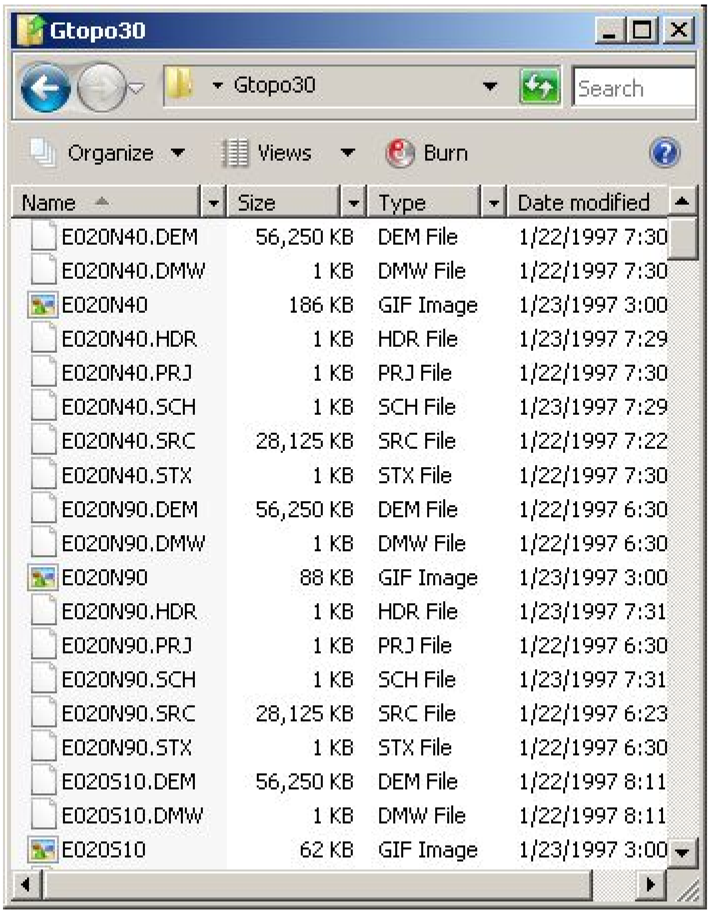
File Name:

E020N40, E020N90, E020S10, E060N40, E060N90, E060S10, E060S60,
E100N40, E100N90, E100S10, E120S60, E140N40, E140N90, E140S10,
W000S60, W020N40, W020N90, W020S10, W060N40, W060N90, W060S10,
W060S60, W100N40, W100N90, W100S10, W120S60, W140N40, W140N90,
W140S10, W180N40, W180N90, W180S10, W180S60

Extension:

DEM,DWM,GIF,HDR,PRJ,SCH,SRC,STX (eight kinds of files for each file name)

Sample of file names



Name	Size	Type	Date modified
E020N40.DEM	56,250 KB	DEM File	1/22/1997 7:30
E020N40.DMW	1 KB	DMW File	1/22/1997 7:30
E020N40	186 KB	GIF Image	1/23/1997 3:00
E020N40.HDR	1 KB	HDR File	1/23/1997 7:29
E020N40.PRJ	1 KB	PRJ File	1/22/1997 7:30
E020N40.SCH	1 KB	SCH File	1/23/1997 7:29
E020N40.SRC	28,125 KB	SRC File	1/22/1997 7:22
E020N40.STX	1 KB	STX File	1/22/1997 7:30
E020N90.DEM	56,250 KB	DEM File	1/22/1997 6:30
E020N90.DMW	1 KB	DMW File	1/22/1997 6:30
E020N90	88 KB	GIF Image	1/23/1997 3:00
E020N90.HDR	1 KB	HDR File	1/23/1997 7:31
E020N90.PRJ	1 KB	PRJ File	1/22/1997 6:30
E020N90.SCH	1 KB	SCH File	1/23/1997 7:31
E020N90.SRC	28,125 KB	SRC File	1/22/1997 6:23
E020N90.STX	1 KB	STX File	1/22/1997 6:30
E020S10.DEM	56,250 KB	DEM File	1/22/1997 8:11
E020S10.DMW	1 KB	DMW File	1/22/1997 8:11
E020S10	62 KB	GIF Image	1/23/1997 3:00

b. Hydro1k（Altitude data）

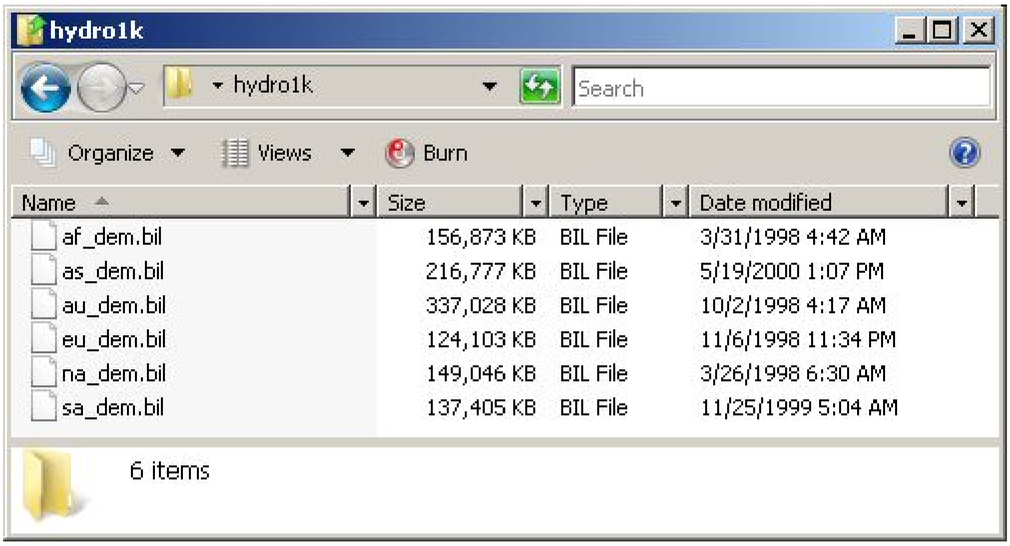
File Name:

af_dem, as_dem, au_dem, eu_dem, na_dem, sa_dem

Extension

bil,blw,hdr,stx (Four kinds of files for each file name)

Sample of file names (only in Asia)



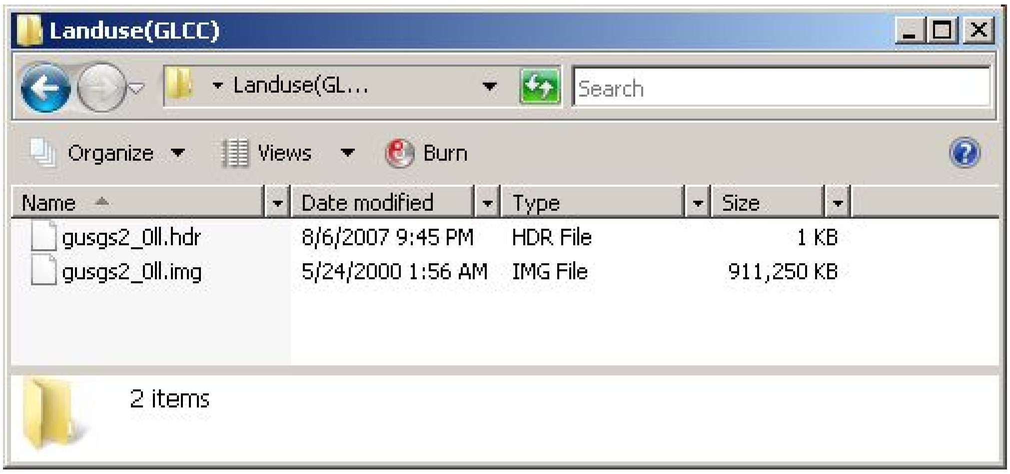
c. GLCC（Land Use）

File Name:

gusgs2_0ll.img

Prepare the installer for file gusgs2_0ll.hdr

Sample of file names

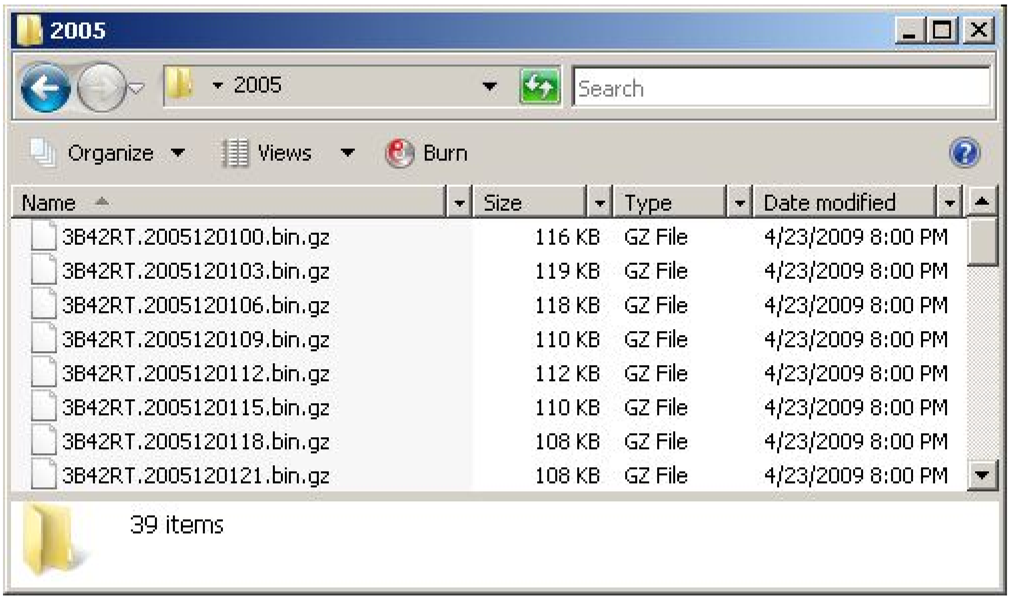


d. 3B42RT_V5（Rainfall）

File Name:

3B42RT.YYYYMMDDHH.bin.gz（V5）

<u>Sample of file names</u>

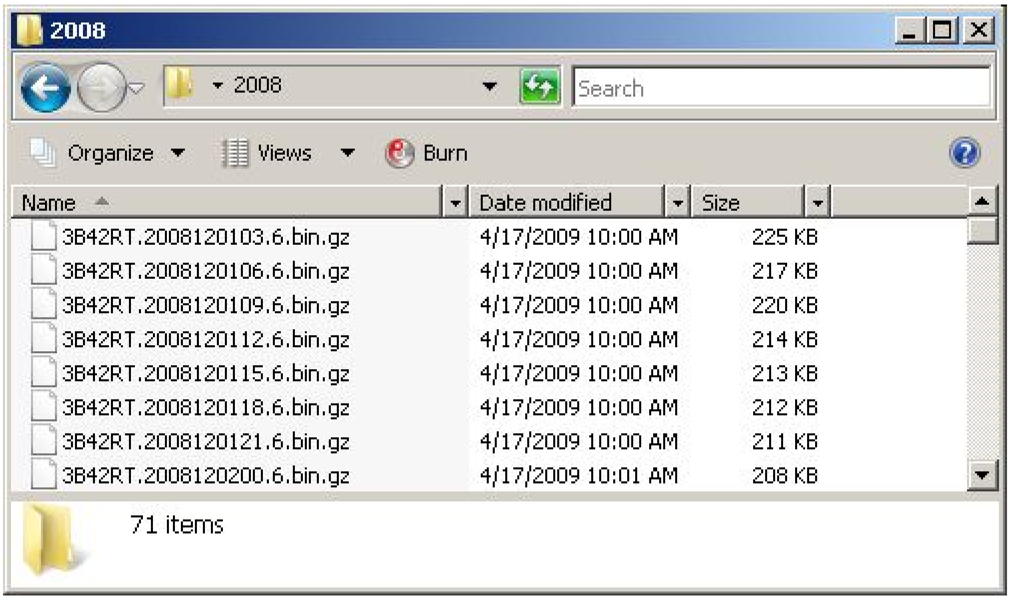


e. 3B42RT_V6（Rainfall）

File Name:

3B42RT.YYYYMMDDHH.6.bin.gz（V6）

<u>Sample of file names</u>



f. GSMaP_NRT（Rainfall）

File Name:

gsmap_nrt.YYYYMMDD.HH00.dat.gz (temporal rainfall data)

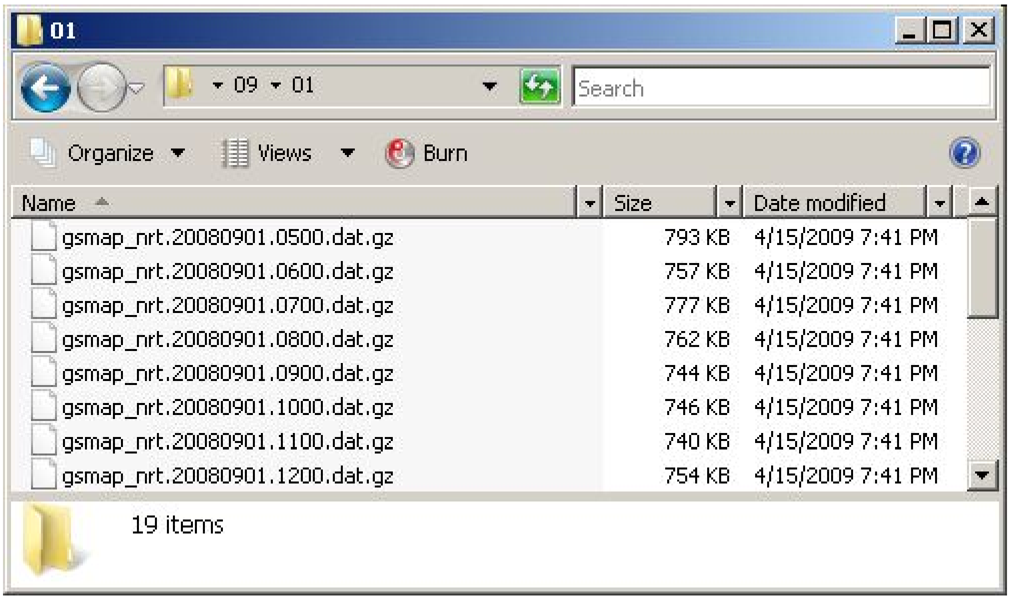
gsmap_nrt.YYYYMMDD.0.25d.daily.00Z-23Z.dat.gz (sum of rainfall data from 0:00 to 23:00)

gsmap_nrt.YYYYMMDD.0.25d.daily.12Z-11Z.dat.gz (sum of rainfall data from 12:00 to 11:00)

notes）The resolution for hourly and daily of GSMaP_NRT data are different.

The resolution for hourly data is 0.1-degree grid and 0.25 of that for daily data.

<u>Sample of file names</u>



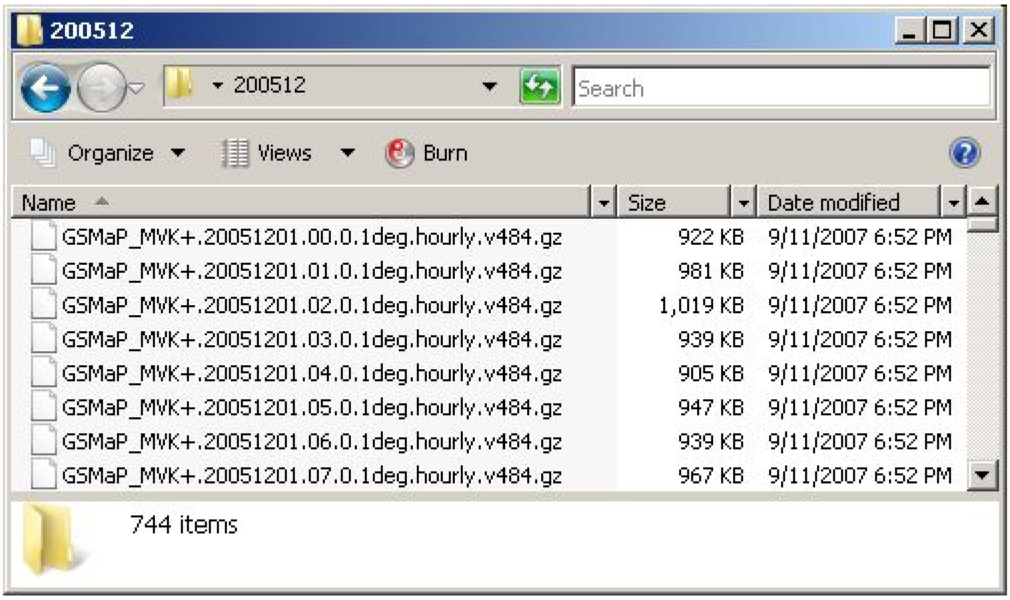
g. GSMaP_MVK+ (Rainfall)

File name

GSMaP_MVK+.YYYYMMDD.HH.0.1deg.hourly.v484.gz (temporal rainfall data)

GSMaP_MVK+.YYYYMMDD.0.1deg.daily.v484.gz (daily rainfall data)

<u>Sample of file names</u>

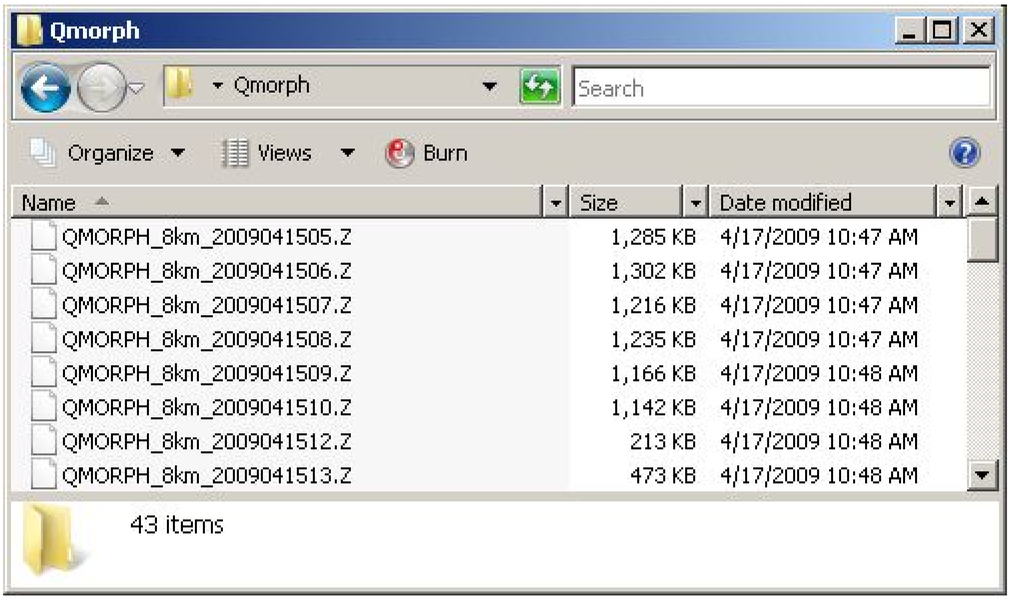


h. Qmorph（Rainfall）

File Name:

QMORPH_8km_YYYYMMDDHH.Z

<u>Sample of file names</u>

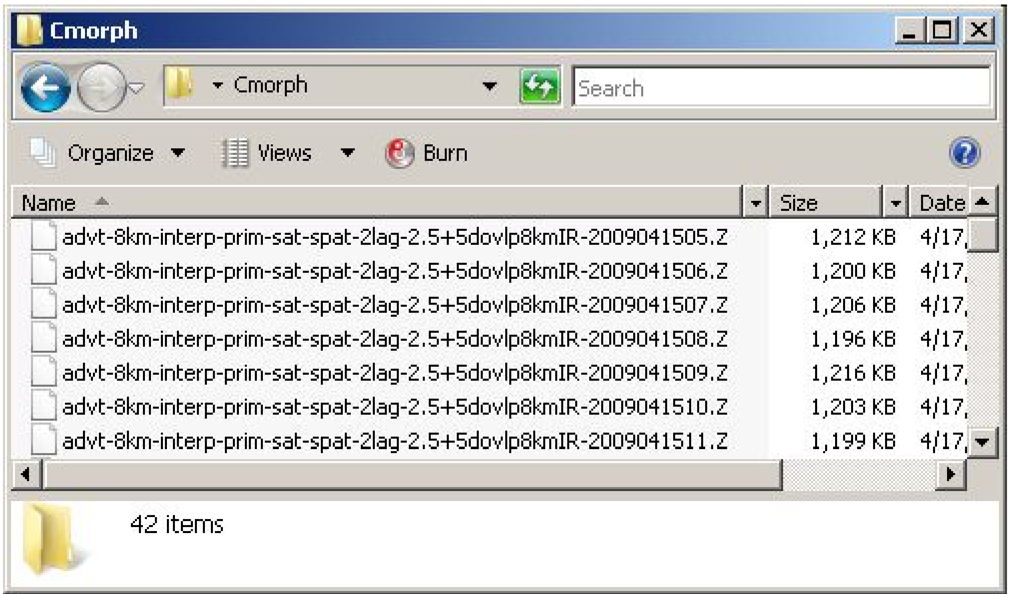


i. Cmorph（Rainfall）

File Name:

advt-8km-interp-prim-sat-spat-2lag-2.5+5dovlp8kmIR-YYYYMMDDHH.Z

<u>Sample of file names</u>

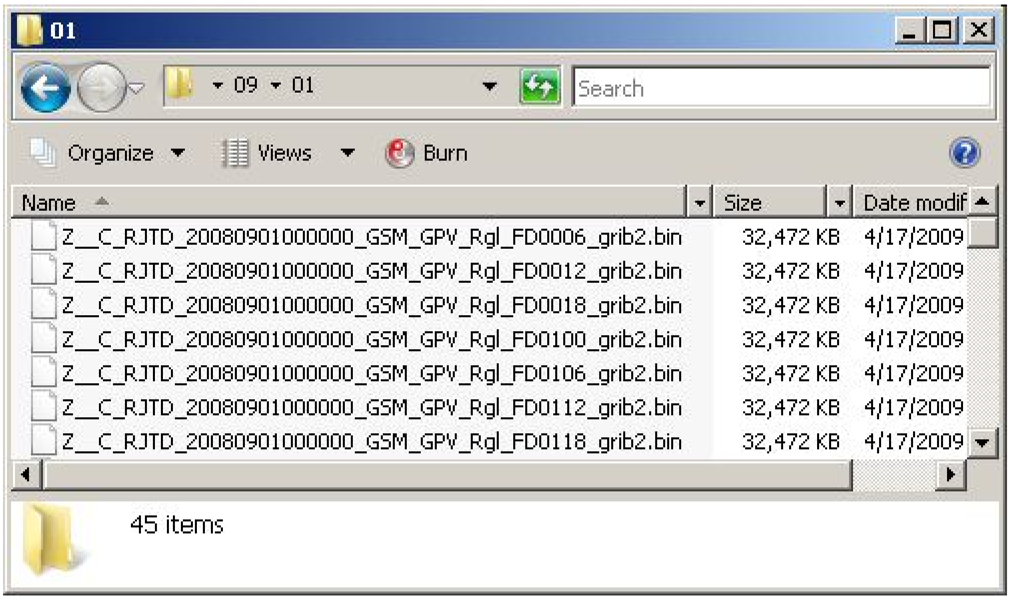


j. GPV（Rainfall）

File Name:

Z__C_RJTD_YYYYMMDDHH0000_GSM_GPV_Rgl_FD0000_grib2.bin
Z__C_RJTD_YYYYMMDDHH0000_GSM_GPV_Rgl_FD0006_grib2.bin
Z__C_RJTD_YYYYMMDDHH0000_GSM_GPV_Rgl_FD0012_grib2.bin
Z__C_RJTD_YYYYMMDDHH0000_GSM_GPV_Rgl_FD0018_grib2.bin
Z__C_RJTD_YYYYMMDDHH0000_GSM_GPV_Rgl_FD0100_grib2.bin
Z__C_RJTD_YYYYMMDDHH0000_GSM_GPV_Rgl_FD0106_grib2.bin
Z__C_RJTD_YYYYMMDDHH0000_GSM_GPV_Rgl_FD0112_grib2.bin
Z__C_RJTD_YYYYMMDDHH0000_GSM_GPV_Rgl_FD0118_grib2.bin
Z__C_RJTD_YYYYMMDDHH0000_GSM_GPV_Rgl_FD0200_grib2.bin
Z__C_RJTD_YYYYMMDDHH0000_GSM_GPV_Rgl_FD0206_grib2.bin
Z__C_RJTD_YYYYMMDDHH0000_GSM_GPV_Rgl_FD0212_grib2.bin
Z__C_RJTD_YYYYMMDDHH0000_GSM_GPV_Rgl_FD0218_grib2.bin
Z__C_RJTD_YYYYMMDDHH0000_GSM_GPV_Rgl_FD0300_grib2.bin
Z__C_RJTD_YYYYMMDDHH0000_GSM_GPV_Rgl_FD0306_grib2.bin
Z__C_RJTD_YYYYMMDDHH0000_GSM_GPV_Rgl_FD0312_grib2.bin

Sample of file names



Notes) explanation for forecast data file names

Z__C_RJTD_ 20090414000000_GSM_GPV_Rgl_FD0118_grib2.bin

→ Date and time for forecast calculation

→ Forecast time
First two digits: day
Last two digits: hour

This file is the forecast data for one day and thirteen-eighteen hours later from 0:00 of 14 April 2009.

Information 2, Format of the import file

(1) Landform elevation data / Elevation grid data(ESRI Arc/Info) file

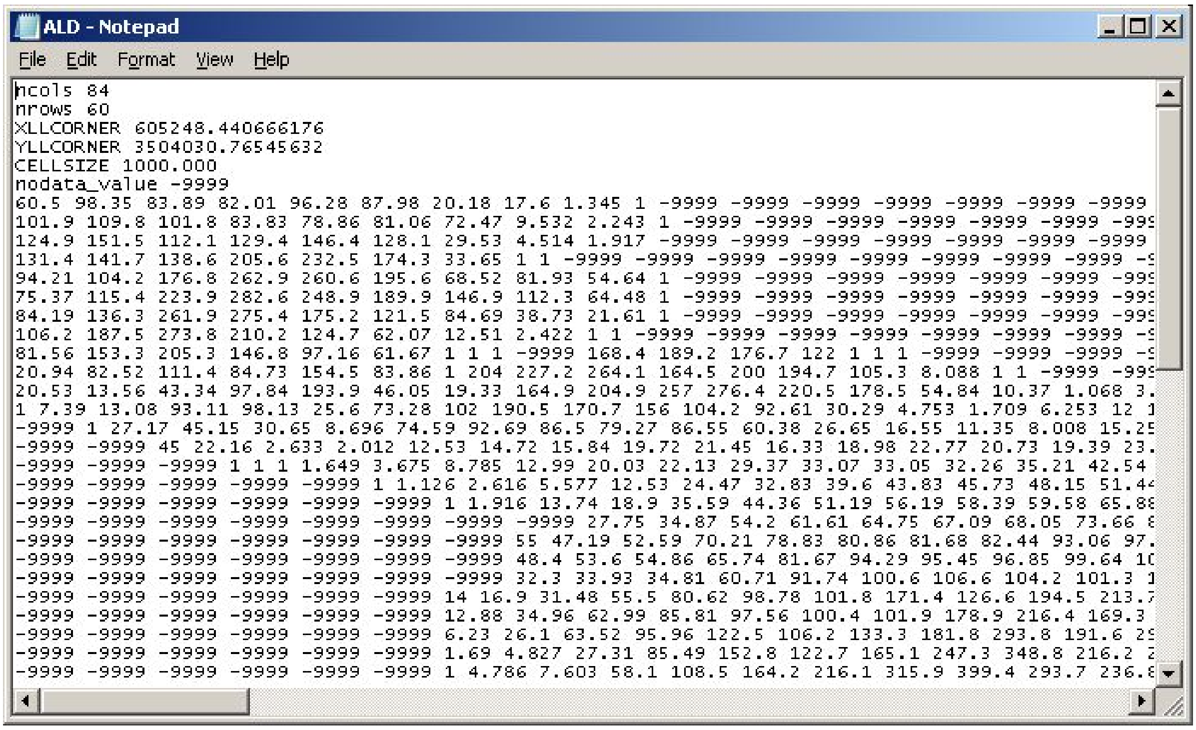
The IFAS can read elevation data, the format of Grid data (ESRI Arc/Info) file is shown below.

```
ncols 84                          ———— Number of colunms
nrows 60                          ———— Number of rows
XLLCORNER 605248.440666176        ———— X coordinates of bottom left
YLLCORNER 3504030.76545632        ———— Y coordinates of bottom left
CELLSIZE 1000.000                 ———— Cell size (m)
nodata_value -9999                ———— Nodata value
61.97 109 102.5 97.23 84.96 60.65 67.08 32.19 1 1 -9999 -9999 ・・・
111.7 151.9 121.7 98.82 137.5 106.7 85.37 8.363 1 1 -9999 -9999・・
181.4 149.1 125.2 221.3 231.7 149.9 51.43 41.89 1 -9999 -9999 ・・・
104.6 118.9 158 239.6 228.9 163.3 83.3 91.23 100 -9999 -9999 ・・・
93.02 133.1 233.6 279.4 247 162.2 131.9 93.21 31.14 1 -9999 -・・・
113.8 167.3 257.8 226.1 177.5 142.6 93.36 100.5 17.76 1 -9999 ・・
121.1 203.9 264.2 192.5 108.8 49.23 18.05 57.63 25.26 1 -9999 ・・
100.1 191.3 190.8 178.1 104.6 22.51 1 1 -9999 -9999 169.1 180.8・・
129.2 131.9 113.1 99.84 92.33 70.7 15.88 125.9 204 267.3 164.7 ・・
75.19 52.4 49.91 141.8 48.38 38.65 40.81 204.3 206.4 271.6 ・・・・
61.04 22.34 33.03 95.95 98.59 55.97 57.42 199.4 250.4 210.7 ・・・
-9999 1 81.3 93.83 32.4 64.09 75.06 100.7 166.5 101.6 94.86 ・・・
-9999 -9999 63.49 6.787 2.989 8.663 16.23 17.56 77.06 26.96 ・・・
-9999 -9999 1 1 1 1.209 2.534 10.49 12.91 15.3 22.78 23.31 ・・・
-9999 -9999 -9999 -9999 1 1 1.927 8.571 11.45 14.48 26.7 35.67 ・・
-9999 -9999 -9999 -9999 -9999 1 3.136 7.361 14.36 20.35 32.75 ・・
-9999 -9999 -9999 -9999 -9999 -9999 -9999 32 27.63 30.6 54.54 ・・
        ・
        ・
```

Elevation value

60 rows × 84 columns

File content sample by text editor



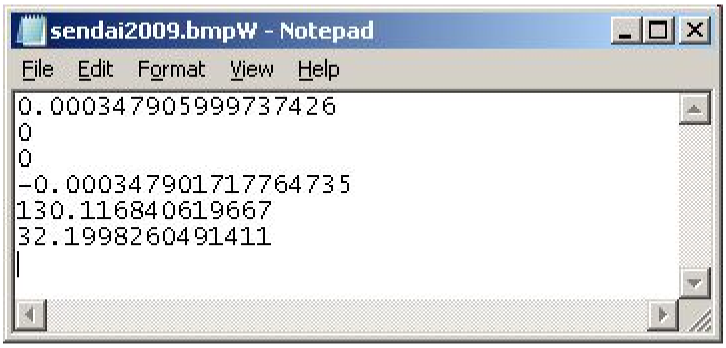

```
ncols 84
nrows 60
XLLCORNER 605248.440666176
YLLCORNER 3504030.76545632
CELLSIZE 1000.000
nodata_value -9999
60.5 98.35 83.89 82.01 96.28 87.98 20.18 17.6 1.345 1 -9999 -9999 -9999 -9999 -9999 -9999 -9999
101.9 109.8 101.8 83.83 78.86 81.06 72.47 9.532 2.243 1 -9999 -9999 -9999 -9999 -9999 -9999 -99
124.9 151.5 112.1 129.4 146.4 128.1 29.53 4.514 1.917 -9999 -9999 -9999 -9999 -9999 -9999 -9999
131.4 141.7 138.6 205.6 232.5 174.3 33.65 1 1 -9999 -9999 -9999 -9999 -9999 -9999 -9999 -9999 -
94.21 104.2 176.8 262.9 260.6 195.6 68.52 81.93 54.64 1 -9999 -9999 -9999 -9999 -9999 -9999 -99
75.37 115.4 223.9 282.6 248.9 189.9 146.9 112.3 64.48 1 -9999 -9999 -9999 -9999 -9999 -9999 -99
84.19 136.3 261.9 275.4 175.2 121.5 84.69 38.73 21.61 1 -9999 -9999 -9999 -9999 -9999 -9999 -99
106.2 187.5 273.8 210.2 124.7 62.07 12.51 2.422 1 1 -9999 -9999 -9999 -9999 -9999 -9999 -9999 -
81.56 153.3 205.3 146.8 97.16 61.67 1 1 1 -9999 168.4 189.2 176.7 122 1 1 1 -9999 -9999 -9999 -
20.94 82.52 111.4 84.73 154.5 83.86 1 204 227.2 264.1 164.5 200 194.7 105.3 8.088 1 1 -9999 -99
20.53 13.56 43.34 97.84 193.9 46.05 19.33 164.9 204.9 257 276.4 220.5 178.5 54.84 10.37 1.068 3.
1 7.39 13.08 93.11 98.13 25.6 73.28 102 190.5 170.7 156 104.2 92.61 30.29 4.753 1.709 6.253 12 1
-9999 1 27.17 45.15 30.65 8.696 74.59 92.69 86.5 79.27 86.55 60.38 26.65 16.55 11.35 8.008 15.2
-9999 -9999 45 22.16 2.633 2.012 12.53 14.72 15.84 19.72 21.45 16.33 18.98 22.77 20.73 19.39 23.
-9999 -9999 -9999 1 1 1 1.649 3.675 8.785 12.99 20.03 22.13 29.37 33.07 33.05 32.26 35.21 42.54
-9999 -9999 -9999 -9999 -9999 1 1.126 2.616 5.577 12.53 24.47 32.83 39.6 43.83 45.73 48.15 51.4
-9999 -9999 -9999 -9999 -9999 -9999 1 1.916 13.74 18.9 35.59 44.36 51.19 56.19 58.39 59.58 65.8
-9999 -9999 -9999 -9999 -9999 -9999 -9999 -9999 27.75 34.87 54.2 61.61 64.75 67.09 68.05 73.66
-9999 -9999 -9999 -9999 -9999 -9999 -9999 55 47.19 52.59 70.21 78.83 80.86 81.68 82.44 93.06 97.
-9999 -9999 -9999 -9999 -9999 -9999 -9999 48.4 53.6 54.86 65.74 81.67 94.29 95.45 96.85 99.64 10
-9999 -9999 -9999 -9999 -9999 -9999 -9999 32.3 33.93 34.81 60.71 91.74 100.6 106.6 104.2 101.3 1
-9999 -9999 -9999 -9999 -9999 -9999 14 16.9 31.48 55.5 80.62 98.78 101.8 171.4 126.6 194.5 213.7
-9999 -9999 -9999 -9999 -9999 -9999 12.88 34.96 62.99 85.81 97.56 100.4 101.9 178.9 216.4 169.3
-9999 -9999 -9999 -9999 -9999 -9999 6.23 26.1 63.52 95.96 122.5 106.2 133.3 181.8 293.8 191.6 2
-9999 -9999 -9999 -9999 -9999 -9999 1.69 4.827 27.31 85.49 152.8 122.7 165.1 247.3 348.8 216.2 2
-9999 -9999 -9999 -9999 -9999 -9999 1 4.786 7.603 58.1 108.5 164.2 216.1 315.9 399.4 293.7 236.
```

(2) Header file of background image

In IFAS needs header files for importing image data (raster data) to background image. Format of the header files is shown as below.

0.000347905999737426	Longitude angle of one pixel
0.0	Rotational speed of row
0.0	Rotational speed of column
-0.000347901717764735	Latitude angle of one pixel
130.116840619667	Longitude of center of the top-left pixel
32.1998260491411	Latitude of center of the top-left pixel

File content sample by text editor



(3) Ground rainfall data

The IFAS import the ground rainfall data that is recorded as CSV file.

The ground rainfall data is measured natural data from the observation site. It contains location of observation site (latitude, longitude), time, and precipitation information's. The format is shown below.

Hourly rainfall data in case of three locations on 14 April 2009 (24 hours)

Line 1: empty, location 1, location 2, location 3
Line 2: Latitude of, location 1, location 2, location 3
Line 3: Longitude of, location 1, location 2, location 3

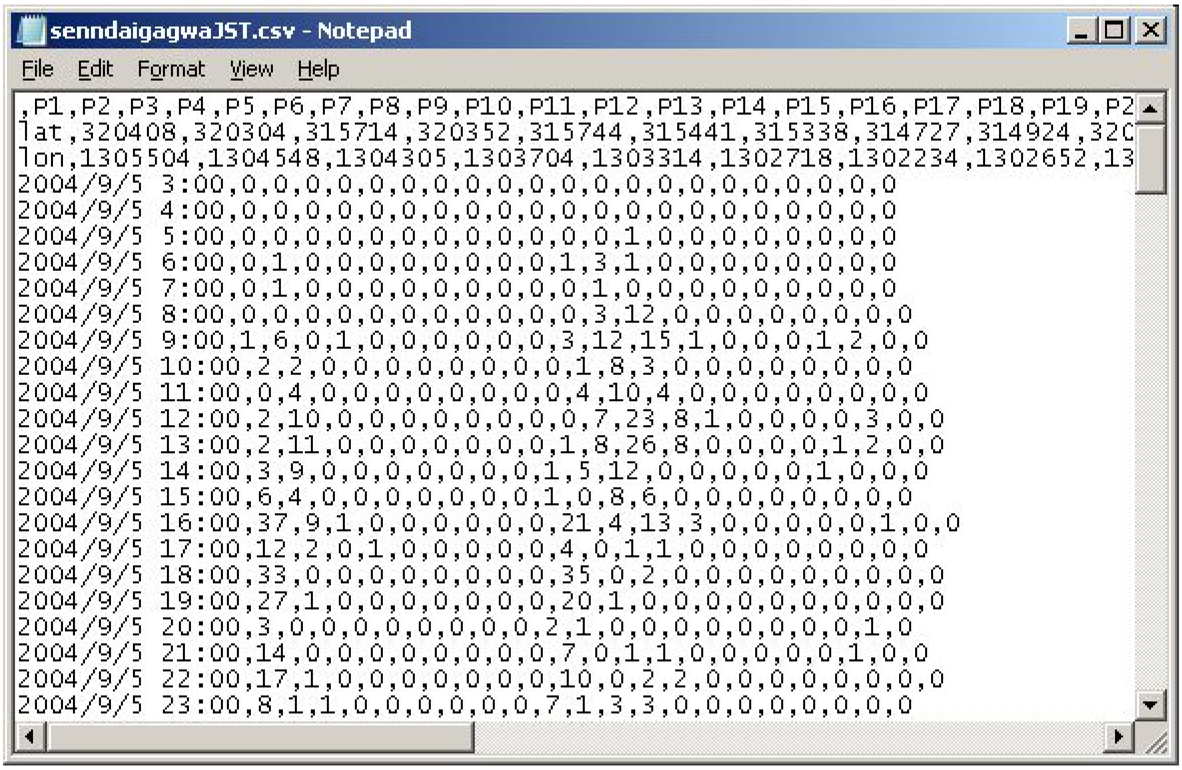
Information of observation locations

Line 4: 2009/04/14 0:00, observed value for, location 1, location 2, location 3
Line 5: 2009/04/14 1:00, observed value for, location 1, location 2, location 3
Line 6: 2009/04/14 2:00, observed value for, location 1, location 2, location 3
.
.
.
Line 27: 2009/04/14 23:00, observed value for, location 1, location 2, location 3

Information of observed values Date, time and raifall

【Notes】Latitude and Longitude are integrate values, which were multiplied by10000.

File content sample by text editor


senndaigagwaJST.csv - Notepad
File Edit Format View Help

```
,P1,P2,P3,P4,P5,P6,P7,P8,P9,P10,P11,P12,P13,P14,P15,P16,P17,P18,P19,P2
lat,320408,320304,315714,320352,315744,315441,315338,314727,314924,32C
lon,1305504,1304548,1304305,1303704,1303314,1302718,1302234,1302652,13
2004/9/5 3:00,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
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2004/9/5 9:00,1,6,0,1,0,0,0,0,0,0,3,12,15,1,0,0,0,1,2,0,0
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2004/9/5 11:00,0,4,0,0,0,0,0,0,0,0,4,10,4,0,0,0,0,0,0,0
2004/9/5 12:00,2,10,0,0,0,0,0,0,0,0,7,23,8,1,0,0,0,0,3,0,0
2004/9/5 13:00,2,11,0,0,0,0,0,0,0,1,8,26,8,0,0,0,0,1,2,0,0
2004/9/5 14:00,3,9,0,0,0,0,0,0,0,1,5,12,0,0,0,0,0,1,0,0,0
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2004/9/5 16:00,37,9,1,0,0,0,0,0,0,21,4,13,3,0,0,0,0,0,1,0,0
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2004/9/5 21:00,14,0,0,0,0,0,0,0,0,7,0,1,1,0,0,0,0,0,1,0,0
2004/9/5 22:00,17,1,0,0,0,0,0,0,0,10,0,2,2,0,0,0,0,0,0,0,0
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```
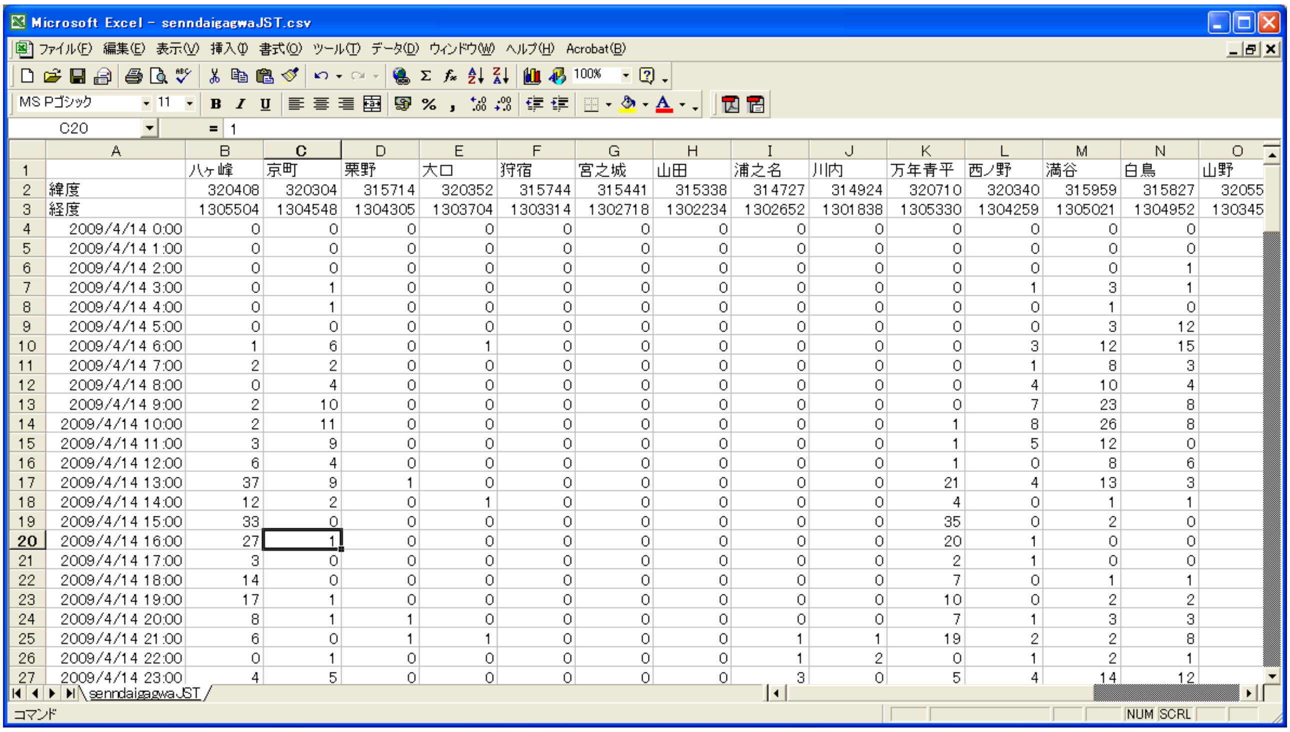

File content sample by Excel



Microsoft Excel - senndaigagwaJST.csv

C20 = 1

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1		八ヶ峰	京町	栗野	大口	狩宿	宮之城	山田	浦之名	川内	万年青平	西ノ野	満谷	白鳥	山野
2	緯度	320408	320304	315714	320352	315744	315441	315338	314727	314924	320710	320340	315959	315827	32055
3	経度	1305504	1304548	1304305	1303704	1303314	1302718	1302234	1302652	1301838	1305330	1304259	1305021	1304952	130345
4	2009/4/14 0:00	0	0	0	0	0	0	0	0	0	0	0	0	0	
5	2009/4/14 1:00	0	0	0	0	0	0	0	0	0	0	0	0	0	
6	2009/4/14 2:00	0	0	0	0	0	0	0	0	0	0	0	0	1	
7	2009/4/14 3:00	0	1	0	0	0	0	0	0	0	0	1	3	1	
8	2009/4/14 4:00	0	1	0	0	0	0	0	0	0	0	0	1	0	
9	2009/4/14 5:00	0	0	0	0	0	0	0	0	0	0	0	3	12	
10	2009/4/14 6:00	1	6	0	1	0	0	0	0	0	0	3	12	15	
11	2009/4/14 7:00	2	2	0	0	0	0	0	0	0	0	1	8	3	
12	2009/4/14 8:00	0	4	0	0	0	0	0	0	0	0	4	10	4	
13	2009/4/14 9:00	2	10	0	0	0	0	0	0	0	0	7	23	8	
14	2009/4/14 10:00	2	11	0	0	0	0	0	0	0	1	8	26	8	
15	2009/4/14 11:00	3	9	0	0	0	0	0	0	0	1	5	12	0	
16	2009/4/14 12:00	6	4	0	0	0	0	0	0	0	1	0	8	6	
17	2009/4/14 13:00	37	9	1	0	0	0	0	0	0	21	4	13	3	
18	2009/4/14 14:00	12	2	0	1	0	0	0	0	0	4	0	1	1	
19	2009/4/14 15:00	33	0	0	0	0	0	0	0	0	35	0	2	0	
20	2009/4/14 16:00	27	1	0	0	0	0	0	0	0	20	1	0	0	
21	2009/4/14 17:00	3	0	0	0	0	0	0	0	0	2	1	0	0	
22	2009/4/14 18:00	14	0	0	0	0	0	0	0	0	7	0	1	1	
23	2009/4/14 19:00	17	1	0	0	0	0	0	0	0	10	0	2	2	
24	2009/4/14 20:00	8	1	1	0	0	0	0	0	0	7	1	3	3	
25	2009/4/14 21:00	6	0	1	1	0	0	0	1	1	19	2	2	8	
26	2009/4/14 22:00	0	1	0	0	0	0	0	1	2	0	1	2	1	
27	2009/4/14 23:00	4	5	0	0	0	0	0	3	0	5	4	14	12	

senndaigagwaJST

コマンド NUM SCRL

The IFAS can treat ground rainfall data of both hourly and daily.

The daily rainfall can be treated to hourly ones, by distributing the value in a simple way.

The format of daily rainfall is as follows.

Daily rainfall data in case of three locations from14 April 2009 to 23 April 2009

Line 1: empty, location 1, location 2, location 3
Line 2: Latitude of, location 1, location 2, location 3
Line 3: Longitude of, location 1, location 2, location 3
Line 4: 2009/04/14 0:00, observed value for, location 1, location 2, location 3
Line 5: 2009/04/15 0:00, observed value for, location 1, location 2, location 3
Line 6: 2009/04/16 0:00, observed value for, location 1, location 2, location 3
.
.
.
Line13: 2009/04/23 0:00, observed value for, location 1, location 2, location 3

Information of observation locations (Lines 1–3)

Information of observed values Date, time and rainfall (Lines 4–13)

【Notes】the time of daily rainfall can be 0:00 or the calculation start time.

(4) Actual flow data

In IFAS, the Result Viewer can display hydro-graph when importing the actual flow data.

The data file format of actual flow is as follows.

The file format is CSV text, which is comma separated.

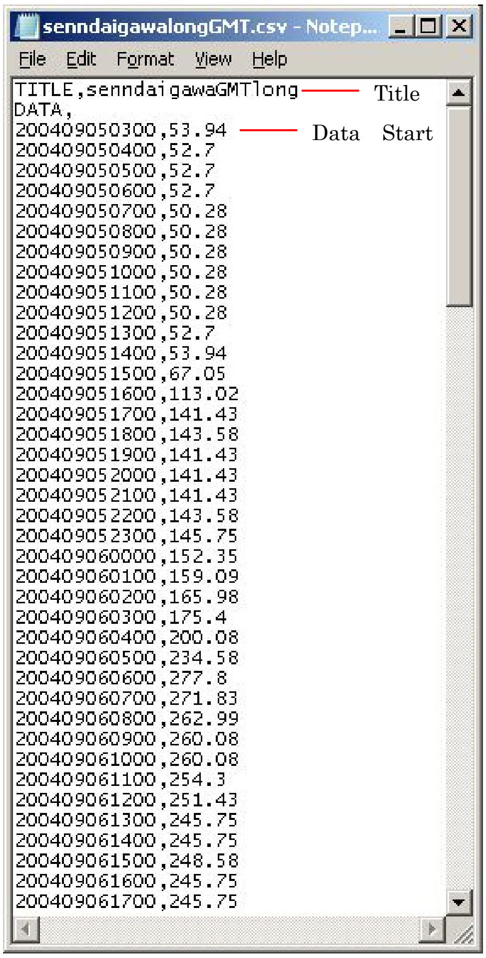
Actual flow on14 April 2009 (hourly data)

Line 1: "TITLE", title	"TITLE" is fixed; title is optional.
Line 2: "DATA",	"DATA" is fixed (comma is necessary)
Line 3: 200904140000, Actual flow Line 4: 200904140100, Actual flow Line 5: 200904140200, Actual flow Line 6: 200904140300, Actual flow . . . Line 27: 200904142300, Actual flow	Information of observed values Date, time and raifall Lines between "DATA" and "EOD" are data.
Line 28: "EOD",	"EOD" is fixed (comma is necessary)

【Notes】"TITLE", "DATA" ,"EOD" are capital letters.

Lines after "EOD" are treated as invalid.

File content sample by text editor




```
TITLE,senndaigawaGMTlong
DATA,
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200409050400,52.7
200409050500,52.7
200409050600,52.7
200409050700,50.28
200409050800,50.28
200409050900,50.28
200409051000,50.28
200409051100,50.28
200409051200,50.28
200409051300,52.7
200409051400,53.94
200409051500,67.05
200409051600,113.02
200409051700,141.43
200409051800,143.58
200409051900,141.43
200409052000,141.43
200409052100,141.43
200409052200,143.58
200409052300,145.75
200409060000,152.35
200409060100,159.09
200409060200,165.98
200409060300,175.4
200409060400,200.08
200409060500,234.58
200409060600,277.8
200409060700,271.83
200409060800,262.99
200409060900,260.08
200409061000,260.08
200409061100,254.3
200409061200,251.43
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200409061500,248.58
200409061600,245.75
200409061700,245.75
```

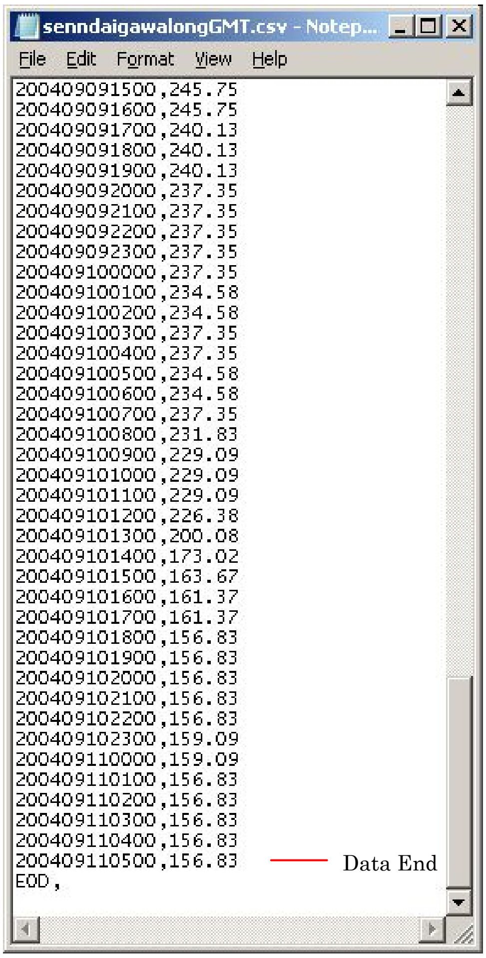


```
200409091500,245.75
200409091600,245.75
200409091700,240.13
200409091800,240.13
200409091900,240.13
200409092000,237.35
200409092100,237.35
200409092200,237.35
200409092300,237.35
200409100000,237.35
200409100100,234.58
200409100200,234.58
200409100300,237.35
200409100400,237.35
200409100500,234.58
200409100600,234.58
200409100700,237.35
200409100800,231.83
200409100900,229.09
200409101000,229.09
200409101100,229.09
200409101200,226.38
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200409101400,173.02
200409101500,163.67
200409101600,161.37
200409101700,161.37
200409101800,156.83
200409101900,156.83
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200409102100,156.83
200409102200,156.83
200409102300,159.09
200409110000,159.09
200409110100,156.83
200409110200,156.83
200409110300,156.83
200409110400,156.83
200409110500,156.83
EOD,
```
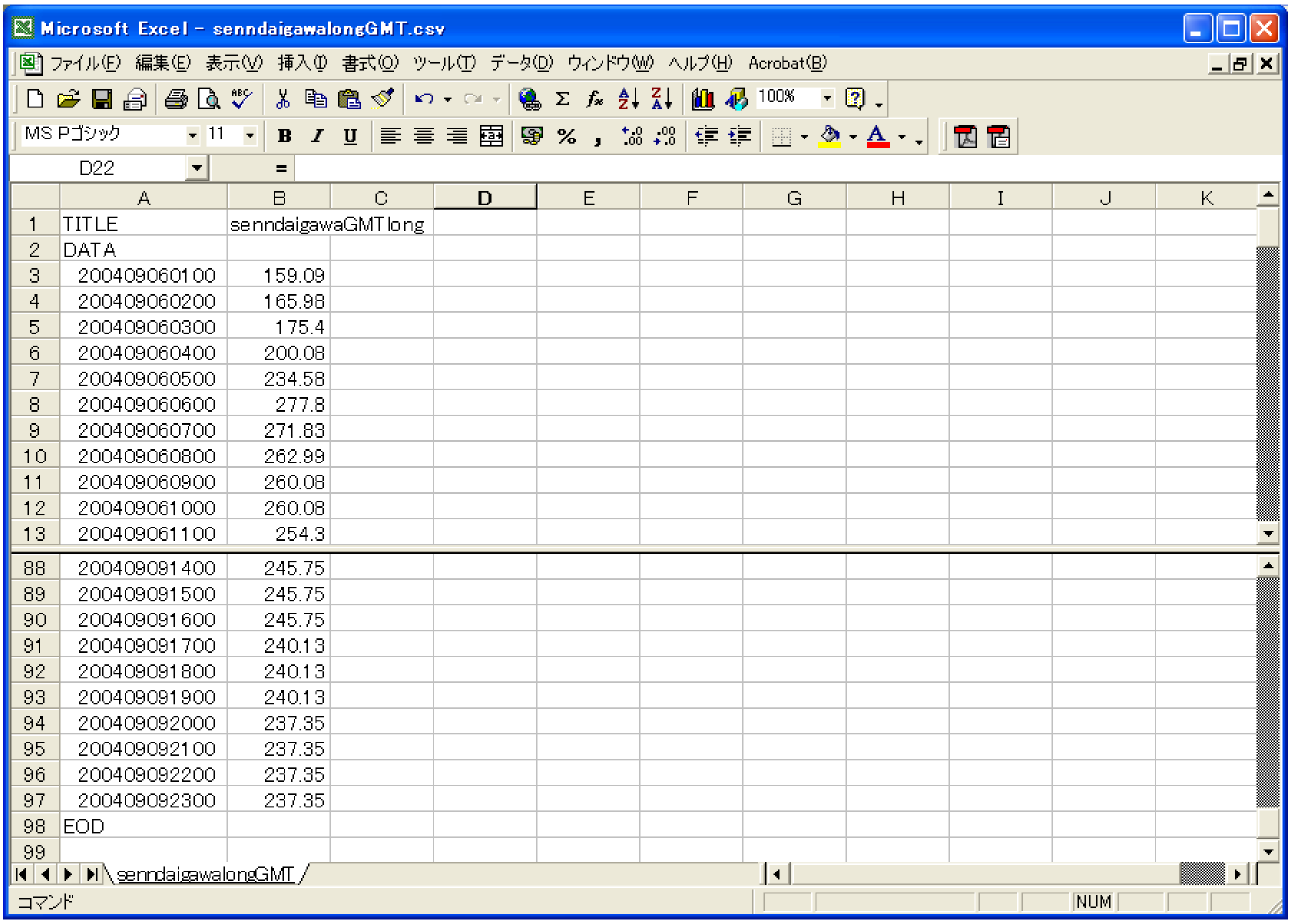
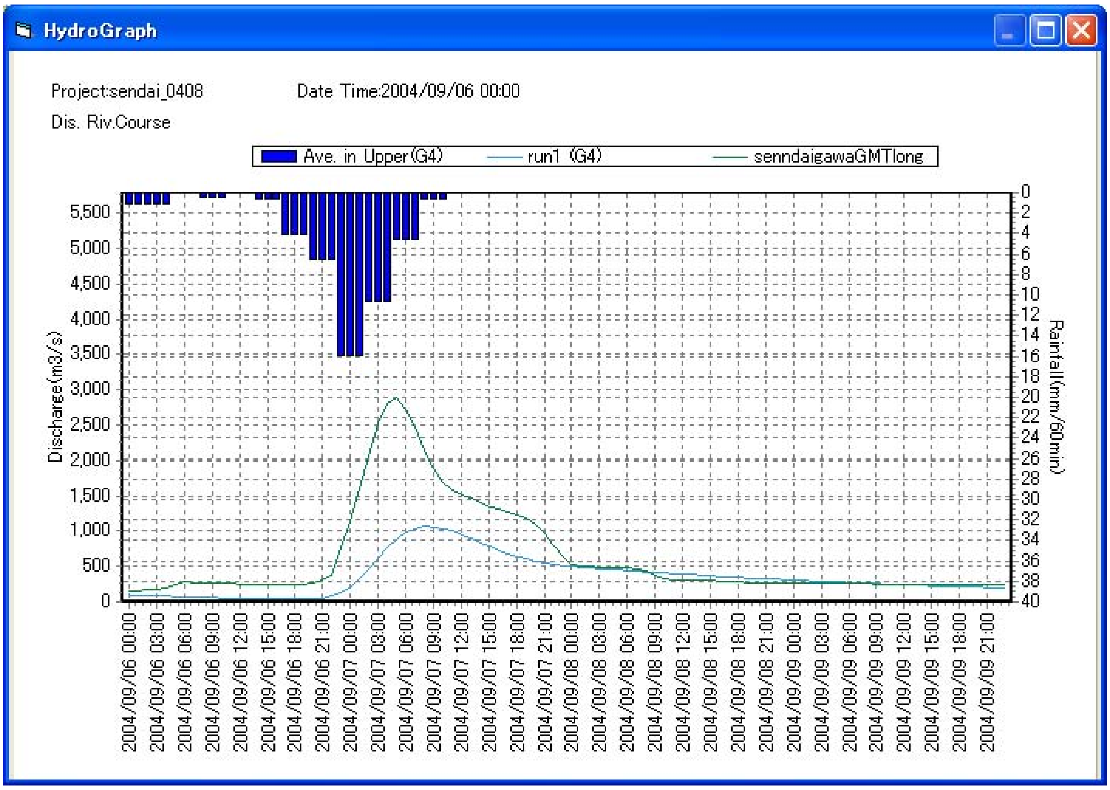

File content sample by Excel



Microsoft Excel - senndaigawalongGMT.csv

	A	B
1	TITLE	senndaigawaGMTlong
2	DATA	
3	200409060100	159.09
4	200409060200	165.98
5	200409060300	175.4
6	200409060400	200.08
7	200409060500	234.58
8	200409060600	277.8
9	200409060700	271.83
10	200409060800	262.99
11	200409060900	260.08
12	200409061000	260.08
13	200409061100	254.3
88	200409091400	245.75
89	200409091500	245.75
90	200409091600	245.75
91	200409091700	240.13
92	200409091800	240.13
93	200409091900	240.13
94	200409092000	237.35
95	200409092100	237.35
96	200409092200	237.35
97	200409092300	237.35
98	EOD	
99		

Sample of calculation result hydrograph with the imported actual flow data



(5) River cross section chart and H-Q data

In IFAS, the Result Viewer can display water table of section shape and calculation flow in hydro-graph when importing the cross section data and coefficient of H-Q equation.

The file format of river cross section chart and H-Q data are as follows.

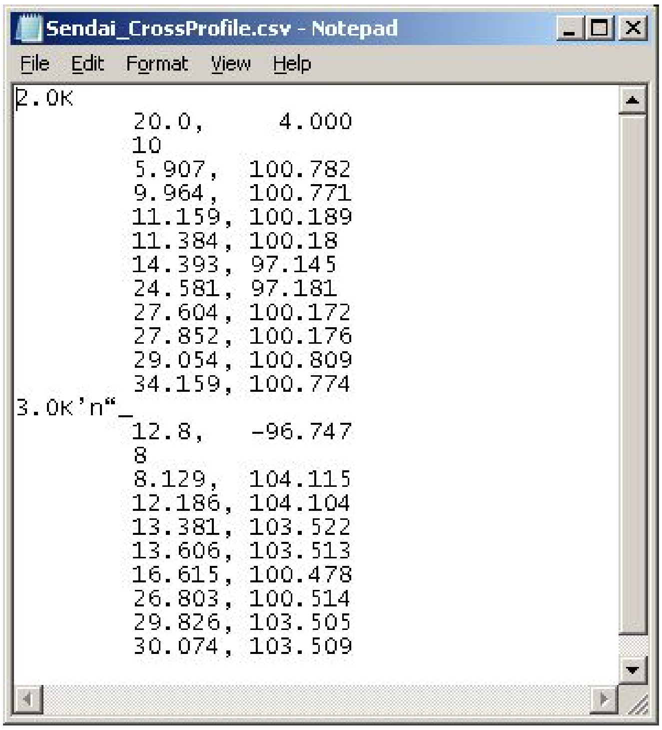
The file format is CSV text, which is comma separated.

Data with a number of cross section grids of ten

Line 1: Label (location name etc.)	Location name, any text distance mark
Line 2: coefficient a, b	Coefficient of H-Q equation
Line 3: number of cross sections	Number of cross section's coordinatitions (intergal value)
Line 4: X Coordinates (1), Y Coordinates (1) Line 5: X Coordinates (2), Y Coordinates (2) Line 6: X Coordinates (2), Y Coordinates (2) . . . Line n+3: X Coordinates (n), Y Coordinates (n)	Grid data of cross section (number of lines = number of grids) X Coordinates (horizontal distance), Y Coordinates (elevation)

Notes) the system repeats the data in same style to create multiple cross sections (refer to the sample below).

File content sample by text editor




```
2.0K
         20.0,     4.000
         10
         5.907,  100.782
         9.964,  100.771
         11.159, 100.189
         11.384, 100.18
         14.393, 97.145
         24.581, 97.181
         27.604, 100.172
         27.852, 100.176
         29.054, 100.809
         34.159, 100.774
3.0K'n"_
         12.8,    -96.747
         8
         8.129,  104.115
         12.186, 104.104
         13.381, 103.522
         13.606, 103.513
         16.615, 100.478
         26.803, 100.514
         29.826, 103.505
         30.074, 103.509
```

H-Q equation

$$Q = a \times (H + b)^2 , \qquad H = \sqrt{a \div Q} - b$$

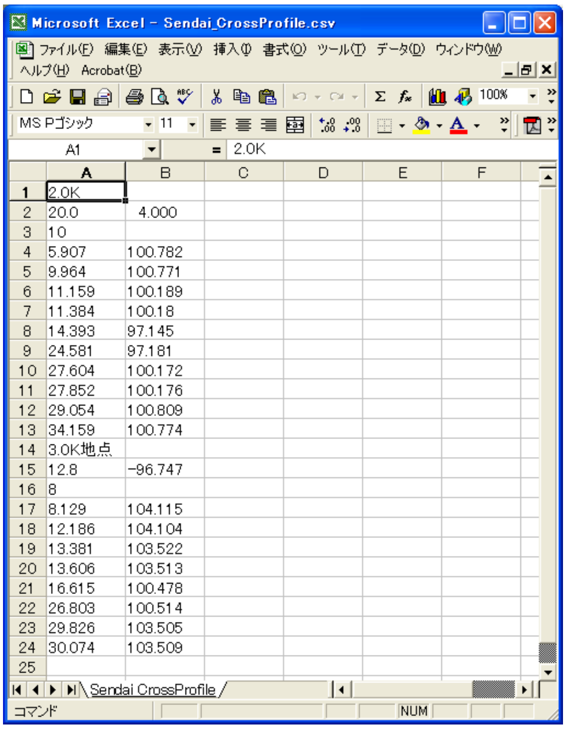
Q : flow

H : water height

a : coefficient a

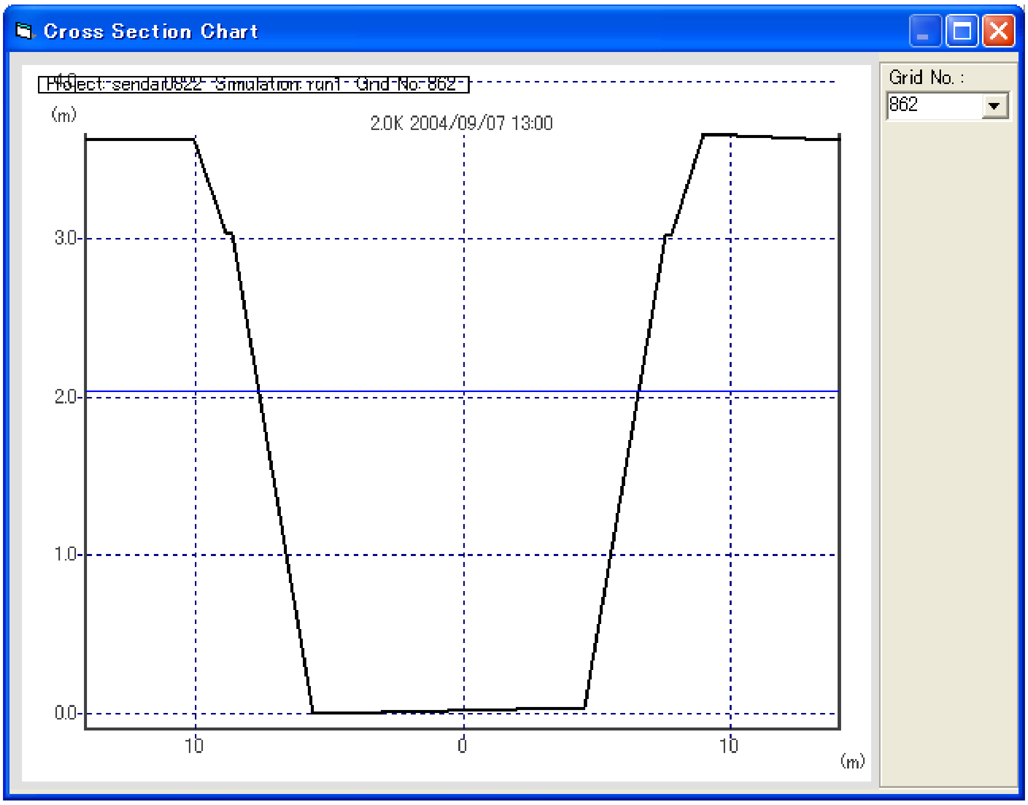
b : coefficient b

File content sample by Excel



	A	B
1	2.0K	
2	20.0	4.000
3	10	
4	5.907	100.782
5	9.964	100.771
6	11.159	100.189
7	11.384	100.18
8	14.393	97.145
9	24.581	97.181
10	27.604	100.172
11	27.852	100.176
12	29.054	100.809
13	34.159	100.774
14	3.0K地点	
15	12.8	-96.747
16	8	
17	8.129	104.115
18	12.186	104.104
19	13.381	103.522
20	13.606	103.513
21	16.615	100.478
22	26.803	100.514
23	29.826	103.505
24	30.074	103.509
25		

Sample of calculation result hydrograph with the imported cross section and coefficient data of H-Q equation.



Information 3, Simulation engine: the PWRI (Public Works Research Institute, Japan) Distributed Model

(1) The distributed model

The runoff model is a model used to calculate the conversion of rainfall into runoff. It can be approximately classified to distributed and centralized models.

The centralized model is based on the assumed relationship between rainfall and outflow. The relationship is a Black Box and contains several constants that determine the relationship. The constants can be set from the observed rainfall and outflow data, or estimated from the similar rivers.

The distributed model can be divided to physical distributed and constant distributed models. The physical distributed model treats the outflow as a migration phenomenon of rainfall in the river basin and represents the migration process by using infiltration and/or simple inequilateral flow equations

In current, there is no model that can totally represent the migration process by physical functions; however, several models that can partly represent the migration process have been promoted. Generally, the physical distributed model needs much information as soil, geology, and river shape for modeling; consequently, the time for calculation becomes long. However, the constant model uses the concept model for estimating outflow that comes from the river basin (generally on mesh), which greatly shortens the calculation time and is considered as the appropriate model for flood forecasting.

(2) Feature of the PWRI Distributed Model

So far, the development of the PWRI Distributed Model has processed from ver.1 to ver.3.

Ver1: configured by three tanks on vertical direction

Ver2: configured by two tanks on vertical direction (shortening the calculation time for flood outflow calculation)

Ver3: considering evaporation and transpiration for low outflow calculation

The IFAS uses PWRI Distributed Model (ver.2) as the runoff simulation engine, features of which are shown below.

① The outflow from each mesh is estimated by non-linear tank model. The non-linear ship is not totally a Black Box but also uses the Manning and hyperbolic approximations

② The model uses landform, soil, geology, and land use information as its constants; and can simply estimate the parameters.

③ For storage coefficients, the saturated rainfall has to be changed according to each flood to enhance the fitness of flood. However, it is difficult to forecast the saturated rainfall before a flood. The PWRI Distributed Model has used a two-layer non-linear tank configuration for avoiding the said changing on saturated rainfall. Because there is no need to estimate the saturated rainfall of an uncertain flood, the model is considered as an appropriate flood forecast model.

④ In general, the fitness to middle and small flood of flood simulation using storage coefficient method is low. Because of that the storage coefficient method is a one-layer non-linear model and is difficult to overlap the big flood and middle/small ones, which have the distinguishing features. The PWRI Distributed Model has used the two-layer non-linear tank configuration for enhancing the fitness to middle/small floods.

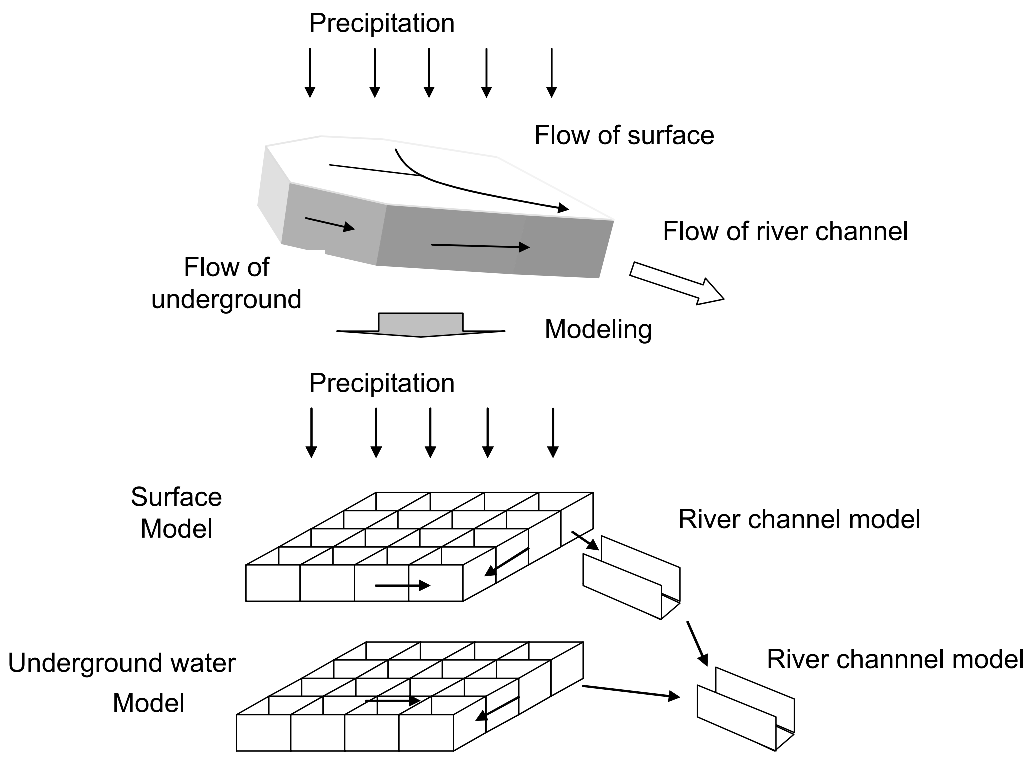
⑤ For numerical calculation, the IFAS does not use the convergence calculation for analyzing differential equation. It uses a function approximation to calculate the time integral equation can conducts the analyzing by repeating the integral calculation. Because of the said reason, the system can conduct the numeral calculation smoothly and rapidly and is appropriate for real time operation.

⑥ For tracking river channels, the IFAS uses Kinematic Wave Model to calculate the time delay without thinking mistake.

In addition, the ver.2 of PWRI Distributed Model contains the configuration of two tanks on vertical direction, the concept is shown as follows.

Configuration of the model

Model	Function
Surface Model	Infiltration to underground. Surface runoff. Surface storage. Evaporation from ground level. Rapid intermediate ouflow.
Underground water Model	Outflow of underground water
River course Model	Flowing of river channel

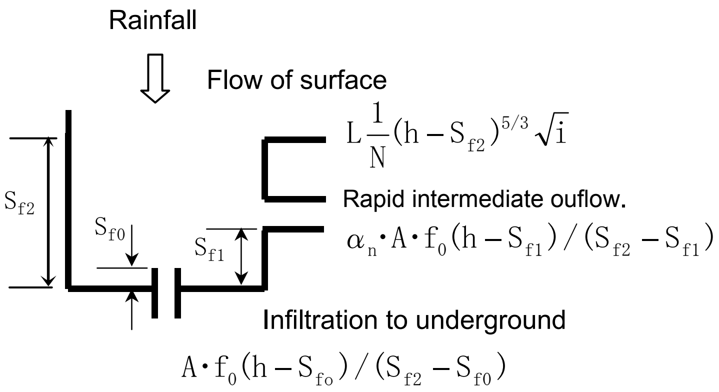


Scheme image of the model

(3) Outlines of each model

a. Surface model

The surface model is a model used to divide the rainfall to surface, rapid intermediate, and ground infiltration flows. The top right, bottom right and central bottom orifices represent the surface, rapid intermediate and ground infiltration flows, respectively. The surface outflow is estimated as a fraction (3/5) of storage capacity based on the Manning Law. The rapid intermediate flow is also estimated as a fraction of storage capacity. The ground infiltration is estimated as a fraction of storage capacity based on the Darcy Law.



Concept image of the surface model

① If $h \geqq S_{f2}$, then

$$\frac{\partial h}{\partial t} = R - E_{ps} - Q_0 - Q_{sf} - Q_{ri} \quad \cdots\cdots \quad (1)$$

② If $S_{f1} \leqq h < S_{f2}$, then

$$\frac{\partial h}{\partial t} = R - E_{ps} - Q_0 - Q_{ri} \quad \cdots\cdots \quad (2)$$

③ If $S_{f0} \leqq h < S_{f1}$, then

$$\frac{\partial h}{\partial t} = R - E_{ps}/S_{f1} \cdot h - Q_0 \quad \cdots\cdots \quad (3)$$

④ If $h \leqq S_{f0}$, then

$$\frac{\partial h}{\partial t} = R - E_{ps}/S_{f1} \cdot h \quad \cdots\cdots \quad (4)$$

where, R: rainfall; Q_0: infiltration for infiltrate model

Q_{sf}: surface outflow; h: storage height for model

S_{f2}: height where surface flow occurs; Q_{ri}: fast intermediate outflow

S_{f1}: height where intermediate outflow occurs; S_{f0}: height where ground infiltration occurs

E_{ps}: Evapotranspiration

Assume that the ground infiltration equal to saturated hydraulic conductivity (h = S_{f2}), then

$$Q_0 = \alpha_0(h - S_{f0})A \qquad \alpha_0 = f_0/(S_{f2} - S_{s0}) \cdots\cdots \quad (5)$$

where, f_0 is final infiltration capacity.

Assume that the early intermediate flow is a fraction of water depth, then

$$Q_{ri} = \alpha_{ri} \cdot \alpha_0 \cdot (h - S_{f1})A \cdots\cdots \quad (6)$$

where, α_{ri} is a coefficient.

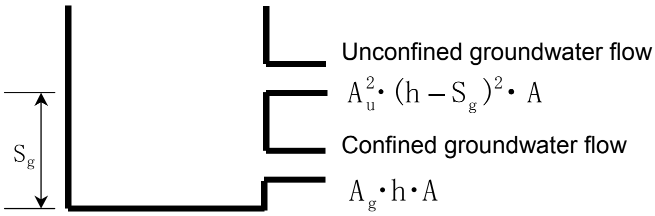
The surface flow is the equation as below. Assume that the roughness coefficient is equal to N of equivalent roughness model, then

$$Q_s = \beta(h - S_{f2})^{5/3} \qquad \beta = 1/ni^{1/2}/L \cdots\cdots \quad (7)$$

where, n is roughness coefficient; L is length of mesh

b. Groundwater tank

The configuration of groundwater model is shown as figure below. The top right and button right orifices represent the unconfined and confined groundwater flows, respectively. Outflow of ground water is considered as a fraction of confined ground water to h, and of unconfined groundwater to h^2.



Concept image of groundwater model

① If $h \geqq S_g$, then

$$\frac{\partial h}{\partial t} = Q_{in} - Q_{g1} - Q_{g2} \cdots\cdots \quad (8)$$

② If $h < S_g$, then

$$\frac{\partial h}{\partial t} = Q_{in} - Q_{g1} - Q_{g2} \cdots\cdots \quad (9)$$

where, Q_{in}: inflow from infiltration mode; h: storage height of model

Q_{g1}: Unconfined groundwater outflow; S_g: height where unconfined groundwater outflow occurs

Q_g: Unconfined and confined groundwater outflow

The outflows of unconfined and confined groundwater are as follows

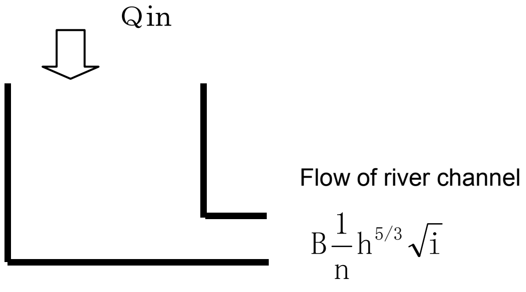
$$Q_{in} = A_u^2(h - S_g)^2 A \cdots\cdots \quad (10)$$

$$Q_{g2} = A_g hA \cdots\cdots \quad (11)$$

where, A_u and A_g are coefficients for calculating unconfined and confined groundwater outflows.

c. River channel model

The configuration of river channel model is shown in figure below. Outflow is base on Manning equation.



Concept image of river channel model

$$LB\frac{\partial h}{\partial t} = Q_{in}\text{-}Q_r \quad \cdots\cdots \quad (12)$$

where, Q_{in}: inflow from ground water and upstream river channel models

Q_r: outflow of river channel

L: length of river channel

B: breadth of river channel

Assume that the river channel flow adapts to Manning Equation

$$Qr = 1/nh^{5/3}i^{1/2}B \quad \cdots\cdots \quad (13)$$

Base on the Resume Law, the river channel breadth will be

$$B = cA^s \quad \cdots\cdots \quad (14)$$

where, c and s are constants (s is generally less than one).

Because the model has considered runoff, the influence on outflow of river course can be omitted.

The model also has considered time delay; the basic equation is as follows:

$$\frac{\partial A}{\partial t} + \frac{\partial Q}{\partial x} = 0 \quad Q = \frac{1}{n}Bh^{5/3}I^{1/2} \quad \cdots\cdots \quad (15)$$

where, Q is flow; A is area of cross-section, which equals to Bh; h is water depth; I is gradient of riverbed; n is coefficient of roughness; x is the coordinates of flow direction; t is time.

Simulation is conducted by using the difference method, as $\frac{\partial Q}{\partial t} + C\frac{\partial Q}{\partial x} = 0$ and $C = \frac{dQ}{dA}$

Differential equation is represented as following,

$$\frac{1}{2\Delta t}\left(Q_i^{n+1} + Q_{i+1}^{n+1} - Q_i^n - Q_{i+1}^n\right) + \frac{C}{2\Delta x}\left(Q_{i+1}^n + Q_{i+1}^{n+1} - Q_i^n - Q_i^{n+1}\right) = 0 \quad \cdots\cdots \quad (16)$$

where, I is falling distance multiplying by suffix; n is suffix of time direction.

$$Q_{i+1}^{n+1} = \frac{\left(\frac{1}{2\Delta t} + \frac{C}{2\Delta x}\right)Q_i^n + \left(\frac{1}{2\Delta t} - \frac{C}{2\Delta x}\right)Q_{i+1}^n + \left(-\frac{1}{2\Delta t} + \frac{C}{2\Delta x}\right)Q_i^{n+1}}{\frac{1}{2\Delta t} + \frac{C}{2\Delta x}} \quad \cdots\cdots\cdots\cdots \text{(17)}$$

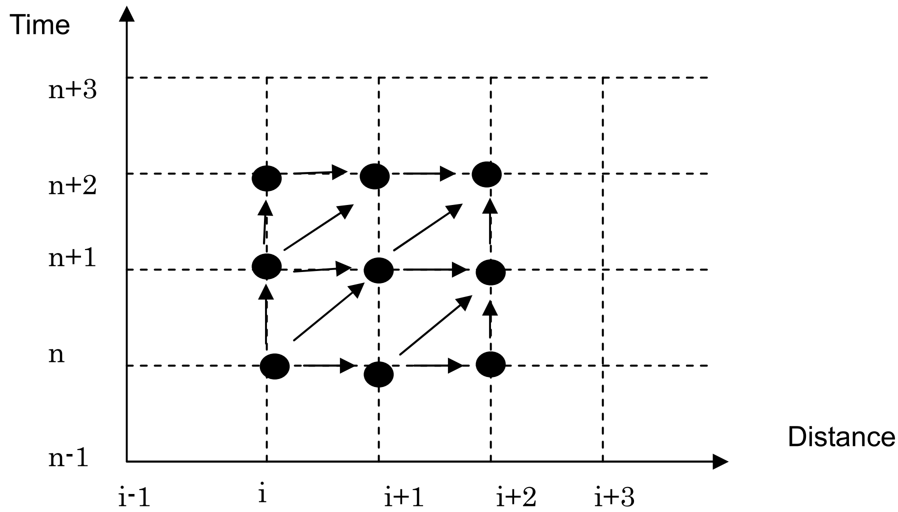
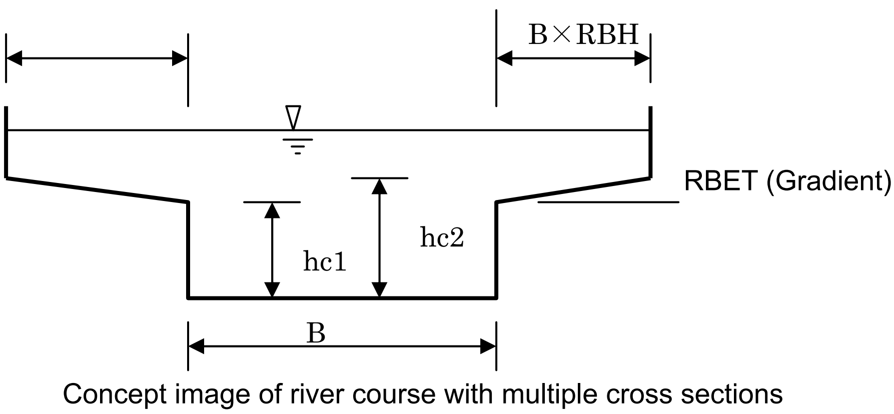


Image of Kinematic Wave difference method

This model conducts calculation by treating *Δx* as the mesh length and by shortening the *Δt.* In addition, river course with compound sections also can be calculated in this model. Furthermore, the model assumes that the flow rate of flood channel is 0 m^3/hour or day, and calculates the discharge of low flow channel section only. Because the section area contains that of flood channel, storage effect with considering the flood channel has been included in the model. Finally, the storage effect of flood channel (considered as flood area) around the river can be optionally selected in this model.



Concept image of river course with multiple cross sections

① *B* is set as:

$B = RBW \cdot A^{RBS}$ where, *B* is river breadth (m); *A* is area of river basin (km^2); *RBW* and *RBS* are constants.

② *hc1* is set as:

$hc1 = RHW \cdot A^{RHS}$ where, *B* is river breadth (m); *A* is area of river basin (km^2); *RHW* and *RHS* are constants.

③ *hc2* is set as:

$$hc2 = RHW \cdot A^{RHS} + B \cdot RBH \cdot RBET$$

④ Because the wave speed when *h*≦*hc1* is

$A = Bh$, then

$$C_0 = \frac{\frac{dQ}{dh}}{\frac{dA}{dh}} = \frac{\frac{5}{3}\frac{1}{n}Bh^{2/3}i^{1/2}}{B} = \frac{5}{3}\frac{1}{n}h^{2/3}i^{1/2} = \frac{5}{3}Q^{2/5}n^{-3/5}I^{3/10}B^{-2/5} \quad \cdots\cdots\cdots\cdots \quad (18)$$

⑤ Wave speed, when *hc1*≦*h*＜*hc2*

Because $A = Bh + RBET \cdot (h - h_{c1})^2$, then

$$C = \frac{\frac{dQ}{dh}}{\frac{dA}{dh}} = \frac{\frac{5}{3}\frac{1}{n}Bh^{2/3}i^{1/2}}{B + 2(h - h_{c1})/RBET} = \frac{B}{B + 2\left(\left(\frac{Qn}{BI^{1/2}}\right)^{3/5} - h_{c1}\right)/RBET}C_0 \quad \cdots \quad (19)$$

⑥ Wave speed, when *hc2*≦*h*

Because $A = Bh + RBET \cdot (h_{c2} - h_{c1})^2 + 2B \cdot RBET(h - h_{c2})$, then

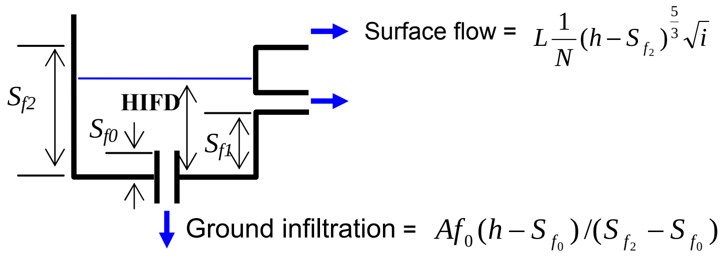
$$C = \frac{\frac{dQ}{dh}}{\frac{dA}{dh}} = \frac{\frac{5}{3}\frac{1}{n}Bh^{2/3}i^{1/2}}{B + 2B \cdot RBH} = \frac{1}{1 + 2RBH}C_0 \quad \cdots\cdots\cdots\cdots \quad (20)$$

Information 4, Setting parameters

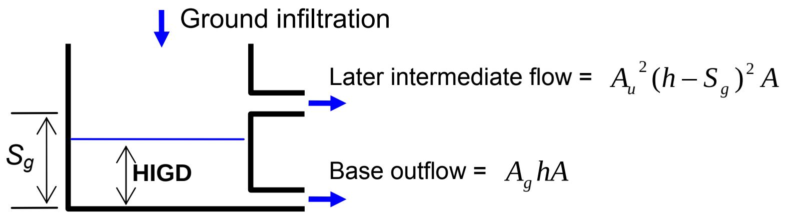
(1) Description of parameters

The PWRI model (ver.2) is used for runoff simulation engine in IFAS. The PWRI consists of three models, which are surface, groundwater, and river course models. The figures below show the outlines and parameters of each model.

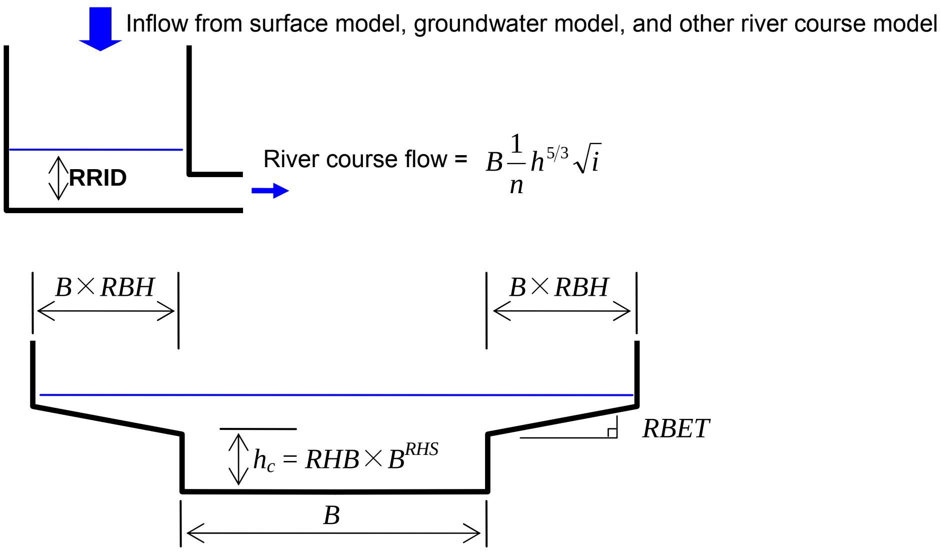
【Surface model】



【Groundwater model】



【River course model】



Simulation model and parameters (PWRI distributed model ver.2)

The tables below show the explanation of parameters.

Surface model: list of parameters

Parameter	Symbol	Notation	Unit	Explanation
Final infiltration capacity	f_0	SKF	cm/s	This coefficient regulates the flow of water infiltrating from surface to underground. Higher the coefficient is, higher the storage height of aquifer tank, and lower the surface outflow will be. The approximate values for different land use from reference are listed as below: ・for paddy field and urban land: 10^{-4}～10^{-5} ・for mountain and natural forest: 10^{-3} ・for active fault: 10^{-2}
Maximum storage height	S_{f2}	HFMXD	m	Storage height when the surface runoff occurs The value for forest where the surface runoff can easily occurs is high than that for urban land where the surface runoff can hardly occurs
Rapid intermediate flow Height where occurs	S_{f1}	HFMND	m	The height where a rapid intermediate flow occurs
Height where ground infiltration occurs	S_{f0}	HFOD	m	The height where a ground infiltration occurs The storage water doesn't flow if the height is less than S_{f0}
Surface roughness coefficient	N	SNF	$m^{-1/3}/s$	The roughness coefficient of ground surface Dividing land use by using GLCC data etc.
Mesh length	L	—	m	Mesh length of the simulation model In IFAS, it can be set when getting the elevation model.
Rapid intermediate flow Regulation coefficient	α_n	FALFX	Non-dimensional	Regulation factor that determining the rapid intermediate flow. Set as a value of primary outflow rate. The standard value for rivers of Japan is 0.5 (by storage function method). Historical value at the Fourth Epoch in volcanic basin area is 0.65. In addition, the value changes with the saturated situation of ground.
Initial storage height	—	HIFD	m	Initial value for surface model Set as 0 m by assuming the surface dryness condition before the flood is coming.

Groundwater model: list of parameters

Parameter	Symbol	Notation	Unit	Explanation
Slow intermediate flow Regulation coefficient	A_u	AUD	$(1/mm/day)^{1/2}$	Regulation factor that determining the slow intermediate flow. The IFAS focuses on the target flood that coming in one week and this factor can be regulated when simulating the slow intermediate flow.
Base flow coefficient	A_g	AGD	1/day	Regulation factor that determining the base flow. The IFAS focuses on the target flood that coming in one week and this factor can be regulated when simulating the outflow before flood is coming.
Storage height where the slow intermediate flow occurs	S_g	HCGD	m	Storage height at which the slow intermediate flow occurs
Initial storage height	—	HIGD	m	Initial value for groundwater model This value and A_g are used for setting outflow before flood is coming. Because the calculation is not smooth when HIGD ＞ HCGD, so set HIGD≦HCGD

River course model: list of parameters

Parameter	Symbol	Notation	Unit	Explanation
Breadth of river channel	B	-	m	Estimated width of river channel base on the Resume Law. The Resume Law is a equation based on the hypothesis that river width is determined based on river flow $B = c \times Q^s$; Q is outflow
Constant of the Resume Law: c	c	RBW	Non-dimensional	Constant of the Resume Law Generally c＝3.5～7
Constant of the Resume Law: *s*	*s*	RBS	Non-dimensional	Constant of the Resume Law Generally s = 0.5
Manning's roughness coefficient	*n*	RNS	$m^{-1/3}/s$	Manning's roughness coefficient n=1/M
Initial water table of river channel	—	RRID	m	Initial value for calculation
Infiltration of aquifer tank	—	RGWD	1/day	Coefficient of infiltration from the river channel to the groundwater tank The IFAS focuses on the target flood that coming in one week, so set the infiltration from river channel tank to aquifer tank as 0.
Coefficient of cross shape	—	RHW	Non-dimensional	Height from low flow channel to bank (h_c) estimated as h_c = RHB×B^{RHS}
Same as above	—	RHS	Non-dimensional	Height from low flow channel to bank (h_c) estimated as h_c = RHB×B^{RHS}
Same as above	—	RBH	Non-dimensional	Flood channel width and low-flow channel width Flood channel width = B×RBH B is the width of river channel that estimated according to Resume Law
Same as above	—	RBET	Non-dimensional	Vertical gradient of flood channel
Same as above	—	RLCOF	Non-dimensional	Because the landform model of IFAS is composed by square meshes, length of river is set as that of the mesh. However, for serpentine rivers, the length is not equal to that of mesh, modification is necessary.

(2) How to set parameters

This section explains how to set parameters. The system firstly sets a standard parameter as the initial value and finally calibrates that by using the observed and/or hydrological reference data. Locations where the hydrological reference data cannot be fully generated should use the standard values.

Hereafter is the explanation on standard parameters and on how to set parameter for each model.

Setting parameters with or without the river basin data

		Observed hydrological data	
		with	without
River channel data	with	・ Verification and calculation on parameters of surface and groundwater models ・ Setting parameters of river channel	・ Setting parameters of river channel ・ Using standard value for surface and groundwater models
	without	・ Verification and calculation on parameters of surface and groundwater models ・ Using standard value for parameters of river channel	・ Using standard value for all models

Observed hydrological observation data: temporal flow data at flow calculated location. Including *H-Q* equation, using temporal data of water table data to calculate flow.

River channel data: investigating figure of cross-section, plane map, local photos etc.. Data that can distinguish the river width, situation inner river channel (for setting roughness coefficient use).

a. Standard parameters

The standard parameters are used as the initial values of parameter verification and for calculation when there is no observed flood data. They are set when developing IFAS based on the test cases. Though the system can calculate by using the standard parameter when the historical hydrology data is unavailable, we recommend user checking the flood trace data and/or flow ratio data (outflow/basin area) around target calculation area, confirming the validity of results, and calibrating the parameters by site measurement.

b. How to set the parameters of surface and groundwater models

This section explains how to set the parameters of surface and groundwater models. The parameters are set by trail and error, as calculated wave form of flood outflow can be simulated by measured values. The figure shows the principles for setting parameters below.

How to set the parameters of surface and groundwater models

Surface model

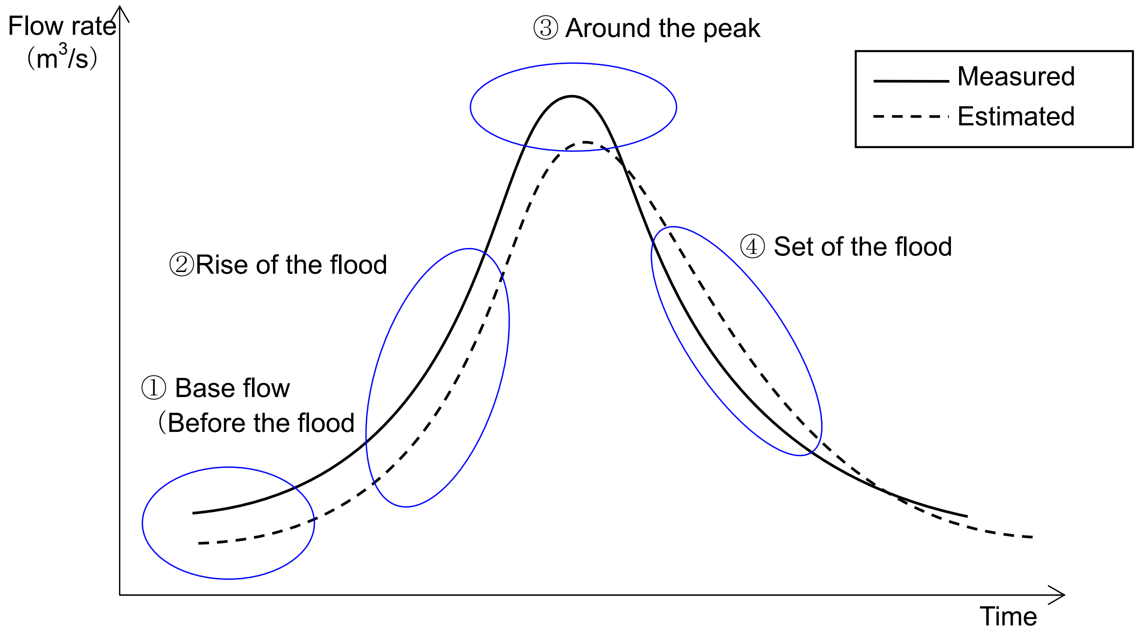
<table>
<tr><th>Parameter</th><th>Symbol</th><th>Notation</th><th>Unit</th><th>How to set</th></tr>
<tr><td>Final infiltration capacity</td><td>f_0</td><td>SKF</td><td>cm/s</td><td>Set by trail and error</td></tr>
<tr><td>Maximum storage height</td><td>S_{f2}</td><td>HFMXD</td><td>m</td><td>Set by trail and error</td></tr>
<tr><td>Rapid intermediate flow
Height where occurs</td><td>S_{f1}</td><td>HFMND</td><td>m</td><td>Set by trail and error</td></tr>
<tr><td>Height where ground infiltration occurs</td><td>S_{f0}</td><td>HFOD</td><td>m</td><td>Set by trail and error</td></tr>
<tr><td>Surface roughness coefficient</td><td>N</td><td>SNF</td><td>$m^{-1/3}/s$</td><td>The value refers to equivalent roughness coefficient
Land use if classified by GLCC

Reference equivalent roughness coefficient (N)
<table>
<tr><th colspan="3">Land use</th><th>Std. value</th></tr>
<tr><td colspan="3">Water surface</td><td>0.0</td></tr>
<tr><td colspan="3">Paddy filed</td><td>2.0</td></tr>
<tr><td colspan="3">Mountain forest</td><td>0.7</td></tr>
<tr><td colspan="3">Hills, pastures, parks, golf ground, cropland</td><td>0.3</td></tr>
<tr><td colspan="3">Urban land</td><td>0.03</td></tr>
<tr><td rowspan="4">Urbanization level</td><td>1°</td><td>Road and street are partly paved, lots of bare ground are left.
Drainage network is completed</td><td>0.1</td></tr>
<tr><td>2°</td><td>Road and street pavement is in progress
Sewage nets is not completed</td><td>0.05</td></tr>
<tr><td>3°</td><td>50% road and street are paved
Sewage network is almost completed</td><td>0.01</td></tr>
<tr><td>4°</td><td>Road and street are completely paved. Sewage network is completed</td><td>0.005</td></tr>
</table>
Source） Hashimoto et., al., 1977. Runoff model and civil technological material for evaluating land use. In Japanese. We added water surface as a new item</td></tr>
<tr><td>Mesh length</td><td>L</td><td>—</td><td>m</td><td>Mesh length of the simulation model</td></tr>
<tr><td>Rapid intermediate flow
Regulation coefficient</td><td>α_n</td><td>FALFX</td><td>Non-dimensional</td><td>Set by trail and error</td></tr>
<tr><td>Initial storage height</td><td>—</td><td>HIFD</td><td>m</td><td>Basically, as 0 m</td></tr>
</table>

Groundwater model

Parameter	Symbol	Notation	Unit	Explanation
Runoff coefficient of unconfined groundwater	A_u	AUD	$(1/mm/day)^{1/2}$	Set by trail and error
Runoff coefficient of confined groundwater	A_g	AGD	1/day	Set by trail and error
Height where the unconfined groundwater runs off	S_g	HCGD	m	Set by trail and error
Initial storage height	—	HIGD	m	Set by trail and error

Here, we explain the response change of waveform to adjustment of each parameter.

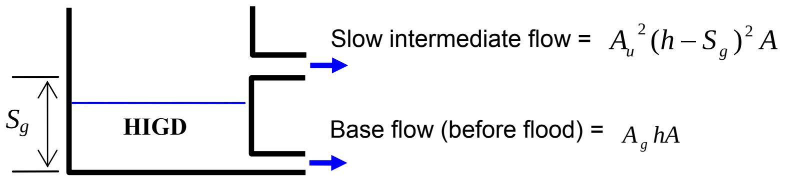


Modified locations in flood wave-form and the parameters

① Base flow (before flood)

The outflow before flood is used to modify the parameters of groundwater model. It is the outflow from the river basin under no rain conditions. It depends on the coefficient A_g (AGD), which determines the initial storage height (HIGD) of groundwater tank and base flow.

To enlarge the outflow that before flood, enlarge the values of HIGD and AGD. This value and A_g are used for setting outflow before flood is coming. Because a slow intermediate flow will occur from the calculation start time when enlarging the initial value HIGD higher than S_g (HCGD), and the calculation will become not smooth, the system sets HIGD≦HCGD.

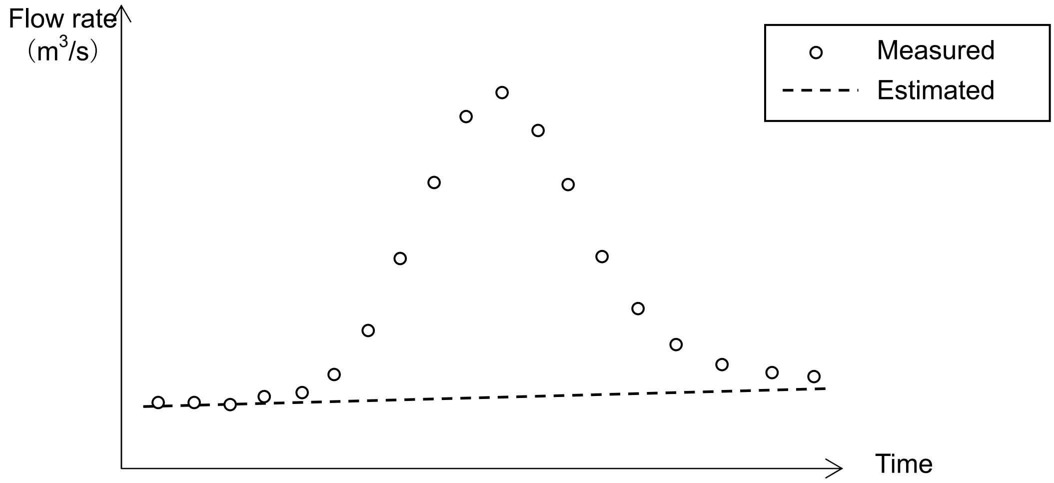


Setting Base flow (before flood)

[Reference]

This a method for setting parameters HIGD and S_g (HCGD) by calculating with rainfall as 0, and comparing the calculated result with observed flow data. When calculation is conducted as the condition of no rainfall, because the water in groundwater tank (HIGD > 0) will flow to the end with time goes by, the outflow slowly increases and goes through the water of lower reach and approaches 0.

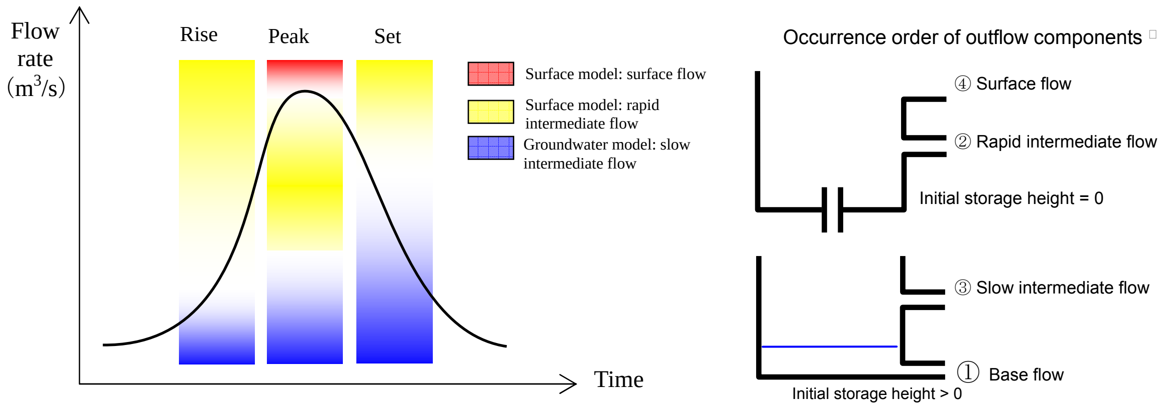
The calculating time of which calculation is conducted as the condition of no rainfall is an approximate one during the no-rain period in local basin area. Take a case in Japan as example, empirically, the flow becomes stable in a calculation time of one – two weeks.



Wave form of outflow under no rain conditions

② Rise part

For tank model, the outflow from upper tanks is earlier than that from lower tanks. This is because the outflow of structurally upper and lower tanks occurs only after the water has been supplied from upper tanks through the infiltration under ground. The figure shows each part of waveform of flood and the configuration ratio of outflow components. The major outflow of rise part is “rapid intermediate flow”, whose flow is early. In contrast, the major outflow of set part is “slow intermediate flow”, which is caused by the increased storage height of groundwater tank. When adjusting the waveform of flood to measured values, users has to understand the configuration features of tank model and verify the parameters firstly.



※ Enlarging the infiltration capacity of f_0 (SKF) that to groundwater tank may make the slow intermediate flow become faster. Oppositely, the surface outflow may become faster.

Configuration ratio of runoff components (scheme image)

The flow of rise part mainly depends on the rapid intermediate flow of surface model. User can correct the rise part of waveform by correcting the parameters of outflow components form surface.

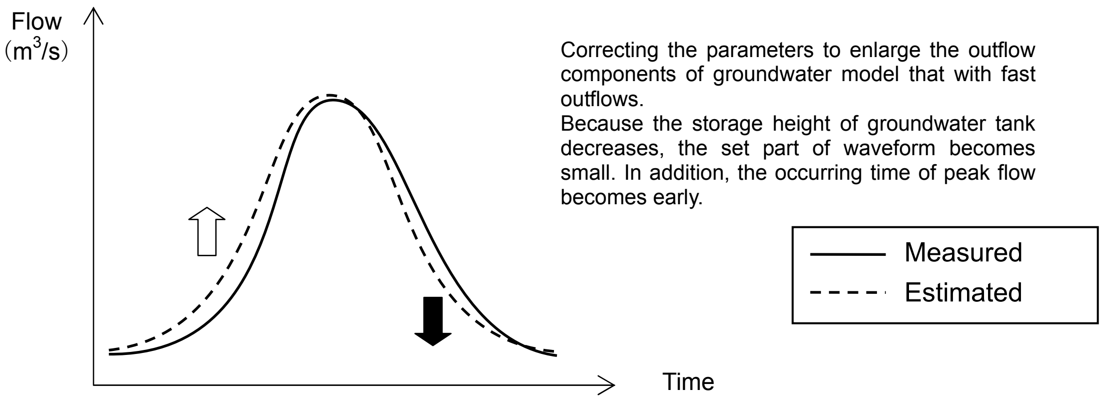
To enlarge the outflow of rise part, user can adjust the parameters below.

・adjusting the value of f_0 (SKF) smaller to enlarge the storage height of surface model.

・adjusting the value of S_{f1} (HFMND) smaller to make the rapid intermediate flow occurs easily.

・adjusting the value ofα_n (FALAX) smaller to enlarge the volume of rapid intermediate flow.

In addition, if the outflow of surface model is enlarged, because the storage height of groundwater model will decrease, the set part of flood waveform becomes smaller.

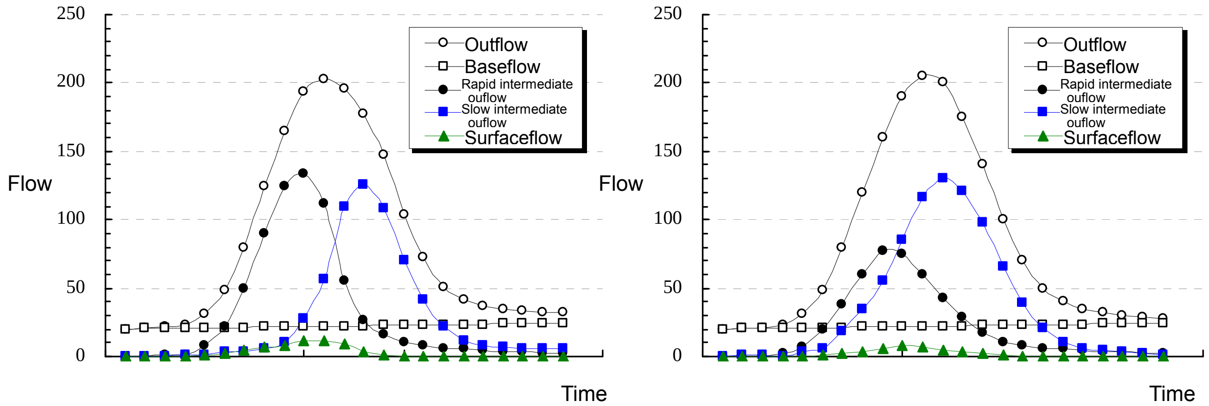


Modification of rise part (in case of increased)

③ Around the peak flow

The estimated flow is a sum of the outflow components of surface model (surface flow and slow intermediate flow) and groundwater model (base flow and slow intermediate flow). To enlarge to peak flow, user has to try-and-error each parameter to match the peaks of each outflow components.

The peak flow may be approximately simulated when the configurations of outflow components are different. In Fig. 4.7, (a) is the calculated result when rapid intermediate ouflow is higher than slow intermediate outflow; (b) is that when rapid intermediate ouflow is lower than low intermediate outflow. Thouth the waveform of rise and set part differs, the values of peak flow are always the same. Because the simulation of rise part in flood forecasting is comparatively important, the system uses the parameter with good performance in simulation as the final value when estimating the peak flow.



(i) Rapid intermediate ouflow > Slow intermediate outflow (ii) Rapid intermediate ouflow < Slow intermediate outflow

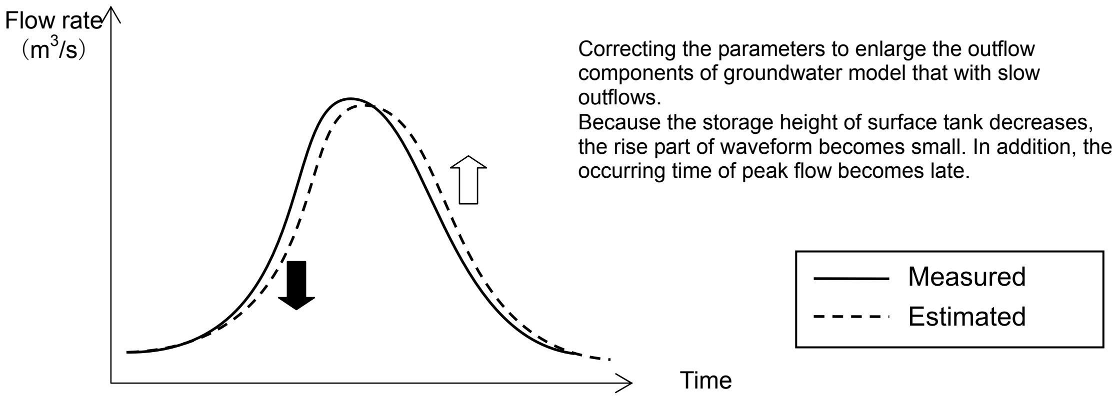
Attention point when simulating the peak flow

④ Set part

The set part depends on the outflow components of groundwater model at which the outflow is slow. User can enlarge the outflow of set part by adjusting the parameters below.

- Enlarging the value of S_{f1}(HFMND) to set the rapid intermediate flow smaller
- Enlarging the value of f_0(SKF) to set the storage height of groundwater model bigger
- Enlarging the value of AUD to set the slow intermediate flow bigger

For enlarging the outflow of groundwater model, because the storage height of surface model decreases when setting the storage height of groundwater model bigger, the rise part of wave from becomes smaller.



Modification of set part (in case of increased)

The features of each parameter are shown in the table below. These features are qualitative ones and may be different due to satiations of storage height and/or landform of each tank.

Features for parameters of surface and groundwater models

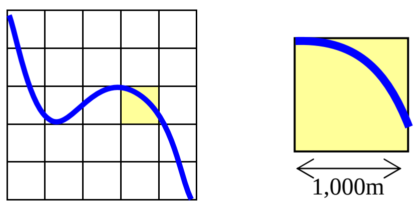
Parameter	Symbol	Notation	Variation in constant	Features
Final infiltration capacity	f_0	SKF	big	Storage height of groundwater tank increases. Because of the increased outflow from groundwater tank, it is effective to enlarge the set part of wave form and/or delay the peak.
			small	Storage height of surface tank increases. Because of the increased outflow from groundwater tank, it is effective to enlarge the rise part of wave form and/or delay the peak.
Maximum storage height	S_{f2}	HFMXD	big	Surface outflow becomes slow. Whether or not the peak flow will become small depends on the flow from tank, landform and land use.
			small	Surface outflow becomes fast. Whether or not the peak flow will become big depends on the flow from tank, landform and land use.
Height where rapid intermediate outflow occurs	S_{f1}	HFMND	big	Rise part of wave form becomes small. Peak flow becomes slow.
			small	Rise part of wave form becomes big. Peak flow becomes fast.
Height where underground infiltration occurs	S_{f0}	HFOD	big	Whole wave form becomes small. Water cannot be converted to runoff component increases
			small	Whole wave form becomes big. When set as 0, water can all be converted to runoff component.
Roughness coefficient of ground surface	N	SNF	big	Surface outflow becomes slow. Whether or not the peak flow will become small depends on the flow from tank, landform and land use.
			small	Surface outflow becomes fast. Whether or not the peak flow will become big depends on the flow from tank, landform and land use.
Mesh length	L	—	big	—
			small	—
Regulation coefficient of rapid intermediate outflow	α_n	FALFX	big	Rise part of wave form becomes big.
			small	Rise part of wave form becomes small.
Initial storage height of surface tank	—	HIFD	big	—
			small	—
Regulation coefficient of slow intermediate outflow	A_u	AUD	big	Set part of wave form becomes big.
			small	Set part of wave form becomes small.
Coefficient of base outflow	A_g	AGD	big	Base flow becomes big.
			small	Base flow becomes small.
Height where slow intermediate outflow occurs	S_g	HCGD	big	Set part of wave form becomes small.
			small	Set part of wave form becomes big. Peak flow becomes fast.
Initial storage height of groundwater tank	—	HIGD	big	Base flow becomes big.
			small	Base flow becomes small.

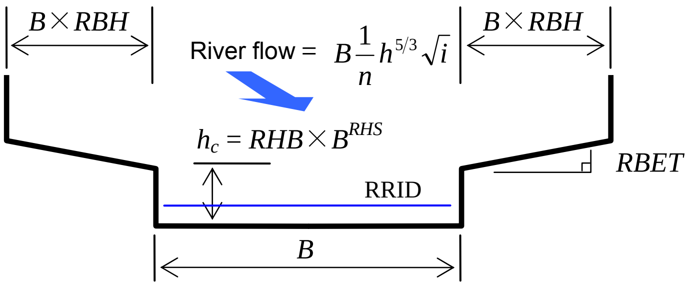
c. How to set parameters of river channel

This section explains how to set the parameters of river channel. The parameters of river channel are set based on the features of river channel and without using the adjustment on wave form of flood. This is for avoiding the complex verifications of parameters by fixing them.

The feature of river channel can be determined from local survey, landform map, and air photos.

How to set parameters for river channel model

<table>
<tr><th>Parameter</th><th>Symbol</th><th>Notation</th><th>Unit</th><th>How to set</th></tr>
<tr><td>Breadth of river channel</td><td>B</td><td>-</td><td>m</td><td>Estimated width of river channel base on the Resume Law.
$B = c \times Q^{s}$; Q is outflow</td></tr>
<tr><td>Constant of the Resume Law: c</td><td>c</td><td>RBW</td><td>m</td><td>Constant of the Resume Law
Generally c＝3.5～7</td></tr>
<tr><td>Constant of the Resume Law: s</td><td>s</td><td>RBS</td><td>Non-dimensional</td><td>Constant of the Resume Law
Generally s = 0.5</td></tr>
<tr><td>Manning's roughness coefficient</td><td>n
(=1/M)</td><td>RNS</td><td>$m^{-1/3}/s$</td><td>Set from the feature of river channel
Reference: Condition of river and waterway and range of roughness coefficient
<table>
<tr><th colspan="2">Condition of river and waterway</th><th>Range of Manning's n</th></tr>
<tr><td rowspan="8">Artificial waterway and rehabilitated rivers</td><td>Concrete artificial waterway</td><td>0.014～0.020</td></tr>
<tr><td>Half spiral tube waterway</td><td>0.021～0.030</td></tr>
<tr><td>Small waterway with stone-banks (mud bed)</td><td>0.025(Ave.)</td></tr>
<tr><td>Bedrock unregulated</td><td>0.035～0.050</td></tr>
<tr><td>Bedrock regulated</td><td>0.025～0.040</td></tr>
<tr><td>Clay bed, flow rate without scouring</td><td>0.016～0.022</td></tr>
<tr><td>Sandy roam, clay roam</td><td>0.020(Ave.)</td></tr>
<tr><td>Drag line dredge, little grass</td><td>0.025～0.033</td></tr>
<tr><td rowspan="7">Natural rivers</td><td>Plain without small waterway and grass</td><td>0.025～0.033</td></tr>
<tr><td>Plain with small waterway, grass, irrigation</td><td>0.030～0.040</td></tr>
<tr><td>Small waterway, much grass, car polite bed</td><td>0.040～0.055</td></tr>
<tr><td>Mountain channel, gravel, boulder</td><td>0.030～0.050</td></tr>
<tr><td>Mountain channel, gravel, large boulder</td><td>0.040 以上</td></tr>
<tr><td>Big channel, clay, sandy riverbed</td><td>0.018～0.035</td></tr>
<tr><td>Big channel, car polite riverbed</td><td>0.025～0.040</td></tr>
</table>
Source） Supervised by the River Bureau, Ministry of Construction「River Erosion Control Technology Standards (Draft) chapter Survey」</td></tr>
<tr><td>Initial water table of river channel</td><td>—</td><td>RRID</td><td>m</td><td>Set from the ordinary water table</td></tr>
<tr><td>Infiltration of aquifer tank</td><td>—</td><td>RGWD</td><td>1/day</td><td>Basically, as 0</td></tr>
<tr><td>Coefficient of cross shape</td><td>—</td><td>RHW</td><td>Non-dimensional</td><td>Set from the features of river channel</td></tr>
<tr><td>Same as above</td><td>—</td><td>RHS</td><td>Non-dimensional</td><td>Set from the features of river channel</td></tr>
<tr><td>Same as above</td><td>—</td><td>RBH</td><td>Non-dimensional</td><td>Set from the features of river channel</td></tr>
<tr><td>Same as above</td><td>—</td><td>RBET</td><td>Non-dimensional</td><td>Set from the features of river channel</td></tr>
<tr><td>Same as above</td><td>—</td><td>RLCOF</td><td>Non-dimensional</td><td>Set from landform and mesh figures.
i.e.） If mesh length is 1,000 m, the river length of one mesh will be 1000 m. In field, the river length may longer than 1000 m, correction of coefficient is needed.

</td></tr>
</table>



Parameters of the river channel model

The parameters of river channel are for determining the range of catchments cells, and can be set multiply. For example, if the ranges of catchments cells run to river channel model are 0-100, 101-200, parameters can be respectively set for upstream river channel with less number of catchments cells and for lower reach with big catchments cells.

Information 5, Refer to the calculation of the evapotranspiration data

NCEP-DOE Reanalysis 2

We used the monthly averaged latent heat flux of the NCEP-DOE Reanalysis 2 to calculate evapotranspiration in IFAS. The URL of websites of the NCEP-DOE Reanalysis 2 is as follows;
http://www.cdc.noaa.gov/data/gridded/data.ncep.reanalysis2.html

The monthly averaged latent heat flux is available for download from the following URL.
ftp://ftp.cdc.noaa.gov/Datasets/ncep.reanalysis2.derived/gaussian_grid/lhtfl.sfc.mon.mean.nc
Spatial coverage of the data is from 88.542 N to 88.542 S and from 0 E to 358.125 E. Spatial resolution is approximately 1.9° degrees in latitude and longitude (Global T62 Gaussian grid 192 x 94). Temporal coverage is from January, 1979 to December, 2008

Calculation of evapotranspiration in the IFAS system

Evapotranspiration used in FAS is calculated from latent heat flux of the NCEP-DOE Reanalysis 2, which is shown as follows.
Latent heat of vaporization at -20°C, 0°C, 20°C is 2.549 x 10^6 J kg^{-1}, 2.5 x 10^6 J kg^{-1}, 2.453 x 10^6 J kg^{-1}, respectively. We used latent heat of vaporization at 20°C in all cases.
Latent heat requited to evaporate 1(mm day^{-1} m^{-2}) of water is calculated in the following equations. As the mass of the water per a unit area is 1 kg m^{-2}, therefore latent heat is calculated in the equation (1)

$$1\ (kg\ m^{-2}) / 86400\ (s) \times 2.5 \times 10^6\ (J\ kg^{-1}) = 28.4\ (J\ s^{-1}\ m^{-2}) \qquad (1)$$

As watt (W) is equivalent to joule per a second (J s^{-1}), therefore 28.4 (J s^{-1} m^{-2}) is equivalent to 28.4 (W m^{-2}). Evapotranspiration is written as,

$$1\ (mm\ day^{-1}) = 28.4\ (W\ m^{-2}) \qquad (2)$$

We use the equation (2) to calculate evapotranspiration from latent heat flux.

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