Annex 2

Step-by-step Guideline

for

MIKE 11-RR (NAM) Model

Biala River basin (EABD)

Pirinska Bistritsa River basin (WABD)

JICA Study Team

1. Biala River Basin

/Available information for model

From Core Data of GIS-DB

- Digital elevation model (50m grid)
- RiverNetwork and Catchment boundary

From Analysis Data of GIS-DB

- Monthly Potential Evapo-Transpiration (1km grid)

From TimeSeries Data of GIS-DB

- Daily average water quantity at HMS 62800 (2000 – 2005)
- Daily precipitation at precipitation sts. at 43450, 44410, 44420 (2000 – 2005)
- Daily average temperature at Meteorological st. at 43010 (Haskovo) (2000-2005)
-

/Model setting

Total catchment Area: 598.77 km^2

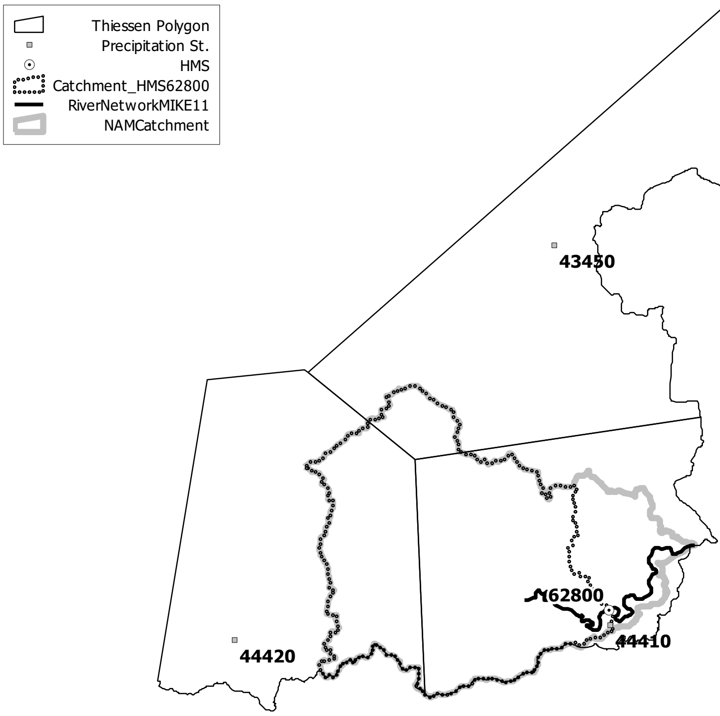
Number of catchment for Rainfall-Runoff model (NAM Catchment): 1

Number of river for MIKE11-HD: 1 (for next exercise)

In this exercise, effect of water abstraction and waste water discharge is neglected. Therefore, it is regarded that daily average water quantity at 62800 is almost equal to quasi-natural water quantity.

(1) Input data

1) Average Precipitaton



Average precipitation over a catchment is estimated by the following equation.

$$P_{ave} = C_{elc} P_{ave0}$$

$$C_{ele} = exp\left[0.0003\left(E_{ave} - E_{ave\_P}\right)\right]$$

$$P_{ave0} = \sum C_{pn} P_n$$

$$E_{ave\_p} = \sum C_{pn} E_n$$

where P_{ave} = average precipitation (mm), P_{ave0} = average precipitation before correction for elevation difference (mm), C_{ele} = correction coefficient for elevation difference between average elevation of catchment and one for precipitation sts. (-), E_{ave} = average elevation of catchment (m), E_{ave_p} = average elevation of precipitation stations (m), P_n = precipitation at station "n" (mm), C_{pn} = Thiessen coefficient for station "n" (-), E_n = elevation at station "n" (m).

Average elevation of catchment is derived from digital elevation model.

Thiessen coefficients for each precipitation station are calculated as follows.

Total catchment of Biala River Basin (NAM Catchment:BI_M)

Average elevation of catchment (m) E_{ave}	418	Catchment Area (km^2)	598.77

Station No.	43450	44410	44420	Average elevation of Precipitation sts. E_{ave_P}
Thiessen Coefficient C_{pn}	0.060	0.643	0.296	N/A
Elevation (m) E_n	240	100	450	212

Correction coefficient for elevation difference (m) C_{ele}	1.064

Watershed for HMS62800

Average elevation of catchment (m) E_{ave}	452	Catchment Area (km^2)	506.71

Station No.	43450	44410	44420	Average in catchment E_{ave_P}
Thiessen Coefficient C_{pn}	0.071	0.579	0.350	N/A
Elevation (m) E_n	240	100	450	233

Correction coefficient for elevation difference (m) C_{ele}	1.068

2) Average Potential Evapo-Transpiration

Average potential evapo-transpiration for a catchment is derived from 1km grid monthly evapo-transpiration.

3) Daily Average Temperature

Daily average temperature at Meteorological st. at 43010 (Haskovo) is directly used for simulation.

Elevation of Meteorological St. (m) at 43010	230

4) Elevation zone distribution

Catchment area is divided into several elevation zones for snow module in NAM model. Based on digital elevation model, area for each elevation zone within total catchment area is calculated as follows.

Total Catchment of Biala River Basin (NAM Catchment:BI_M)

Elevation Zone (m)	0 – 200	200 - 400	400 -600	600 - 800	800 - 1000	1000-1200	1200-1400
Representative Elevation (m)	100	300	500	700	900	1100	1300
Area (km^2)	59.58	231.92	210.33	77.28	13.32	6.26	0.08
Elevation Zone (m)	1400-1600	1600-1800	1800-2000	2000-2200	2200-2400	2400-2600	2600-2800
Representative Elevation (m)	1500	1700	1900	2100	2300	2500	2700
Area (km^2)	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Watershed for HMS62800

Elevation Zone (m)	0 – 200	200 - 400	400 -600	600 - 800	800 - 1000	1000-1200	1200-1400
Representative Elevation (m)	100	300	500	700	900	1100	1300
Area (km^2)	21.57	183.45	204.76	77.28	13.32	6.26	0.08
Elevation Zone (m)	1400-1600	1600-1800	1800-2000	2000-2200	2200-2400	2400-2600	2600-2800
Representative Elevation (m)	1500	1700	1900	2100	2300	2500	2700
Area (km^2)	0.00	0.00	0.00	0.00	0.00	0.00	0.00

5) Precipitation correction for each elevation zone

Catchment area is divided into several elevation zones for snow module in NAM model. Amount of precipitation for each elevation zone is corrected based on the following equation.

$$R_i = 100\left\{exp\left[0.0003\left(E_i - E_{ave}\right)\right] \quad 1\right\}$$

where R_i = Correction ratio (%), E_i = average elevation of each elevation zone (m), E_{ave} = average elevation of catchment (m),.

Correction ratio for each elevation zone is calculated as follows.

Total Catchment of Biala River Basin (NAM Catchment:BI_M)

Elevation Zone (m)	0 – 200	200 - 400	400 -600	600 - 800	800 - 1000	1000-1200	1200-1400
Representative Elevation (m)	100	300	500	700	900	1100	1300
Ri (%)	-9.09	-3.47	2.50	8.83	15.56	22.71	30.30
Elevation Zone (m)	1400-1600	1600-1800	1800-2000	2000-2200	2200-2400	2400-2600	2600-2800
Representative Elevation (m)	1500	1700	1900	2100	2300	2500	2700
Ri (%)	38.35	46.91	55.99	65.64	75.88	86.76	98.31

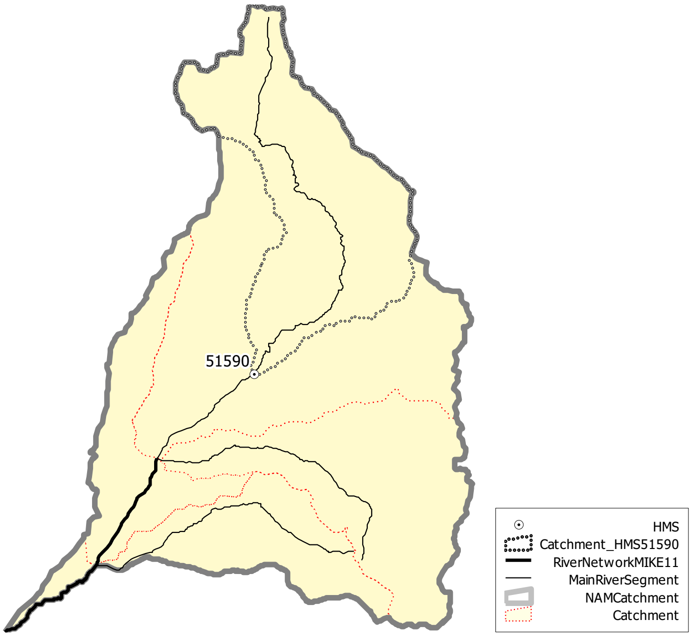
Watershed for HMS62800

Elevation Zone (m)	0 – 200	200 - 400	400 -600	600 - 800	800 - 1000	1000-1200	1200-1400
Representative Elevation (m)	100	300	500	700	900	1100	1300
Ri (%)	-10.02	-4.46	1.45	7.72	14.39	21.46	28.97
Elevation Zone (m)	1400-1600	1600-1800	1800-2000	2000-2200	2200-2400	2400-2600	2600-2800
Representative Elevation (m)	1500	1700	1900	2100	2300	2500	2700
Ri (%)	36.94	45.41	54.40	63.95	74.09	84.85	96.29

6) Input file name

	Total catchment of Biala River Basin (NAM Catchment: BI_M)	Watershed for HMS62800
DailyPrecipitation	DailyPrecipitation_Biala.dfs0	DailyPrecipitation_62800.dfs0
Monthly PET	MonthlyPET_Biala.dfs0	MonthlyPET_62800.dfs0
DailyAveTemperature	DailyAveTemperature.dfs0	DailyAveTemperature.dfs0
DailyAveWaterQuantity for calibration	N/A	DailyAveDischarge_62800.dfs0
Elevation zone	NAM_Parameters_Training.xls	NAM_Parameters_Training.xls
Precipitation correction ratio for each elevation zone	NAM_Parameters_Training.xls	NAM_Parameters_Training.xls

2. Pirinska Bistritsa River Basin



/Available information for model

From Core Data of GIS-DB

- Digital elevation model (50m grid)
- RiverNetwork and Catchment boundary

From Analysis Data of GIS-DB

- Monthly Potential Evapo-Transpiration (1km grid)

From TimeSeries Data of GIS-DB

- Daily average water quantity at HMS 51590 (2000 – 2005)
- Daily precipitation at precipitation sts. at 61600, 61610, 61640, 61660, 61670 (2000 – 2005)
- Daily average temperature at Meteorological st. at 15712 (Sandanski) (2000- 2005)

/Model setting

Total catchment Area: 508.29 km^2

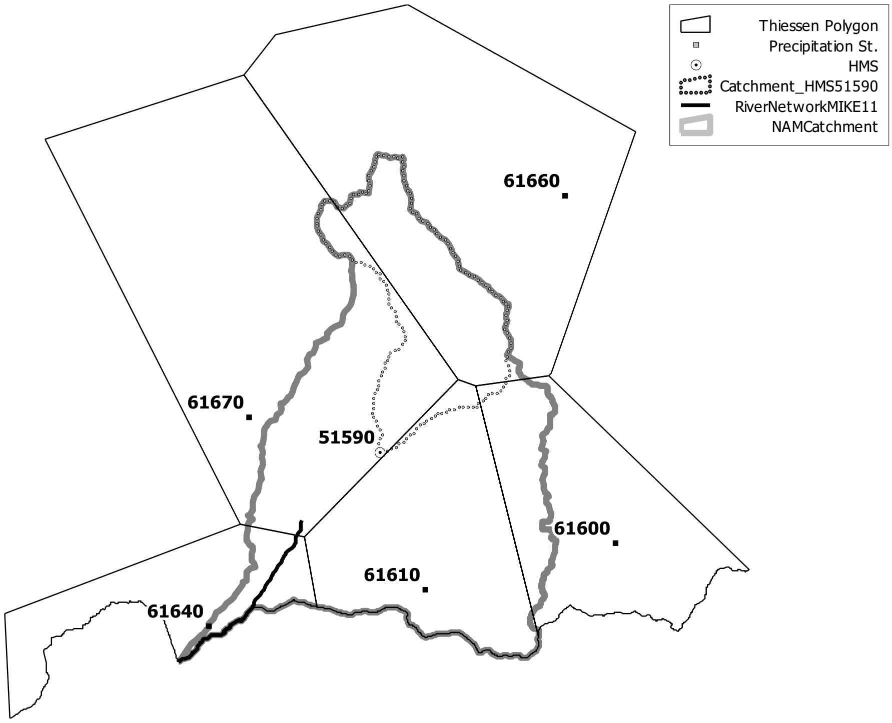
Number of catchment for Rainfall-Runoff model (NAM Catchment): 1

Number of river for MIKE11-HD: 1 (for next exercise)

In this exercise, effect of water abstraction and waste water discharge except intake by Pirinska Bistritsa-HPP is neglected. Observed data at HMS51590 is strongly affected by HPP. Based on monthly used water amount by Pirinska Bistritsa HPP, quasi-natural flow at HMS 51590 is estimated (2001-2004 only).

(2) Input data

1) Average Precipitaton



Average precipitation over a catchment is estimated by the following equation.

$$P_{ave} = C_{elc} P_{ave0}$$

$$C_{ele} = exp\left[0.0003\left(E_{ave} - E_{ave\_P}\right)\right]$$

$$P_{ave0} = \sum C_{pn} P_n$$

$$E_{ave\_p} = \sum C_{pn} E_n$$

where P_{ave} = average precipitation (mm), P_{ave0} = average precipitation before correction for elevation difference (mm), C_{ele} = correction coefficient for elevation difference between average elevation of catchment and one for precipitation sts. (-), E_{ave} = average elevation of catchment (m), E_{ave_p} = average elevation of precipitation stations (m), P_n = precipitation at station "n" (mm), C_{pn} = Thiessen coefficient for station "n" (-), E_n = elevation at station "n" (m).
Average elevation of catchment is derived from digital elevation model.

Thiessen coefficients for each precipitation station are calculated as follows.

Total catchment of Pirinska Bistritsa River Basin (NAM Catchment:ST_PIR)

Average elevation of catchment (m) E_{ave}	1015	Catchment Area (km^2)	508.29

Station No.	61600	61610	61640	61660	61670	Average elevation of Precipitation sts. E_{ave_P}
Thiessen Coefficient C_{pn}	0.100	0.377	0.059	0.167	0.298	N/A
Elevation (m) E_n	710	760	100	860	382	620

Correction coefficient for elevation difference (m) C_{ele}	1.126

Watershed for HMS51590

Average elevation of catchment (m) E_{ave}	1507	Catchment Area (km^2)	133.71

Station No.	61600	61610	61640	61660	61670	Average elevation of Precipitation sts. E_{ave_P}
Thiessen Coefficient C_{pn}	0.012	0.047	0.00	0.624	0.318	N/A
Elevation (m) E_n	710	760	100	860	382	702

Correction coefficient for elevation difference (m) C_{ele}	1.273

2) Average Potential Evapo-Transpiration

Average potential evapo-transpiration for a catchment is derived from 1km grid monthly evapo-transpiration.

3) Daily Average Temperature

Daily average temperature at Meteorological st. at 15712 (Sandanski) is directly used for simulation.

Elevation of Meteorological St. (m) at 15712	206

4) Elevation zone distribution

Catchment area is divided into several elevation zones for snow module in NAM model. Based on digital elevation model, area for each elevation zone within total catchment area is calculated as follows.

Total Catchment of Pirinska Bistritsa River Basin (NAM Catchment:ST_PIR)

Elevation Zone (m)	0 – 200	200 - 400	400 -600	600 - 800	800 - 1000	1000-1200	1200-1400
Representative Elevation (m)	100	300	500	700	900	1100	1300
Area (km^2)	18.39	62.09	70.96	51.35	58.09	52.20	60.76
Elevation Zone (m)	1400-1600	1600-1800	1800-2000	2000-2200	2200-2400	2400-2600	2600-2800
Representative Elevation (m)	1500	1700	1900	2100	2300	2500	2700
Area (km^2)	51.65	34.10	20.09	11.41	10.10	7.10	0.00

Watershed for HMS51590

Elevation Zone (m)	0 – 200	200 - 400	400 -600	600 - 800	800 - 1000	1000-1200	1200-1400
Representative Elevation (m)	100	300	500	700	900	1100	1300
Area (km^2)	0.00	0.18	3.22	7.98	10.92	14.62	22.06
Elevation Zone (m)	1400-1600	1600-1800	1800-2000	2000-2200	2200-2400	2400-2600	2600-2800
Representative Elevation (m)	1500	1700	1900	2100	2300	2500	2700
Area (km^2)	18.49	18.15	12.56	8.34	10.09	7.10	0.00

5) Precipitation correction for each elevation zone

Catchment area is divided into several elevation zones for snow module in NAM model. Amount of precipitation for each elevation zone is corrected based on the following equation.

$$R_i = 100\left\{exp\left[0.0003\left(E_i - E_{ave}\right)\right] \quad 1\right\}$$

where R_i = Correction ratio (%), E_i = average elevation of each elevation zone (m), E_{ave} = average elevation of catchment (m),.

Correction ratio for each elevation zone is calculated as follows.

Total Catchment of Pirinska Bistritsa River Basin (NAM Catchment:ST_PIR)

Elevation Zone (m)	0 – 200	200 - 400	400 -600	600 - 800	800 - 1000	1000-1200	1200-1400
Representative Elevation (m)	100	300	500	700	900	1100	1300
Ri (%)	-24.02	-19.32	-14.33	-9.03	-3.40	2.57	8.91
Elevation Zone (m)	1400-1600	1600-1800	1800-2000	2000-2200	2200-2400	2400-2600	2600-2800
Representative Elevation (m)	1500	1700	1900	2100	2300	2500	2700
Ri (%)	15.65	22.80	30.39	38.45	47.01	56.11	65.76

Watershed for HMS51590

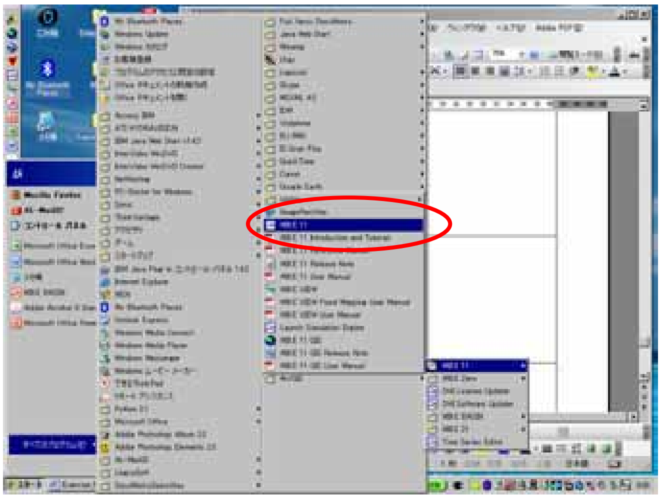
Elevation Zone (m)	0 – 200	200 - 400	400 -600	600 - 800	800 - 1000	1000-1200	1200-1400
Representative Elevation (m)	100	300	500	700	900	1100	1300
Ri (%)	-34.43	-30.38	-26.07	-21.50	-16.65	-11.49	-6.02
Elevation Zone (m)	1400-1600	1600-1800	1800-2000	2000-2200	2200-2400	2400-2600	2600-2800
Representative Elevation (m)	1500	1700	1900	2100	2300	2500	2700
Ri (%)	-0.21	5.96	12.51	19.47	26.86	34.70	43.03

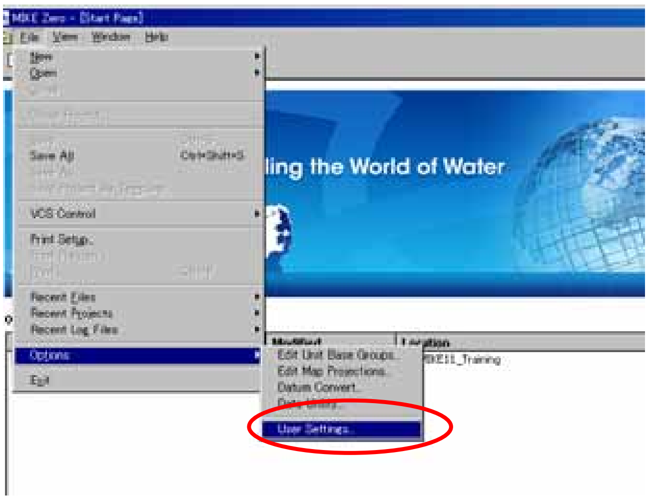
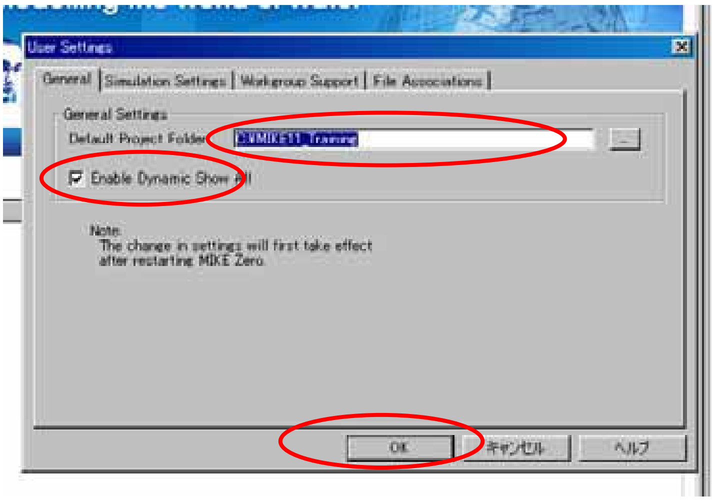
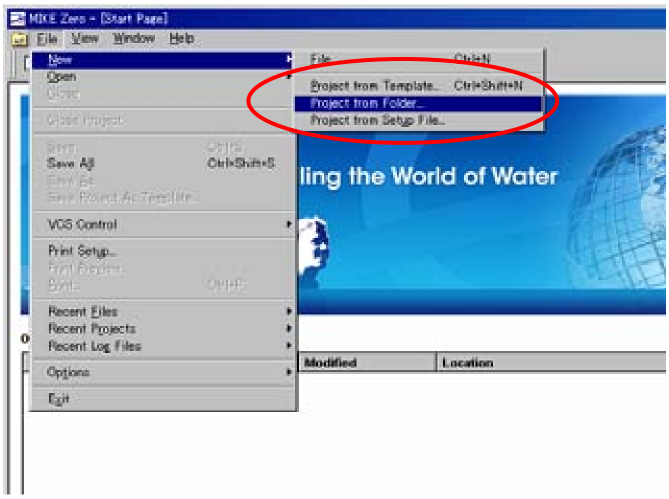
6) Input file name

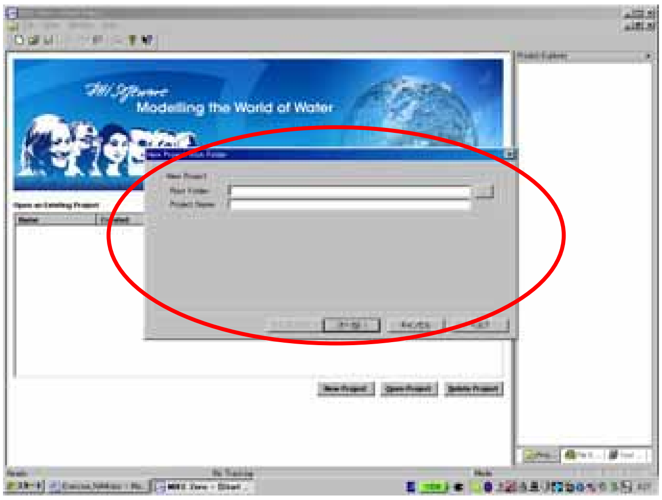
	Total catchment of Pirinska Bistritsa River Basin (NAM Catchment: ST_PIR)	Watershed for HMS51590
DailyPrecipitation	DailyPrecipitation_PirinskaB.dfs0	DailyPrecipitation_51590.dfs0
Monthly PET	MonthlyPET_PirinskaB.dfs0	MonthlyPET_51590.dfs0
DailyAveTemperature	DailyAveTemperature.dfs0	DailyAveTemperature.dfs0
DailyAveWaterQuantity for calibration	N/A	DailyAveDischarge_51590_cal.dfs0
Area for each elevation zone	NAM_Parameters_Training.xls	NAM_Parameters_Training.xls
Precipitation correction ratio for each elevation zone	NAM_Parameters_Training.xls	NAM_Parameters_Training.xls

3. Model set-up

Here, example for Biala River Basin is shown. Set-up procedure for Pirinska Bistritsa River Basin is principally same.

Copy the folder"MIKE11_Training" from CD, which includes training material, to hard disk in your computer.	
Start MIKE11 from "start menu".	
Now, MIKE11 with MIKE ZERO platform started.	

Setting Option in MIKE Zero Select File -> Options -> User Setting	
Set Default Project Folder, (if necessary). Check "Enable Dynamic Show all". **(Important)** Click "OK". **Restart MIKE11**	
Making a new project *File -> New -> Project from Folders*	

<table>
<tr>
<td>Dialog “New Project from Folder” appears.</td>
<td>
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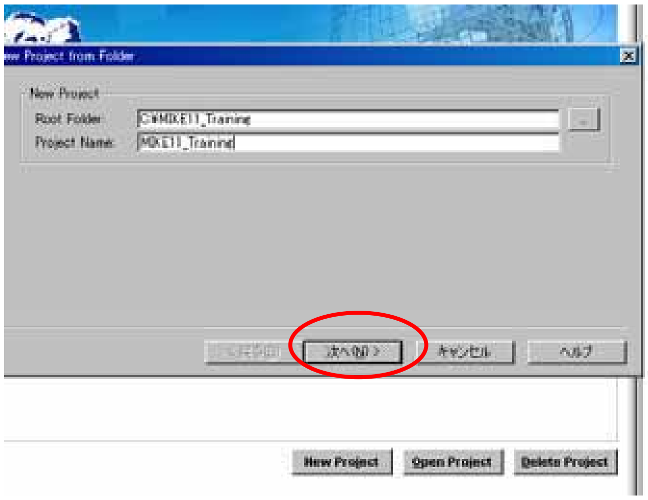
<td>Browse the folder”MIKE11_Training” which was copied to the hard disk in your computer.

Enter Project Name.

Then, click “Next (N)”.</td>
<td>
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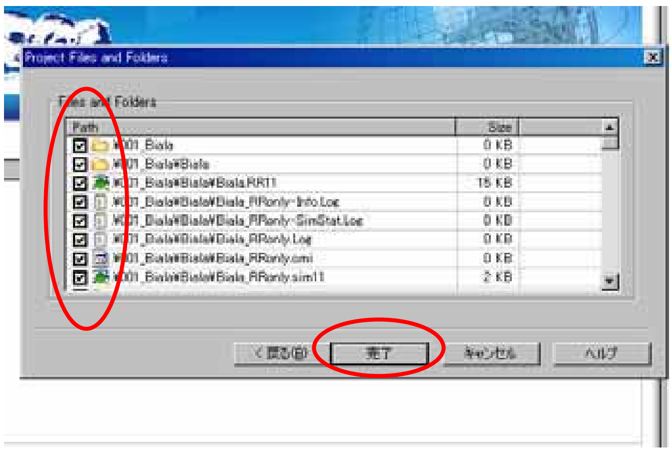
<td>Make sure all are checked in check boxes.

Then click “complete”.</td>
<td>
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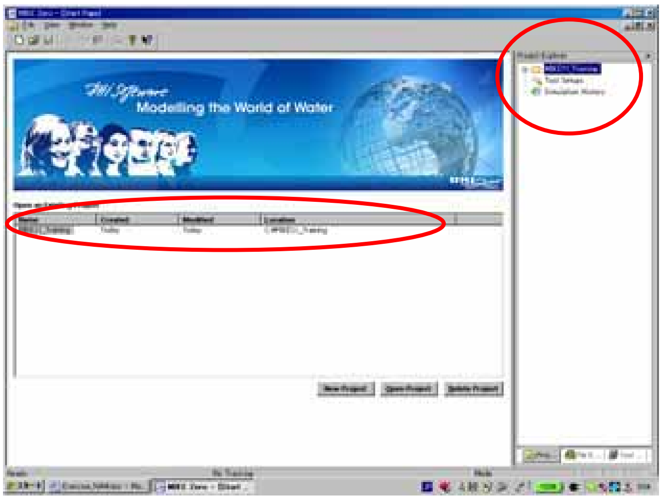
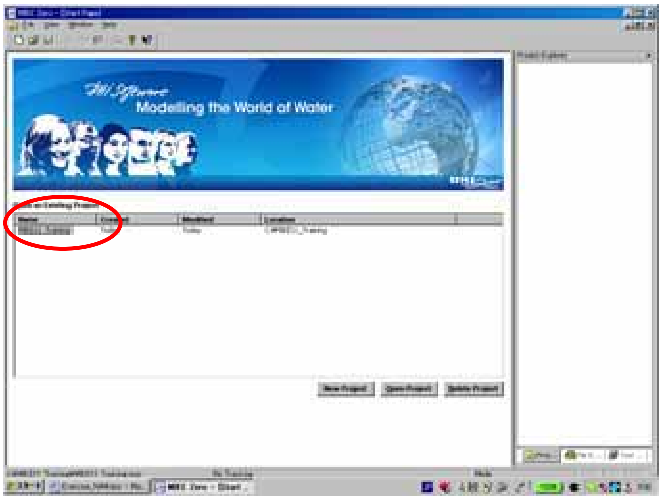
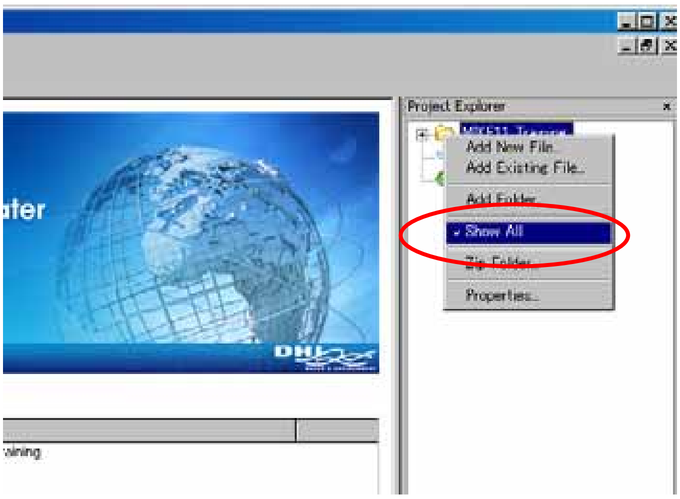
New project opened.	
Once a new project is set, from next time, you can open the project by clicking Name of project shown in “Open an Existing Project”.	
Right click “MIKE11_Traing” folder. Click “Show all”. **(Important)** Without doing this, newly added files in the project are not visible.	

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Setting-up rainfall-runoff model for calibration

In Project Explorer, place cursor on "Biala_Cal", then right click.

Select "Add Folder".

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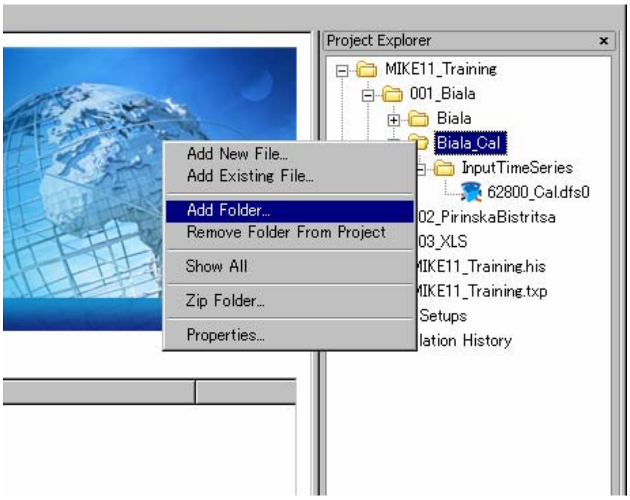

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Dialog "New Folder" appears.

Input folder name. Then, click "OK".

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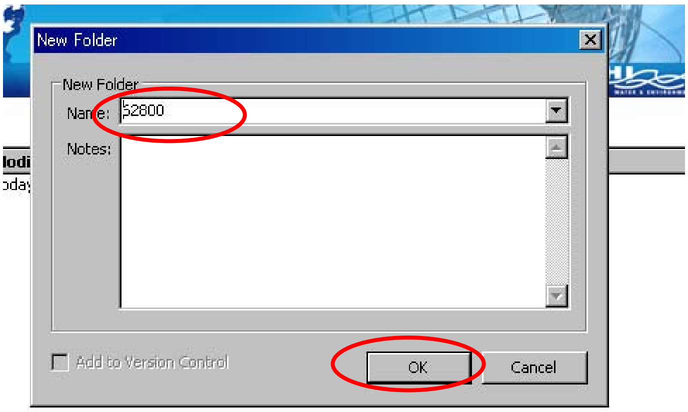

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New folder "62800" under "Biala_Cal" is now in Project Explorer.

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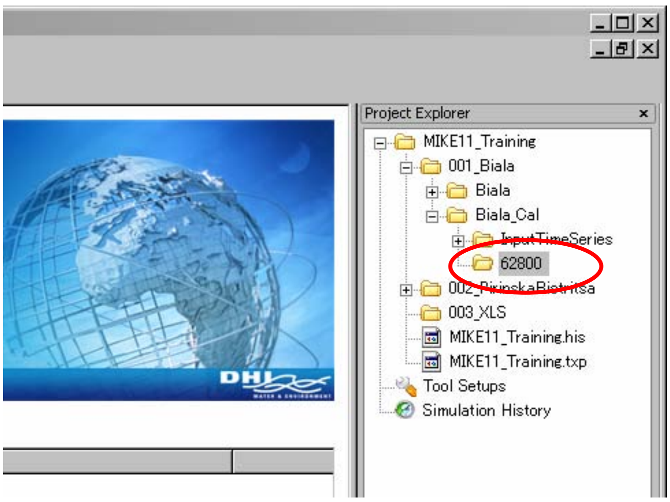

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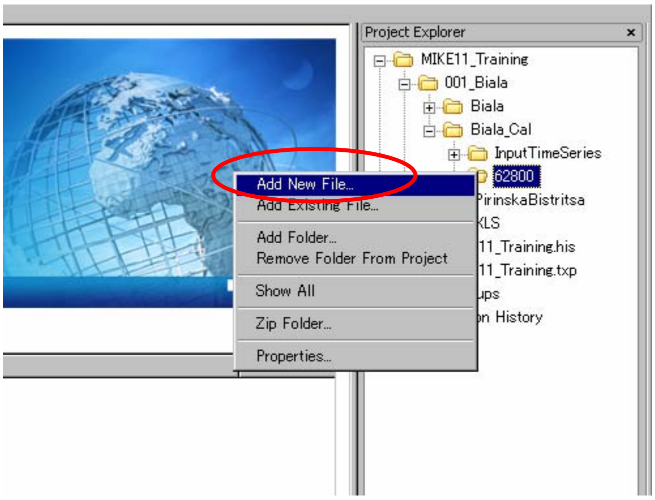
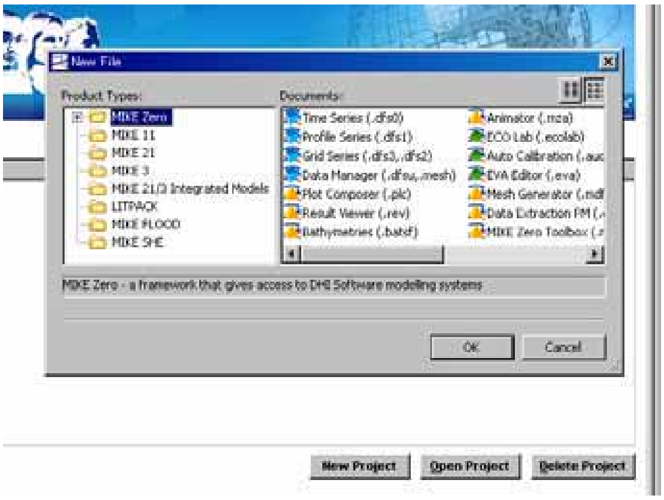
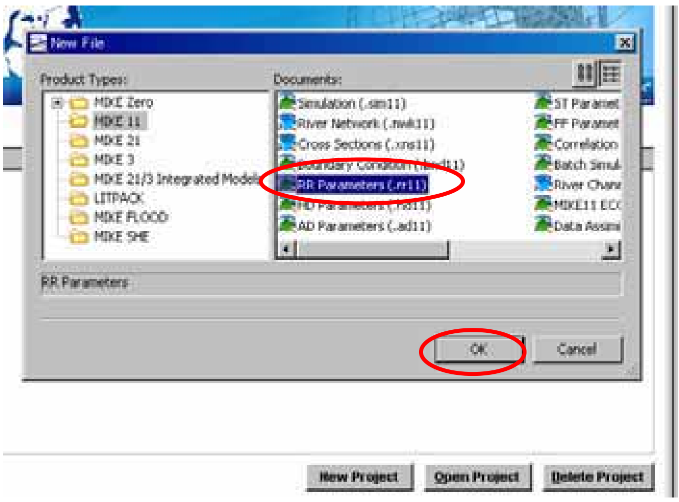
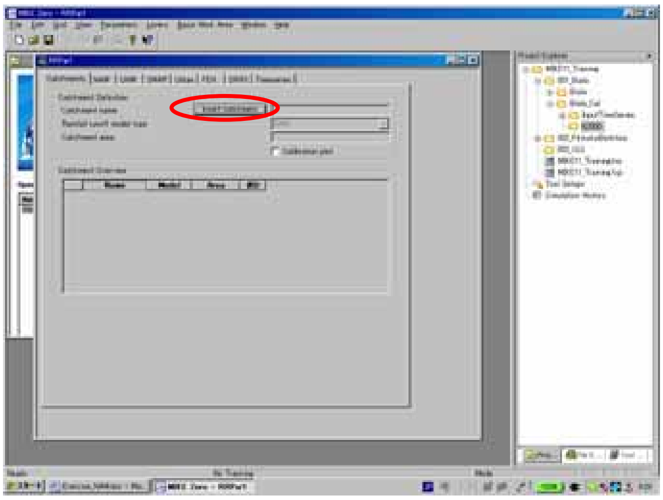
In Project Explorer, place cursor on “62800”, then right click. Select “Add New File”.	
Dialog “New Folder” appears.	
Select MIKE11 -> RR Parameters(RR11) Then. Click “OK”	

Dialog “RRPar1” appears.

Click ”Insert catctment”

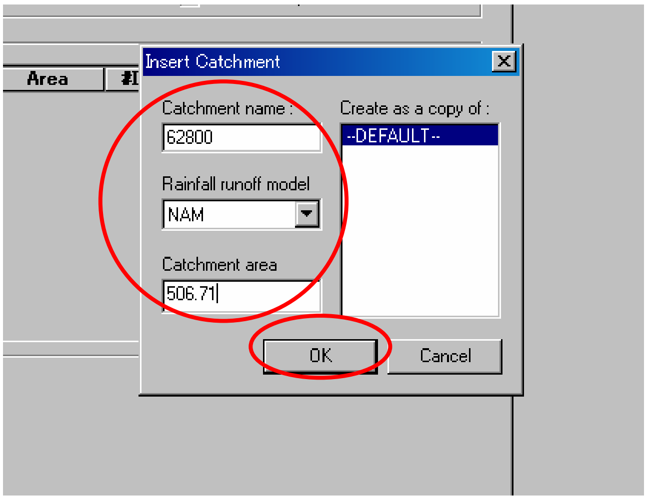


Set the name for “Catchment name”

Select “NAM” from Rainfall runoff model.

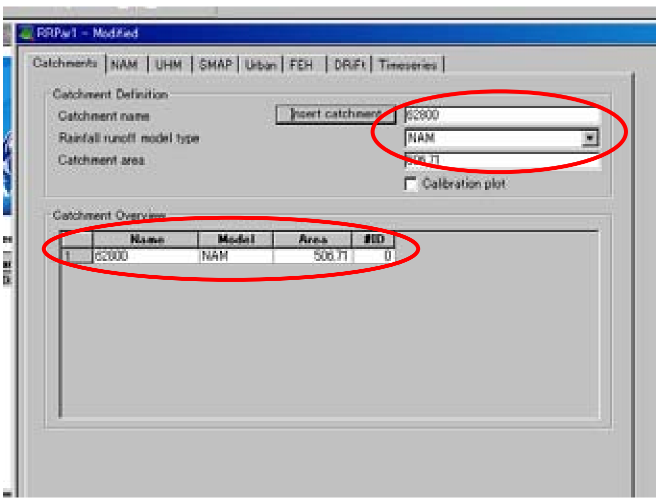
Set the value for “ Catchment area”.

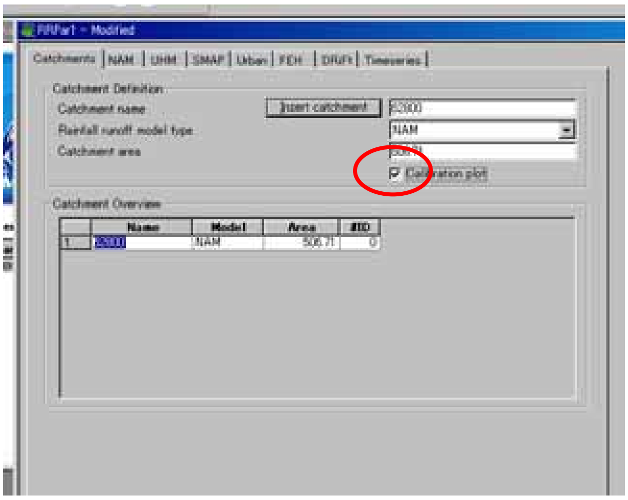
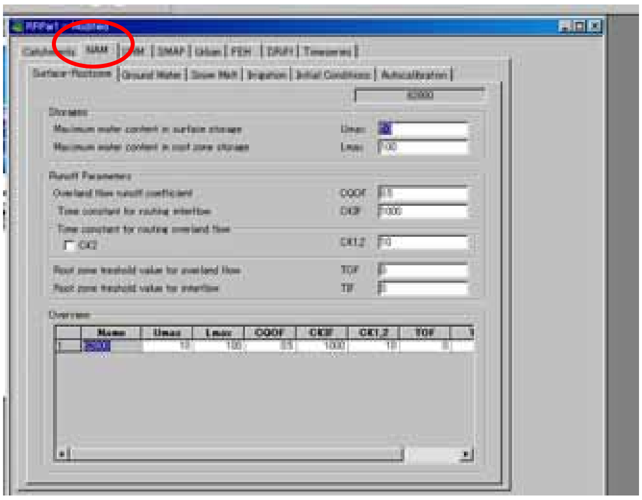
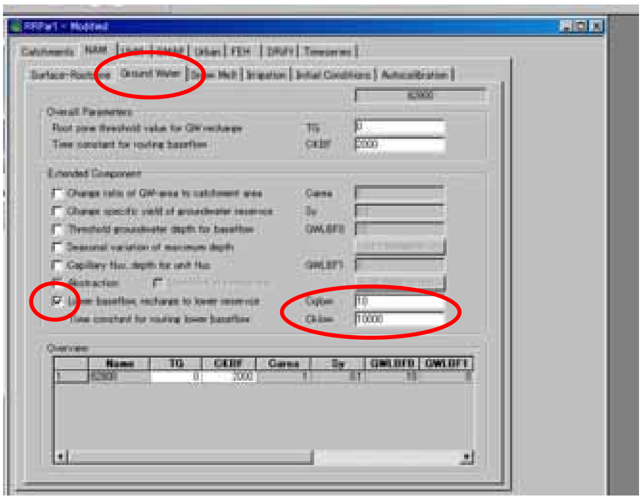
Then, click “OK”.

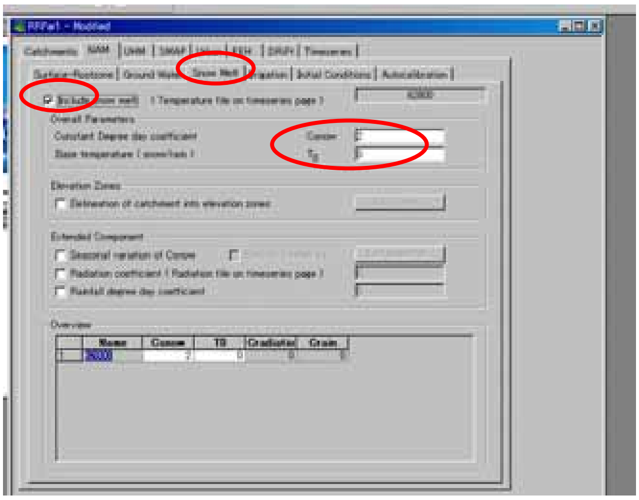
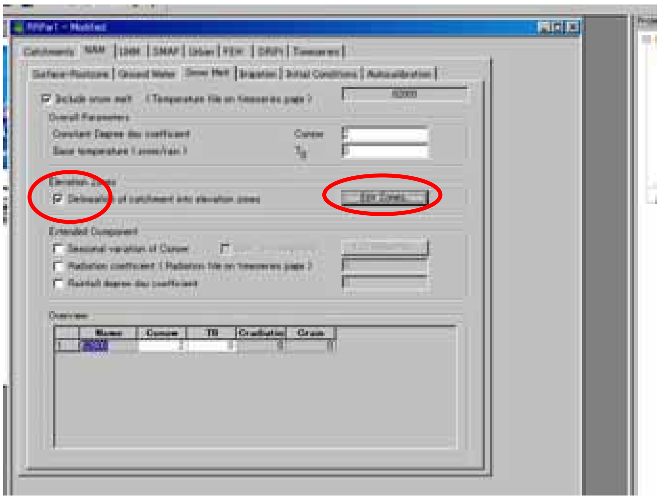
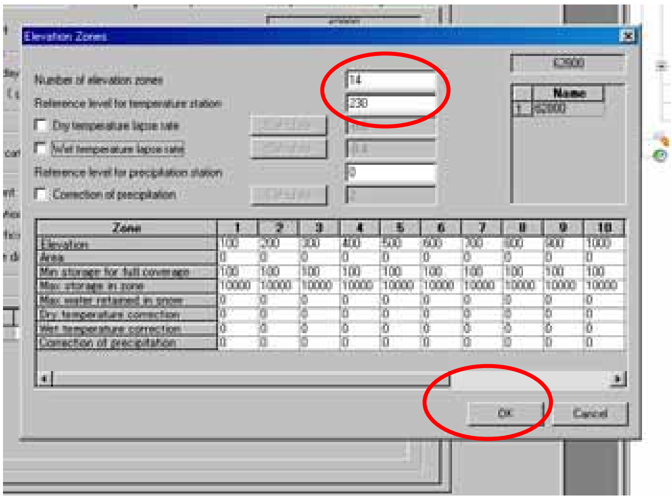


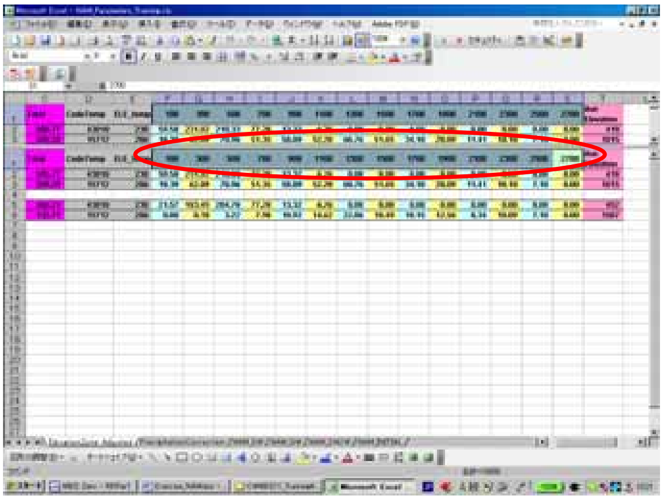
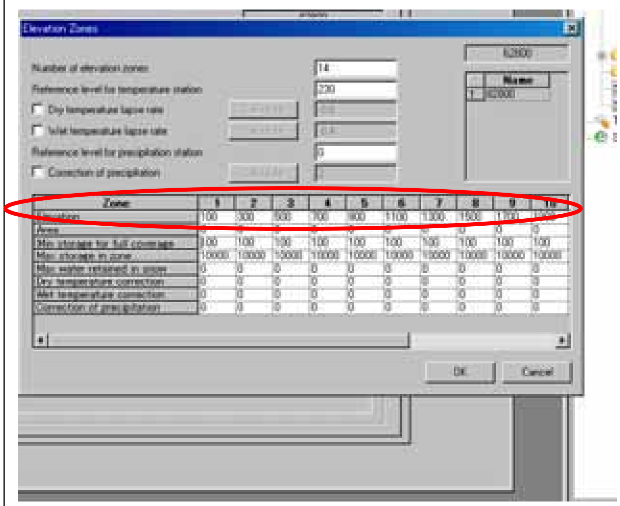
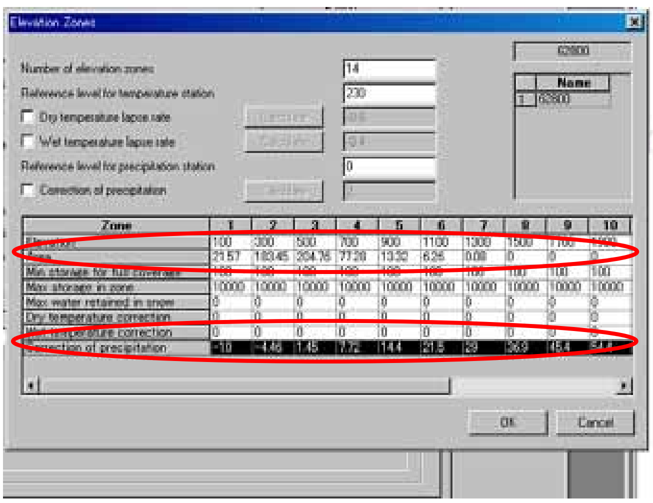
Now, a catchment is set.

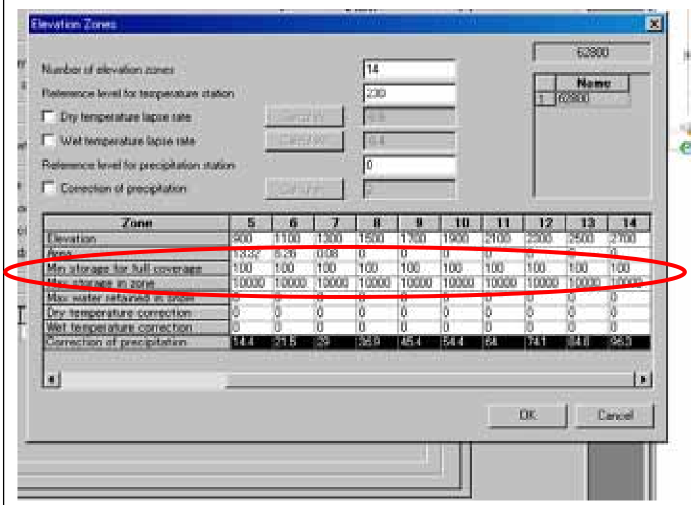
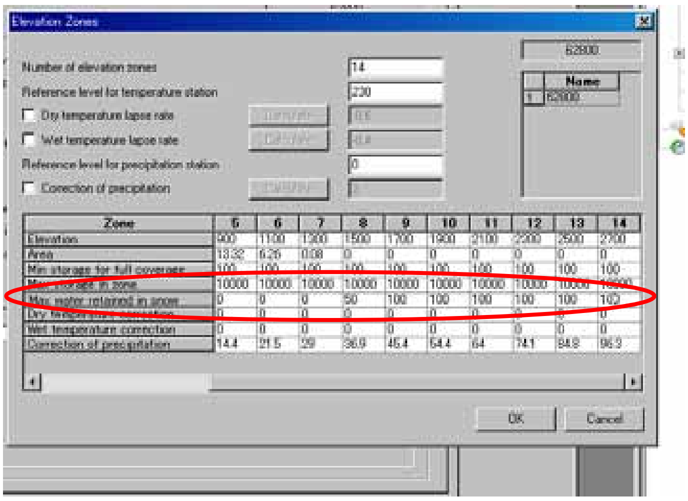
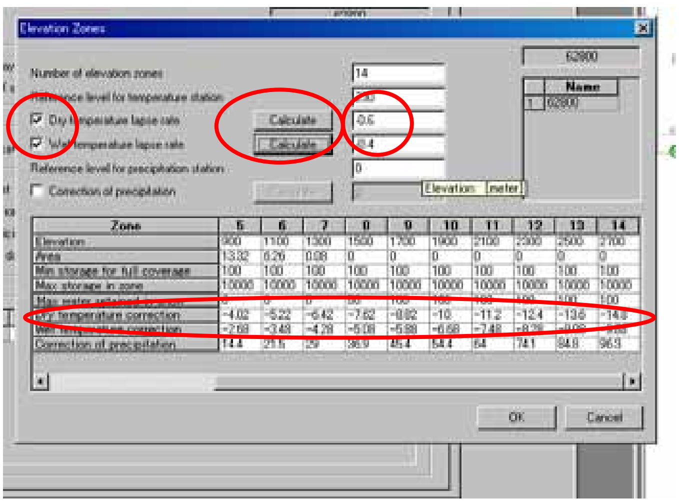
You can see the inserted catchment in “Catchment Overview”.

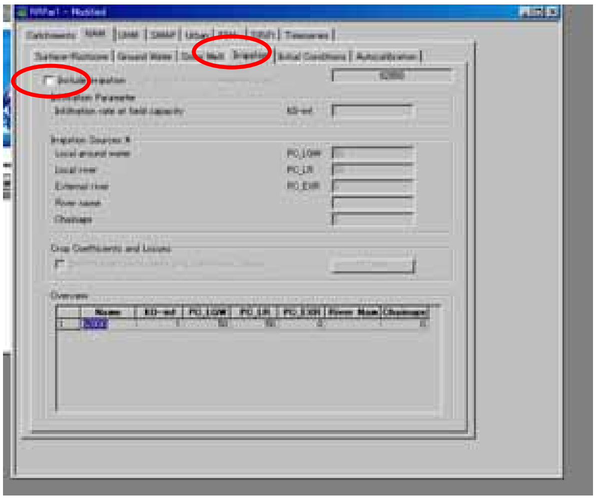
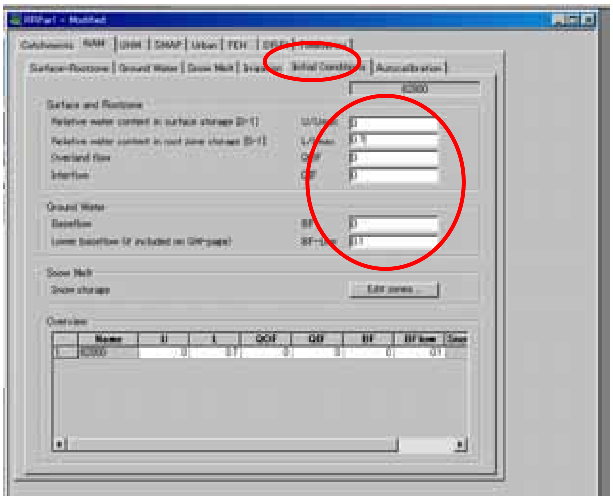
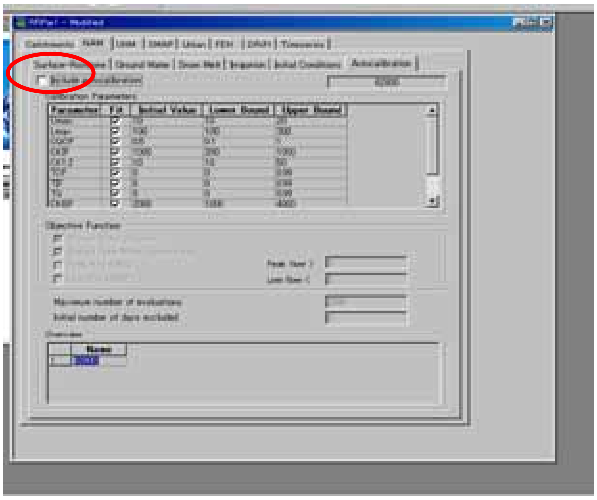


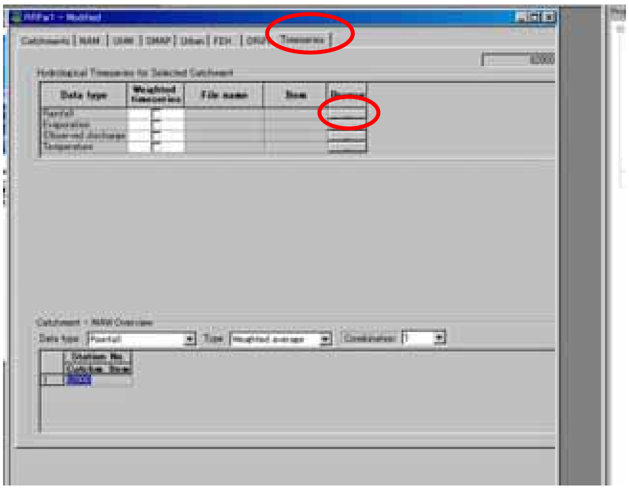
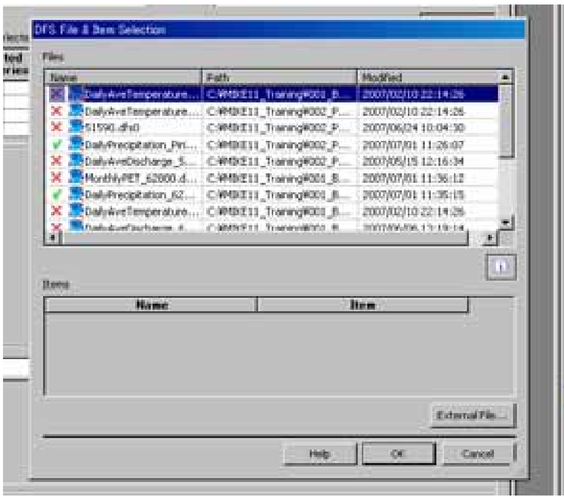
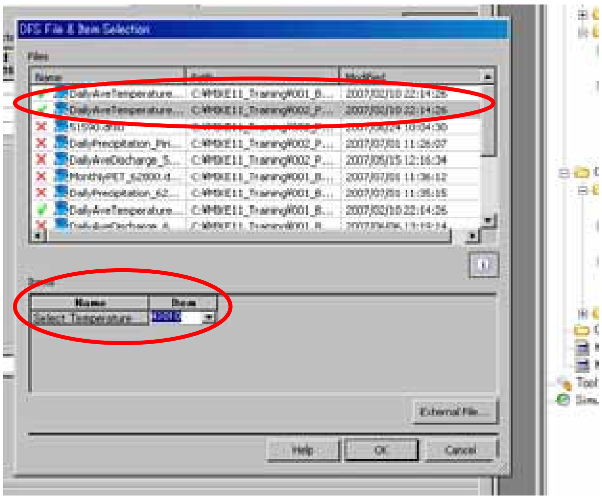
Check “Calibration plot”. By checking this, you can get “calibration plot”, which shows observed and simulated hydrograph together, when you conduct a simulation run.	
Select” NAM” tab. You can see that default parameters are already set in “Surface-Rootzone” tab. Keep default values. (Later, auto-calibration will be done.)	
Select” GroundWater” tab. Check “Lower baseflow….”. Set the value for “Cqlow”, “Cklow”. *Note:* *There is an option not to use “LowerGroundWater component”. However, the study results show that to include “LowerGroundWater component” gives better results for recession process.*	

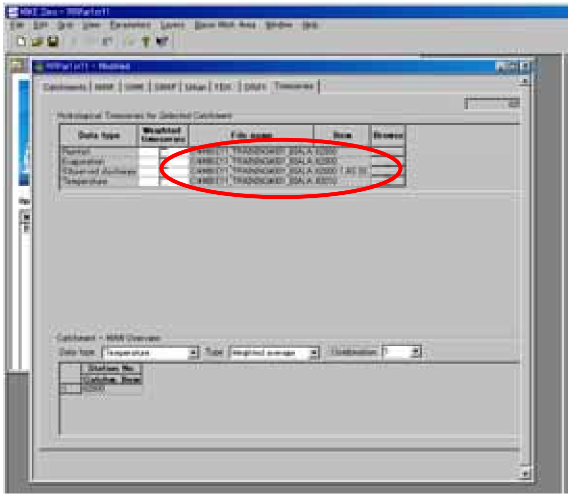
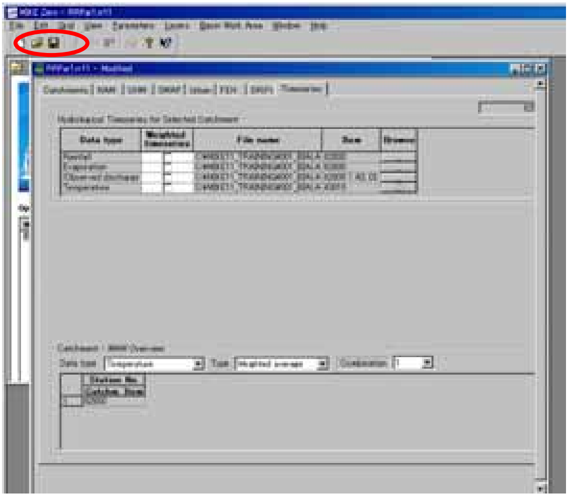
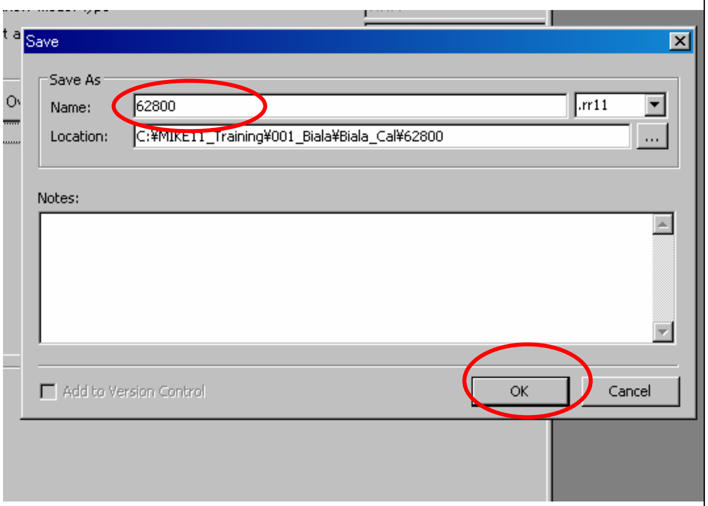
Select" SnowMelt" tab. Check "Include snow melt". Set values for "Csnow","T0".	
Check "Delineation of catchment into elevation zone". Click "Edit Zones".	
Dialog "Elevation Zones" appears. Set values "Number of elevation zone", Reference level for temperature station" Click "OK".	

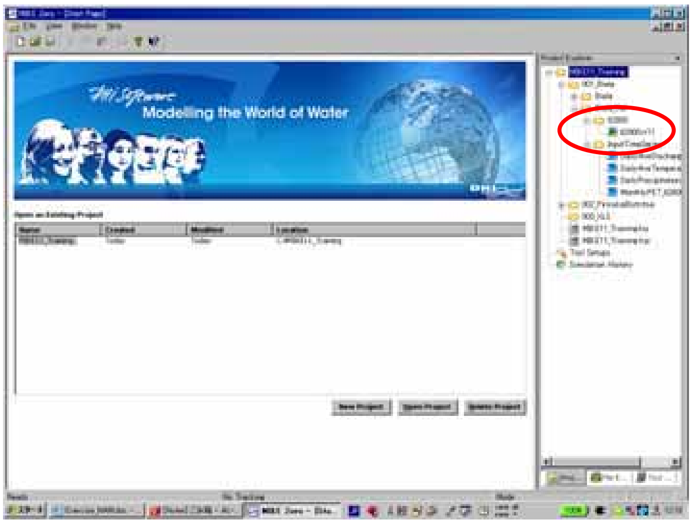
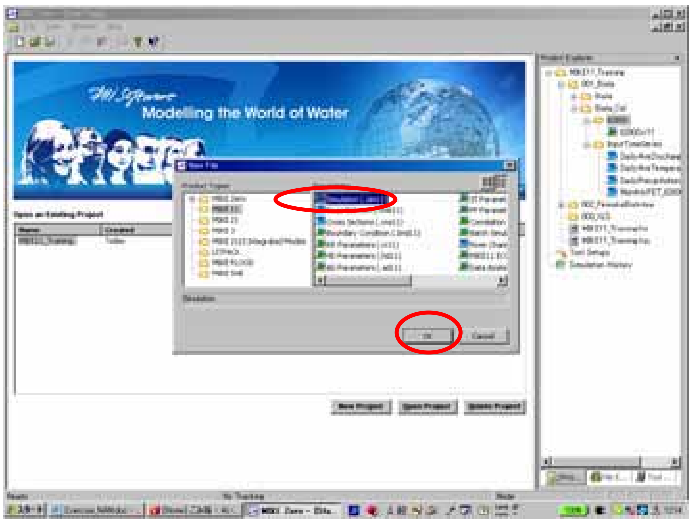
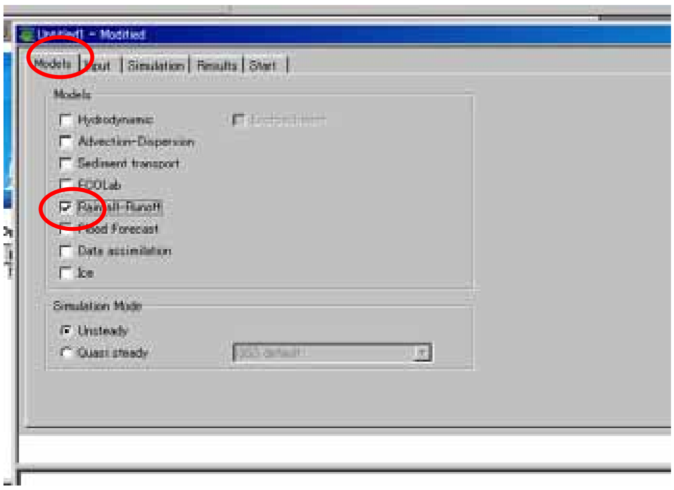
Form folder for training material, open ./003_XLS/NAM_Paramaters_Training.xls”. Activate sheet “ElevationZone_Adjusted”/ Copy elevation zone.	
Open again dialog “Elevation Zones”. Click “elevation”. Then, paste the copied from.xls file.	
Repeat same procedure for “Area”, “Correction of precipitation”.	

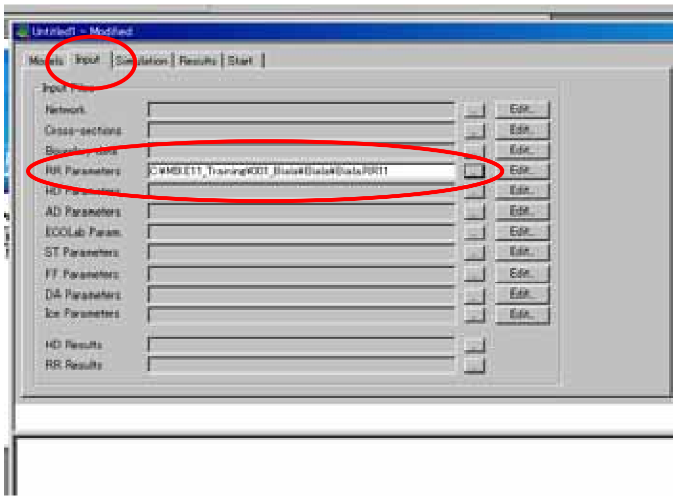
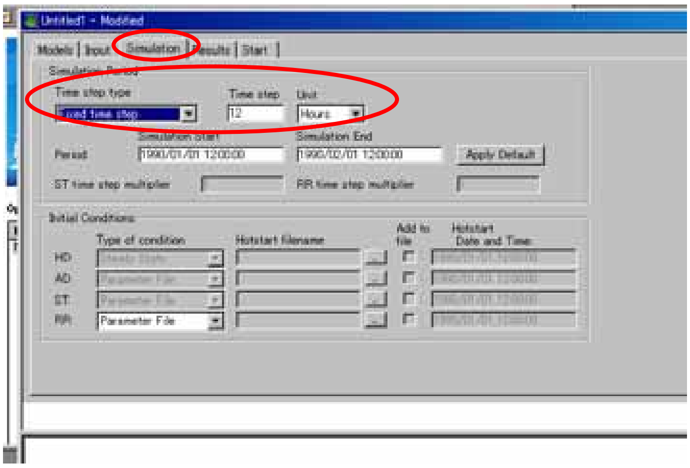
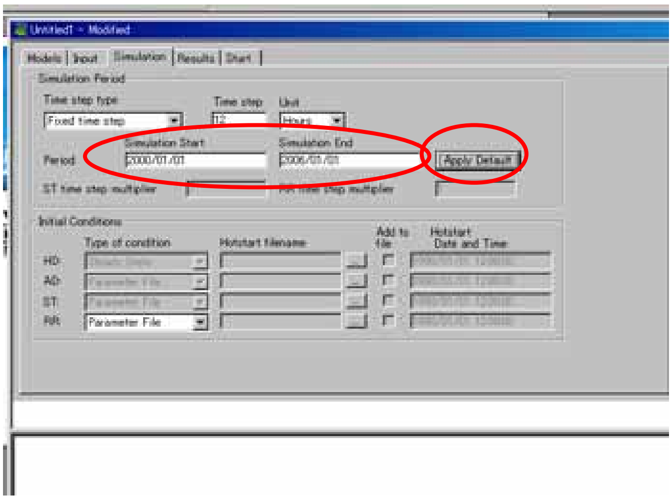
Set values for "Min storage for full coverage" to 100 (default value) for all elevation zones. Set values for "Max storage in zone" to 10000 (default value) for all elevation zones.	
Set values for "Maximum water retained in snow". Based on the calibration results for EABD&WABD catchments, the followings are the most recommended values. Zone:100-1300 -> 0 Zone:1500 -> 50 Zone: 1500- 2700 -> 100	
Check "Dry temperature lapse rate", "Wet temperature lapse rate". Set values for Dry temperature lapse rate", "Wet temperature lapse rate". (Default values are -0.6 and -0.4, respectively.) Click "Calculate". Then the correction values of temperature for each elevation zone are automatically assigned. Finally, click "OK".	

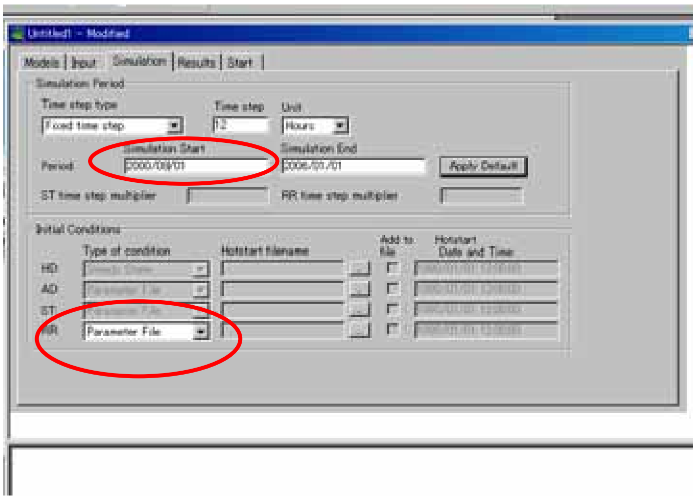
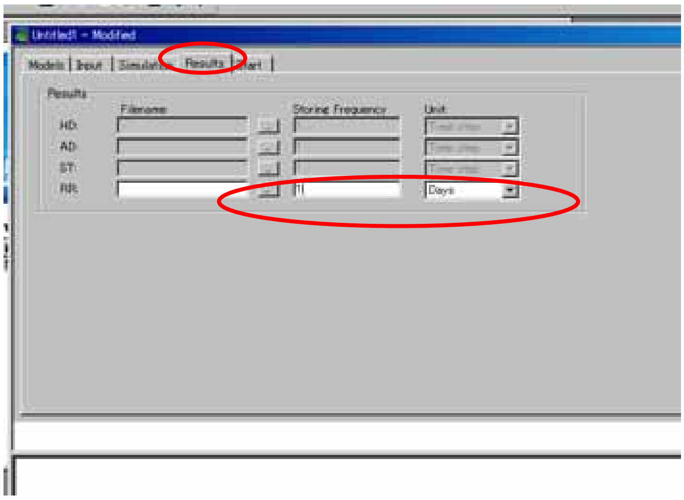
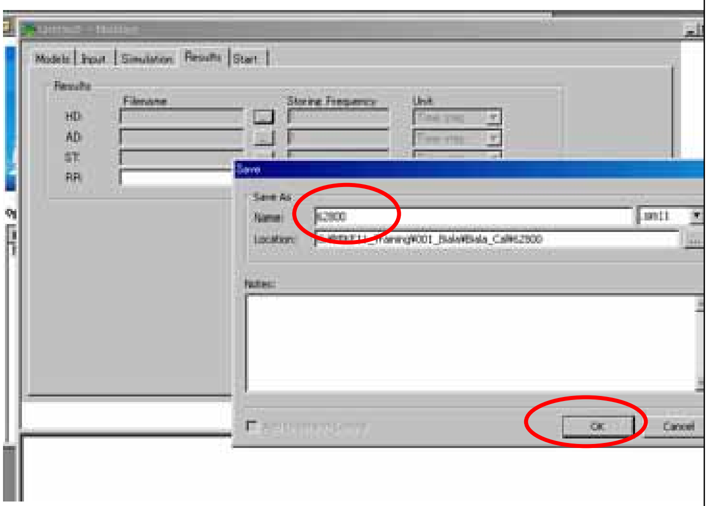
Select" Irrigation" tab. Make sure that"Include irrigation" is not checked.	
Select" Initial Condition" tab. Set values for initial conditions. Please refer "./003_XLS/NAM_Paramaters_Training.xls".	
Select" Auto Calibration" tab. Make sure that "Include autocalibration" is not checked. (At later stabe of this exercise, auto-calibration will be included.)	

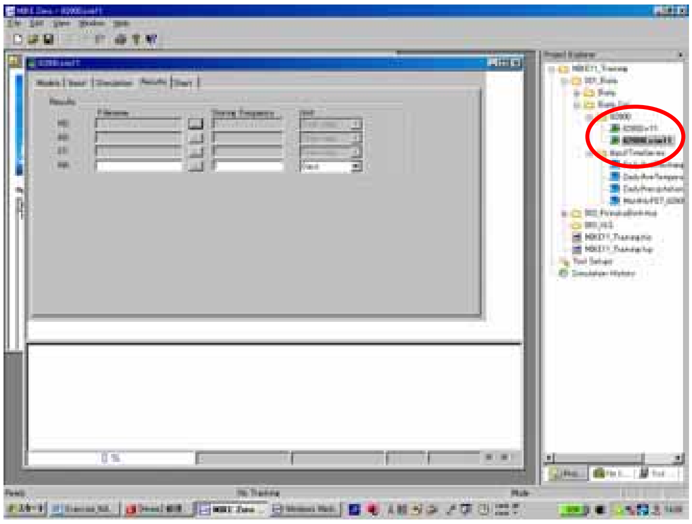
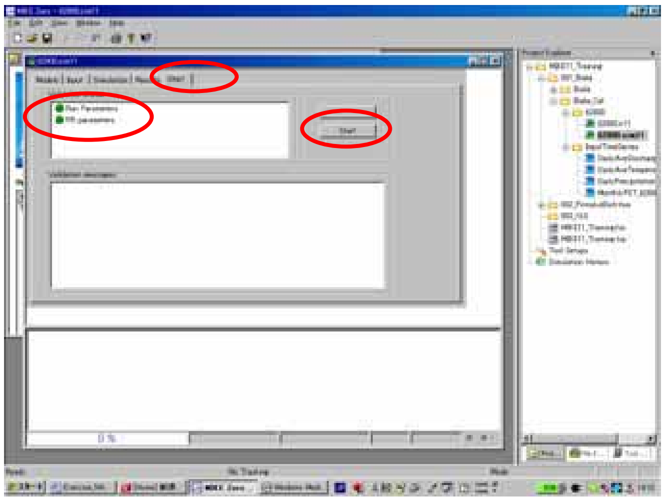
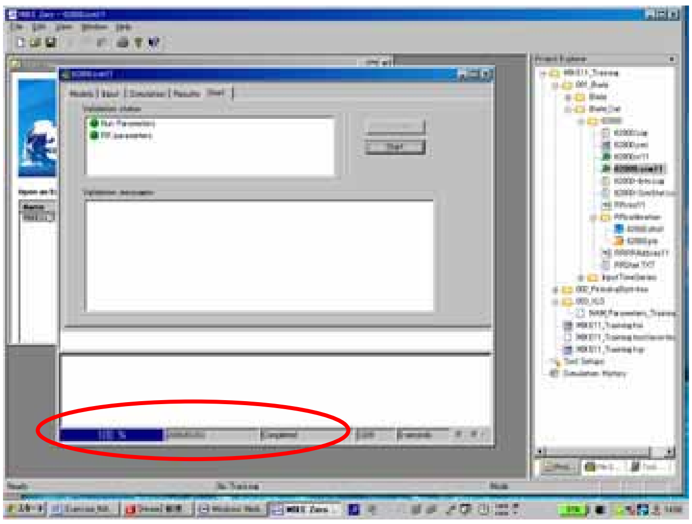
Select" Timeseries" tab. Click Brows for "rainfall input file".	
Dialog "DFS File & Item Selection" appears. It shows available .dfs0 file for selection in the projects. Choose appropriate file, and click "OK". Repeat same procedure for "Evaporation", (Observed discharge)", "Temperature".	
In case of "Temperature", .dfs0 file contains several items (several stations". Please select appropriate item (station).	

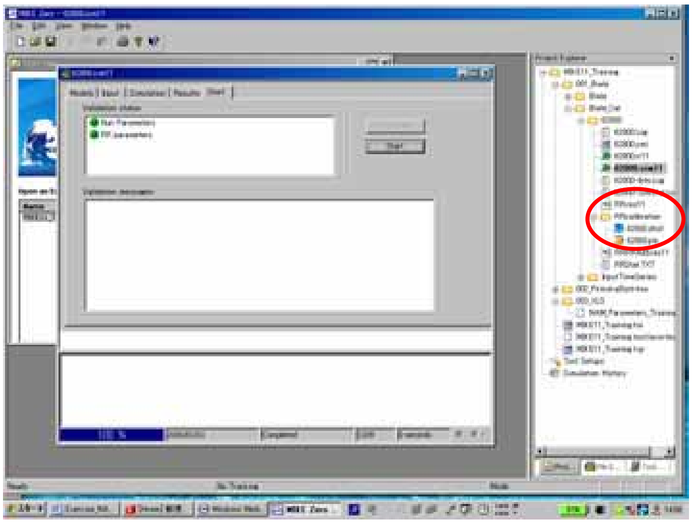
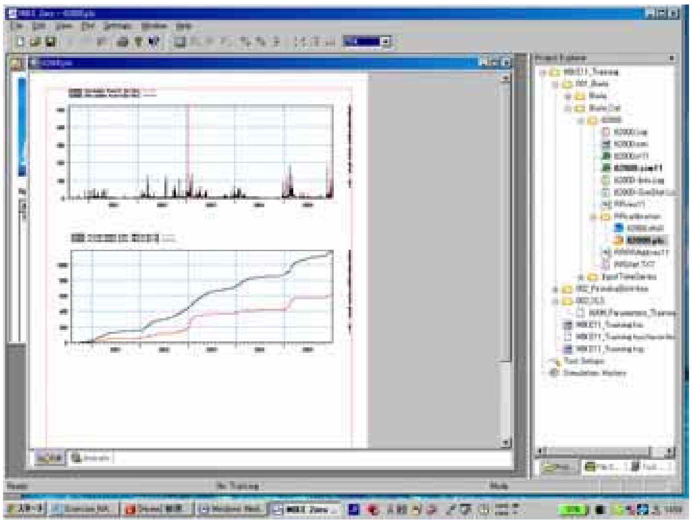
Make sure that all input time series are specified.	
Click “SAVE” button to save .RR11 file.	
Set filename. Click “OK”.	

Now, you should be able to see newly created .rr11 file.	
In Project Explorer, place cursor on "62800", then right click. Select "Add New File", then, after dialog "New Folder" appears, select MIKE11 -> Simulations(.sim11) Then. Click "OK"	
Dialog "simulation editor" appears. Select "Model" tab. Check only "rainfall-runoff".	

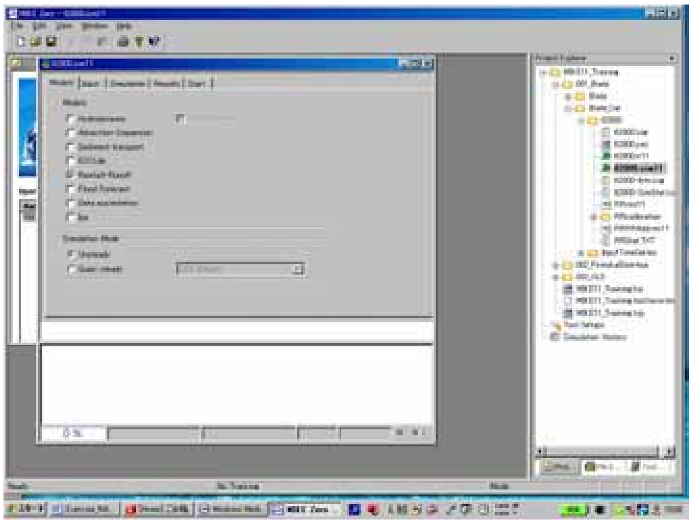
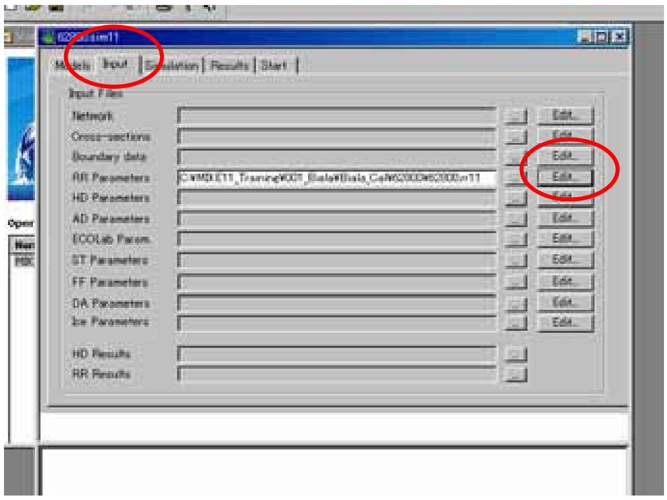
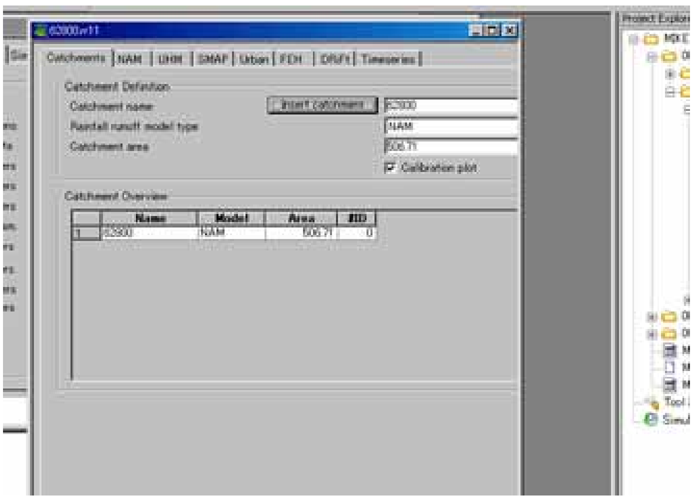
Select “Input” tab. Set “RR parameters” file. You can browse available files in the project by pressing “…” button.	
Select “Simulation” tab. Select “Fixed time step” for time step type. Set values for “Time step”, “Unit”.	
Click “Apply Default”. Then, simulation period is automatically adjusted for available maximum period based on the input timeseries data.	

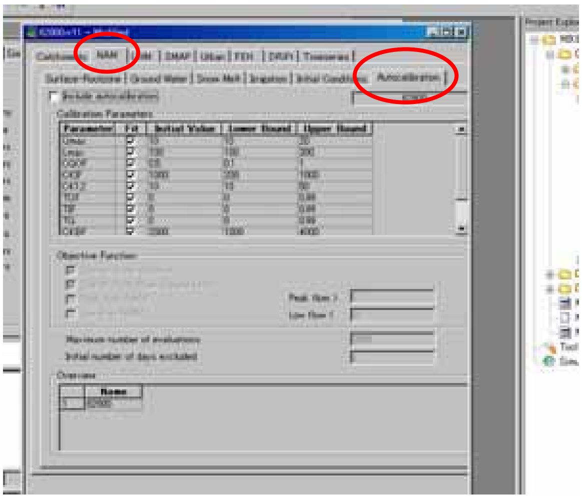
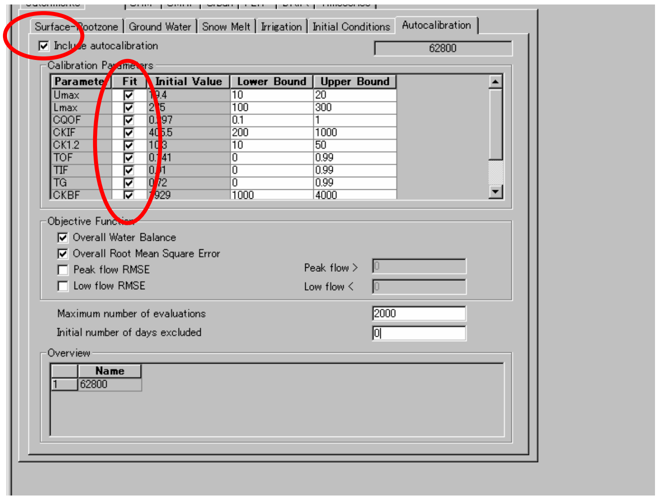
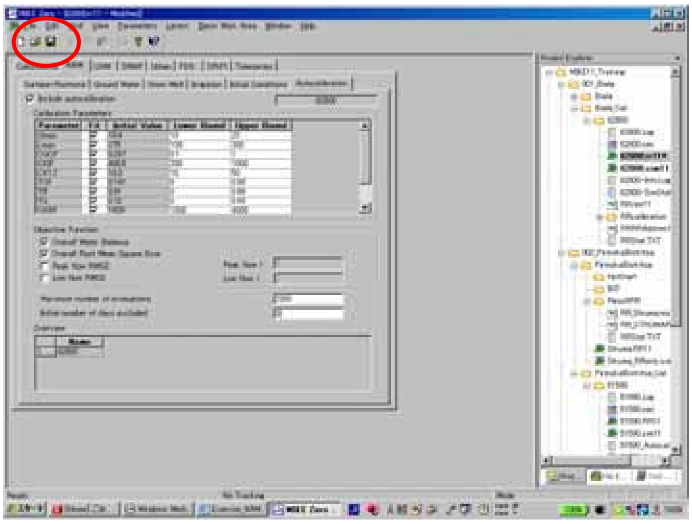
Manually adjust simulation period. For Biala river, 2000/08/01 to 2006/01/01 For Pirinska Bistritsa river, 2001/08/01 to 2004/10/31 Select "Parameter Files" for Initial Condition.	
Select "Results" tab. Set values for "Storing Frequency", "Unit". Filename can be "blank". In this case, result file will be made in the same directory of .sim11 file.	
Click "SAVE" button to save .sim11 file. Set filename. Click "OK".	

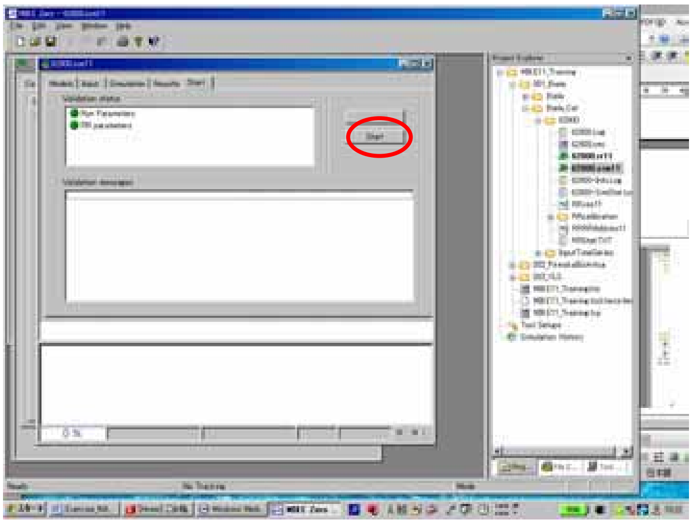
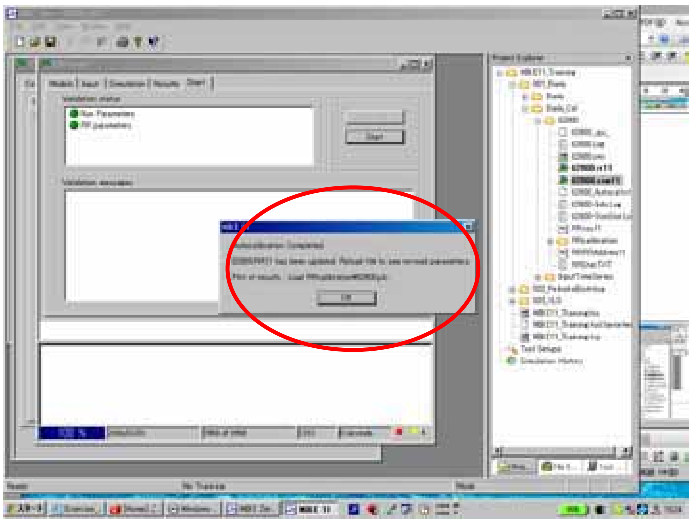
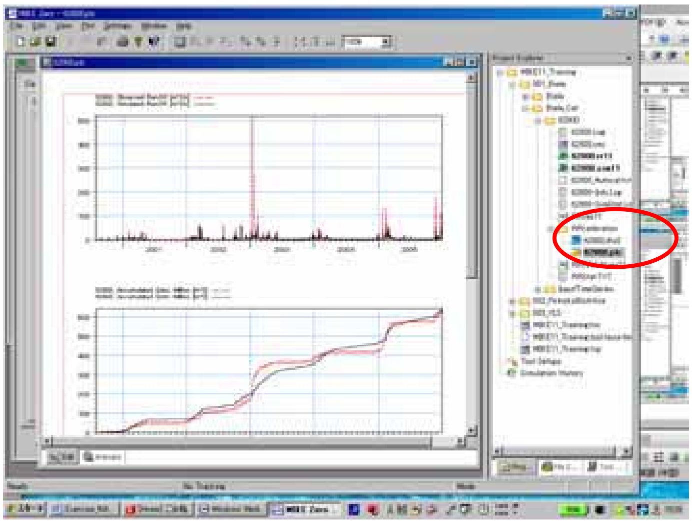
Now, .sim11 file is set. You are ready to run the model.	
Select “Start” tab. Make sure that all of color of buttons in Validation status are green. Click “start”. Then, simulation will start.	
When you see the message “100%”, “completed”, then simulation is completed.	

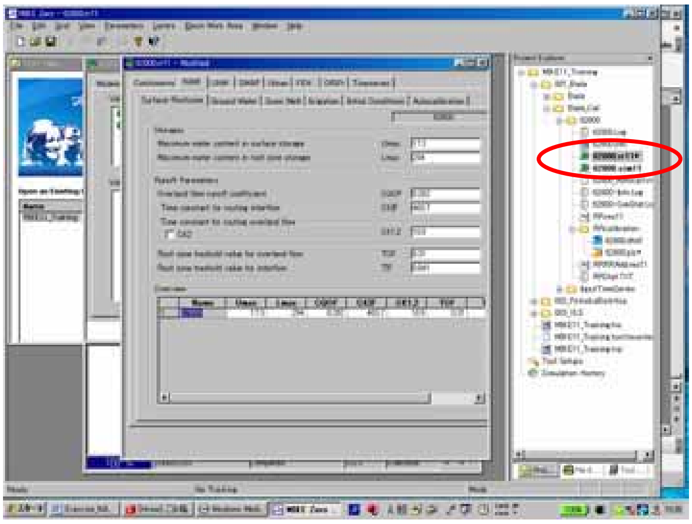
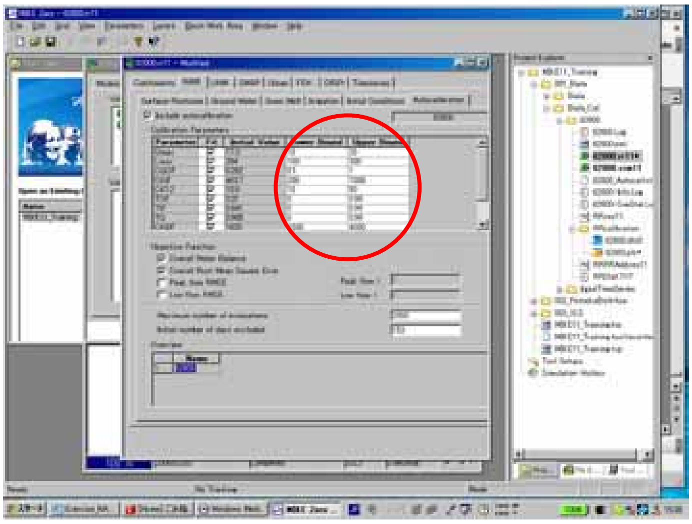
Dibble click .plc file in “RRcalibration“ folder.	
You can see the results. As we have not yet done the calibration, simulated result is completely deferent from observed one.	

4. Calibration

Open project. Double click ".sim11" file prepared by **3.** Then, simulation editor appears.	
Select "Input" tab. Click "Edit".	
Now, .rr11 file is editable.	

Select “Nam“ tab. Select “Autocalibration” tab.	
Check “Include autocalibration”. Check “Fit” in “Calibration Parameters”, if you want to calibrate the parameters automatically.	
Save .rr11 file.	

Activate simulation editor of .sim11. Click “start”.　Then, simulation with auto calibration will be done.	
When auto-calibration is completed, dialog to notice it appears. Click “OK”.	
You can see the results by double clicking .plc file in the Project Explorer.	

<table>
<tr><td>You can see updated model parameters by reloading .rr11 file.</td><td></td></tr>
<tr><td>You can change the range of model parameters to be calibrated.</td><td></td></tr>
<tr><td>Try several options by changing the range of model parameters, calibration parameters.

Some parameters may be fixed. Some other parameters are automatically calibrated.</td><td></td></tr>
</table>

Reference:

Parameters and those ranges for calibration for HMS62800 (Parameters are not yet finalized.)

Calibration Parameters

Parameter	Fit	Initial Value	Lower Bound	Upper Bound
Umax	☑	102	5	200
Lmax	☑	399	50	400
CQOF	☑	0.34	0.1	0.6
CKIF	☐	200	200	1000
CK1.2	☑	10.6	3	72
TOF	☑	0.0292	0	0.99
TIF	☑	0.936	0	0.99
TG	☑	0.38	0	0.99
CKBF	☐	500	300	5000
CQLOW	☐	10	1	100
CKLOW	☐	1e+004	1e+003	3e+004

Parameters and those ranges for calibration for HMS51590

Calibration Parameters

Parameter	Fit	Initial Value	Lower Bound	Upper Bound
Umax	☑	10.5	5	200
Lmax	☑	385	50	400
CQOF	☑	0.108	0.1	0.6
CKIF	☐	500	500	1000
CK1.2	☑	55.9	3	72
TOF	☑	0.671	0	0.7
TIF	☑	0.694	0	0.7
TG	☑	0.186	0	0.7
CKBF	☐	500	500	5000
CQLOW	☐	50	1	100
CKLOW	☐	1e+004	1e+003	3e+004

5. Run the model with calibrated parameters

Model set-up procedure for total catchment area is same as one for calibration.

In this exercise, model set-up for Biala River Basin and Pirinska Bistritsa River Basin have been prepared.

For Biala river basin:

001_BialaBialaBi ala_RRonly.sim11

For Pirinska Bistritsa River Basin:

002_PriniskaBistritsa/PiriniskaBistritsaPirinskaB_RRonly.sim11

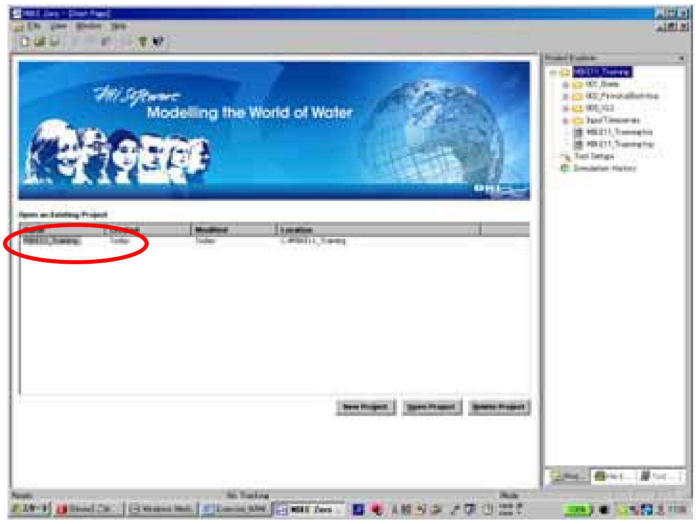
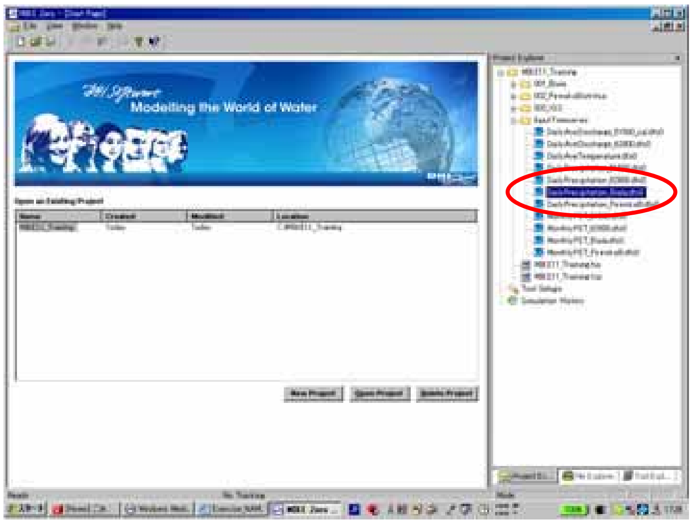
Open those set-up files, and enter the calibrated parameters. Run the model, then see the results with MIKE View.

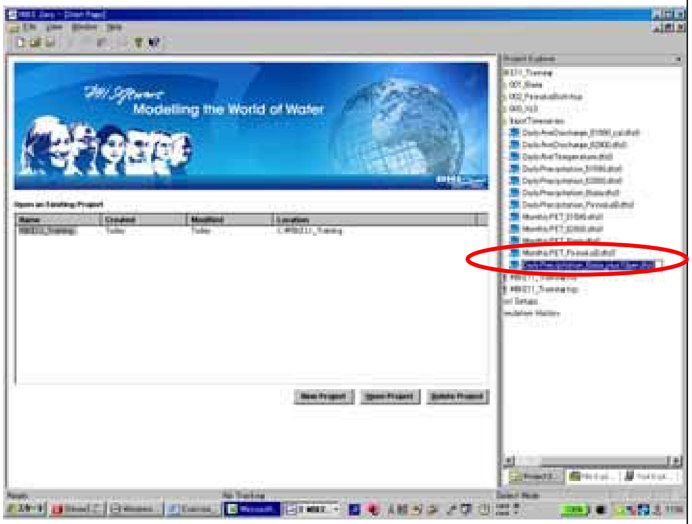
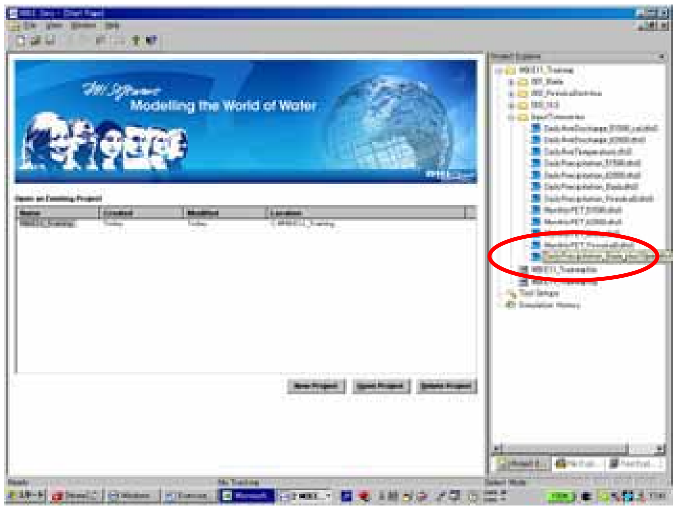
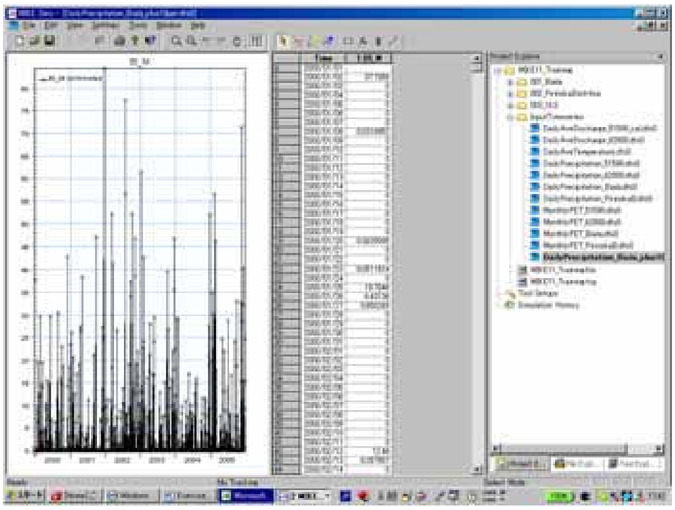
6. Change of Input file

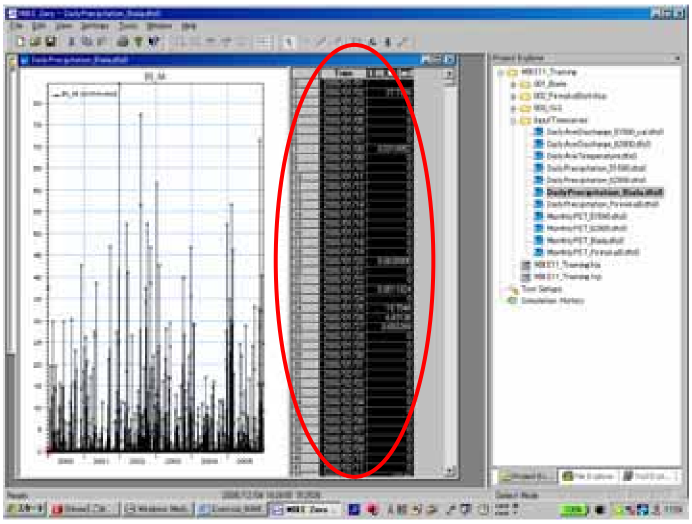
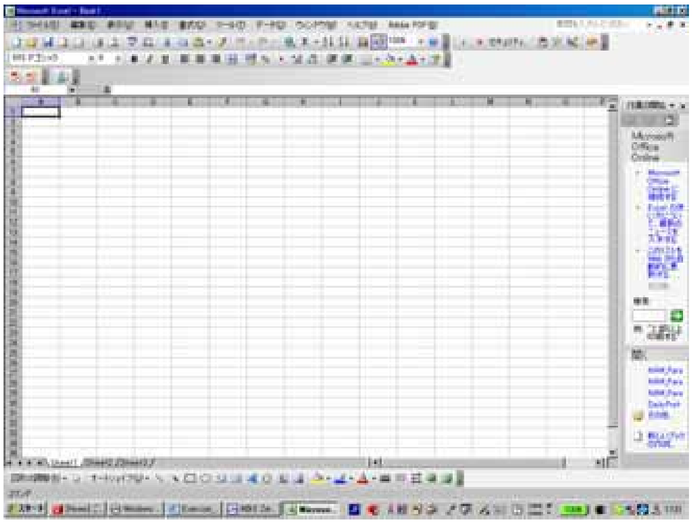
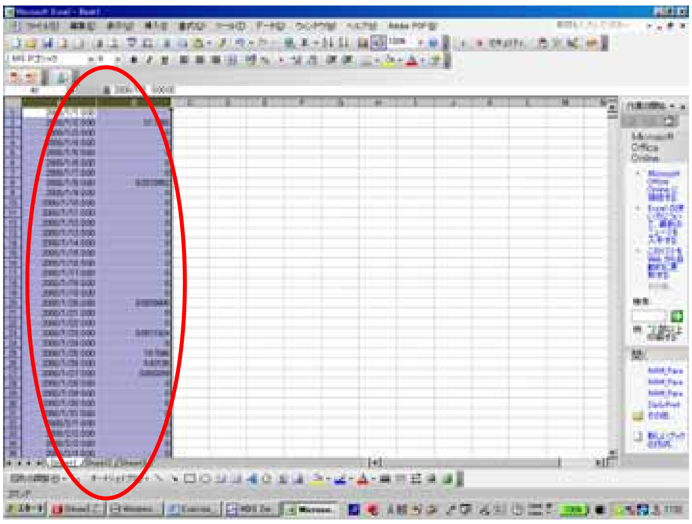
Exercise:

Let's see what happen if precipitation amount increases 10%.

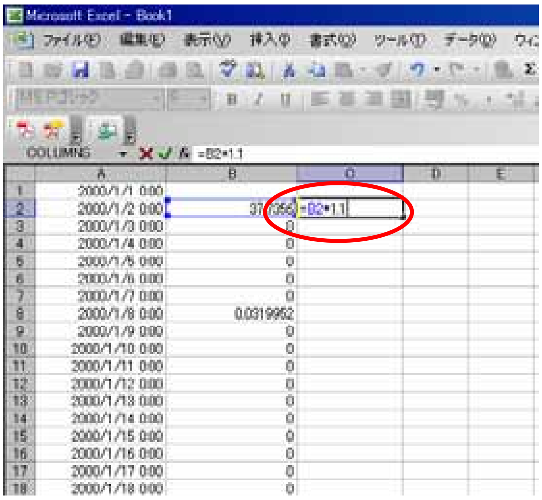
In this case, you may need to change input file for precipitation. This can be done in Temporal Analysts for ArcGIS. However, in this exercise, method to use Excel is introduced.

Open project "MIKE11_Training"	
In Project Explorer, browse /MIKE11_Training/InputTimesereies/DailyPrecipitation_Biala.dfs0	
Right click. Select " Copy"	

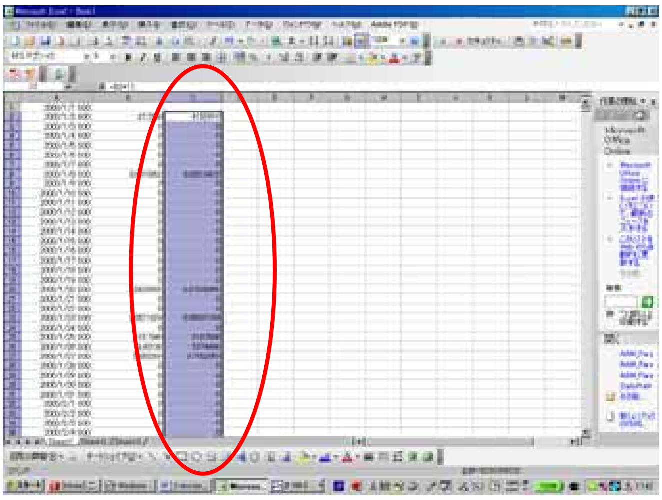
“copy_DailyPrecipitation_Biala.dfs0” appears in Project Explorer. Right click it, and select “Rename”. Change the name of the file” “DailyPrecipitation_Biala_plus10per. dfs0”	
Double click it.	
Timeseries data appears.	

Select columns with time and value. Copy the selected part by "CTRL+C".	
Open MS-Excel.	
Paste the copied parts to excel sheet.	

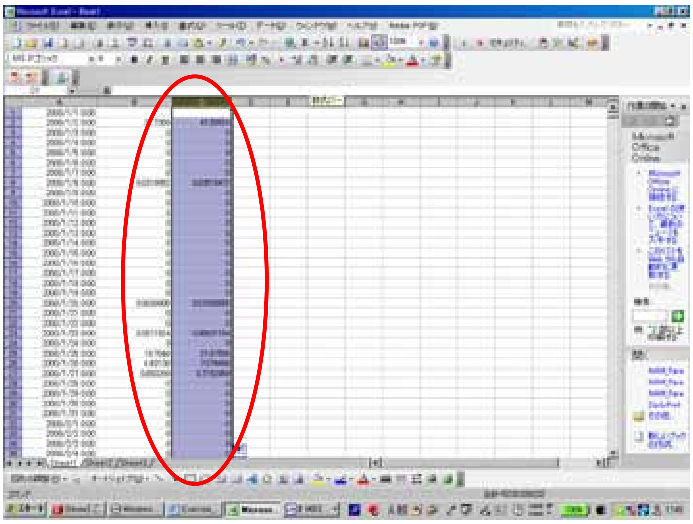
Insert equation

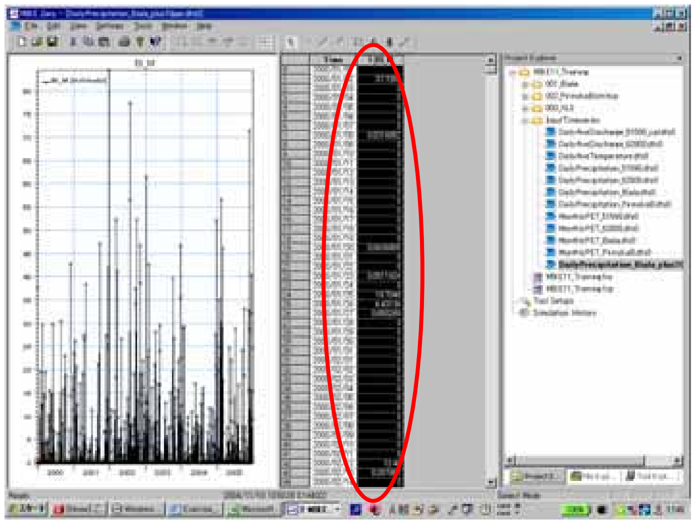
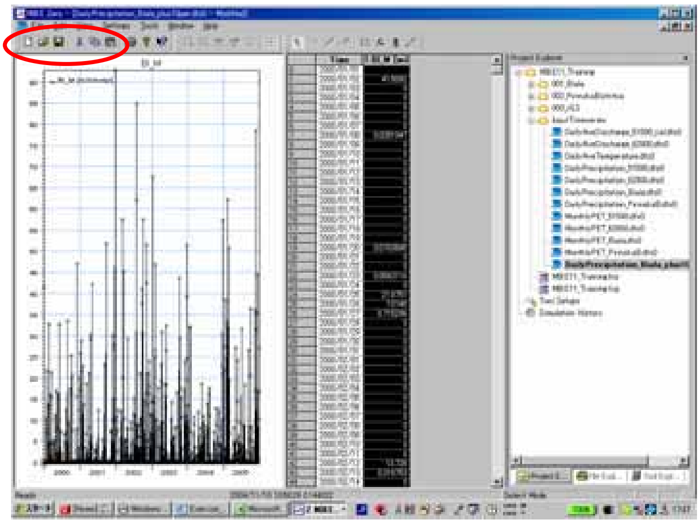
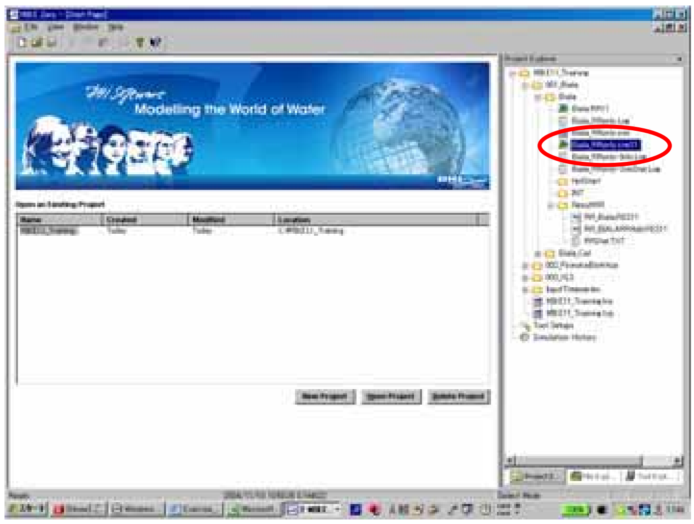


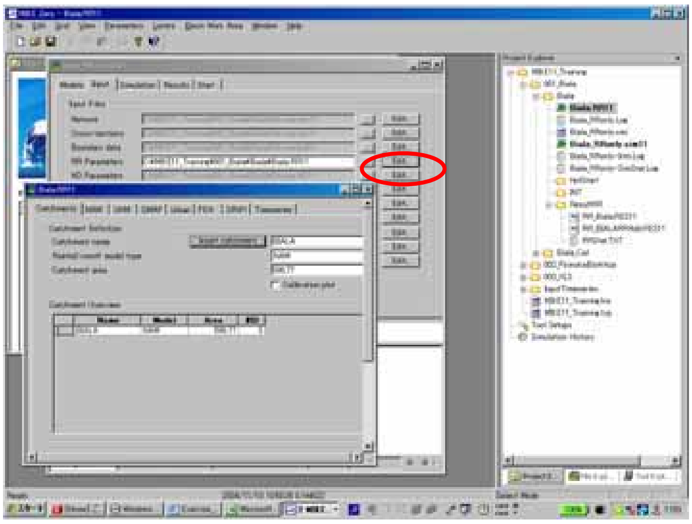
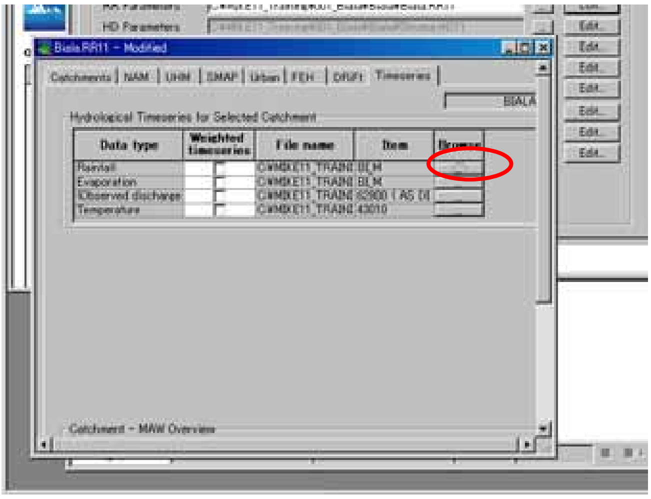
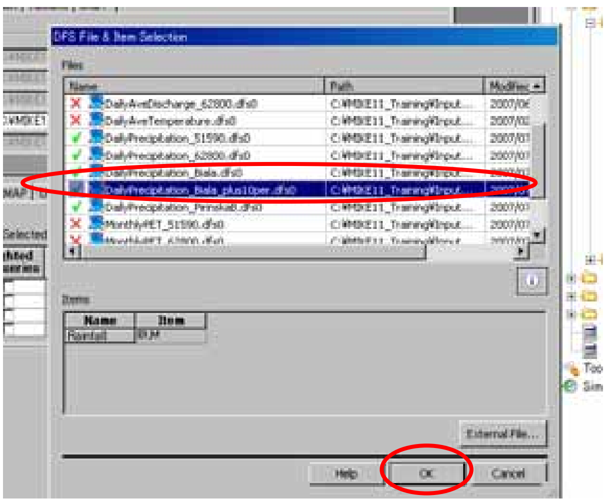
Copy and paste to the end of line

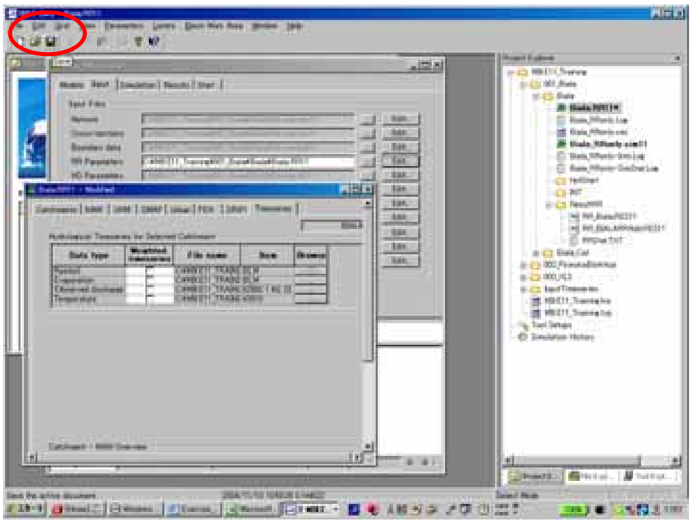
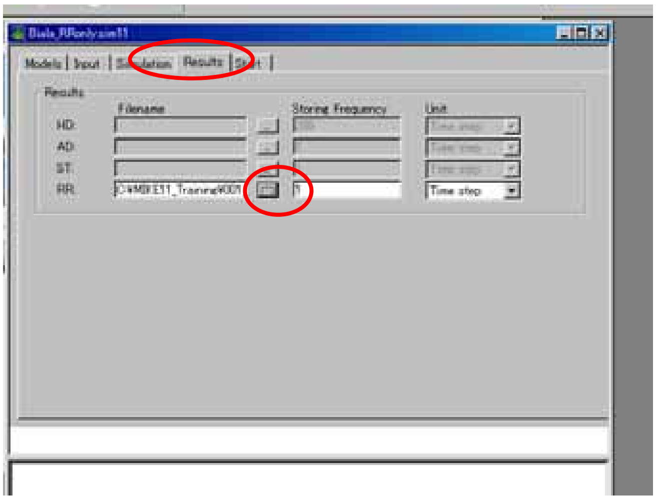
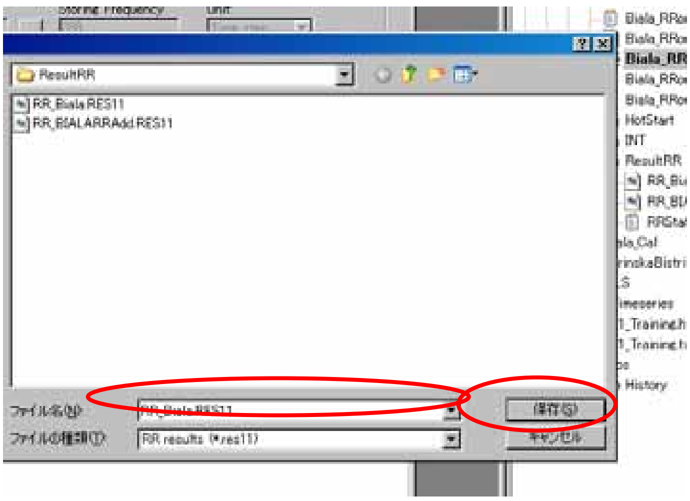


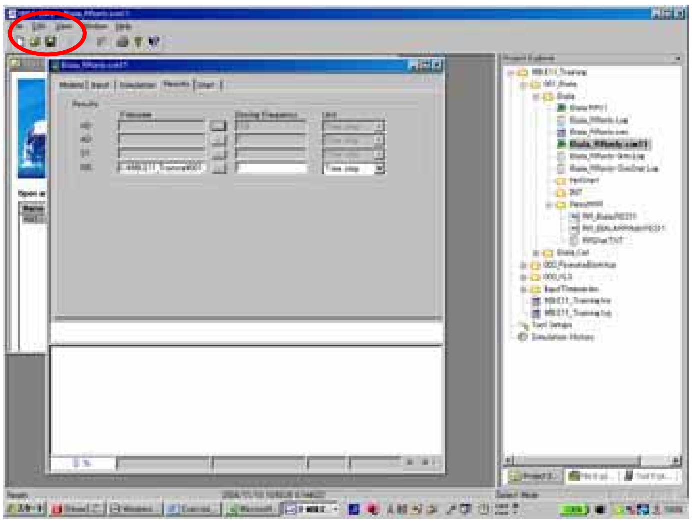
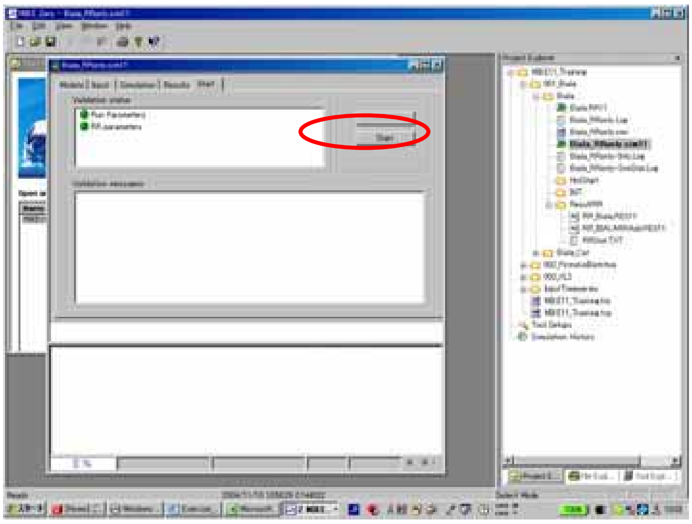
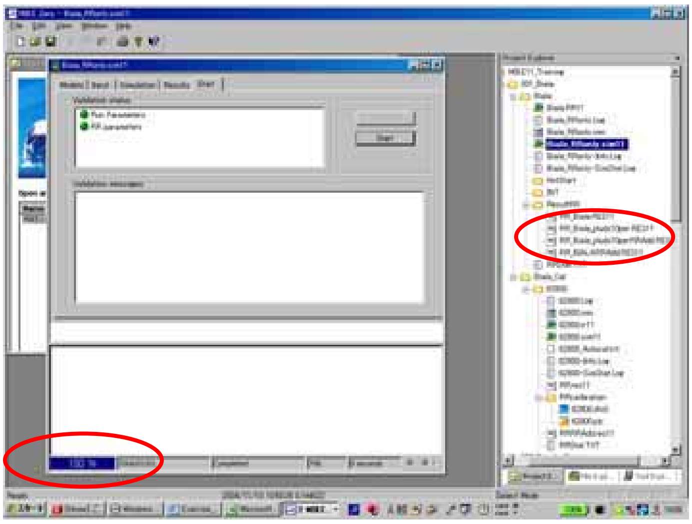
Copy column C

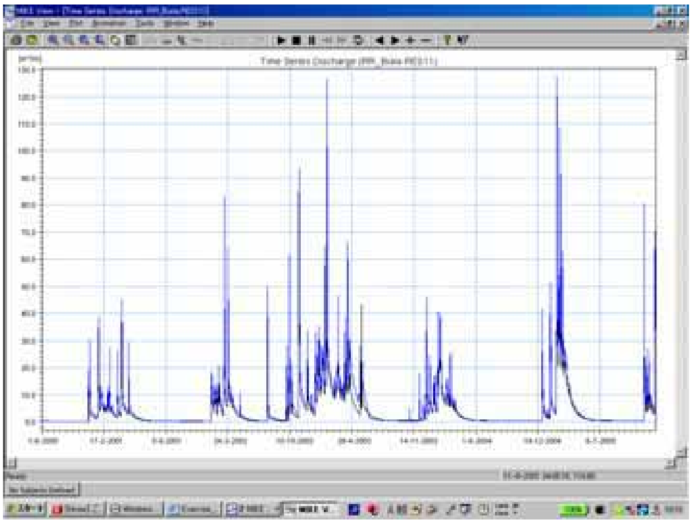


In MIKE Zero, highlight the column which will be changed. The, paste the copied from Excel.	
Save the file. Close the .dfs0 file.	
Open Biala_RRonly.sim11	

After simulation editor appears, select “Input” tab and click ”edit” for input file. Then, editor for “Biala.RR11” appears.	
Select “Timeseries” tab. Click “Browse” for Rainfall.	
After dialog “DFS file & item selection” appears, browse the newly prepared .dfs0 file. Select it and click “OK”.	

Save "Biala_RRonly.rr11"	
Select "results" tab. Click "…".	
Change "results file name". Click "SAVE".	

Save "Biala_RRonly.sim11"	
Select "Start" tab. Click "Start".	
You will get new result. *Note: if you can not see the result, please right click of the folder and select "show all".*	

In MIKE View, you can compare the results.	

End of Exercise

Homework **-** Trial assessment on effect of global warming on run-off

It is said that global warming will bring about increase of average temperature and change of precipitation amount.
Change of precipitation amount would directly affect to run-off amount. In addition, increase of average temperature would alter Potential Evapo-Transpiration and snow melting process.
In this exercise, we change the precipitation amount, temperature by several scenarios. Then, we investigate how such change could alter the run-off amount, using the mode set-up in the training course.

Scenarios

		Precipitation		
		No change	+10%	-10%
Temperature	No change	Case 0	-	-
	+3 degree	Case 1	Case 2	Case 3

Note: Case 0 is existing condition.

Same temporal patterns of precipitation and temperature as 2001-2005 are used. However, average values are changed according to the above scenarios.

PET when temperature increases with 3 degree is prepared.

For Biala River Basin:

MonthlyPET_Biala_p3.dfs0

For Pirinska Bistritsa River basin:

MonthlyPET_PirinskaB_p3.dfs0

Changed temperature is also prepared.

DailyAveTemperature_p3.dfs0

Please change precipitation amount and try to simulate with the above scenarios by changing input files.
Compare the results and discuss the effects of increase of temperature and change of precipitation.

Annex 3

Step-by-step Guideline

for

MIKE 11 HD model

Biala River basin (EABD)

Pirinska Bistritsa River basin (WABD)

JICA Study Team

1. Biala River Basin

/ Available information for model

From Core Data of GIS-DB

- Digital elevation model (50m grid)
- RiverNetwork and Catchment boundary
- *Google Earth*

/ Model setting

Total catchment Area: 598.77 km^2

Number of catchment for Rainfall-Runoff model (NAM Catchment): 1 (Previous Exercise)

Number of river for MIKE11-HD: 1

(1) Input data

Cross-section

No actual cross-section data are available.

Instead of using actual cross-section data, simplified cross-section data are used for upstream-end and downstream end of MIKE11 river network.

Downstream end:

Chainage = 0 m
Elevation from DEM = 34.6 m
Average channel slope from DEM = 0.00386
Approximate width of river (referred Google Earth) = 50 m

Upstream end:

Chainage = 32521.42 m
Elevation from DEM = 160.0 m
Approximate width of river (referred Google Earth) = 50 m

(2) RR-HD Link

Output from Rainfall-Runoff Model (RR) is linked to MIKE11-HD river network.

Rainfall-Runoff Catchment is sub-divided into two parts. One is upstream reach and another is downstream reach.

Those two parts are linked to the river network as follows:

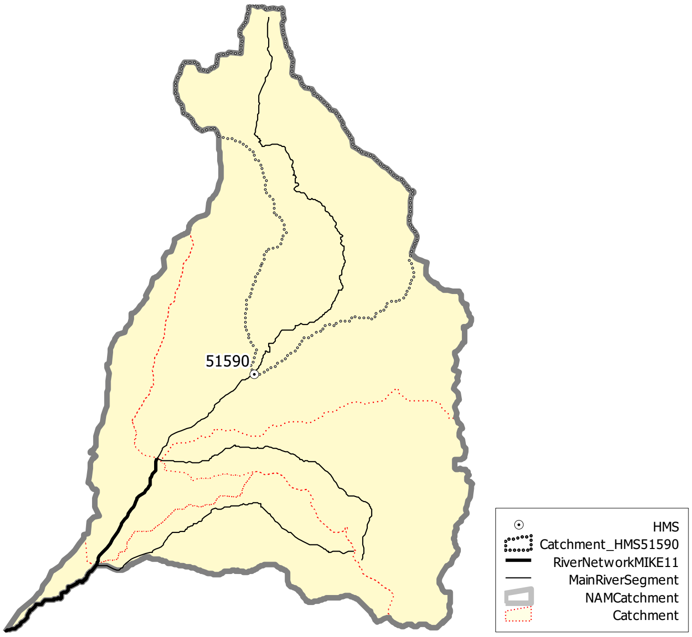
	NAM Catchment Name	Area (km^2)	Branch Name	Upper Chainage	Lower Chainage
Downstream part	Biala	225.40	BI_M	0	32521
Upstream part	Biala	373.37	BI_M	32521	32521

(3) Input File Name

Cross-section data: CS_Biala.xls

RR-Link RRlink_Biala.xls

2. Pirinska Bistritsa River Basin



/ Available information for model

From Core Data of GIS-DB

- Digital elevation model (50m grid)
- RiverNetwork and Catchment boundary
- *Google Earth*

/ Model setting

Total catchment Area: 508.29 km^2

Number of catchment for Rainfall-Runoff model (NAM Catchment): 1 (Previous Exercise)

Number of river for MIKE11-HD: 1

(1) Input data

Cross-section

Data for one cross-section in the middle reach of the river are available. For upstream end and downstream end of MIKE11 river network, copied cross-section from the one in the middle reach are used. However, elevations for upstream end and downstream end are modified by referring DEM.

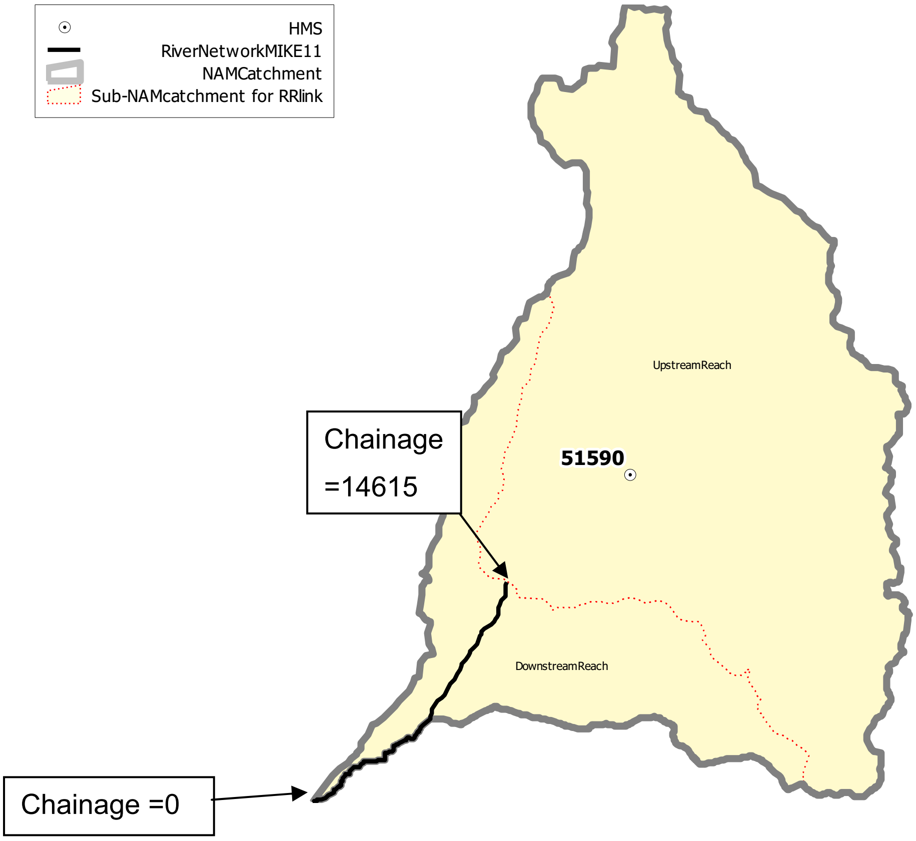
Downstream end:

Chainage = 0 m
Elevation from DEM = 56.6 m
Average channel slope from DEM = 0.00582

Upstream end:

Chainage = 14615.81 m
Elevation from DEM = 147.7 m

(2) RR-HD Link



Output from Rainfall-Runoff Model (RR) is linked to MIKE11-HD river network.

Rainfall-Runoff Catchment is sub-divided into two parts. One is upstream reach and another is downstream reach.

Those two parts are linked to the river network as follows:

	NAM Catchment Name	Area (km^2)	Branch Name	Upper Chainage	Lower Chainage
Downstream part	PirinskaB	119.76	ST_PIR	0	14615
Upstream part	PirinskaB	388.53	ST_PIR	14615	14615

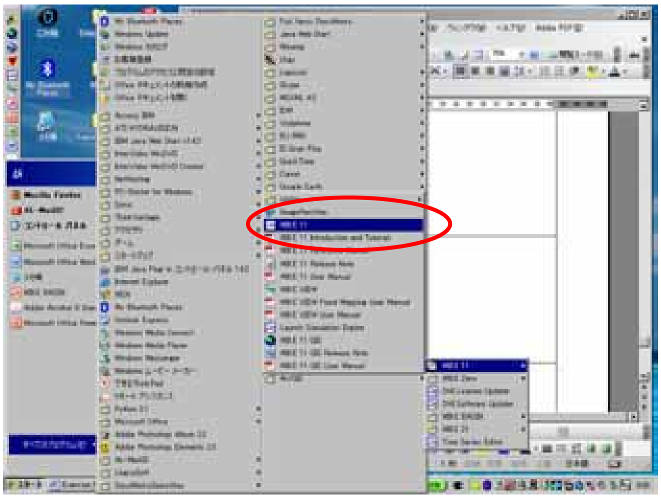
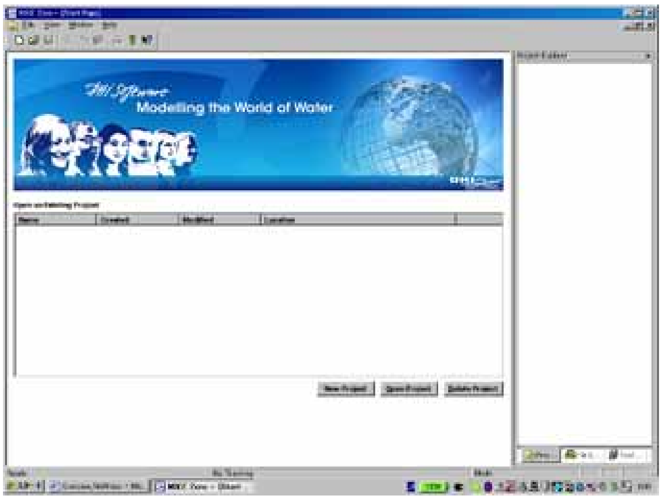
(3) Input File Name

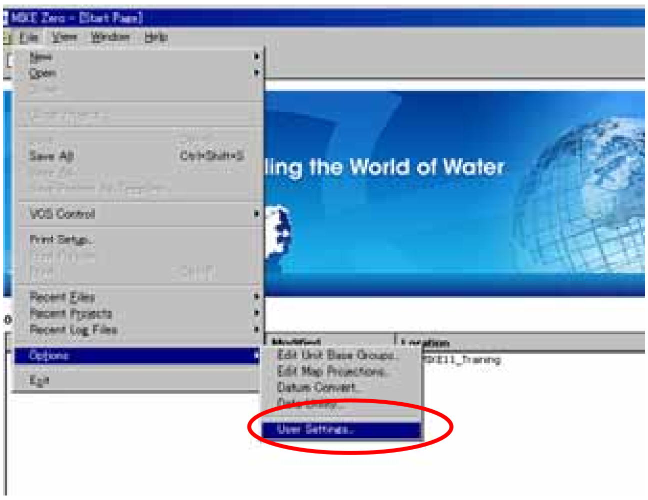
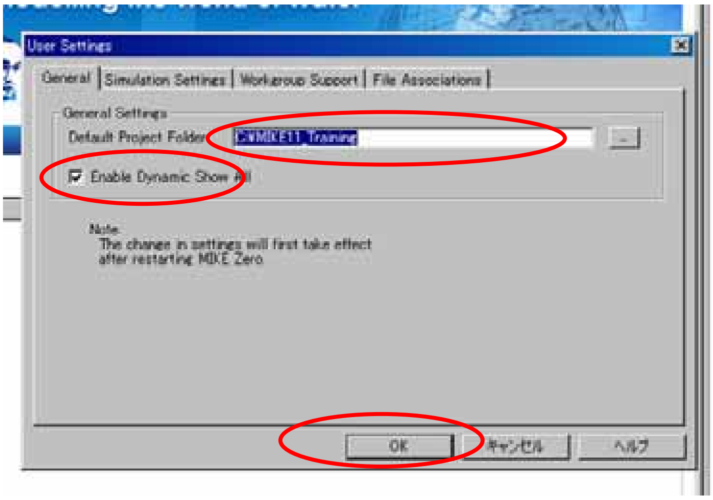
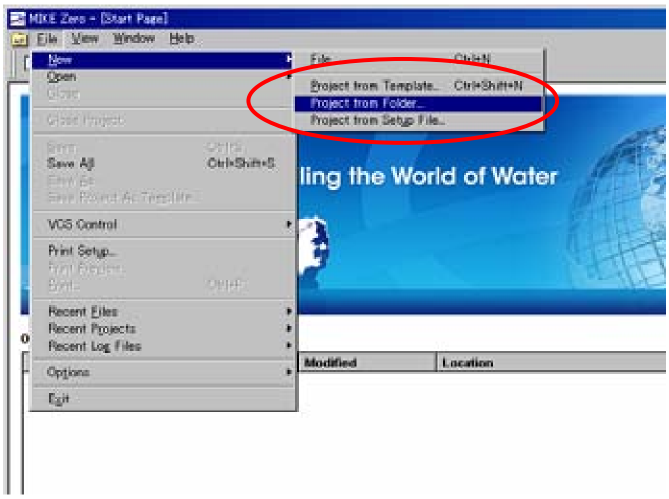
Cross-section data: CS_PirinskaB.xls

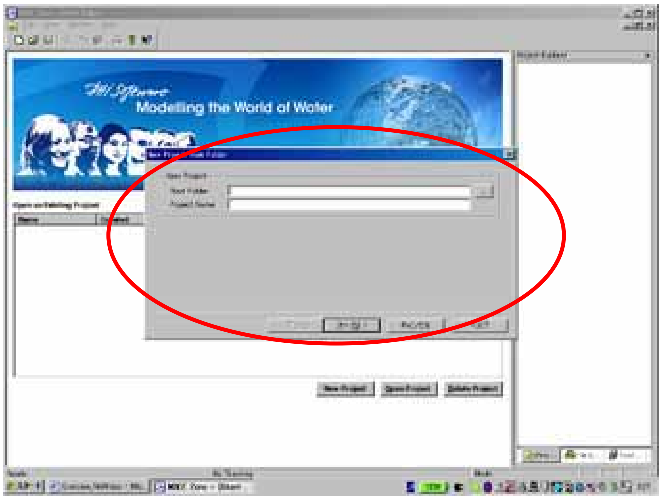
RR-Link: RRlink_PirinskaB.xls

3. Model set-up

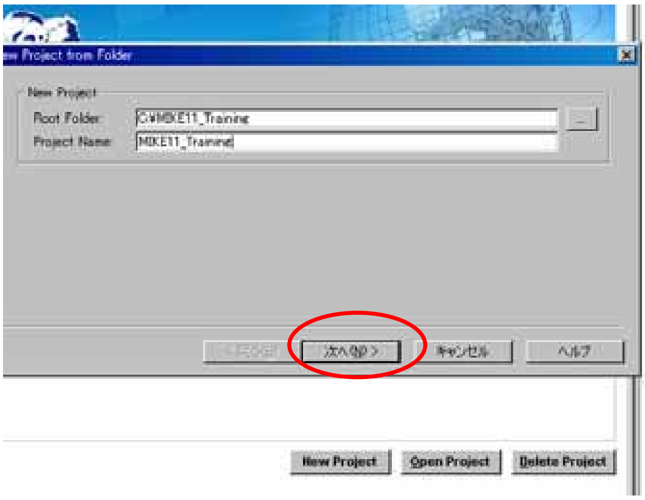
Here, example for Biala River Basin is shown. Set-up procedure for Pirinska Bistritsa River Basin is principally same except setting of cross-section data.

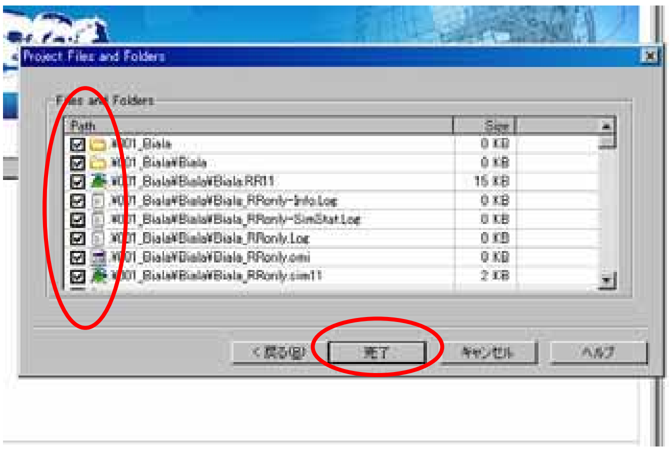
Copy the folder"MIKE11_Training_2" from CD, which includes training material, to hard disk in your computer.	
Start MIKE11 from "start menu".	
Now, MIKE11 with MIKE ZERO platform started.	

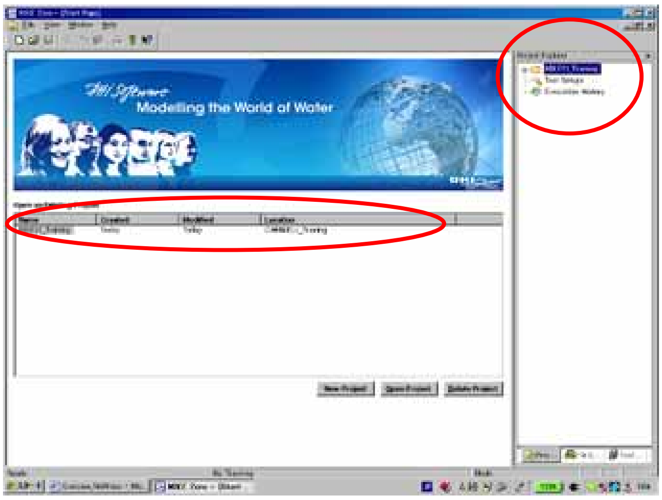
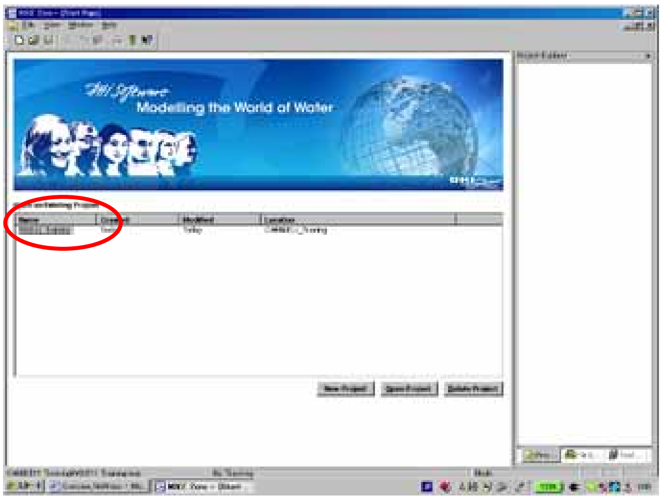
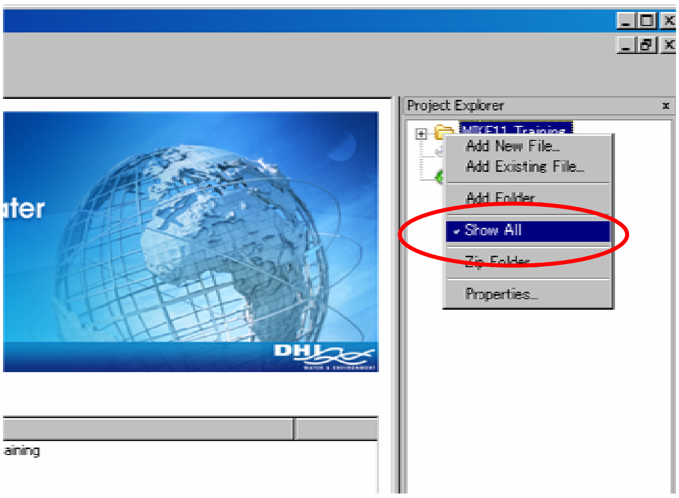
Setting Option in MIKE Zero Select File -> Options -> User Setting	
Set Default Project Folder, (if necessary). Check “Enable Dynamic Show all”. **(Important!)** Click “OK”. **Restart MIKE11**	
Making a new project *File -> New -> Project from Folders*	

<table>
<tr>
<td>Dialog “New Project from Folder” appears.</td>
<td>
</td>
</tr>
<tr>
<td>Browse the folder”MIKE11_Training_2” which was copied to the hard disk in your computer.

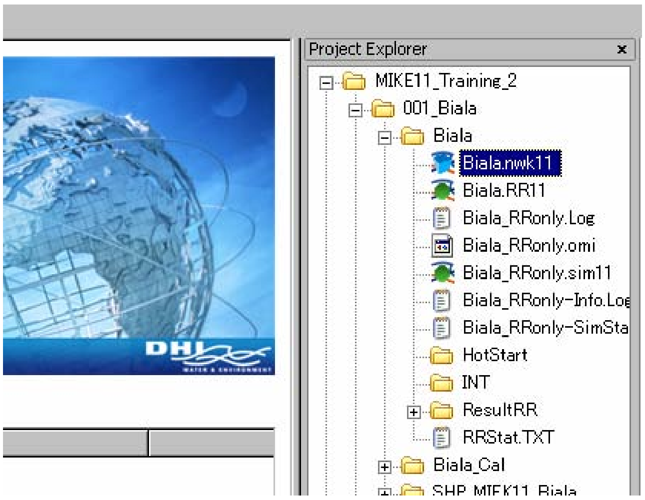
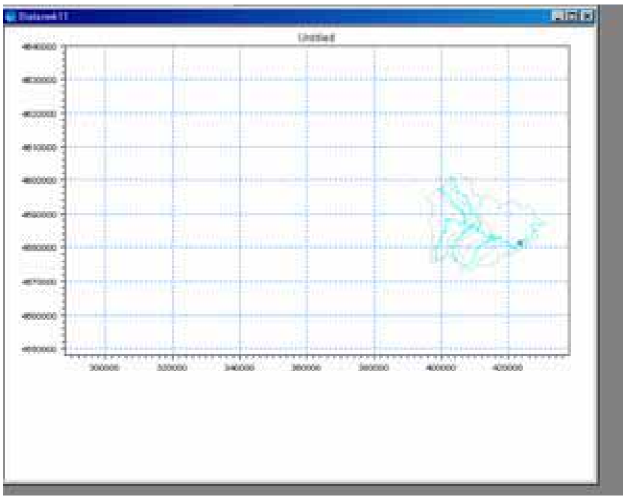
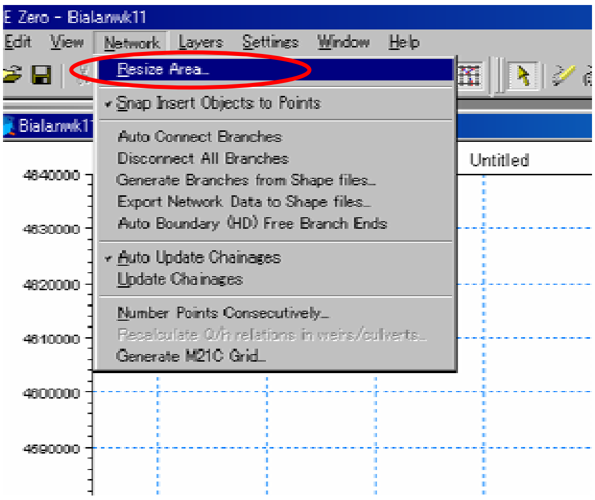
Enter Project Name.

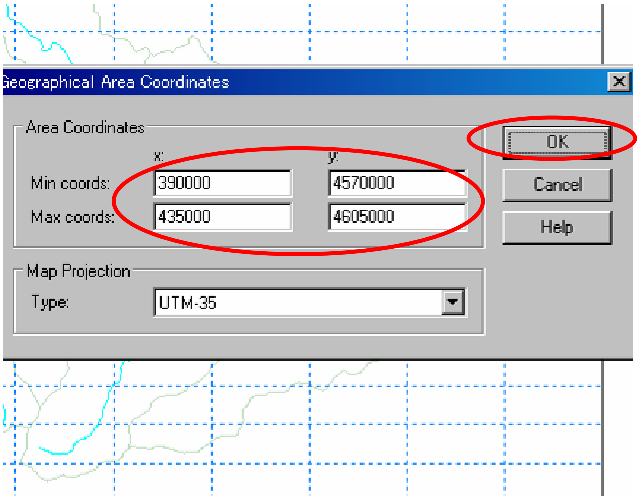
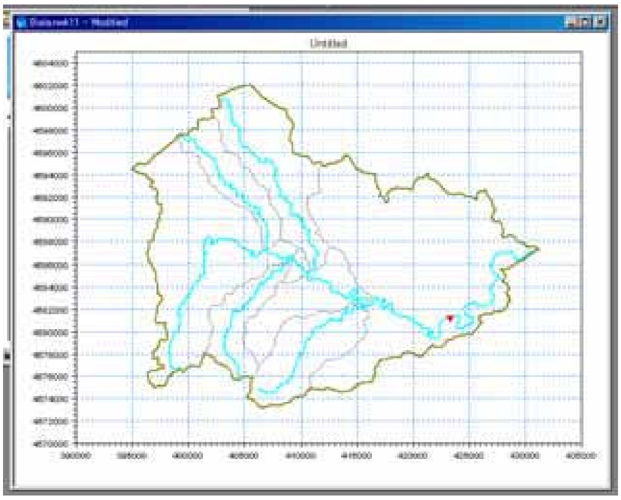
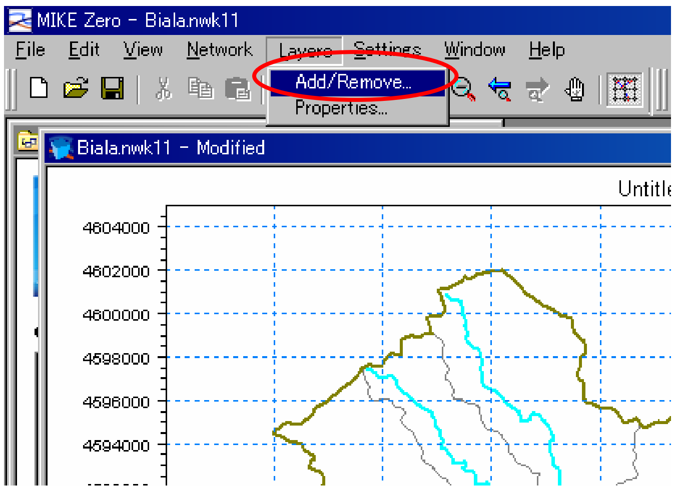
Then, click “Next (N)”.</td>
<td>
</td>
</tr>
<tr>
<td>Make sure all are checked in check boxes.

Then click “complete”.</td>
<td>
</td>
</tr>
</table>

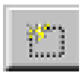
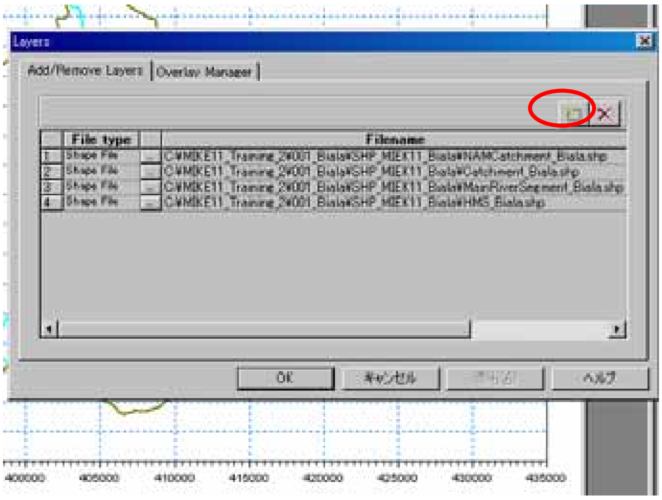
New project opened.	
Once a new project is set, from next time, you can open the project by clicking Name of project shown in “Open an Existing Project”.	
Right click “MIKE11_Traing_2” folder. Click “Show all”. **(Important!)** Without doing this, newly added files in the project are not visible.	

Setting-up .nwk11 file

In Project Explorer, place cursor on "001_Biala/Biala/Biala.nwk11", then double click.	
Network editor "Biala.mwk11" appears. However, area of editing is not so suitable.	
Select Network -> Resize Area	

Dialog “Geographical Area Coordinates” appears. Change Min coords and Max coords for x and y to be appropriate ones. Then, click”OK”.	
Now, area of editing is reset.	
Select Layers -> Add/Remove....	

<table>
<tr>
<td>Dialog “Layers” appears.

Click  button.</td>
<td>
</td>
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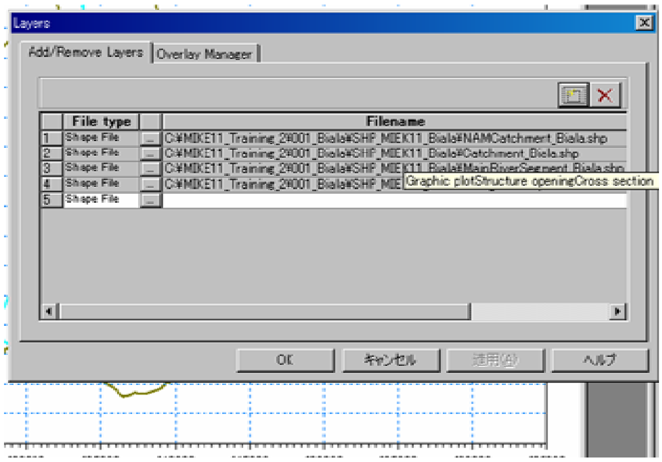
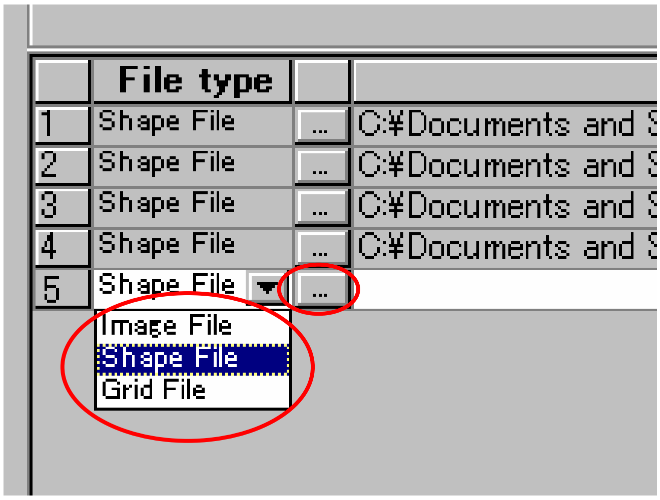
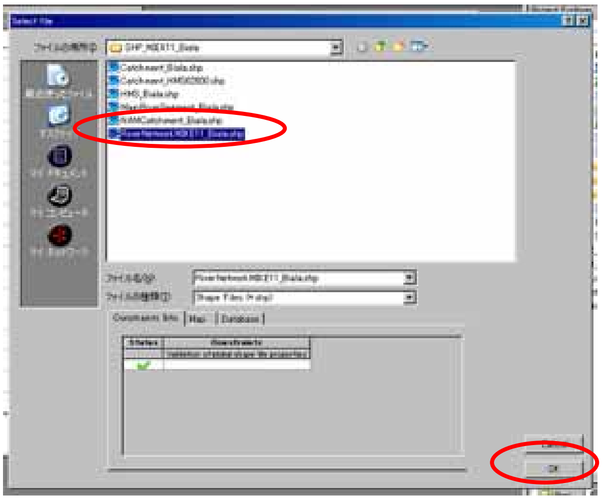
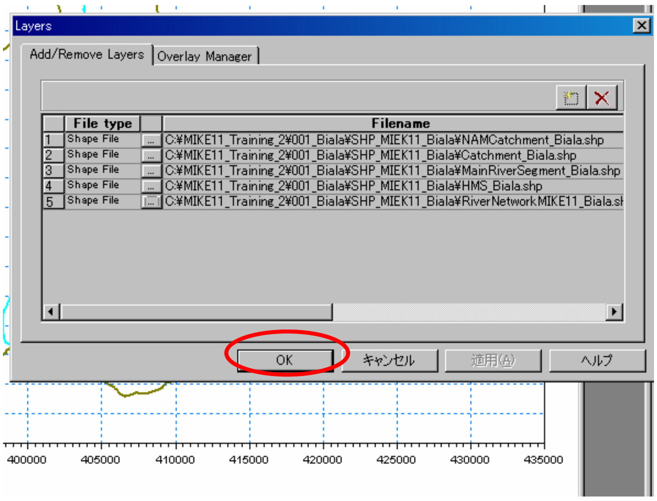
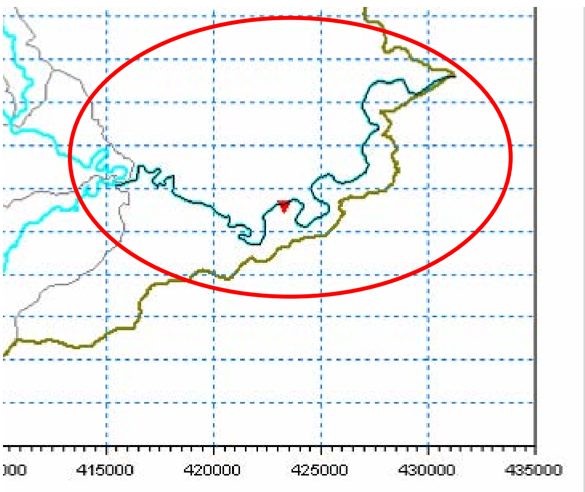
<tr>
<td>New line appears.</td>
<td>
</td>
</tr>
<tr>
<td>Select “Shape File” from File type field.

Then, Click “…”.</td>
<td>
</td>
</tr>
</table>

Dialog “Selection File” appears. Select ”/SHP_MIKE11_Biala/ RiverNetworkMIKE11_Biala.shp” Click “OK”.	
In Dialog “Layers”, Click “OK”.	
Now, shape file of RiverNetworkMIKE11_Biala is inserted to network editor.	

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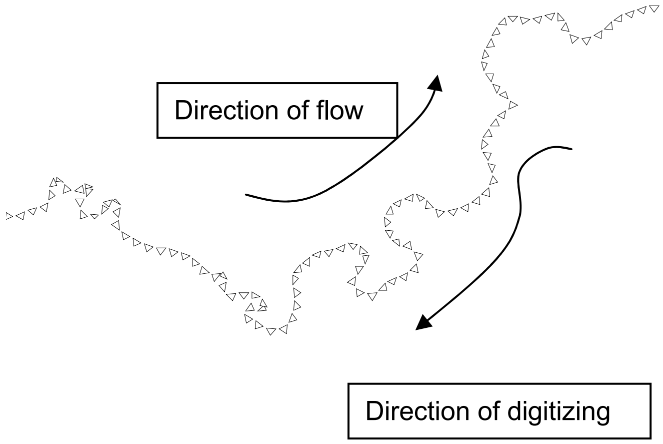
<u>Remarks on .shp file</u>

For auto-conversion of .shp file to MIEK11 river branch, direction of digitizing must be opposite from direction of flow.

This is because it is determined that chainage starts from downstream end point in the present study.

Please also remind that one object will be one river branch by using auto-conversion.

</td>
<td>



</td>
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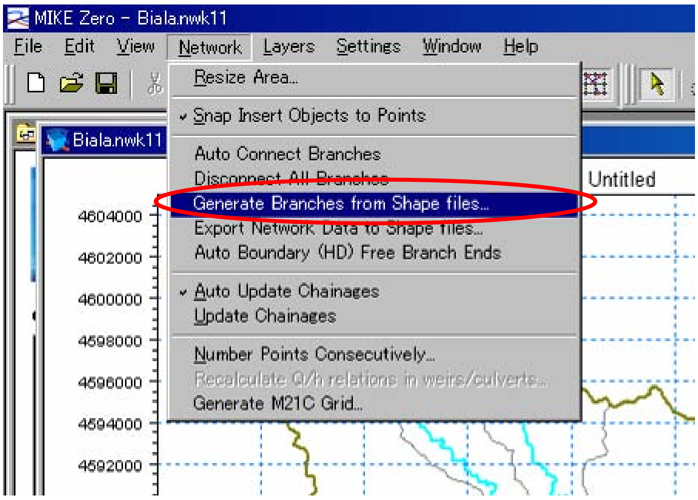
<td>

Select

Network ->

Generate Branch from shape files..

</td>
<td>



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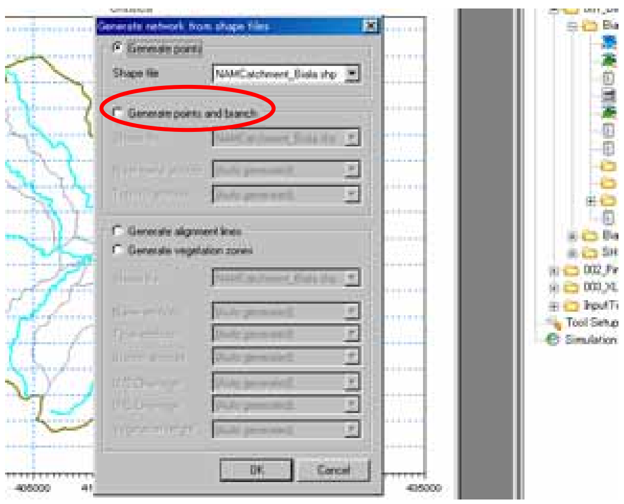
<td>

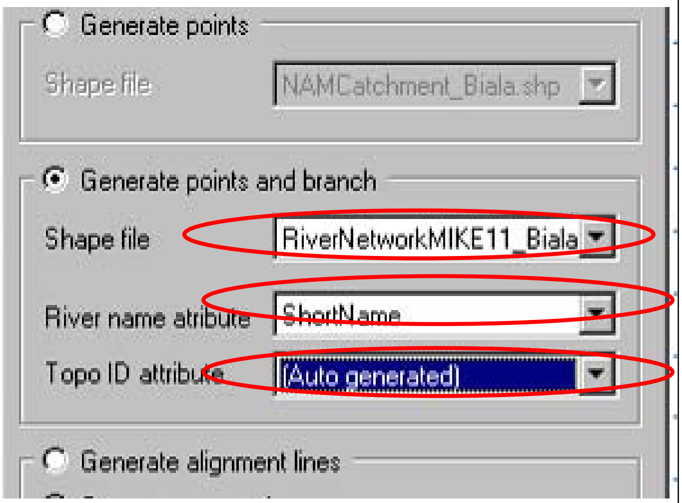
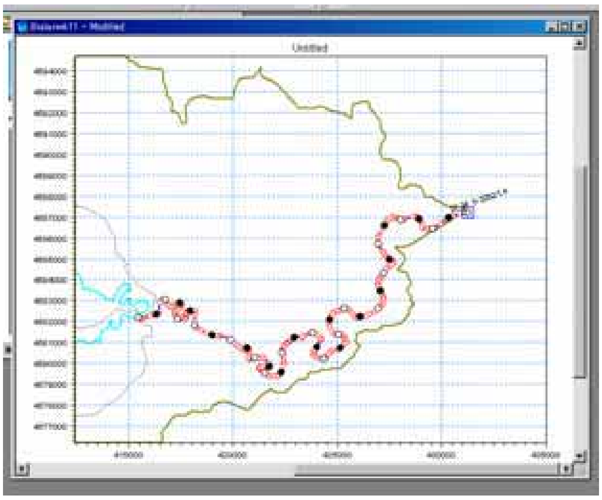
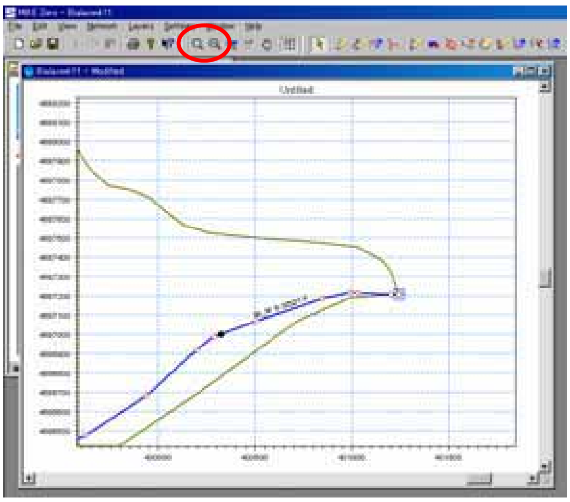
Dialog “Generate Branch from shape files” appears.

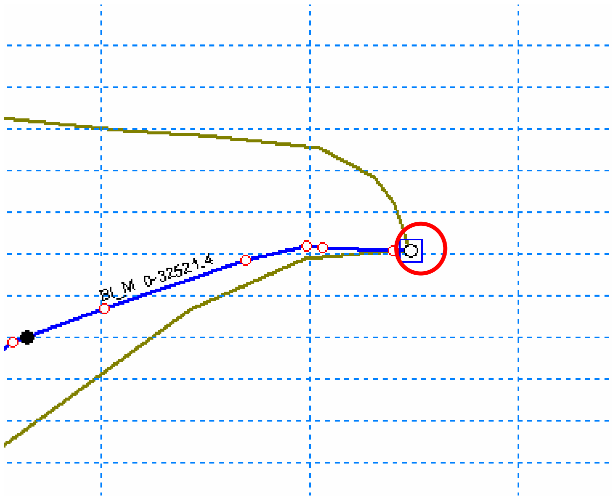
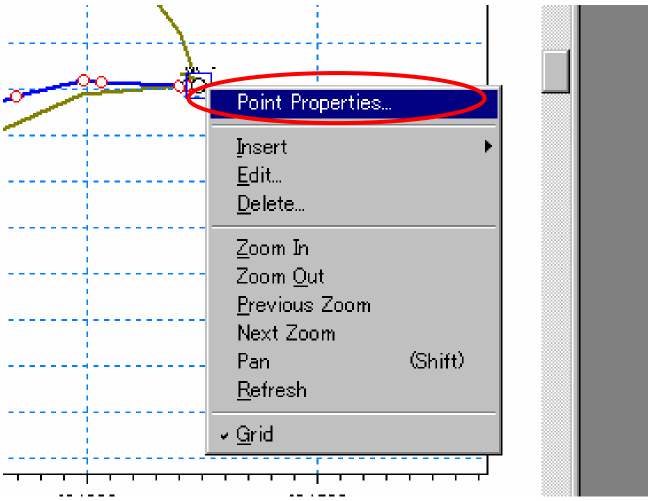
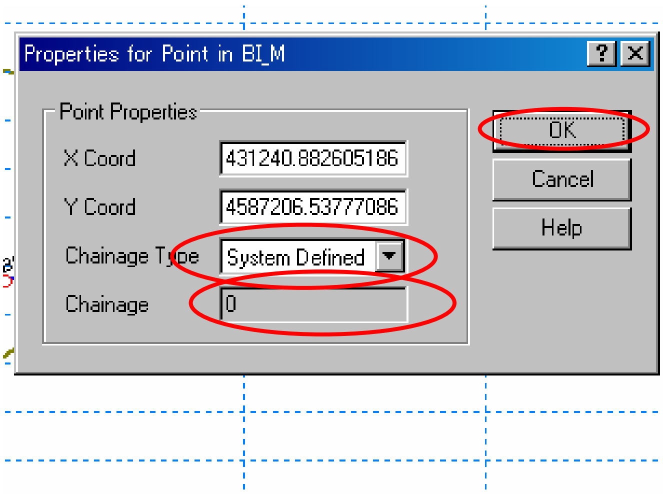
Select “Generate points and branch”.

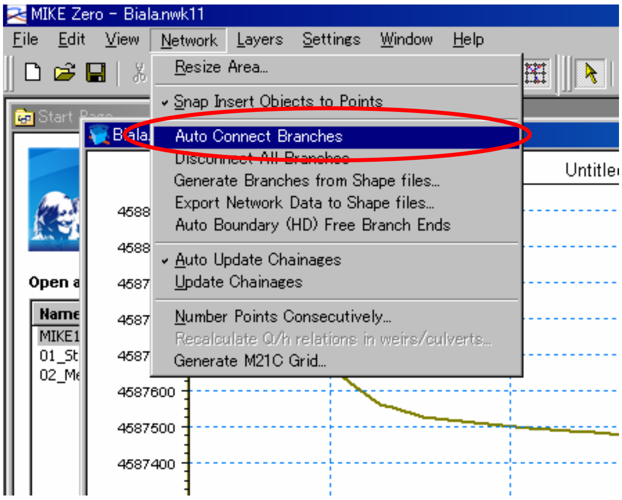
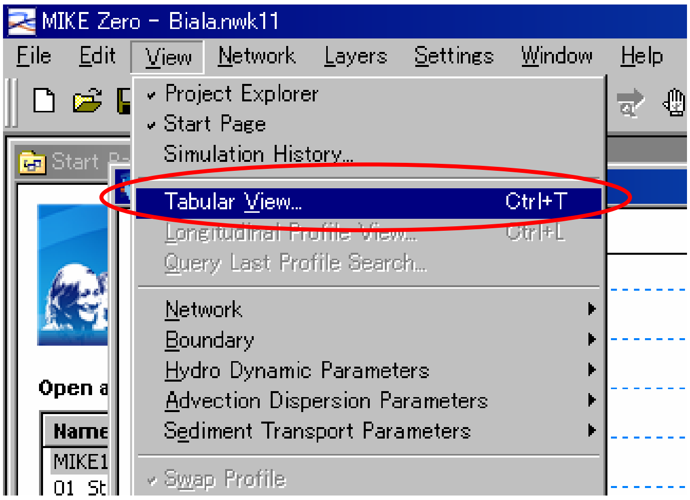
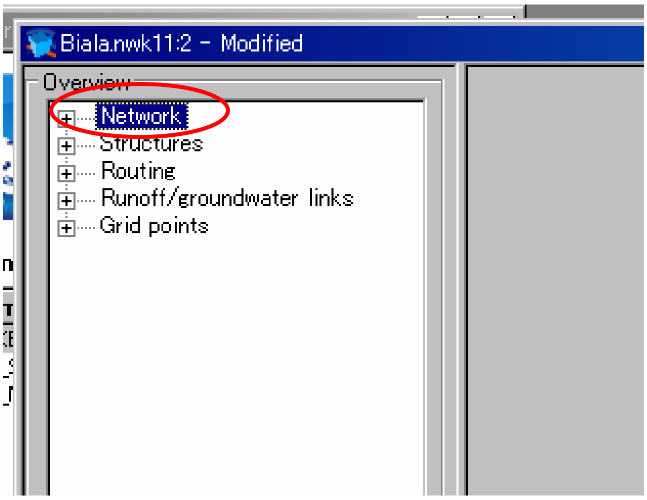
</td>
<td>

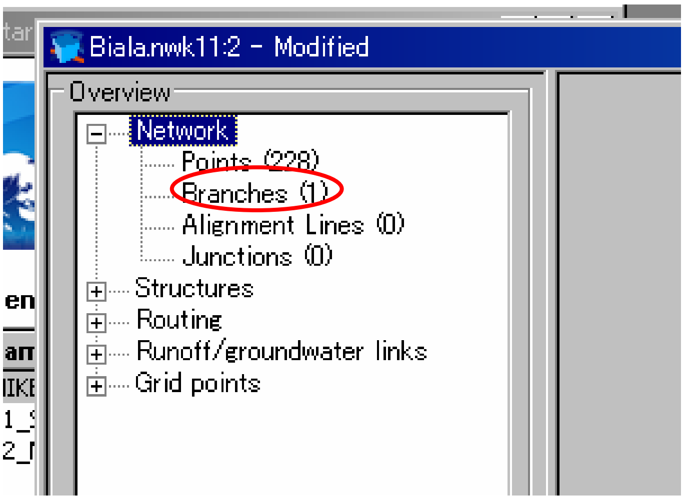
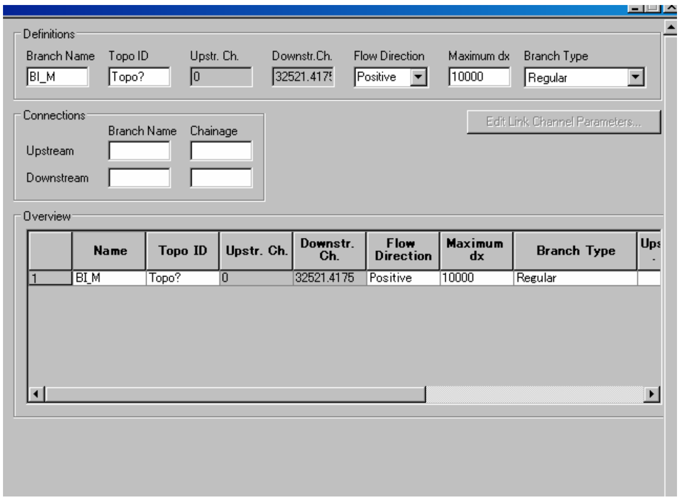


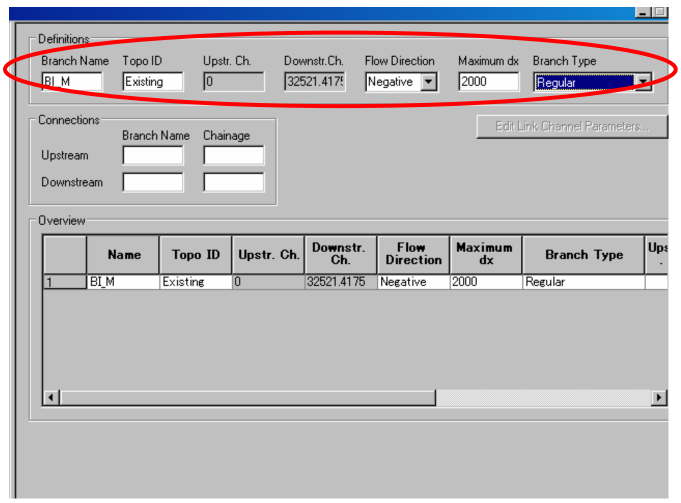
</td>
</tr>
</table>

Select in Shape file field "RiverNetworkMIKE11_Biala.shp" Select in River name attribute field "ShortName" (Branch name will be automatically assigned). Select in Topo ID attribute field "(Auto generated)" Then, click "OK".	
Now, you can see MIKE11 river network branch and points.	
Zoom in to downstream end point using "zoom in tool".	

Place cursor on the point at downstream end, and then right click.	
Dialog appears. Select "Point Properties…", and click it.	
You can see the coordinate of the point and chainage. Please make sure that Chainage type is " System Defined", Chainage is "0". Then, click "OK".	

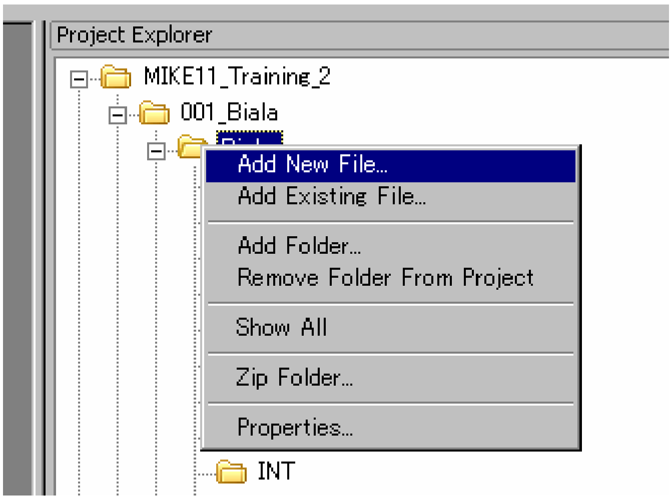
Note: *In this exercise, branch is only one. However, if there are more than two branches, you can automatically connect branches by selecting “Network -> Auto Connect Branches”.*	
Select View -> Tabular View	
Dialog “Biala.nwk11” appears. Select “Network”. Click “+”.	

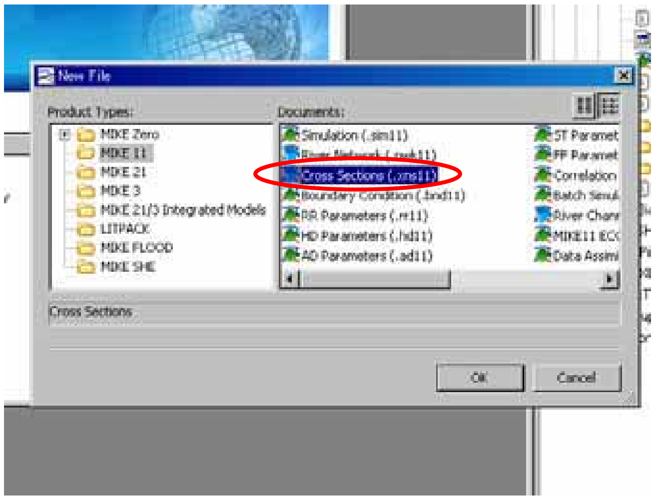
<table>
<tr>
<td>Place cursor on “Branch”, then click.</td>
<td>
</td>
</tr>
<tr>
<td>Now, you can see “Definition”.</td>
<td>
</td>
</tr>
<tr>
<td>Set values as follows.
Topo ID : Existing
Flow direction : Negative
Maximum dx : 2000
Branch Type : Regular

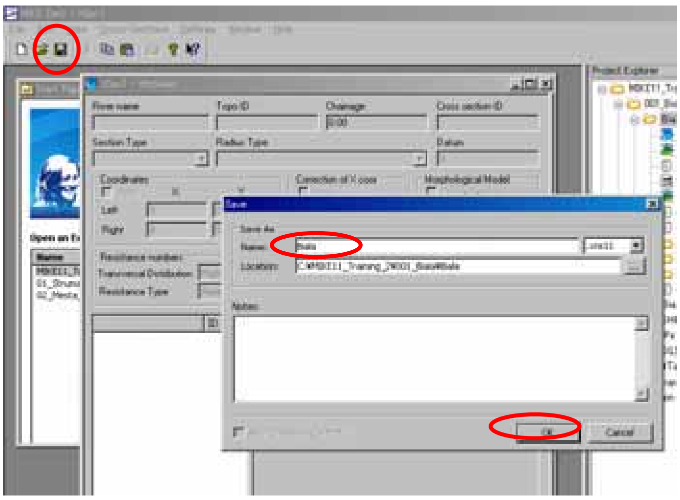
Then, close the dialog.
Save the .nwk11 file and close it.</td>
<td>
</td>
</tr>
</table>

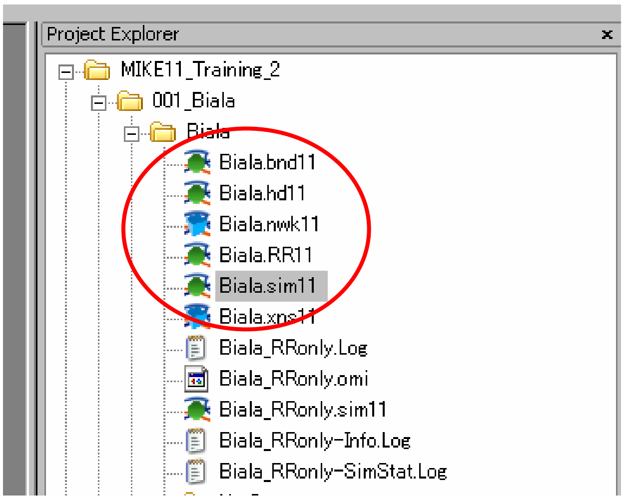
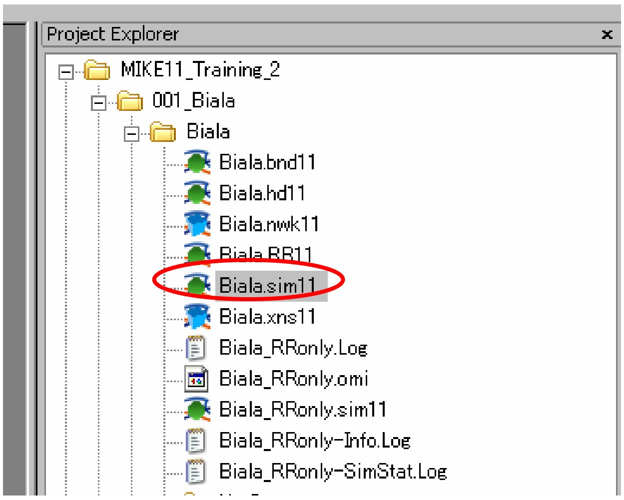
Preparation of files for HD simulation

<table>
<tr><td>In Project explorer, place cursor on folder “Biala”, and then, right click.

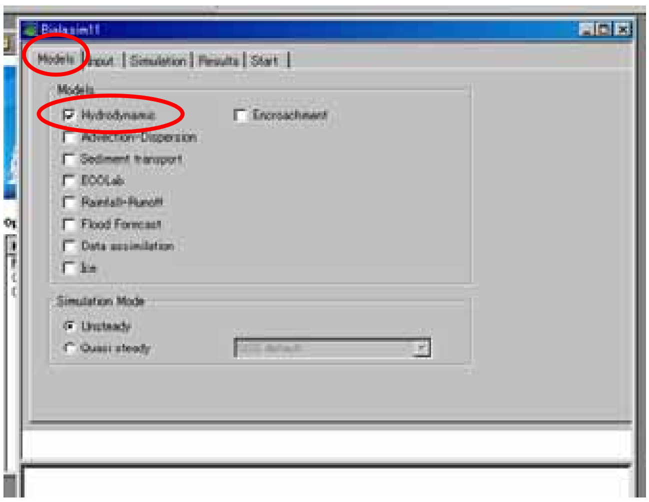
Select “Add New File…”.</td><td>
</td></tr>
<tr><td>Select
MIKE11 -> Cross Sections(.xns11)

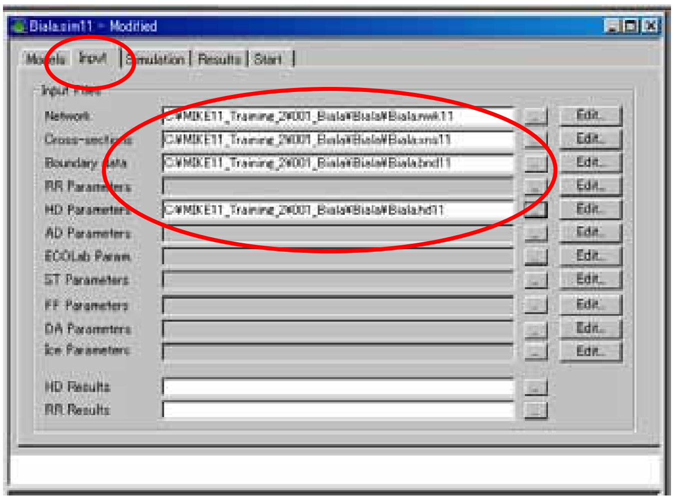
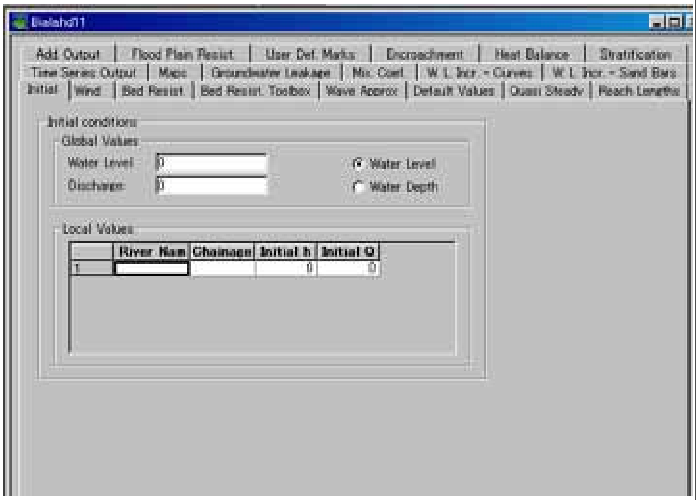
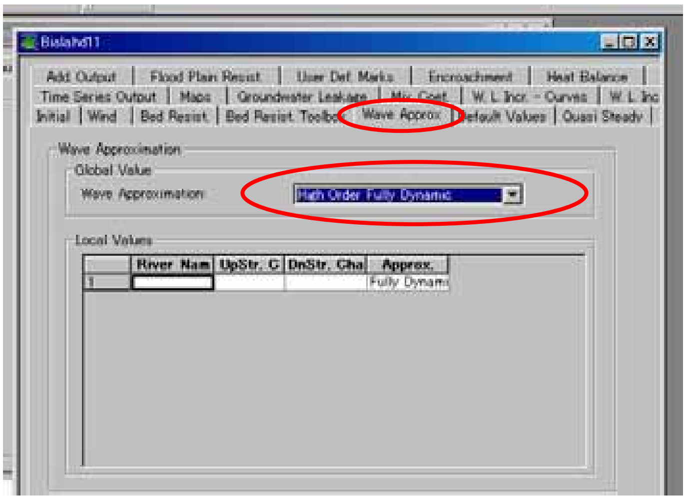
Click” OK”.</td><td>
</td></tr>
<tr><td>After dialog for “cross-section editor” appears, click “save” button.

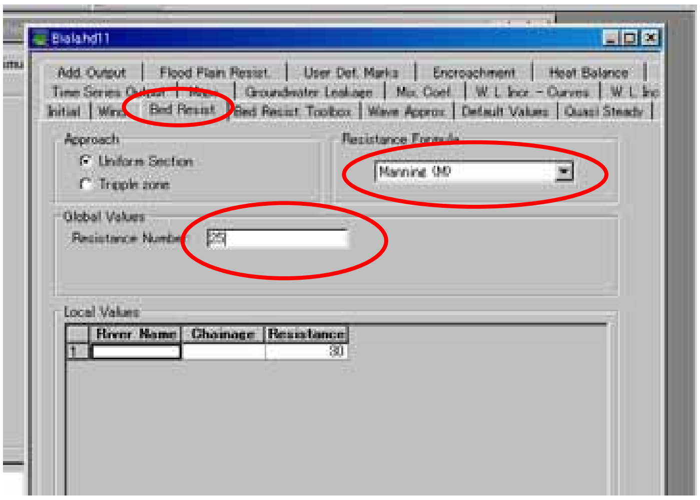
Set filename, and click “OK”.</td><td></td></tr>
</table>

<table>
<tr>
<td>Repeat same procedures for
.bnd11 file
.hd11 file
.sim11 file
You should have the following files.
.bnd11
.hd11
.nwk11
.RR11
.sim11
.xns11</td>
<td>
</td>
</tr>
<tr>
<td>Open “Biala.sim11” by double click.</td>
<td>
</td>
</tr>
<tr>
<td>Dialog “simulation editor” appears.

Select “Model” tab.

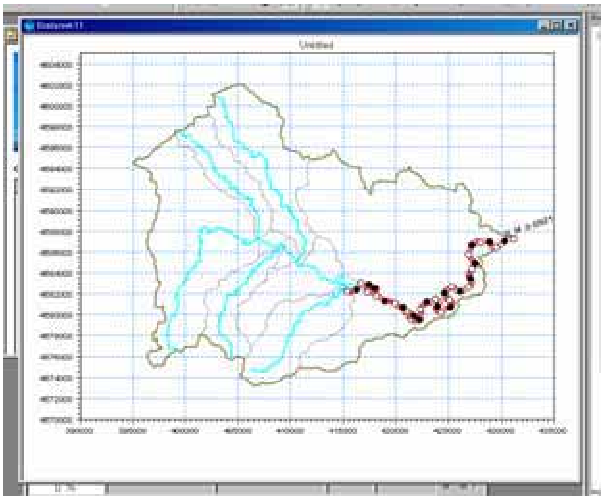
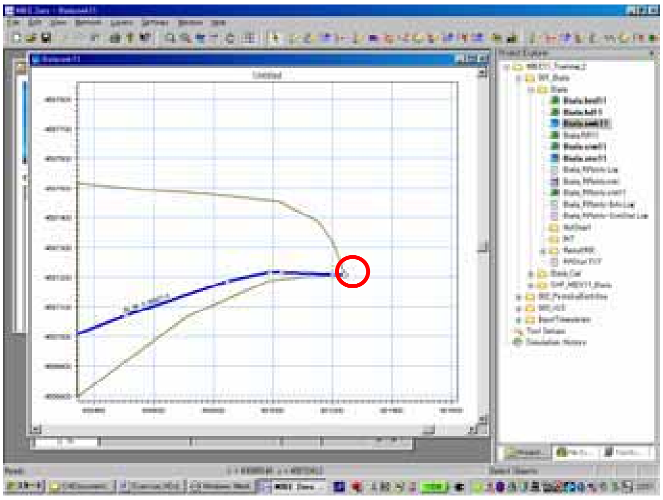
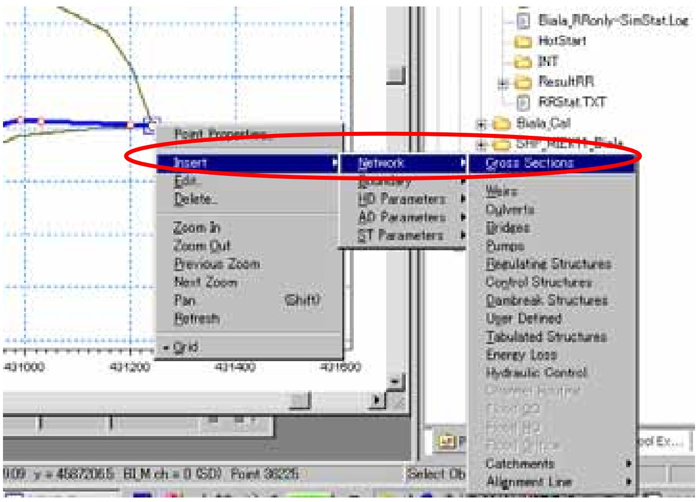
Check only ”Hydrodynamics”.</td>
<td>
</td>
</tr>
</table>

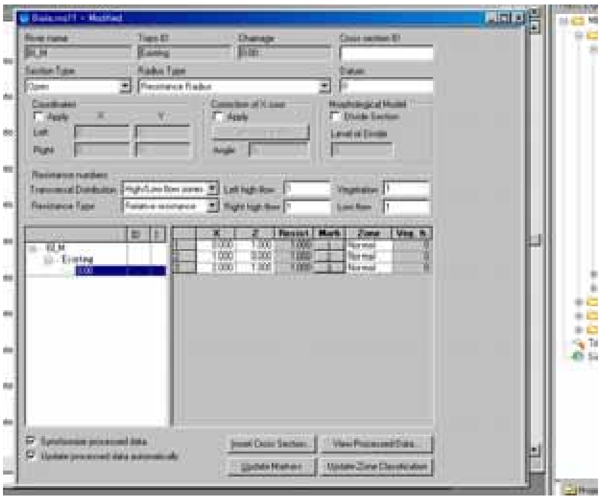
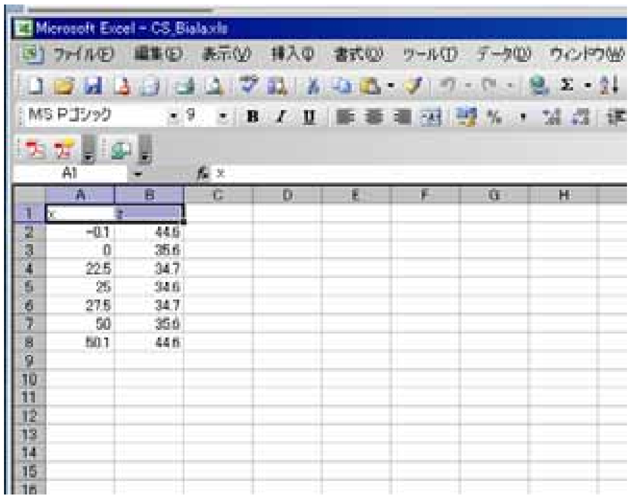
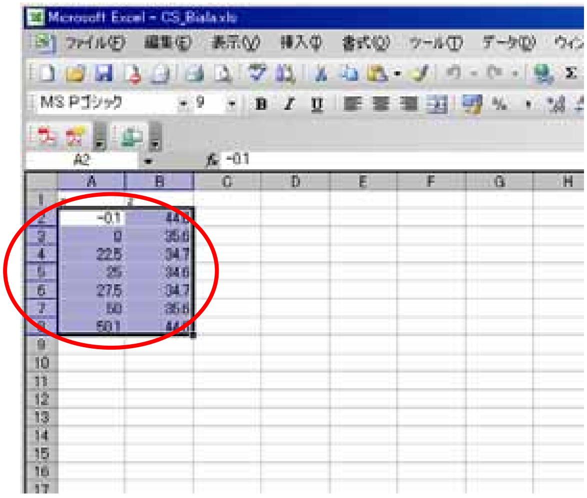
Select “Input” tab. Set Network file Set Cross-sections file Ste Boundary file Set HD file	
Click, “Edit” on HD Parameters. Then, editor for HD parameters appears.	
Select tab” Wave Approximation”. Set Global values for Wave Approximation as “Higher Order Fully Dynamic”.	

Select tab” Bed Resist”. Set resistance Formula as “Manning (M)”. Set Global values for Resistance Number as “25”. Then, save the .hd11 file	

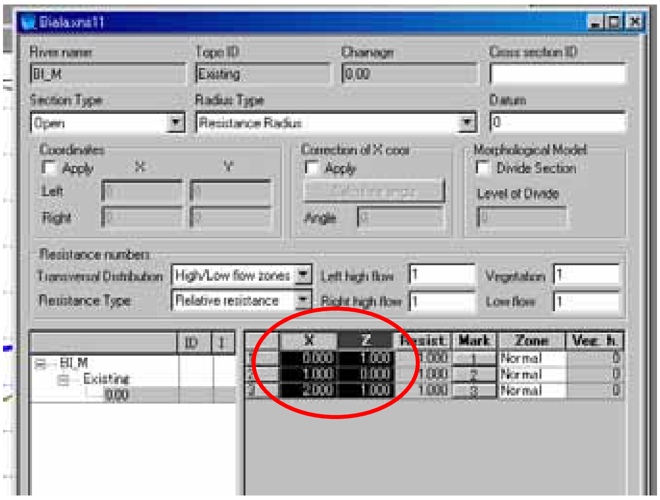
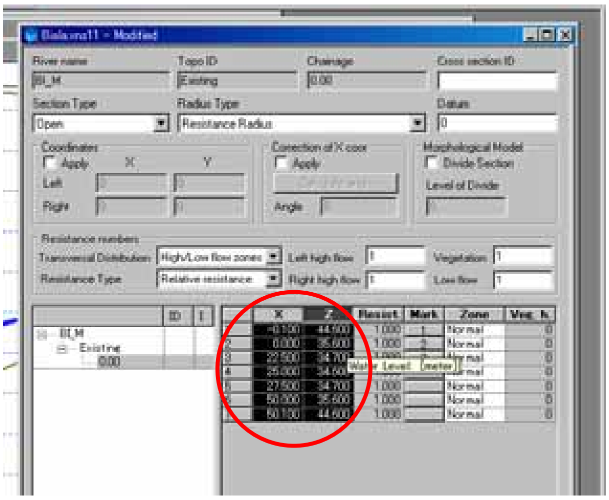
Set Cross-section file for Biala river basin

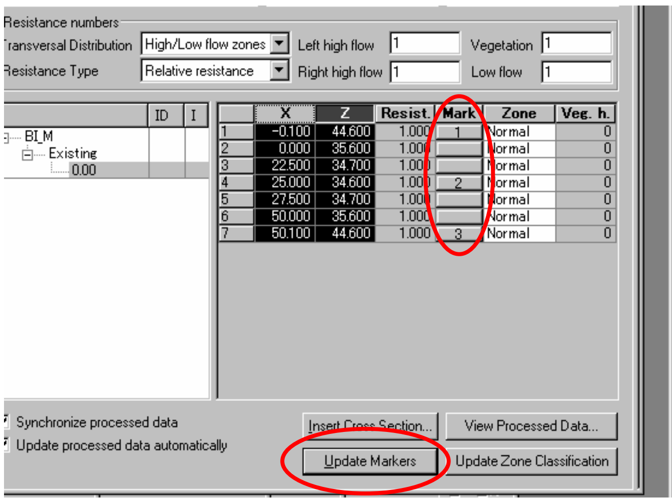
(for Pirinska Bistritsa River, please see after p.31)

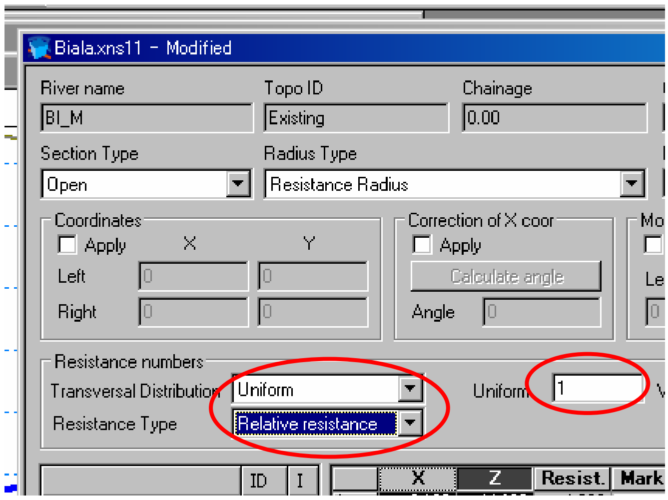
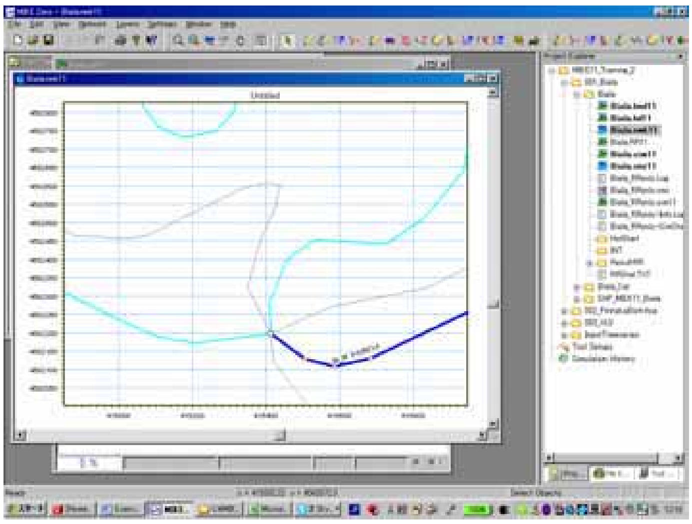
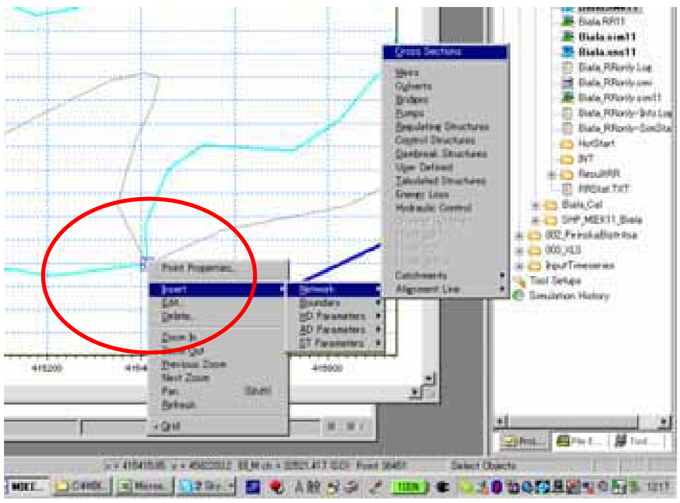
Click, "Edit" on Network. Then, network editor appears.	
Zoom in to downstream end point using "zoom in tool". Place cursor on the point at downstream end, and then right click.	
Dialog appears. Select Insert -> Network -> Cross Sections	

Crosse-section editor appears.	
Open “/003_XLS/CS_Biala.xls” Select sheet ”0” You can see cross-section data at chainage “0”.	
Copy the cross-section data.	

<table>
<tr>
<td>Highlight “x” & “z” columns.

Then, paste the copied from .xls file.</td>
<td></td>
</tr>
<tr>
<td>Now, the cross-sec data are inserted.</td>
<td></td>
</tr>
<tr>
<td>Click “Update Markers”.

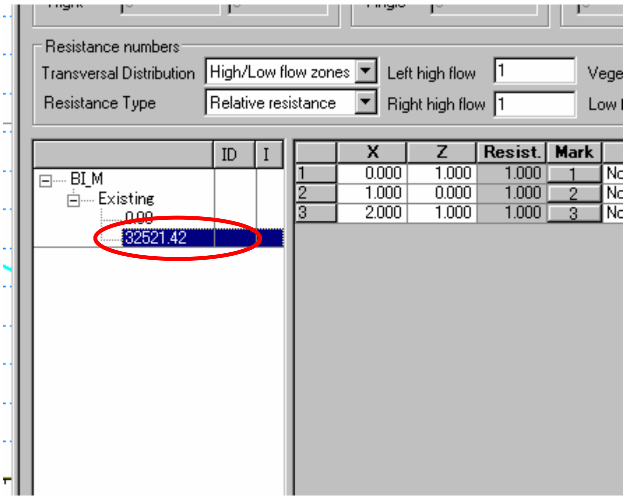
Then, markers are automatically updated.</td>
<td></td>
</tr>
</table>

Set resistance numbers. For Transversal Distribution "Uniform" For Resistance Type "Relative resistance" For Uniform "1"	
In network editor, zoom into upstream end of MIKE11 river network.	
Place cursor on the point at upstream end, and then right click.	

Crosse-section editor appears again.

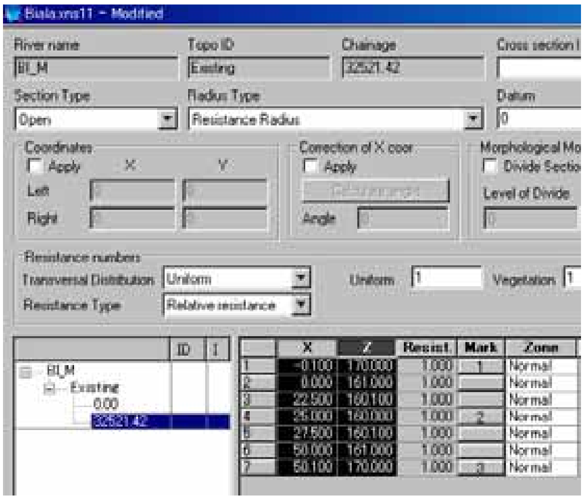
You can see new cross-section is inserted at chainage 32521.42.

Repeat same as chainage “0”.
(insert cross-sec data and so on)

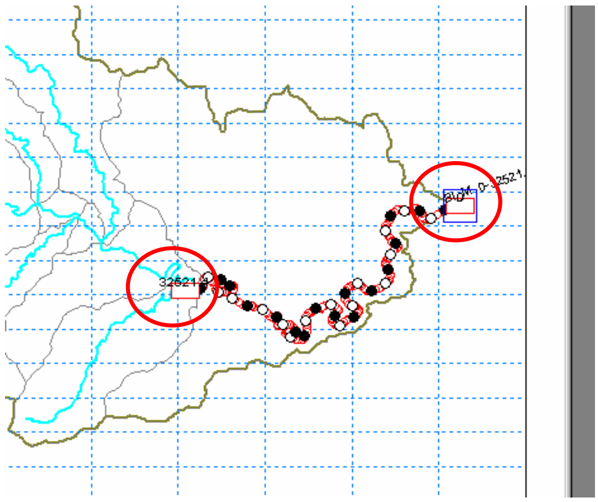


After setting, save the .xns11 file.

Close the .xns11 file.



You will see the mark for cross-section in network editor.



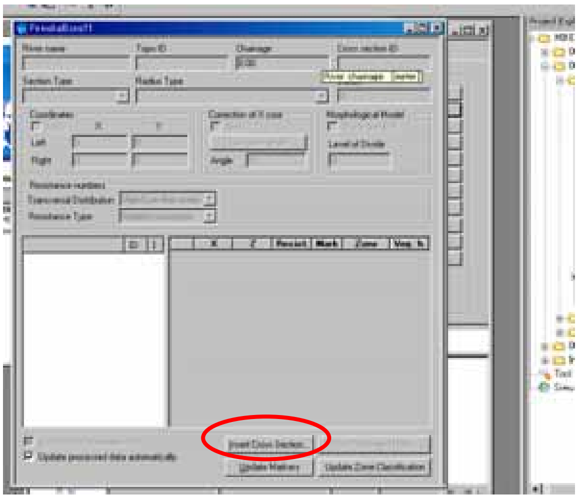
Set Cross-section file for Pirinska Bistritsa River basin

(for Biala River, please skip to p.39)

Click, “Edit” on Cross-sections.

Then, cross-section editor appears.

Click “Insert Cross-section”.



Dialog “Insert branch” appears.

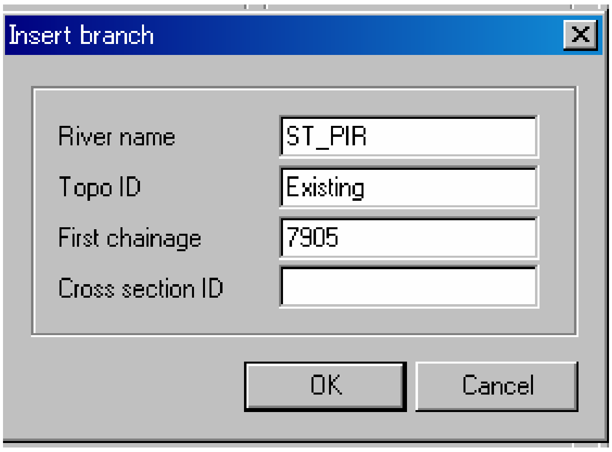
Set values as follows.

River name “ ST_PIR”

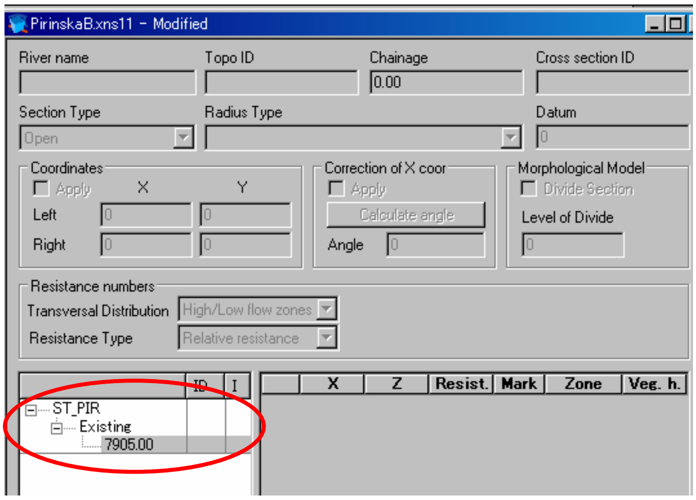
Topo ID “ Existing”

First chainage “7905”

Then, click “OK”.

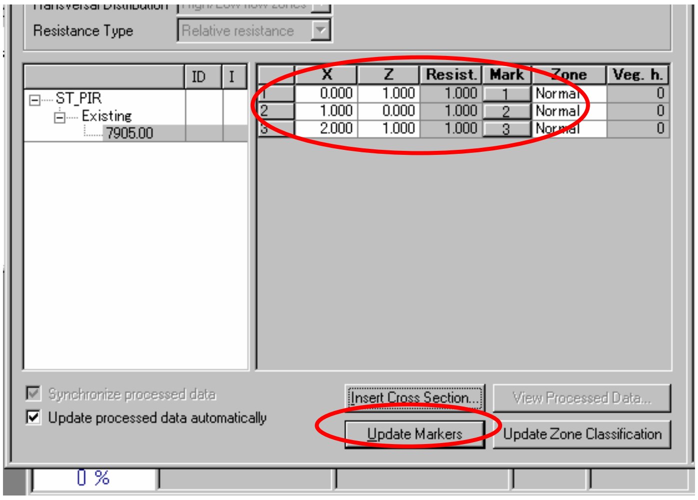


New cross-section is inserted.



Click “Update Markers”.

Then, some lines appear in cross-section editor.

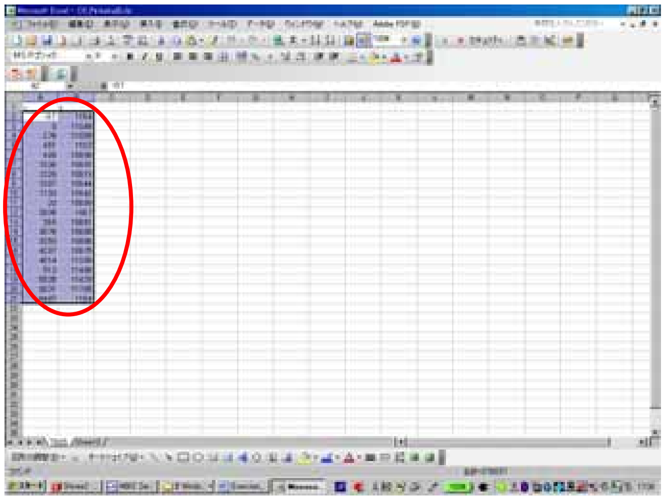


Open

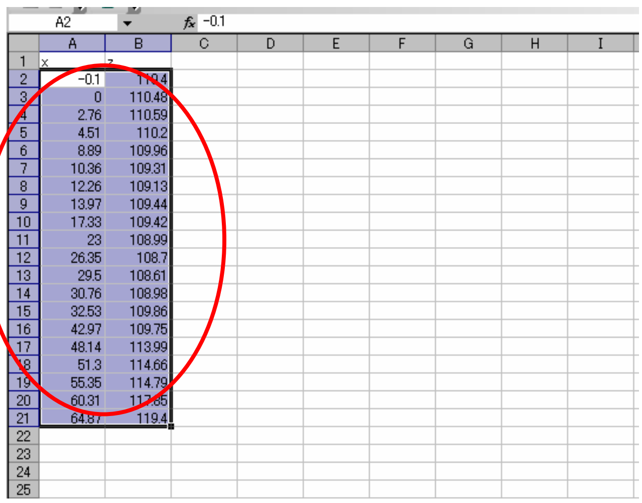
“/003_XLS/CS_PirinskaB.xls”

Select sheet ”7905”

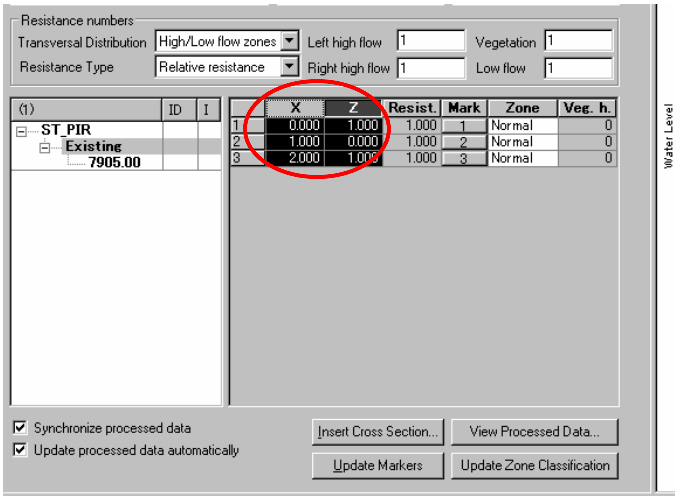
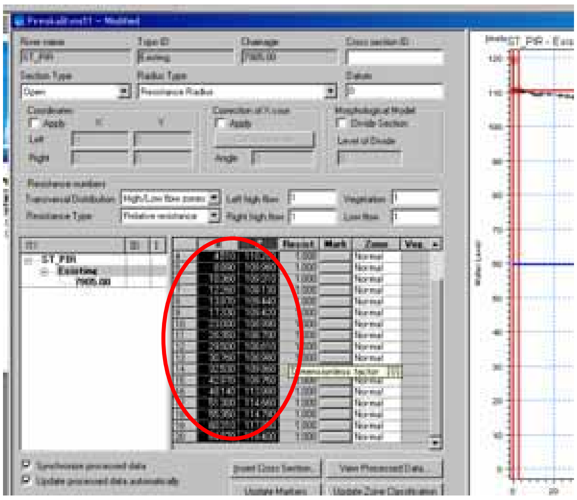
You can see cross-section data at chainage “7905”.

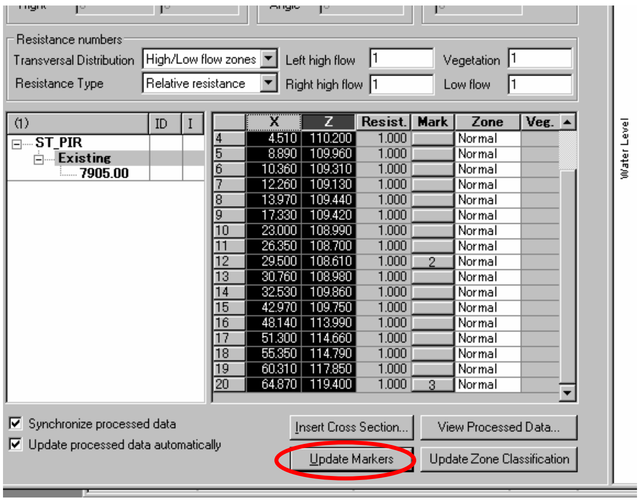


Copy the cross-section data.



<table>
<tr>
<td>Highlight “x” & “z” columns.

Then, paste the copied from .xls file.</td>
<td>
</td>
</tr>
<tr>
<td>Now, the cross-sec data are inserted.</td>
<td></td>
</tr>
<tr>
<td>Click “Update Markers”.

Then, markers are automatically updated.</td>
<td>
</td>
</tr>
</table>

Set resistance numbers.

For Transversal Distribution

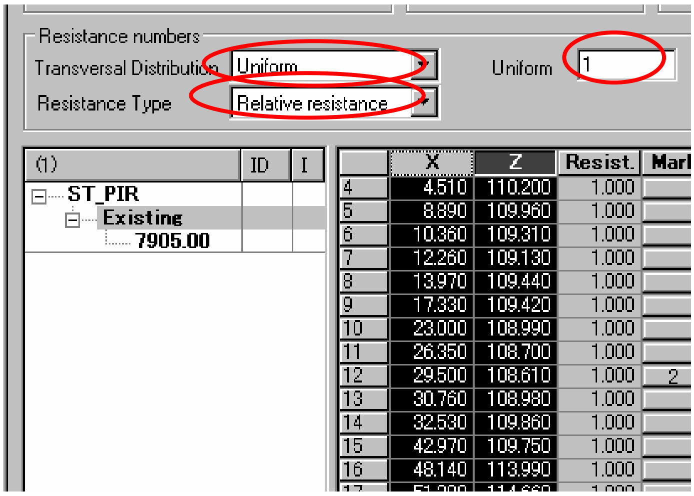
“Uniform”

For Resistance Type

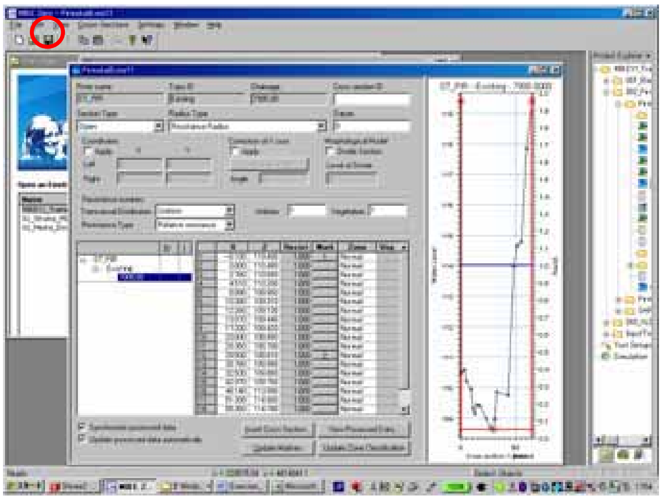
“Relative resistance”

For Uniform

“1”

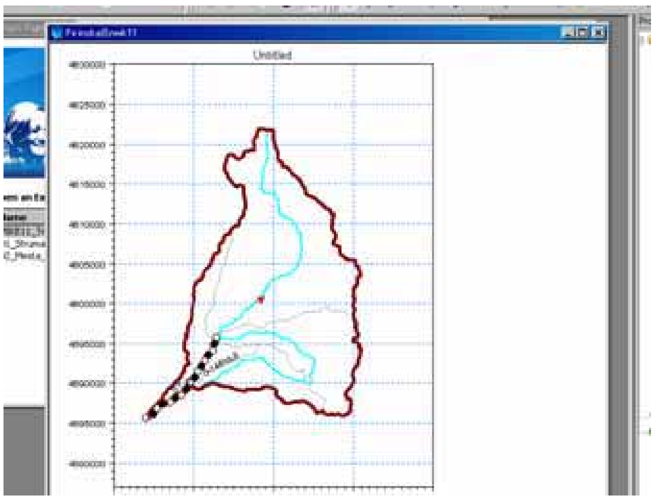


Save .xns11 file and close it.

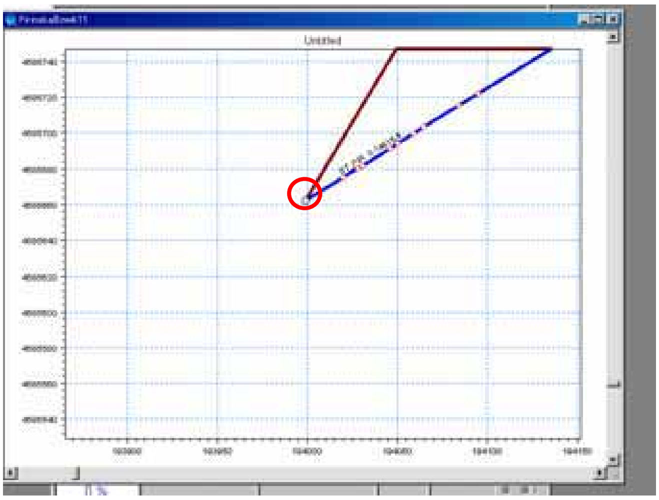


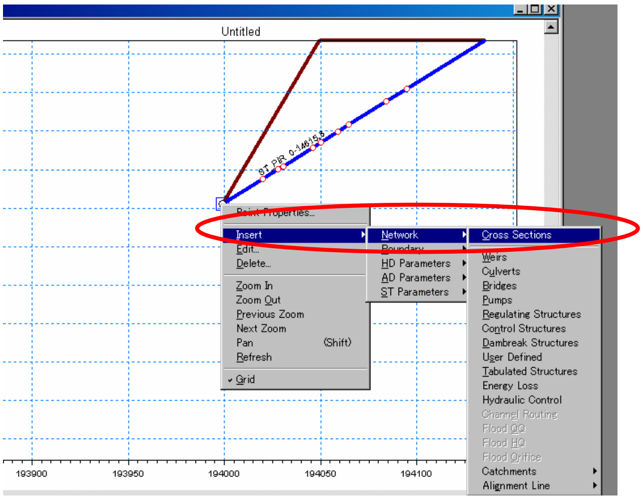
Click, “Edit” on Network.

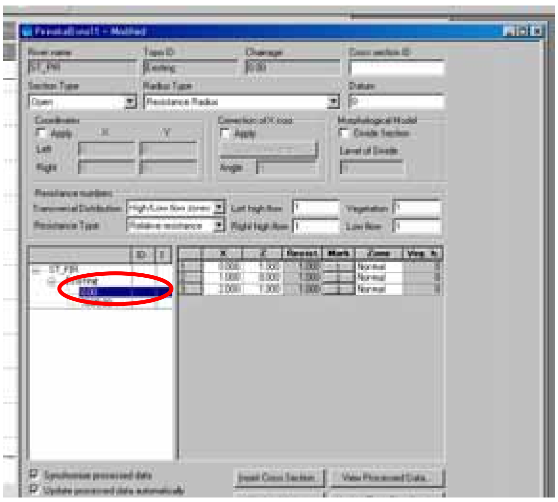
Then, network editor appears.



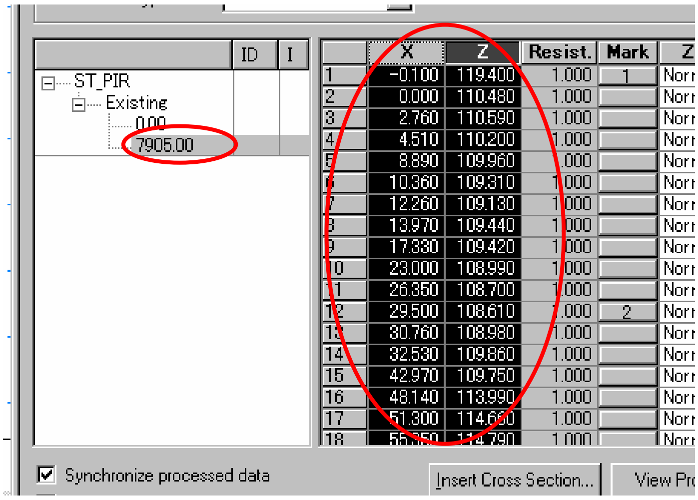
<table>
<tr><td>Zoom in to downstream end point using "zoom in tool".

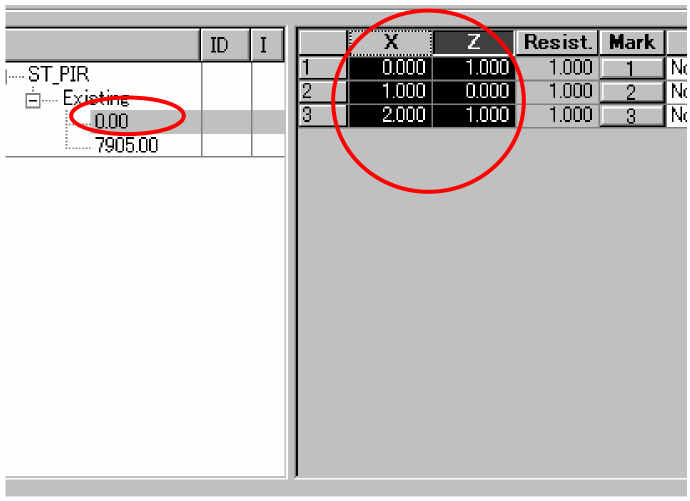
Place cursor on the point at downstream end, and then right click.</td><td></td></tr>
<tr><td>Dialog appears.

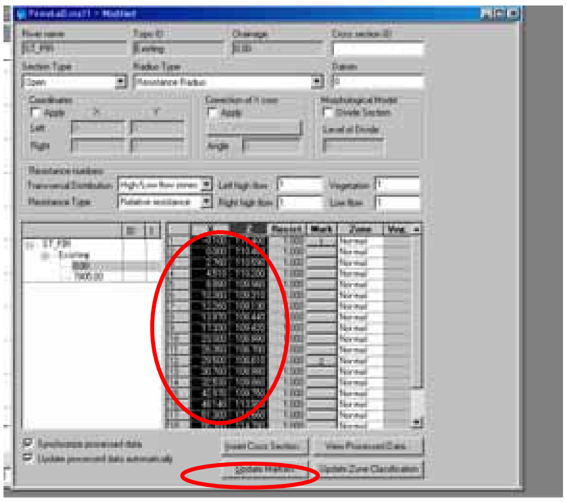
Select
Insert -> Network -> Cross Sections</td><td>
</td></tr>
<tr><td>Cross-section editor appears.

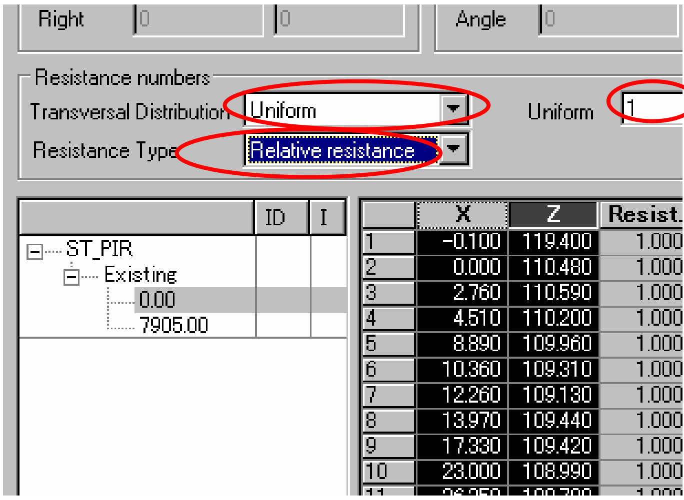
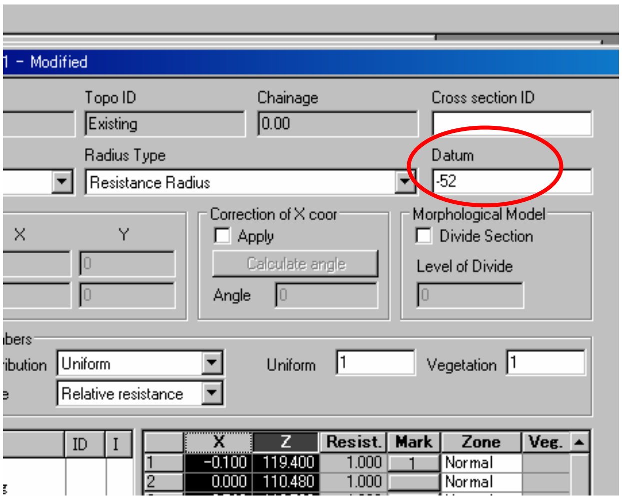
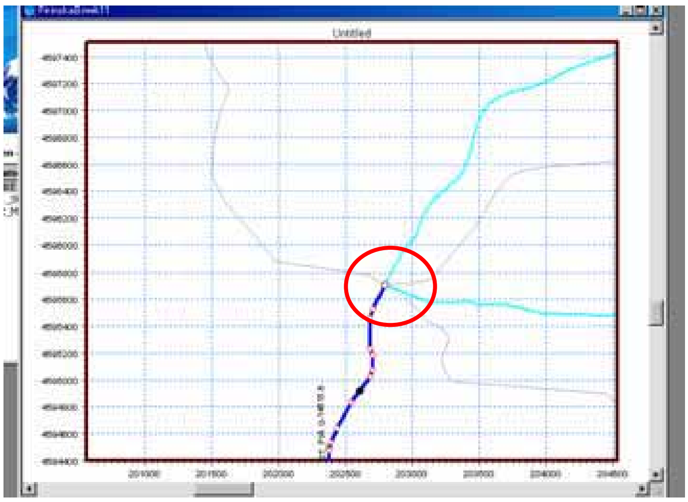
Now, new cross-section is inserted.</td><td></td></tr>
</table>

<table>
<tr><td>Select cross-section at chainage = 7905.

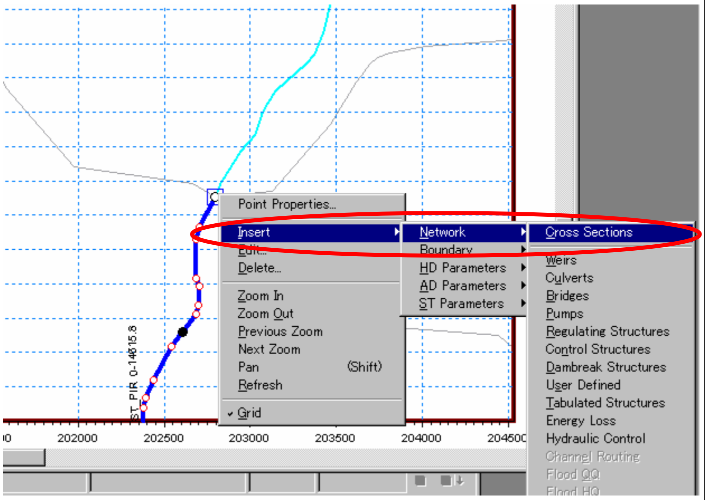
Highlight “x” & “z” columns.
Copy “x” & “z” columns.</td><td>
</td></tr>
<tr><td>Selectabain cross-section at chainage = 0.

Highlight “x” & “z” columns.
Paste the copied.</td><td>
</td></tr>
<tr><td>Cross-section data are copied.

Click “Update Markers”.</td><td></td></tr>
</table>

Set resistance numbers. For Transversal Distribution “Uniform” For Resistance Type “Relative resistance” For Uniform “1”	
Set datum value as “-52” *Note:* *-52 (m) = 56.6 (m) – 108.61 (m)* *(Elevation from DEM at chainage=0)= 56.6 (m)* *(Minimum Elevation of copied cross-section data) =108.61 (m)*	
In network editor, zoom into upstream end of MIKE11 river network.	

Place cursor on the point at upstream end, and then right click.

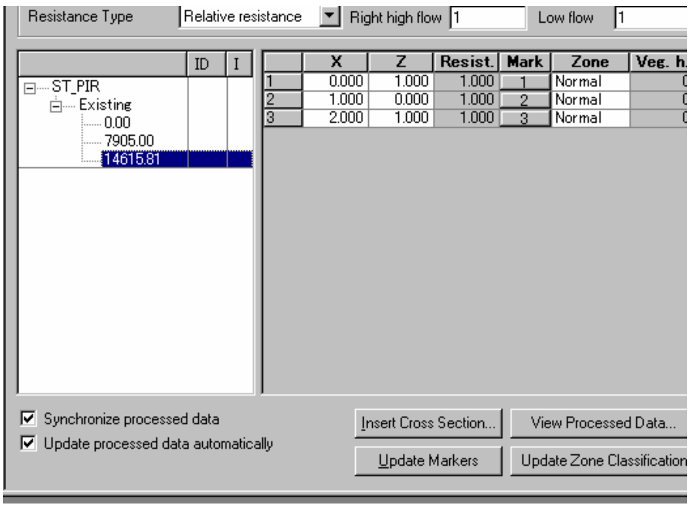


Crosse-section editor appears again.

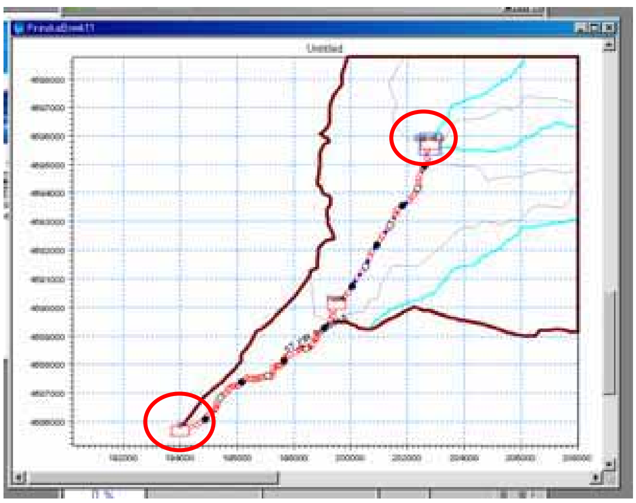
You can see new cross-section is inserted at chainage 14615.81.

Repeat same as chainage "0".

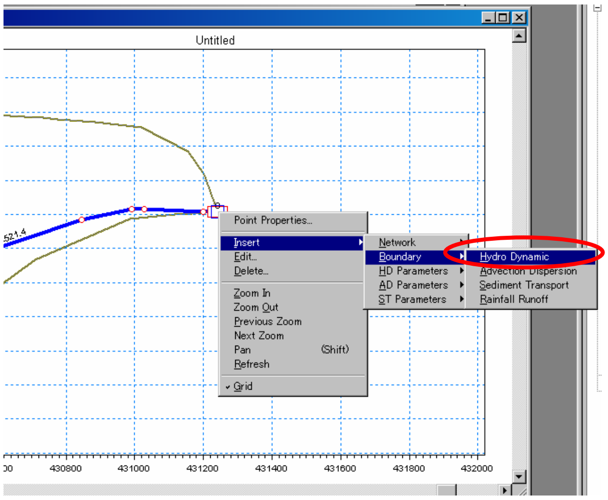
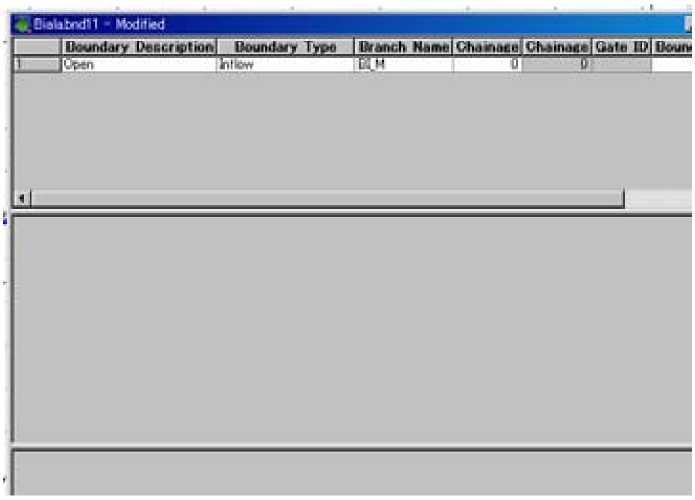
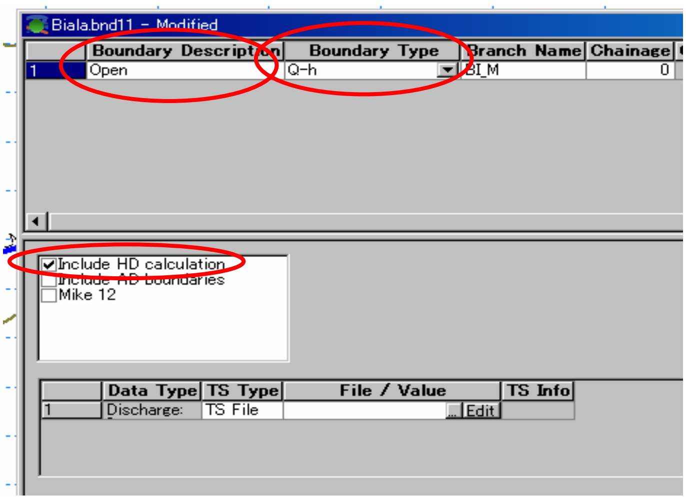
(insert cross-sec data and so on)

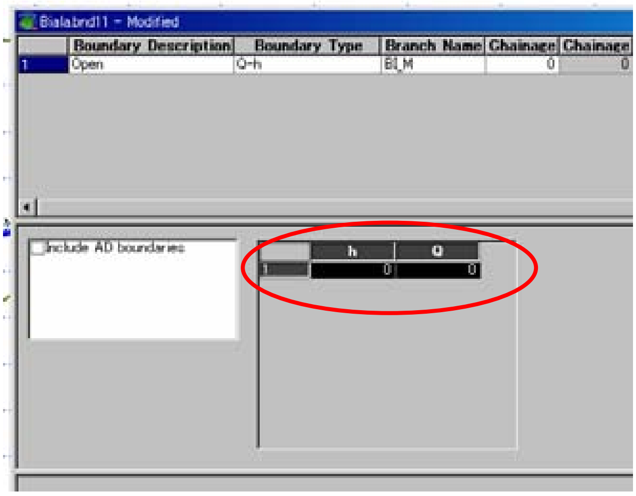
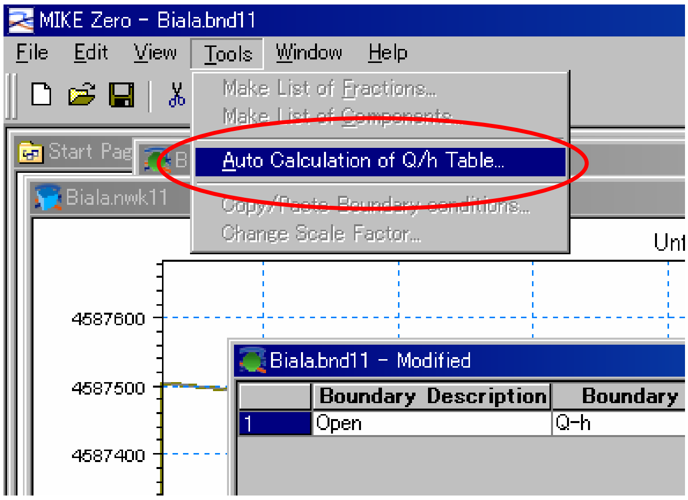


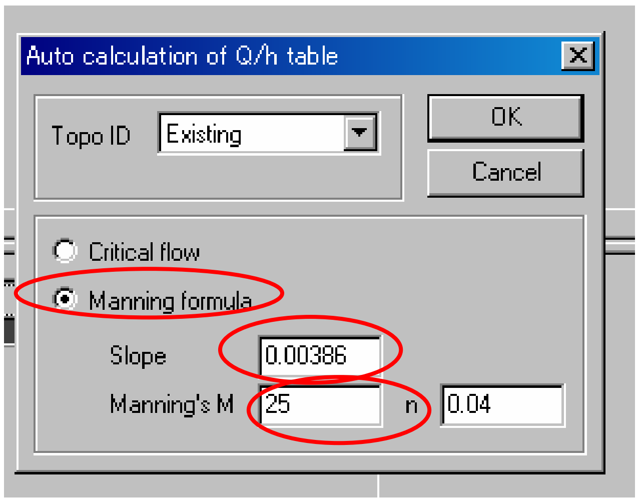
You will see the mark for cross-section in network editor.



Setting .bnd11 file

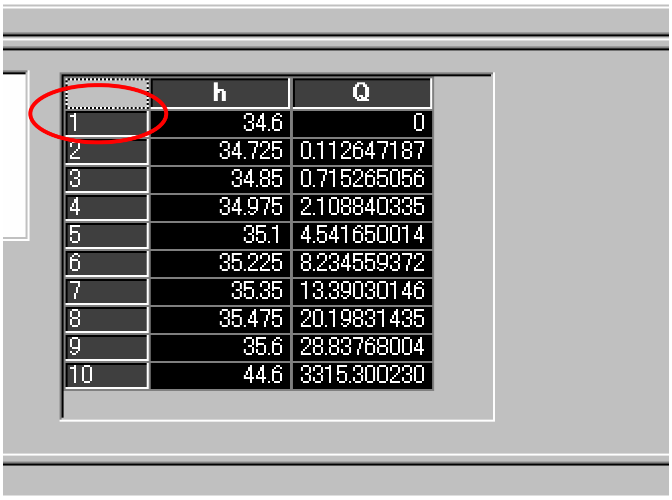
In network editor, zoom in to downstream end point using “zoom in tool”. Place cursor on the point at downstream end, and then right click. After dialog appears, Select Insert -> Boundary -> Hydro Dynamic	
Boundary editor appears.	
Set Boundary Description as “Open”. Set Boundary Type as “Q-h”. Make sure “Include HD calculation” is checked.	

<table>
<tr><td>Highlight h –Q columns.</td><td>
</td></tr>
<tr><td>Tools -> Auto calculation of Q/h Table</td><td>
</td></tr>
<tr><td>Select Manning formula

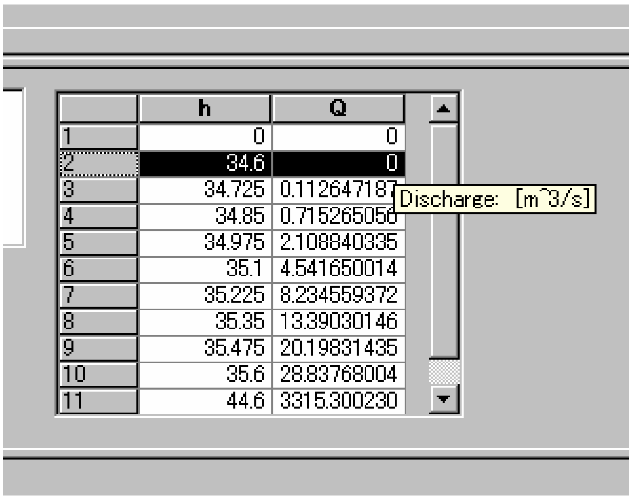
Set values for slope and Manning’s M.</td><td>
</td></tr>
</table>

h-Q relation is automatically calculated.

Highlight line 1, then press “Insert” button in your key board.



New line is inserted.



Insert “0.001” at Q column, line 2.

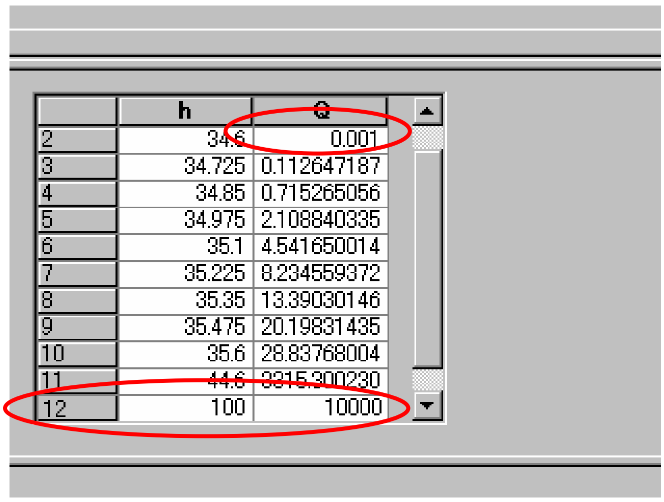
Select line 11, then press “Tab” button in your key board.

You will get new line 12.

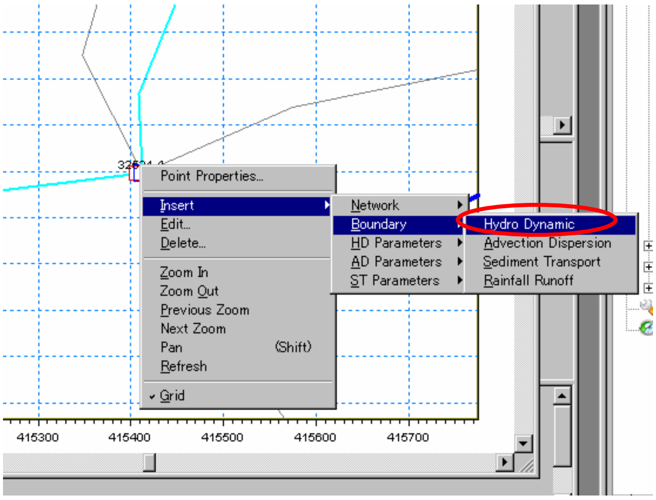
Insert “100”(big number) at h column.

Insert “10000”(big number) at Q column”.

These are for preventing stopping simulation caused by initial instability.



In network editor, zoom in to upstream end point using “zoom in tool”.
Place cursor on the point at upstream end, and then right click.
After dialog appears,
Select
Insert -> Boundary -> Hydro Dynamic

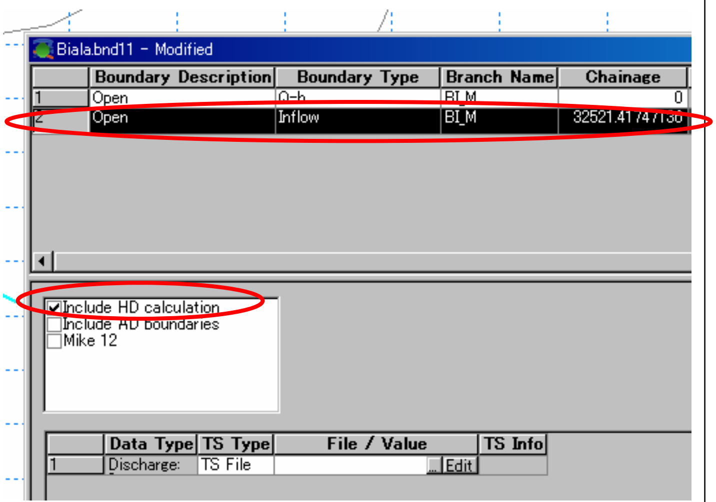


Now, you have new boundary “2”.

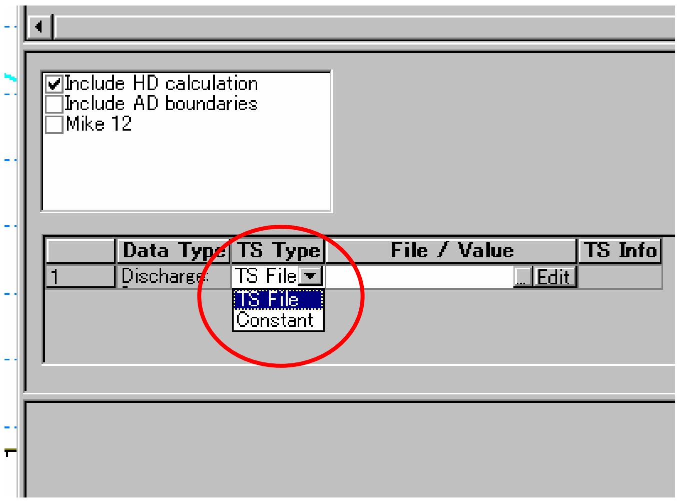
Set Boundary Description as “Open”.

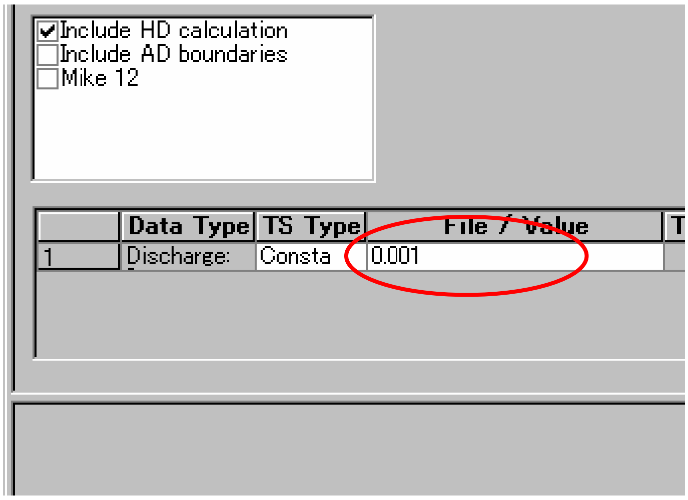
Set Boundary Type as “Inflow”.

Make sure “Include HD calculation” is checked.



Select “Constant” for TS Type.



Set values for constant discharge as “0.001”. (After you enter the value, you should press “return” key.) *Note:* *In this exercise, RR-HD link will be applied. Therefore, inlet discharge can be zero. However, it is better to give very small amount of discharge at upstream end for stabilizing simulation.*	
Save the .bnd11 file and close it.	

4. Preparation of Initial Hot start file

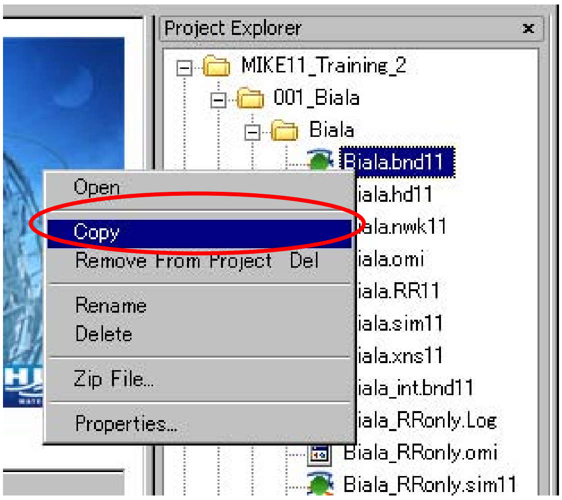
MIKE11-HD becomes easily unstable when it starts from rough estimation of initial condition such as approximation of uniform flow condition.

To prevent this instability, very small time step is required. However, it is not so good idea to use so small time step for entire simulation.

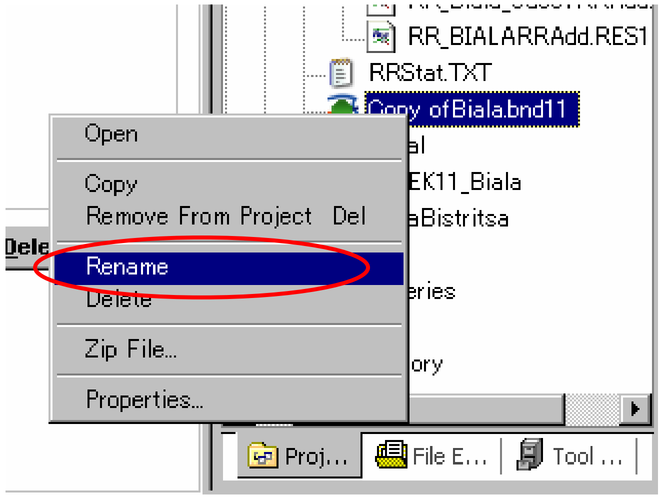
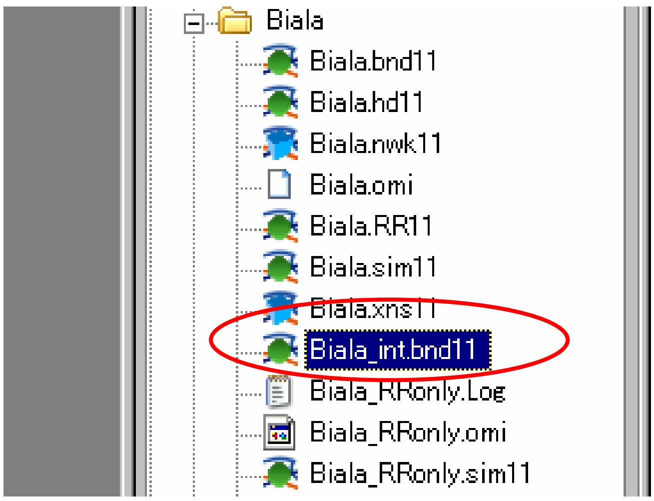
MIKE11-HD has several options for time-step. Adaptive time-step can work very well for changing time step automatically corresponding to the requirement to prevent instability of simulation. However, when RR-HD link is applied, you can not use the option "Adaptive time-step".

To overcome this situation, you have to prepare "Initial Hot start file".

After you prepare "Initial Hot start file", you can use relatively large time step with option "fixed time step" without the initial instability.

<table>
<tr>
<td>In Project Explorer,
Select
001_Biala/Biala/Biala.bnd11
Then, right click
Select “Copy”.</td>
<td>
</td>
</tr>
<tr>
<td>New file “Copy_Biala.bnd11” appears in Project Explorer.

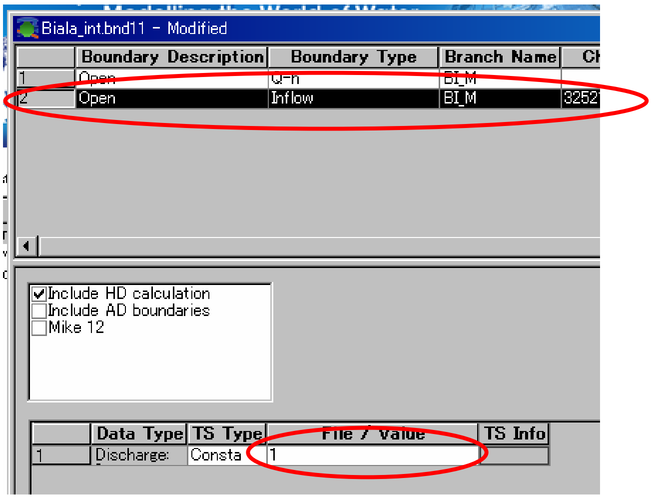
Right click it m select ”Rename”.

Rename it to “Biala_int.bnd11”</td>
<td>
</td>
</tr>
<tr>
<td>Double click “Biala_int.bnd11”</td>
<td>
</td>
</tr>
</table>

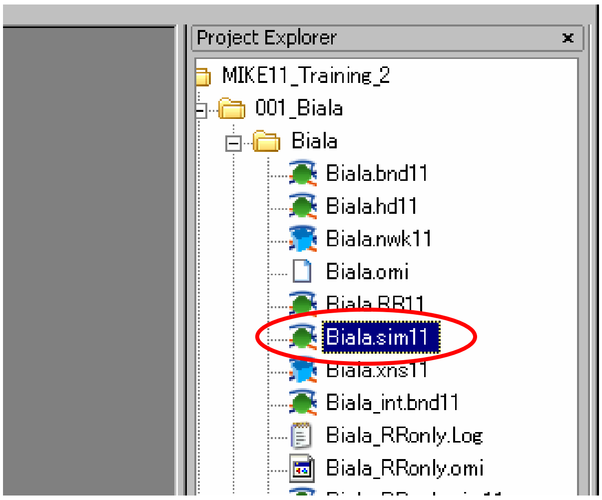
Activate boundary item"2".

Set constant discharge value as "1".

Save the .bnd11 file, and close it.



In Project Explorer, select "Biala.sim11", then double click to start it.

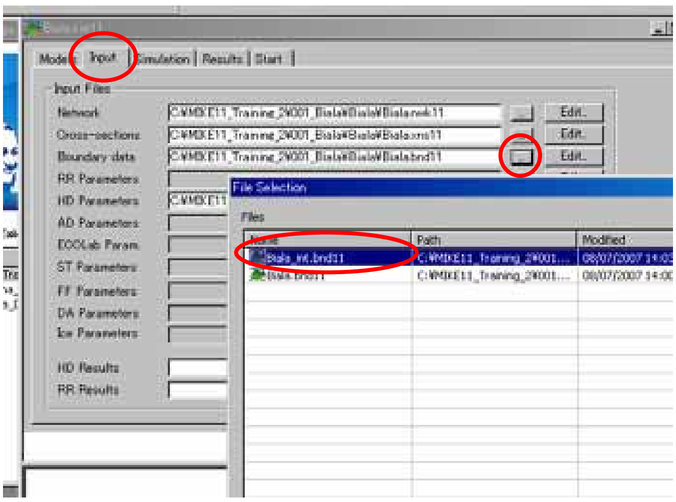


After network editor appears, select tab"Input".

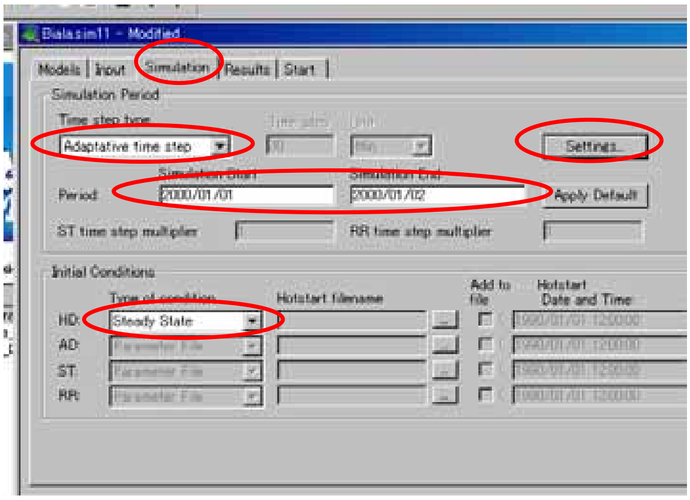
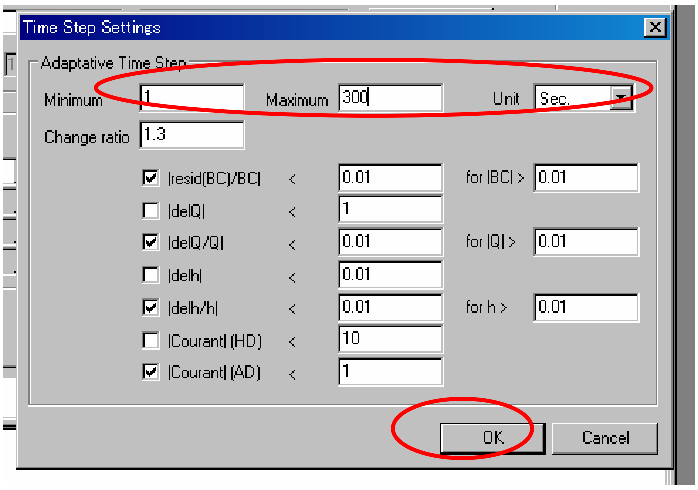
Click"…" for Boundary data.

Select "Baial_int.bnd11" from Dialog "File selection".

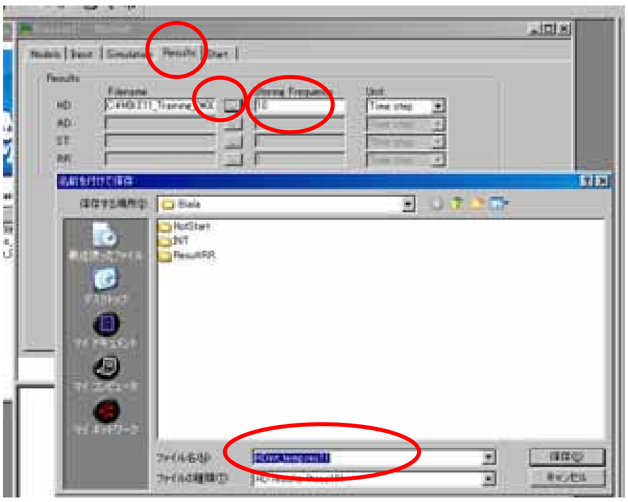
Then, click "OK".



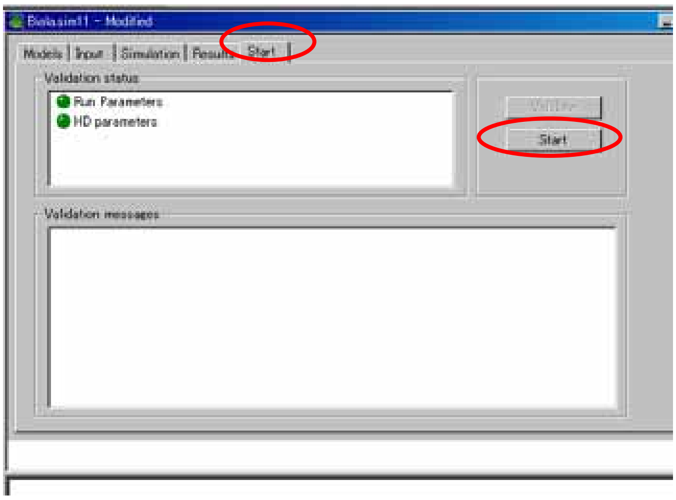
<table>
<tr>
<td>Select tab ”Simulation”.
Set Time step type as
“Adaptive time step”
Set Simulation period
Start : 2000/01/01
End: 2000/01/02
Set Initial condition for HD as
“Steady State”

Click “Settings..”</td>
<td>
</td>
</tr>
<tr>
<td>After dialog “Time Step Setting” appears,
Set values as follows
Minimum -> “1”
Maximum ->”300”
Unit -> “Sec.”
Click “OK”.
Note: The above value is based on experience for EABD & WABD rivers.</td>
<td>
</td>
</tr>
<tr>
<td>Select tab “Results”.

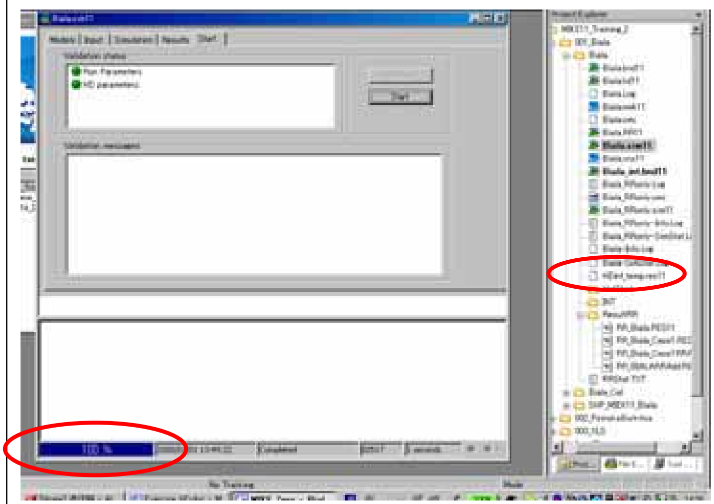
Set value as follows.
For Storing frequency
“10”.
For Unit
“Time step”
Specify result file name as
“HDint_temp.res11”

Click “OK”.</td>
<td></td>
</tr>
</table>

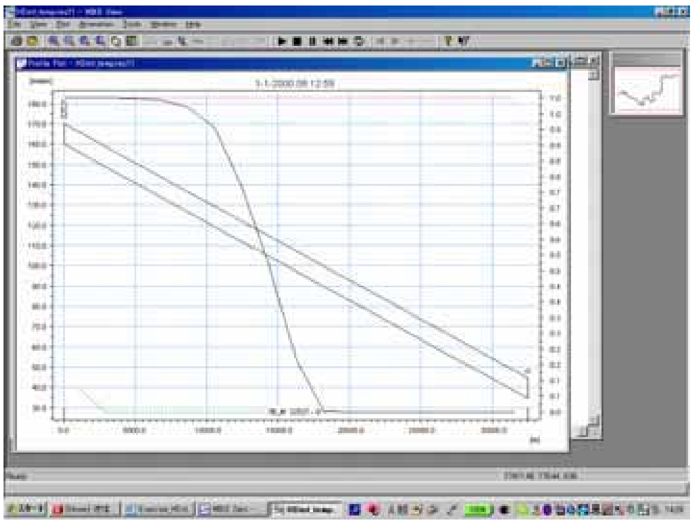
<table>
<tr>
<td>Select tab“Start”.

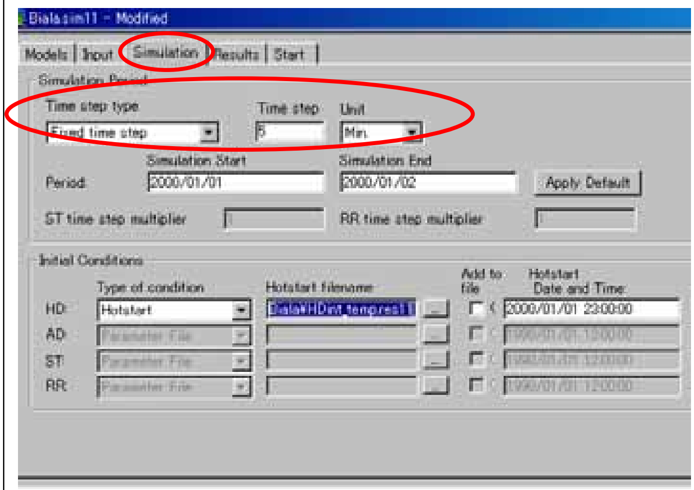
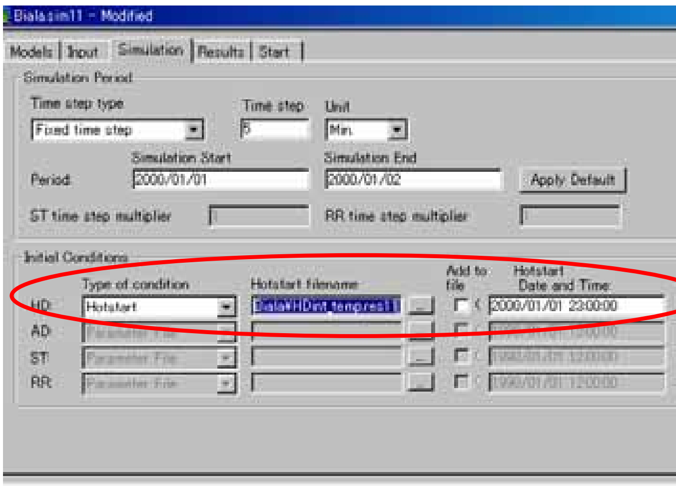
Click “Start” button.</td>
<td>
</td>
</tr>
<tr>
<td>Simulation completed

Now, you have new result file “HDint_temp.res11”.

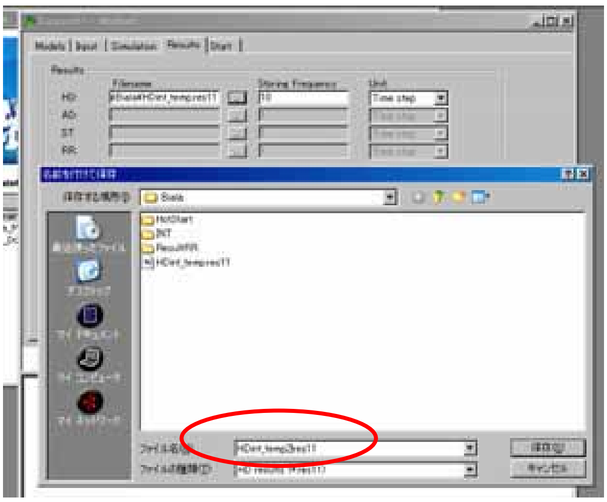
Open it from MIKE View.</td>
<td></td>
</tr>
<tr>
<td>You can see the initial development of flow field.

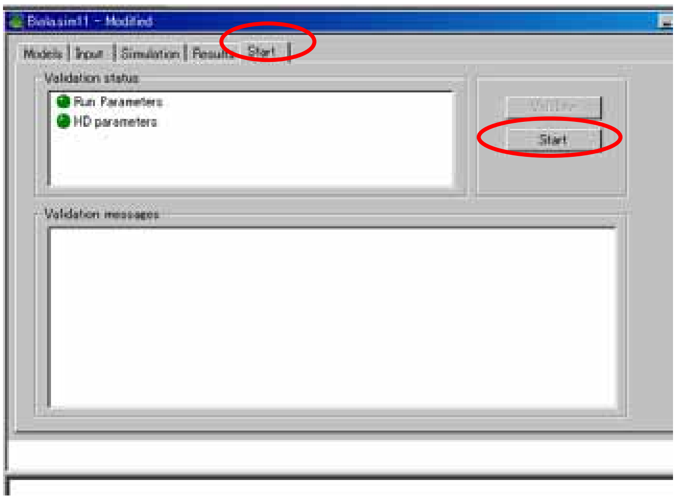
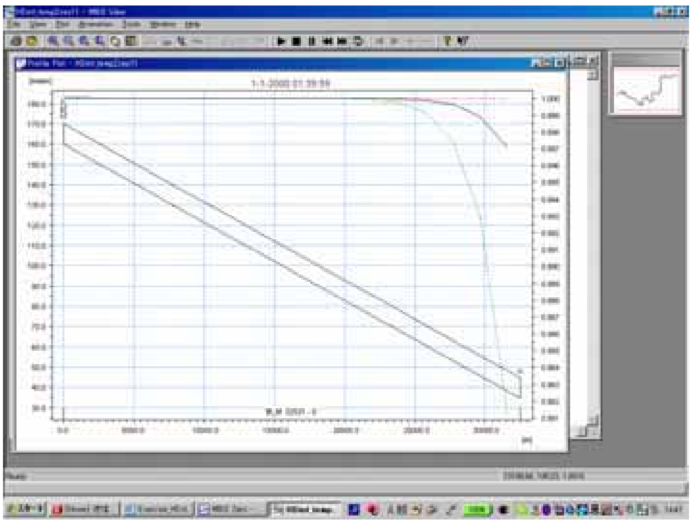
Check if flow condition is almost steady at the final time step.

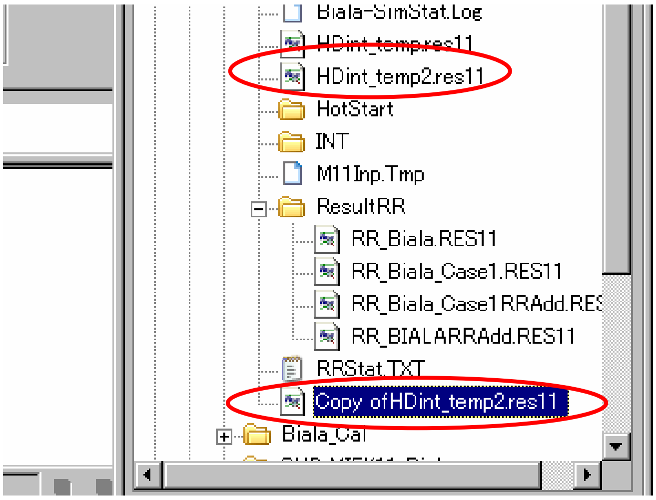
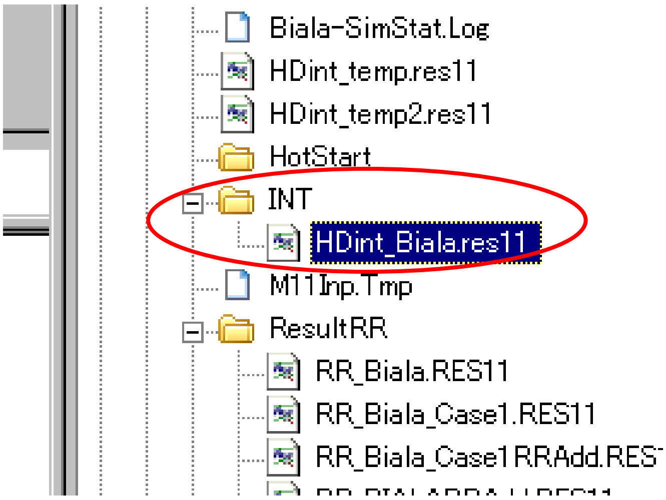
Note:
In this exercise case, 1 day is enough to get steady state. However, if total river length is longer, it may require longer time period.</td>
<td></td>
</tr>
</table>

<table>
<tr>
<td>Select tab “Simulation” from simulation editor again.
Set Time step type as
“Fixed time step”
Set Time step and unit as
“5” & “ Min”</td>
<td>
</td>
</tr>
<tr>
<td>Set Initial condition for HD
For Type of condition,
“Hotstart”
For Hotstart filename
“/001_Biala/Biala/HDint_temp.res11”
For Hotstart date and Time
“2000/01/01 23:00:00”</td>
<td>
</td>
</tr>
<tr>
<td>Select tab “Results”.

Change result file name as
“HDint_temp2.res11”

Click “OK”.</td>
<td></td>
</tr>
</table>

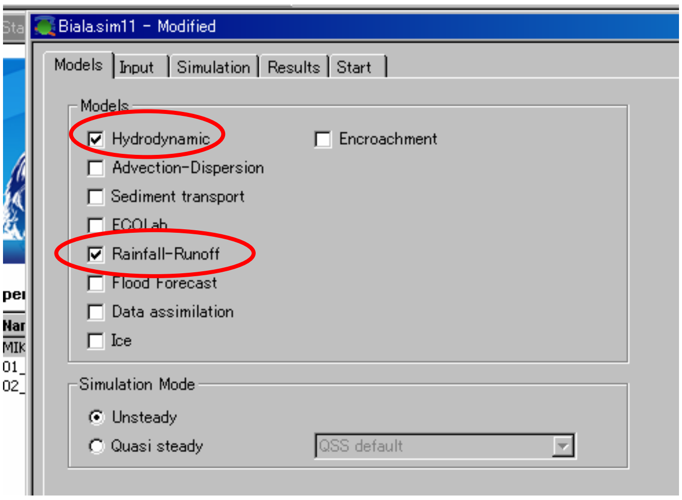
Select tab“Start”. Click “Start” button. Now, you can run with relatively large time step with option “Fixed time step” without initial instability.	
Simulation completed Now, you have new result file “HDint_temp2.res11”. Open it from MIKE View.	
Make sure stable condition is obtained at final time step.	

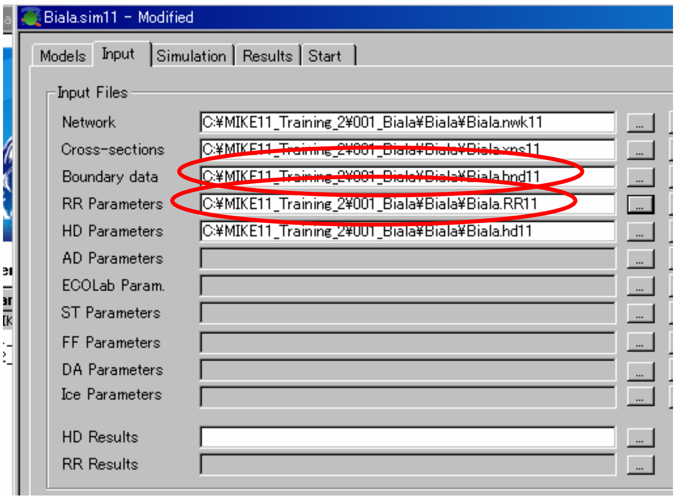
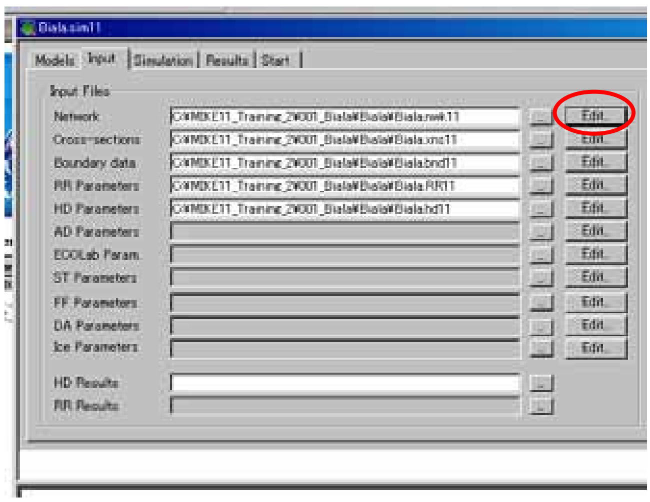
Copy "HDint_temp2.res11" Rename "copy of HDint_temp2.res11" to "HDint_Biala.res11" Then, move it to folder "INT".	
Now, you are ready for actual simulation.	

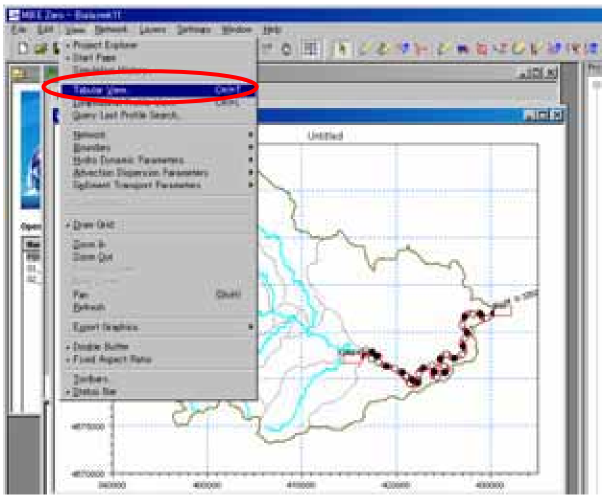
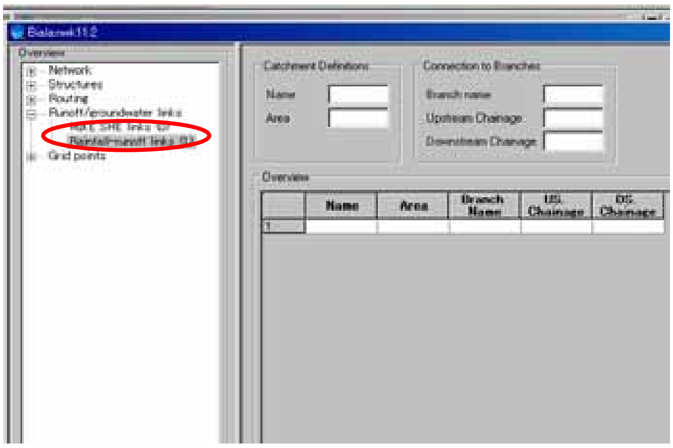
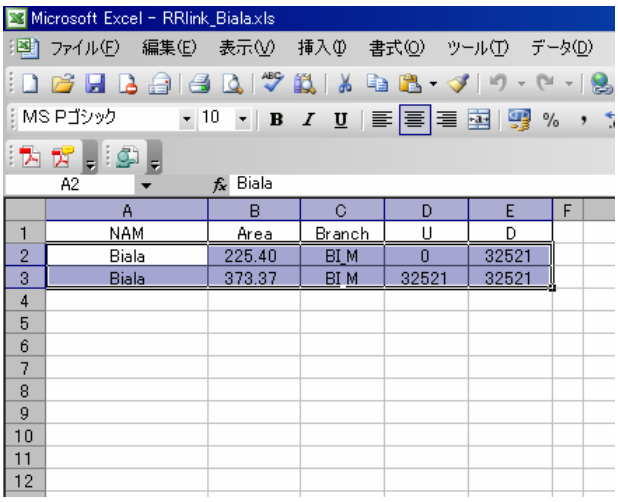
5. RR-link and run the model

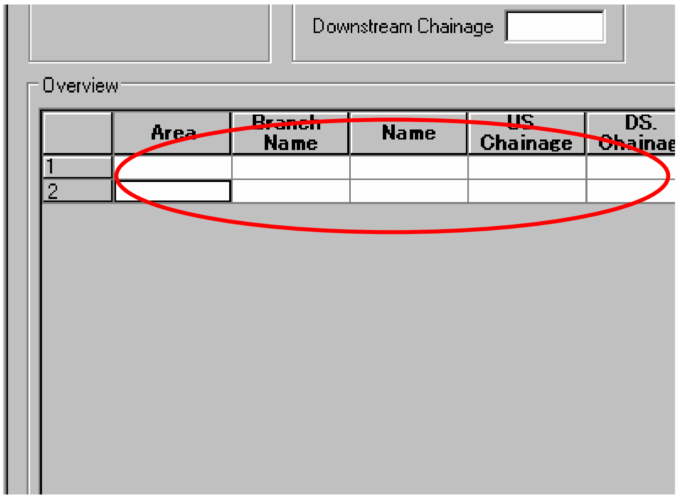
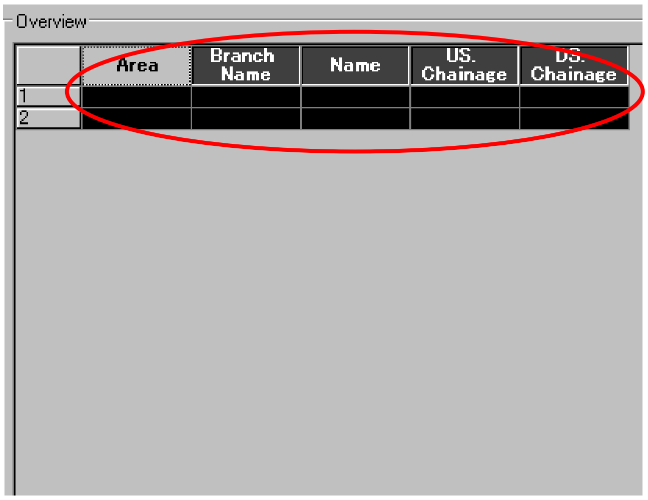
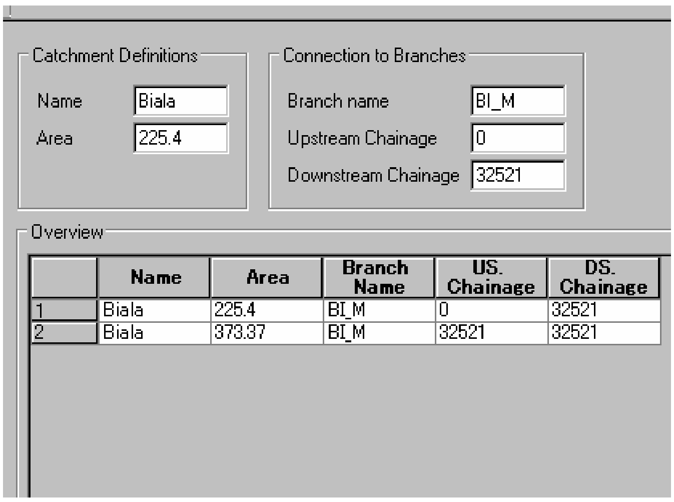
<table>
<tr><td>Open “Biala.sim11” from Project Explore.

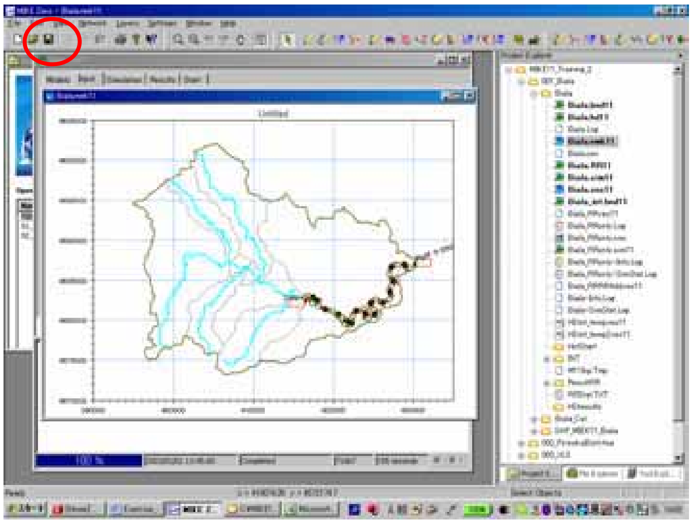
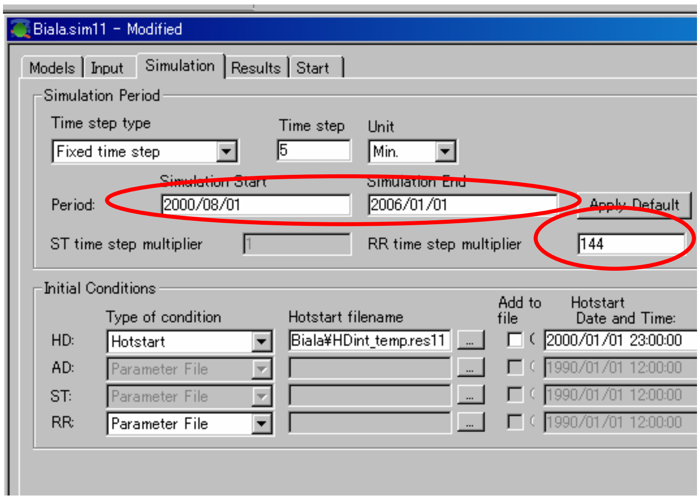
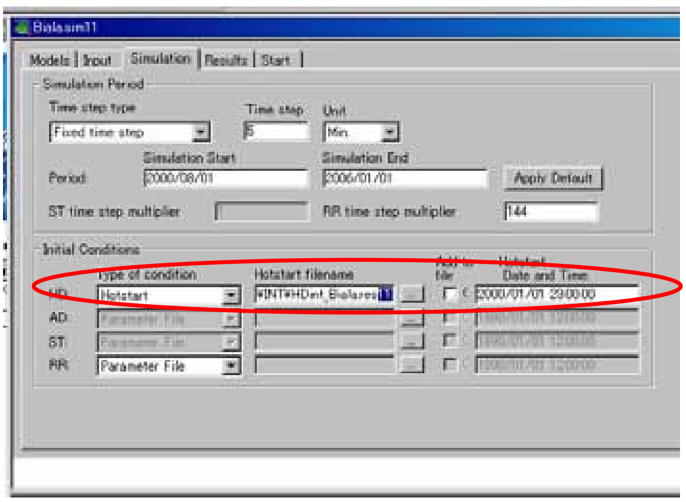
Select tab “Model”.

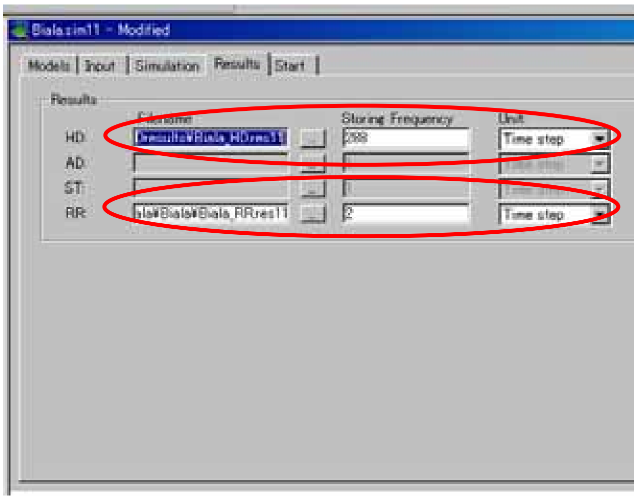
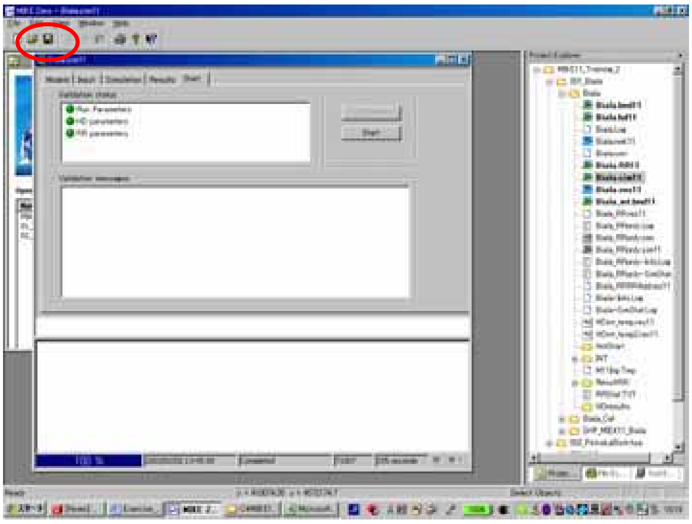
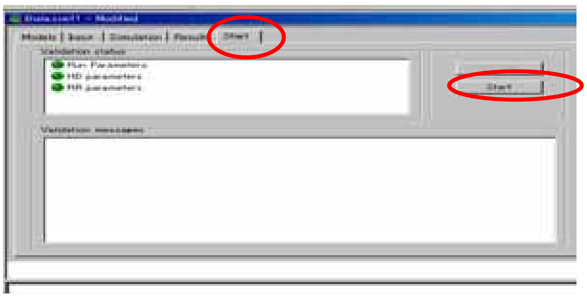
Check ”Hydrodynamic” and ”Rainfall-Runoff”</td><td>
</td></tr>
<tr><td>Select tab “Input”.

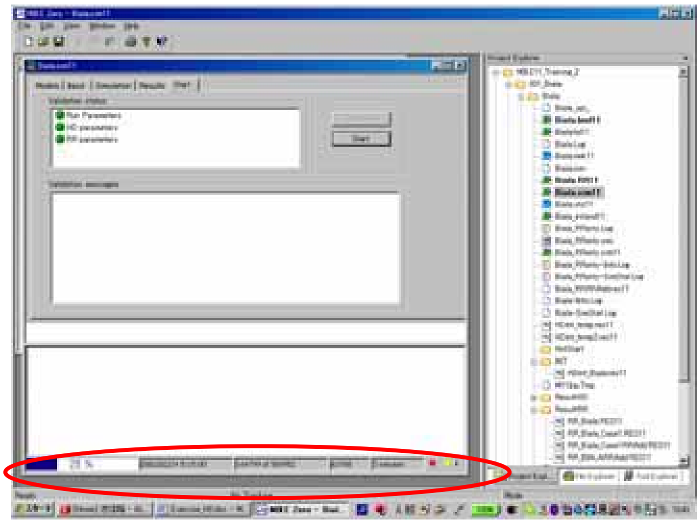
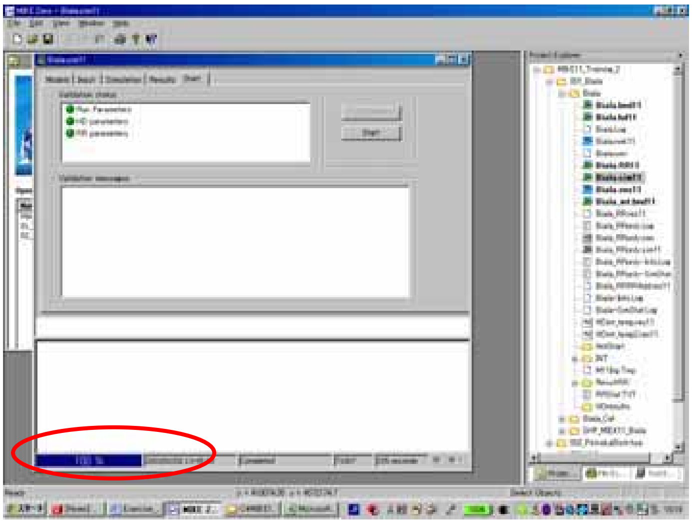
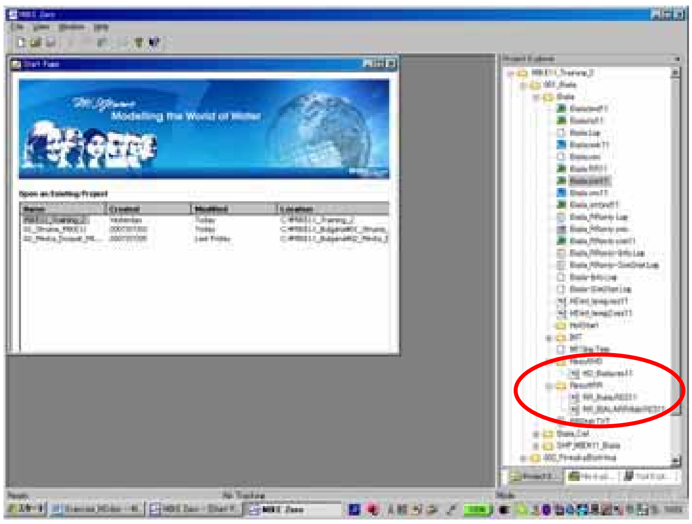
Set filename
For Boundary filename
“001_Biala/Biala/Biala.bnd11”
For RR Parameters
“001_Biala/Biala/Biala.RR11”</td><td>
</td></tr>
<tr><td>Click “Edit” for network.</td><td>
</td></tr>
</table>

After network editor appears, select View -> Tabular View	
In Tabular View, select Runoff/groundwater links -> Rainfall-runoff links	
Open “/003_XLS/RRlink_Biala.xls” Copy line 2&3	

In Tabular view of network editor, Place cursor on any column in line 1. Press “TAB” key in your key board. Then, you can insert new line “2”. Prepare line “1” & “2”. *Note: If number of link is more, please add more line according to the number of links.*	
Highlight NAME to DS chainage column。 Then, paste the copied from .xls file.	
Now, RR-HD link are set.	

<table>
<tr>
<td>Save the .nwk11 file and close it.</td>
<td></td>
</tr>
<tr>
<td>Select tab “Simulation”.
Set Time step type as
“Fixed time step”
Set Time step and unit as
“5” & “ Min”
Set Simulation period
Start : 2000/08/01
End: 2006/01/01
Set RR time step multiplier
“144”
Note: Time step of RR is 12hours. then, 144 = 12 hours x 60min/5min</td>
<td>
</td>
</tr>
<tr>
<td>Set Initial Conditions as follows.
For Type of Condition
“Hotstart”
For Hotstart Filename
“/001_Biala/Biala/INT/HDint_Biala.res11”
For Hotstart Date and Time
“2000/01/01 23:00:00”</td>
<td>
</td>
</tr>
</table>

Select tab "Results". Set Results filename etc. as follows. For HD Filename: "001_Biala/Biala/ResultHD/HD_Biala.res11" Storing Frequency and Unit "288" and "time step" For RR Filename: "001_Biala/Biala/ResultRR/RR_Biala.res11" Storing Frequency and Unit "2" and "time step"	
Save .sim11 file.	
Select tab "Start". Click "Start " button. Then, simulation will start.	

On the bottom of simulation editor, you can check the progress of the simulation.	
When "100%" appears, the simulation is completed.	
There are results files in ResultHD and ResultRR folders. Open result of HD with MIKE View. Enjoy your first HD result.	

End of Exercise