Annex 4

Model Setup

for

MIKE11 Model for EABD and WABD Rivers

JICA Study Team

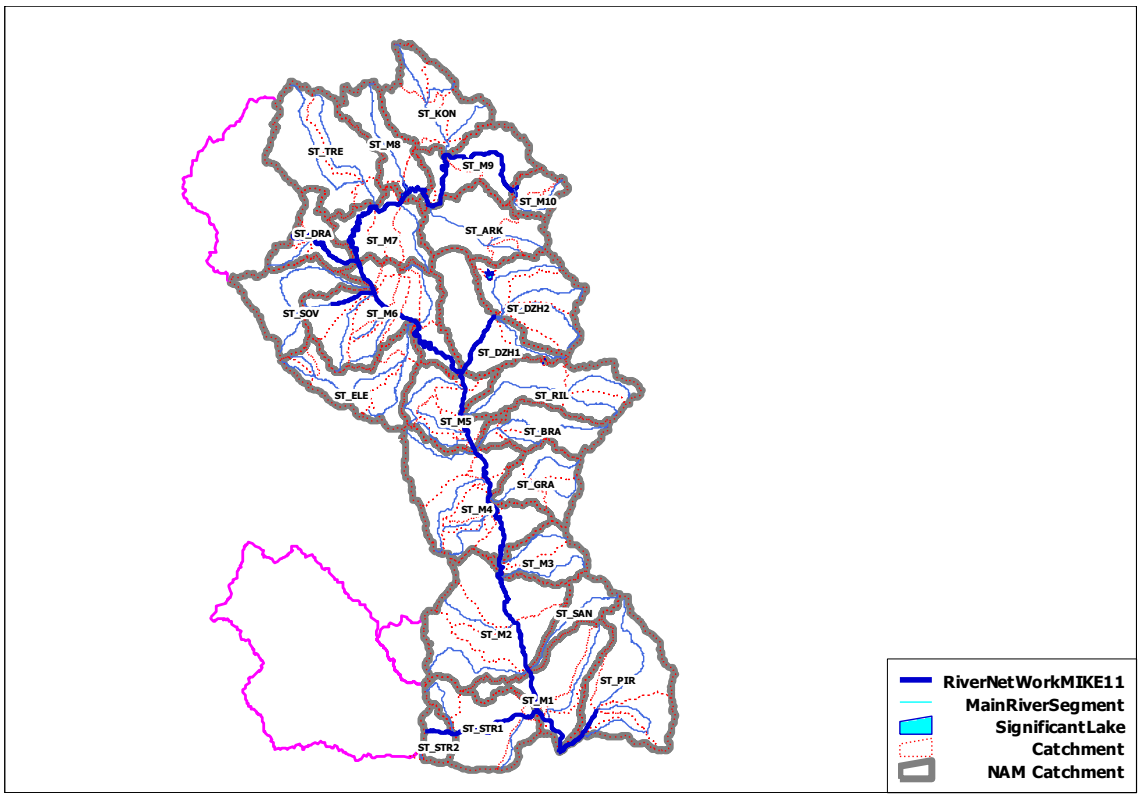
1. Struma River Basin

Outline of Model Setting

- Total Modeling Catchment Area = 8667.18km^2

  (Part of out of territory of Bulgaria is included.)

- Number of Rainfall-Runoff (NAM) Catchment = 25
- Total Length of Modeling River Network = 343.14 km
- Number of Branch = 6



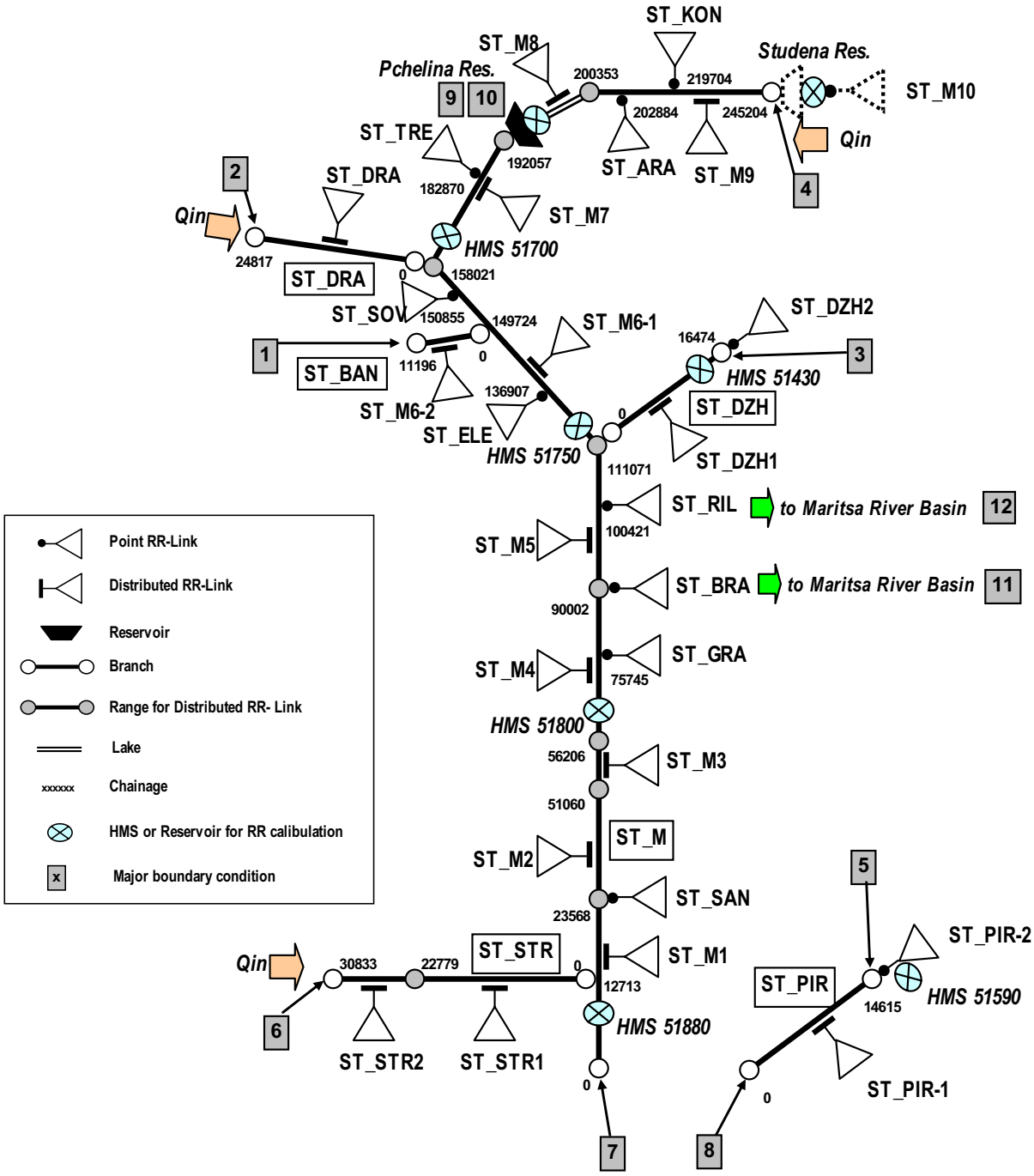
Summary Table of Branch

Branch Name	Length (m)	Main (M) or Tributary (T)	Connection	
			Branch	Chainage (m)
ST_DRA	24817.17	T	ST_M	158021
ST_DZH	16474.95	T	ST_M	111070.1
ST_PIR	14615.81	M		
ST_M	245204.4	M		
ST_STR	30833.9	T	ST_M	12713.45
ST_BAN	11196.4	T	ST_M	149723.6

Summary Table of NAM Catchment

NAM Catchment	Area (km^2)	Average Elevation (m)	Meteo St. for Temperature	Remarks
ST_ARK	360.10	285	15601	
ST_BRA	231.05	568	15601	
ST_DRA	177.00	754	15601	
ST_DZH1	371.51	656	15601	Calibrated result is disturbed condition.
ST_DZH2	398.74	168	15601	Calibrated result is disturbed condition.
ST_ELE	357.20	232	15601	
ST_GRA	235.66	170	15601	
ST_KON	371.84	262	15601	
ST_M1	364.66	277	15712	
ST_M10	102.12	577	15601	Calibrated result is disturbed condition.
ST_M2	826.78	595	15712	Out of territory ($126.28km^2$) is included.
ST_M3	194.47	666	15712	
ST_M4	622.12	728	15601	
ST_M5	302.07	833	15601	
ST_M6	611.02	222	15601	
ST_M7	279.32	273	15601	
ST_M8	242.38	224	15601	
ST_M9	317.54	353	15601	
ST_PIR	508.29	252	15712	
ST_RIL	384.90	285	15601	
ST_SAN	140.50	568	15712	
ST_SOV	302.12	754	15601	
ST_STR1	360.68	656	15712	
ST_STR2	76.60	168	15712	
ST_TRE	528.50	232	15601	

Note: 15601-Kustandiel, 15712 - Sandanski



Schematic Drawing for Model Setting

RR - Link

Link Name	NAM Catchment	Area (km^2)	Branch	US Chainage	DS Chainage
ST_M6-2	ST_M6	95.00	ST_BAN	0	11196
ST_DRA	ST_DRA	177.00	ST_DRA	0	24817
ST_DZH1	ST_DZH1	371.51	ST_DZH	0	16474
ST_DZH2	ST_DZH2	398.74	ST_DZH	16474	16474
ST_M1	ST_M1	364.66	ST_M	0	23568
ST_SAN	ST_SAN	140.50	ST_M	23568	23568
ST_M2	ST_M2	826.78	ST_M	23568	51060
ST_M3	ST_M3	194.47	ST_M	51060	56206
ST_M4	ST_M4	622.12	ST_M	56206	90002
ST_GRA	ST_GRA	235.66	ST_M	75745	75745
ST_BRA	ST_BRA	231.05	ST_M	90002	90002
ST_M5	ST_M5	302.07	ST_M	90002	111071
ST_RIL	ST_RIL	384.90	ST_M	100421	100421
ST_M6-1	ST_M6	516.02	ST_M	111071	158021
ST_ELE	ST_ELE	357.20	ST_M	136907	136907
ST_SOV	ST_SOV	302.12	ST_M	150855	150855
ST_M7	ST_M7	279.32	ST_M	158021	192057
ST_TRE	ST_TRE	528.50	ST_M	182870	182870
ST_M8	ST_M8	242.38	ST_M	192057	200353
ST_M9	ST_M9	317.54	ST_M	200353	245204
ST_ARK	ST_ARK	360.10	ST_M	202884	202884
ST_KON	ST_KON	371.84	ST_M	219704	219704
ST_M10	ST_M10	102.12	ST_M	245204	245204
ST_PIR-1	ST_PIR	119.76	ST_PIR	0	14615
ST_PIR-2	ST_PIR	388.53	ST_PIR	14615	14615
ST_STR1	ST_STR1	360.68	ST_STR	0	22779
ST_STR2	ST_STR2	76.60	ST_STR	22779	30833

Note: ST-M10 is not linked.

Major Boundary Conditions

No	Type	Branch	Chainage		Description	Constant value (m3/s) /File Name
1	Inflow	ST_BAN	11196.4		US End of ST_BAN	0.001
2	Inflow	ST_DRA	24817.17		Inflow from Serbia through ST_DRA	Qin_ST_DRA.dfs0
3	Inflow	ST_DZH	16474.95		US End of ST_DZH	0.001
4	Inflow	ST_M	245204.4		US End of ST_M	StudenaRes_Out_Instream.dfs0
5	Inflow	ST_PIR	14615.81		US End of ST_PIR	0.001
6	Inflow	ST_STR	30833.9		Inflow from Macedonia through ST_STR	Qin_ST_STR.dfs0
7	Q-H	ST_M	0		DS End of ST_M	N/A
8	Q-H	ST_PIR	0		DS End of ST_PIR	N/A
9	Regulating Structure	ST_M	192057.1		Instream flow to DS river from Pchelina Res.	PchelinaRes_Out_Instream.dfs0
10	Inflow	ST_M	192057		Off stream flow from Pchelina Res..	PchelinaRes_Out_Offstream.dfs0
11	Inflow	ST_M	90002		Abstracted Water by feeder channel in ST_BRA	Struma_Trans_ST_BRA.dfs0
12	Inflow	ST_M	100421		Abstracted Water by feeder channel in ST_RIL	Struma_Trans_ST_RIL.dfs0

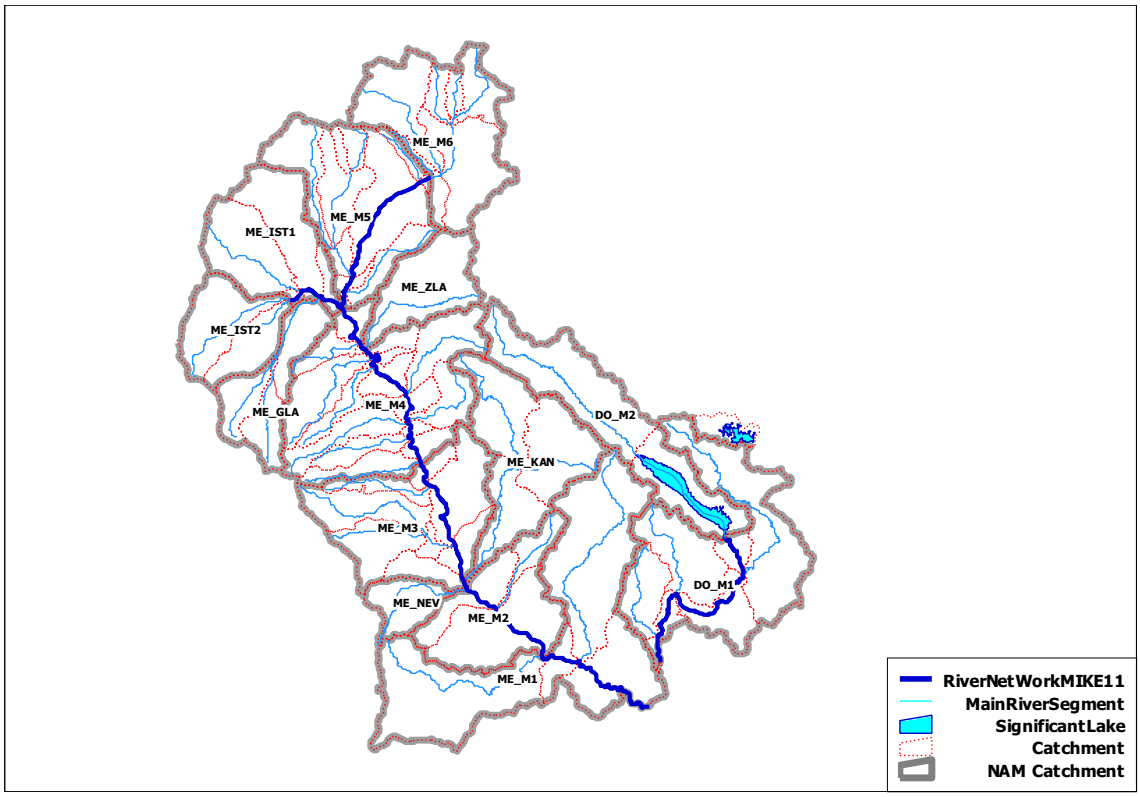
Other Boundary Conditions

Item	Description	Constant Value / File Name
Total Abstracted Water Amount in NAM catchment	For each NAM catchment	Struma_AbstW.dfs0
Distributed Domestic Discharge in NAM catchment	For each NAM catchment	Struma_DisW.dfs0
Domestic Discharge from towns whose PE is more than 2000	For each point	Constant
Industrial Discharge	For each point	Constant

2. Mesta & Dospat River Basin

Outline of Model Setting

- Total Modeling Catchment Area = 3397.71km^2
- Number of Rainfall-Runoff (NAM) Catchment = 14
- Total Length of Modeling River Network = 141.80 km
- Number of Branch = 3



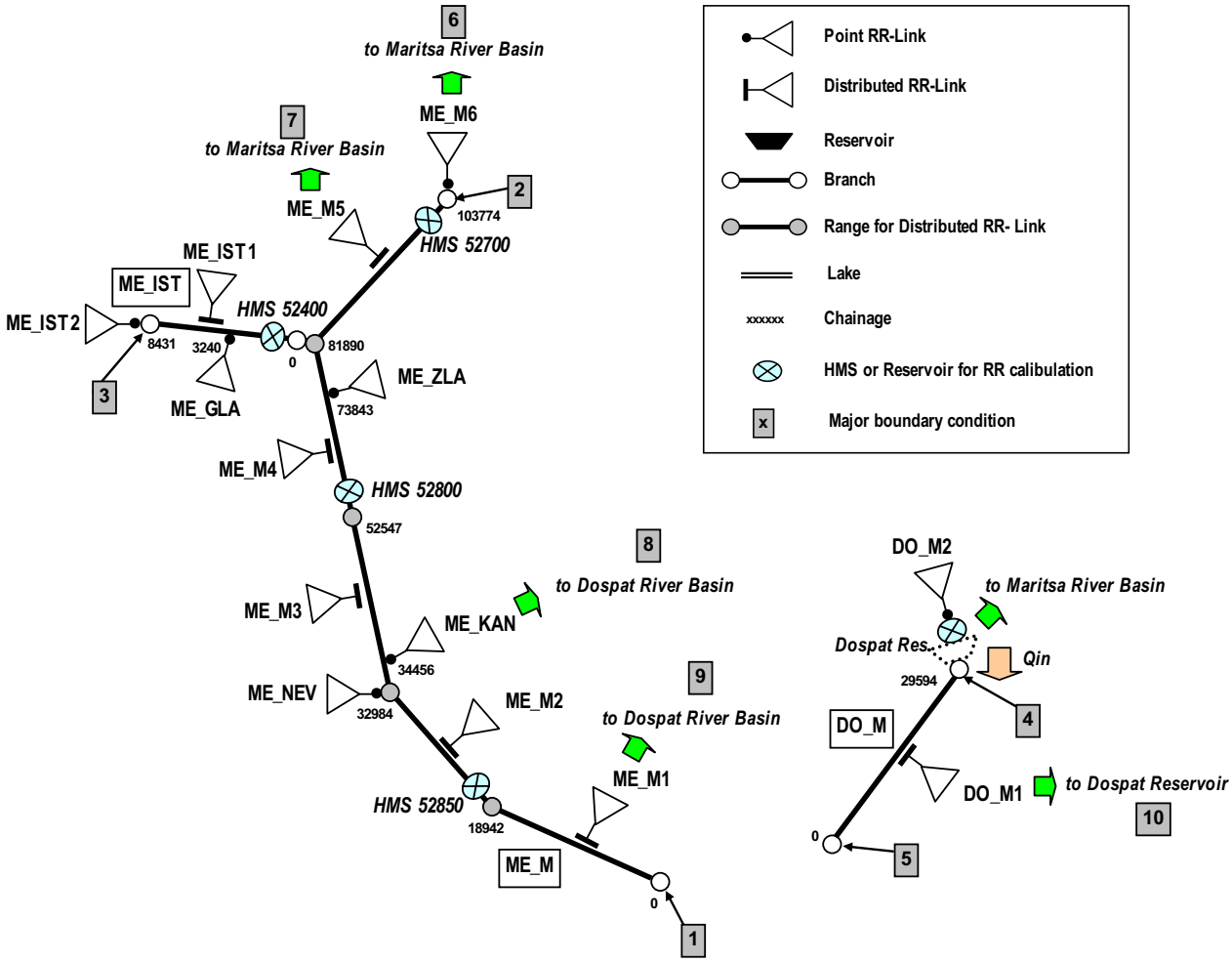
Summary Table of Branch

Branch Name	Length (m)	Main (M) or Tributary (T)	Connection	
			Branch	Chainage (m)
ME_IST	8431.5325	T	ME_M	81889.9
ME_M	103774.99	M		
DO_M	29594.073	M		

Summary Table of NAM Catchment

NAM Catchment	Area (km^2)	Average Elevation (m)	Meteo St. for Temperature	Remarks
ME_GLA	119.64	1687	15601	
ME_IST1	199.47	1309	15601	
ME_IST2	129.59	1309	15601	
ME_KAN	236.40	1395	15712	
ME_M1	485.47	949	15712	
ME_M2	200.58	724	15712	
ME_M3	287.62	1031	15712	
ME_M4	411.39	1252	15601	
ME_M5	288.73	1360	15601	
ME_M6	261.53	1676	15601	
ME_NEV	52.12	1122	15712	
ME_ZLA	112.48	1265	15601	
DO_M1	375.63	1273	15712	
DO_M2	237.06	1420	15712	

Note: 15601-Kustandiel, 15712 - Sandanski



Schematic Drawing for Model etting

RR - Link

Link Name	NAM Catchment	Area (km^2)	Branch	US Chainage	DS Chainage
ME_IST1	ME_IST1	199.47	ME_IST	0	8431
ME_GLA	ME_GLA	119.64	ME_IST	3240	3240
ME_IST2	ME_IST2	129.59	ME_IST	8431	8431
ME_M1	ME_M1	485.47	ME_M	0	18942
ME_M2	ME_M2	200.58	ME_M	18942	32984
ME_NEV	ME_NEV	52.12	ME_M	32984	32984
ME_M3	ME_M3	287.62	ME_M	32984	52547
ME_KAN	ME_KAN	236.40	ME_M	34456	34456
ME_M4	ME_M4	411.39	ME_M	52547	81890
ME_ZLA	ME_ZLA	112.48	ME_M	73843	73843
ME_M5	ME_M5	288.73	ME_M	81890	102314
ME_M6	ME_M6	261.53	ME_M	103774	103774
DO_M1	DO_M1	199.47	DO_M	0	29594

Note: DO-M2 is not linked.

Major Boundary Conditions

No	Type	Branch	Chainage		Description	Constant value (m3/s) / File Name
1	Q-H	ME_M	0		DS End of ME_M	N/A
2	Inflow	ME_M	103774		US End of ME_M	0.001
3	Inflow	ME_IST	8431.532		US End of ME_IST	0.001
4	Inflow	DO_M	29594.07		US End of DO_M	0.001
5	Q-H	DO_M	0		DS End of DO_M	N/A
6	Inflow	ME_M	103774		Abstracted Water by feeder channel in ME_M6	Mesta_Trans_ME_M6.dfs0
7	Inflow	ME_M	86098		Abstracted Water by feeder channel in ME_M5	Mesta_Trans_ME_M5.dfs0
8	Inflow	ME_M	34456		Abstracted Water by feeder channel in ME_KAN	Mesta_Trans_ME_KAN.dfs0
9	Inflow	ME_M	13620		Abstracted Water by feeder channel in ME_M1	Mesta_Trans_ME_M1.dfs0
10	Inflow	DO_M	2000	29594	Abstracted Water by feeder channel in DO_M1	Dospat_Trans_DO_M1.dfs0

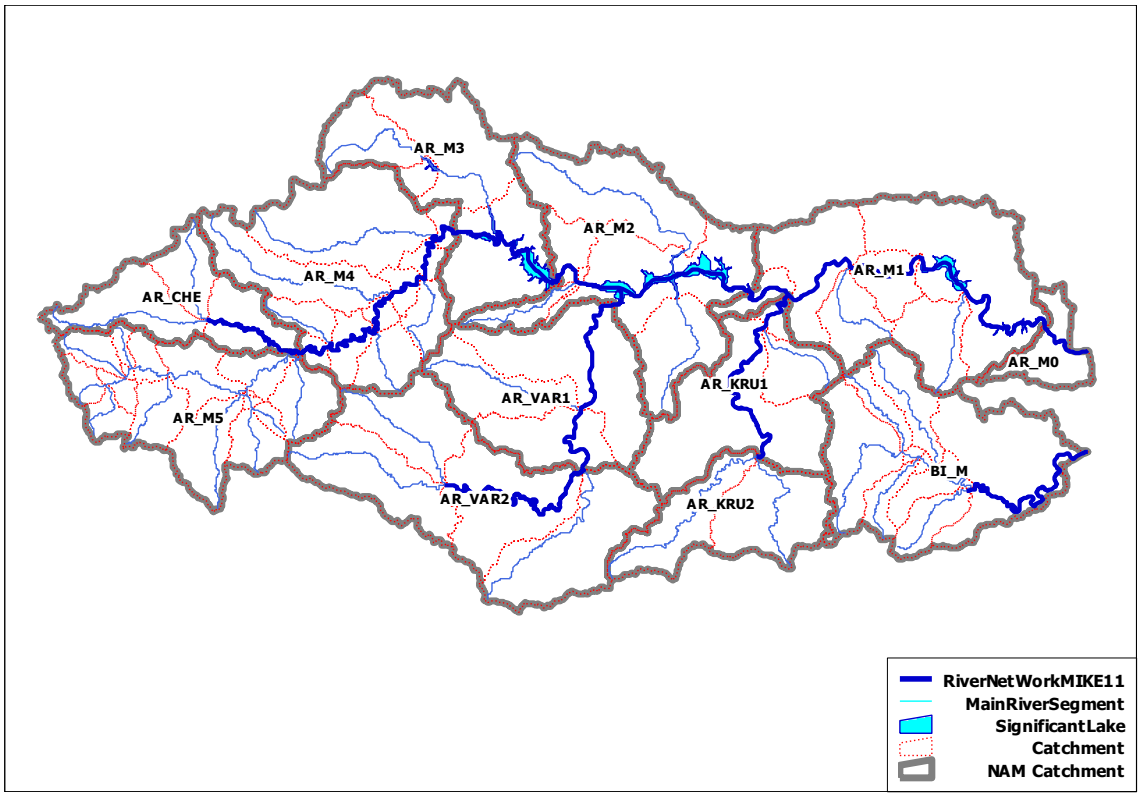
Other Boundary Conditions

Item	Description	Constant Value / File Name
Total Abstracted Water Amount in NAM catchment	For each NAM catchment	Mesta_AbstW.dfs0
Distributed Domestic Discharge in NAM catchment	For each NAM catchment	Mesta_DisW.dfs0
Domestic Discharge from towns whose PE is more than 2000	For each point	Constant
Industrial Discharge	For each point	Constant

3. Arda & Biala River Basin

Outline of Model Setting

- Total Modeling Catchment Area = 5811.84km^2
- Number of Rainfall-Runoff (NAM) Catchment = 12
- Total Length of Modeling River Network = 332.10 km
- Number of Branch = 5



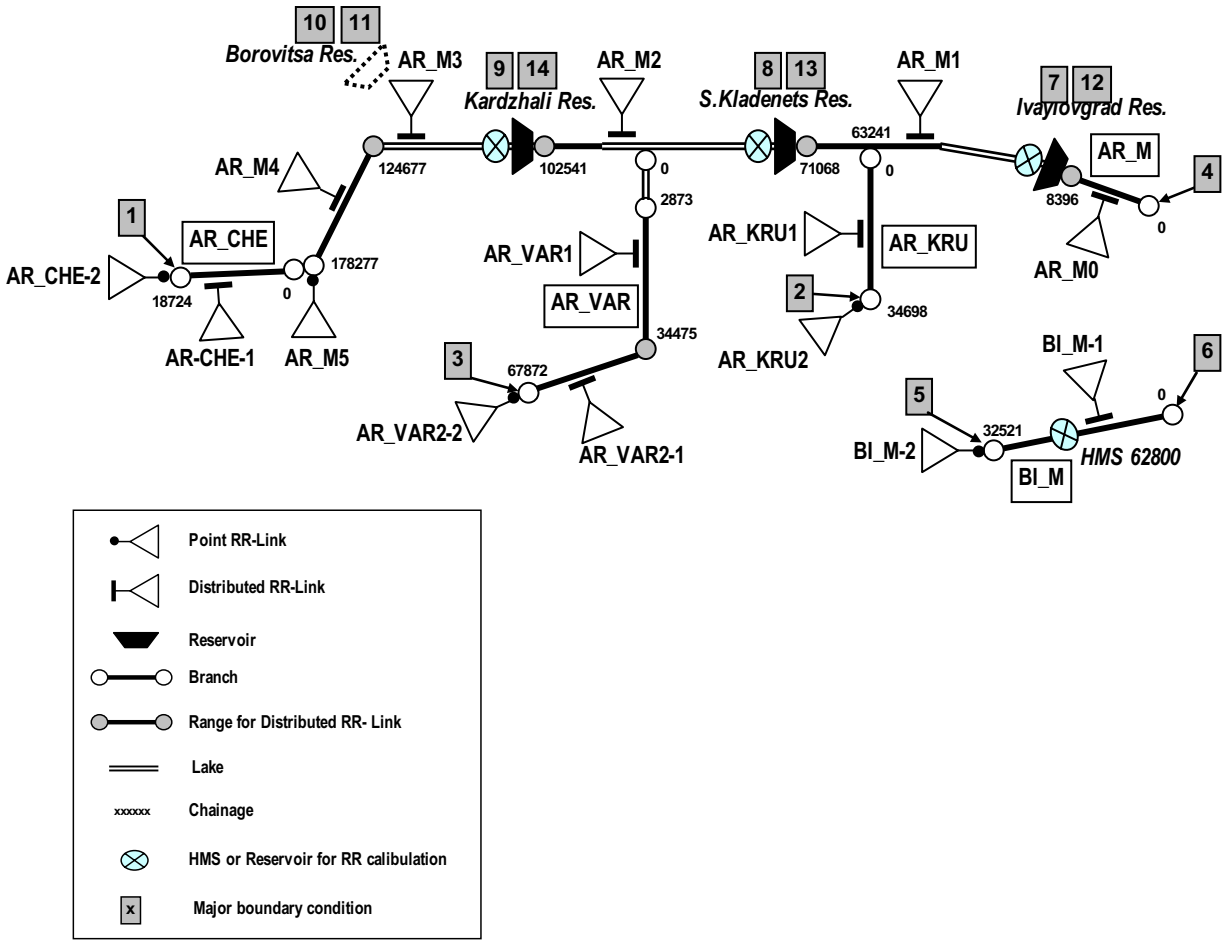
Summary Table of Branch

Branch Name	Length (m)	Main (M) or Tributary (T)	Connection	
			Branch	Chainage (m)
AR_KRU	34698.91	T	AR_M	63241.82
AR_CHE	18724.8	T	AR_M	178278.2
AR_VAR	67872.77	T	AR_M	96187.76
AR_M	178278.2	M		
BI_M	32521.42	M		

Summary Table of NAM Catchment

NAM Catchment	Area (km^2)	Average Elevation (m)	Meteo St. for Temperature	Remarks
AR_CHE	269.72	1231	43010	
AR_KRU1	390.51	397	43010	
AR_KRU2	282.85	510	43010	
AR_M0	83.18	257	43010	
AR_M1	715.55	333	43010	
AR_M2	643.64	423	43010	
AR_M3	475.06	719	43010	
AR_M4	646.09	962	43010	
AR_M5	516.52	1076	43010	
AR_VAR1	467.44	478	43010	
AR_VAR2	722.50	588	43010	
BI_M	598.77	418	43010	

Note: 43010 - Haskovo



Schematic Drawing for Model Setting

RR - Link

Link Name	NAM Catchment	Area (km^2)	Branch	US Chainage	DS Chainage
AR_CHE-1	AR_CHE	84.80	AR_CHE	0	18724
AR_CHE-2	AR_CHE	184.92	AR_CHE	18724	18724
AR_KRU1	AR_KRU1	390.51	AR_KRU	0	34698
AR_KRU2	AR_KRU2	282.85	AR_KRU	34698	34698
AR_M0	AR_M0	83.18	AR_M	0	8396
AR_M1	AR_M1	715.55	AR_M	8396	71068
AR_M2	AR_M2	643.64	AR_M	71068	102541
AR_M3	AR_M3	475.06	AR_M	102541	124677
AR_M4	AR_M4	646.09	AR_M	124677	178277
AR_M5	AR_M5	516.52	AR_M	178277	178277
AR_VAR1	AR_VAR1	467.44	AR_VAR	2873	34475
AR_VAR2-1	AR_VAR2	418.83	AR_VAR	34475	67872
AR_VAR2-2	AR_VAR2	303.67	AR_VAR	67872	67872
BI_M-1	BI_M	225.40	BI_M	0	32521
BI_M-2	BI_M	373.37	BI_M	32521	32521

Major Boundary Conditions

No	Type	Branch	Chainage		Description	Constant value (m3/s) / File Name
1	Inflow	AR_CHE	18724		US End of AR_CHE	0.001
2	Inflow	AR_KRU	34698		US End of AR_KRU	0.001
3	Inflow	AR_VAR	67872		US End of AR_VAR	0.001
4	Q-H	AR_M	0		DS End of AR_M	N/A
5	Inflow	BI_M	32521.42		US End of AR_BI	0.001
6	Q-H	BI_M	0		DS End of AR_M	N/A
7	Inflow	AR_M	8396	37312	Offstream flow from Ivaylovgrad Res..	Ivaylovgrad_Out_Offstream.dfs0
8	Inflow	AR_M	71067	96882	Offstream flow from S.Kladenets Res..	SKladenets_Out_Offstream.dfs0
9	Inflow	AR_M	102540	124676	Offstream flow from Kardzhali Res..	Kardzhali_Out_Offstream.dfs0
10	Inflow	AR_M	102540	124676	Inflow to Borovitsa Res.	Borovitsa_In.dfs0
11	Inflow	AR_M	102540	124676	Instream flow to DS river from Borovitsa Res.	Borovitsa_Out_Instream.dfs0
12	Regulating Structure	AR_M	8396.391		Instream flow to DS river from Ivaylovgrad Res.	Ivaylovgrad_Out_Instream.dfs0
13	Regulating Structure	AR_M	71068.05		Instream flow to DS river from SKladenets Res.	SKladenets_Out_Instream.dfs0
14	Regulating Structure	AR_M	102541.1		Instream flow to DS river from Kardzhali Res.	Kardzhali_Out_instream.dfs0

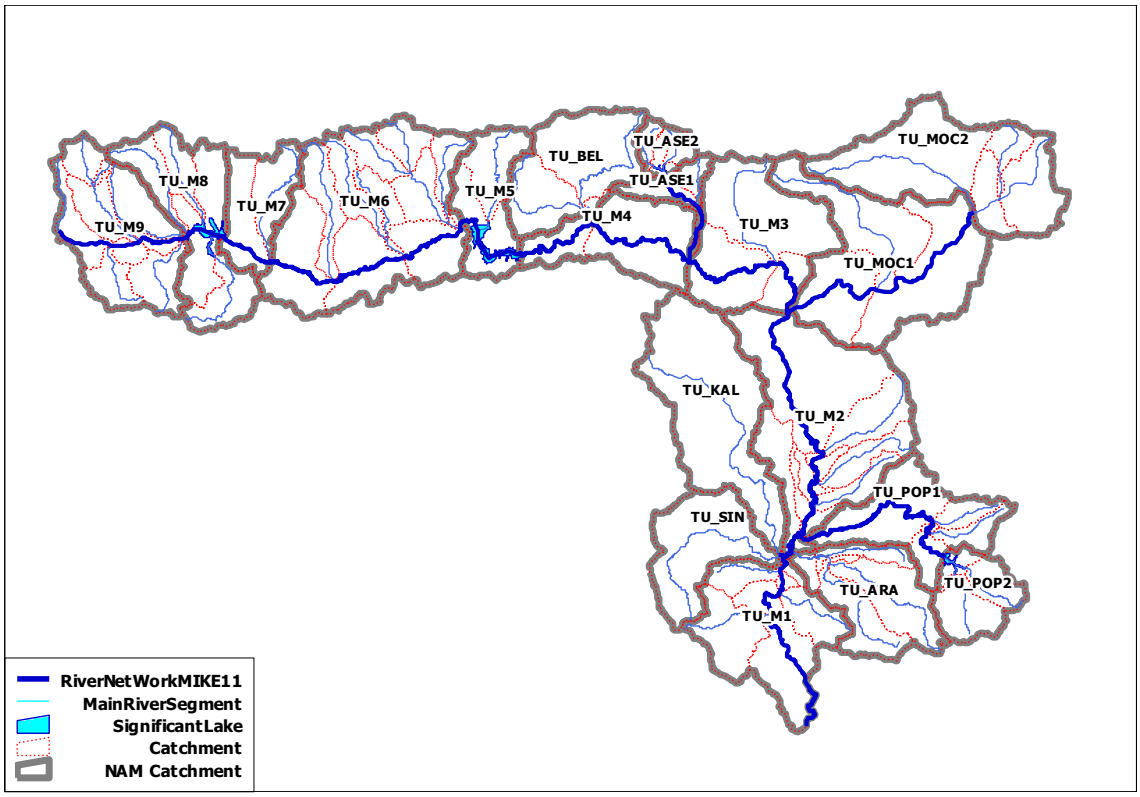
Other Boundary Conditions

Item	Description	Constant Value / File Name
Total Abstracted Water Amount in NAM catchment	For each NAM catchment	Arda_AbstW.dfs0
Distributed Domestic Discharge in NAM catchment	For each NAM catchment	Arda_DisW.dfs0
Domestic Discharge from towns whose PE is more than 2000	For each point	Constant
Industrial Discharge	For each point	Constant

4. Tundzha River Basin

Outline of Model Setting

- Total Modeling Catchment Area = 7890.93km^2
- Number of Rainfall-Runoff (NAM) Catchment = 20
- Total Length of Modeling River Network = 409.46 km
- Number of Branch = 5



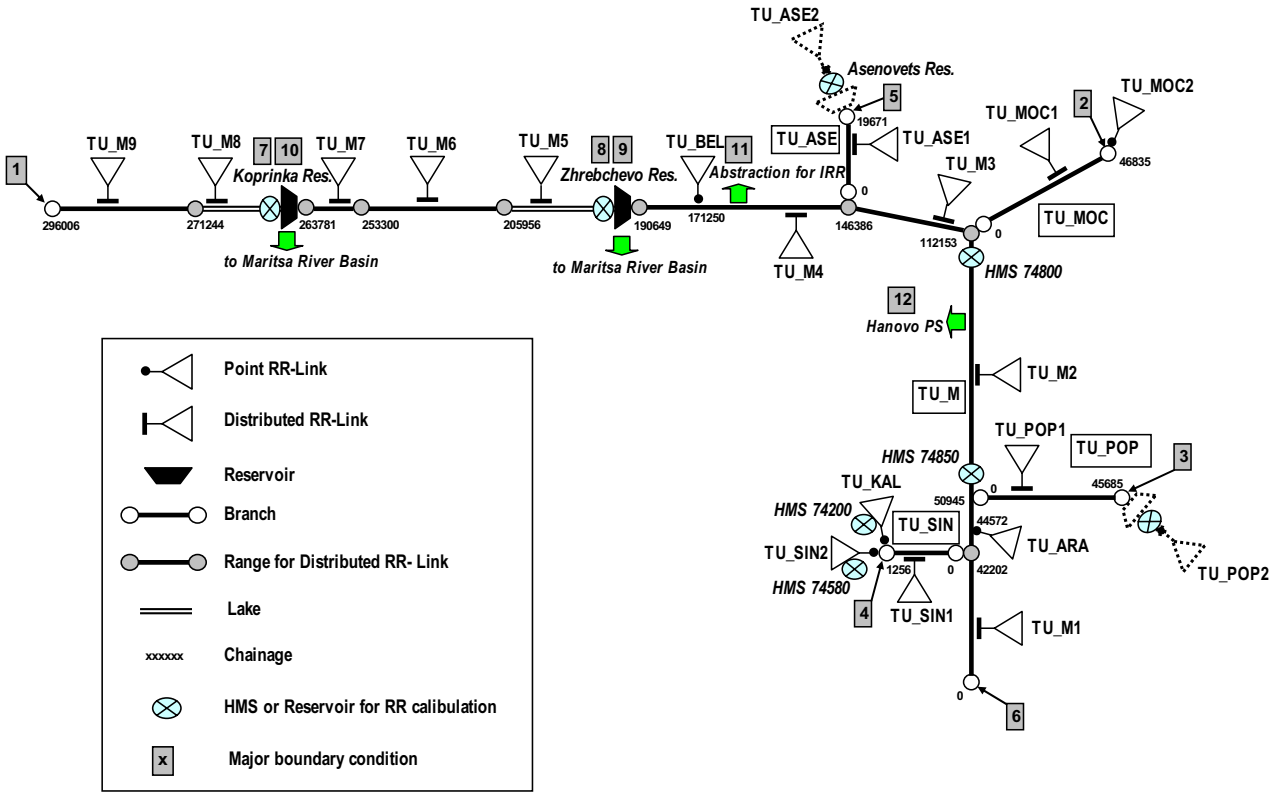
Summary Table of Branch

Branch Name	Length (m)	Main (M) or Tributary (T)	Connection	
			Branch	Chainage (m)
TU_SIN	1256.52	T	TU_M	42201.74
TU_ASE	19671.63	T	TU_M	146386
TU_POP	45685.94	T	TU_M	50945.28
TU_MOC	46835.17	T	TU_M	112152.7
TU_M	296006.3	M		

Summary Table of NAM Catchment

NAM Catchment	Area (km^2)	Average Elevation (m)	Meteo St. for Temperature	Remarks
TU_ARA	350.15	285	43010	
TU_ASE1	87.88	568	15637	
TU_ASE2	75.19	754	15637	
TU_BEL	371.23	656	15637	
TU_KAL	575.86	168	43010	
TU_M1	469.49	232	43010	
TU_M2	799.70	170	43010	
TU_M3	507.26	262	15637	
TU_M4	302.91	277	15637	
TU_M5	245.63	577	15637	
TU_M6	892.56	595	15637	
TU_M7	215.44	666	15637	
TU_M8	407.61	728	15637	
TU_M9	468.85	833	15637	
TU_MOC1	703.38	222	15637	
TU_MOC2	590.88	273	15637	
TU_POP1	346.10	224	43010	
TU_POP2	187.52	353	43010	
TU_SIN	293.29	252	43010	
TU_ARA	350.15	285	43010	

Note: 43010 - Haskovo, 15637 - Kazanlak



Schematic Drawing for Model Setting

RR - Link

Link Name	NAM Catchment	Area (km^2)	Branch	US Chainage	DS Chainage
TU_ASE1	TU_ASE1	87.88	TU_ASE	0	19671
TU_M1	TU_M1	469.49	TU_M	0	42202
TU_M2	TU_M2	799.70	TU_M	42202	112153
TU_ARA	TU_ARA	350.15	TU_M	44572	44572
TU_M3	TU_M3	507.26	TU_M	112153	146386
TU_M4	TU_M4	302.91	TU_M	146386	190649
TU_BEL	TU_BEL	371.23	TU_M	171250	171250
TU_M5	TU_M5	245.63	TU_M	190649	205956
TU_M6	TU_M6	892.55	TU_M	205956	253300
TU_M7	TU_M7	215.44	TU_M	253300	263781
TU_M8	TU_M8	407.61	TU_M	263781	271244
TU_M9	TU_M9	468.85	TU_M	271244	296006
TU_MOC1	TU_MOC1	703.38	TU_MOC	0	46835
TU_MOC2	TU_MOC2	590.88	TU_MOC	46835	46835
TU_POP1	TU_POP1	346.10	TU_POP	0	45685
TU_SIN-1	TU_SIN	0.71	TU_SIN	0	1256
TU_KAL	TU_KAL	575.86	TU_SIN	1256	1256
TU_SIN-2	TU_SIN	292.58	TU_SIN	1256	1256

Note: TU_ASE2, TU_POP2 is not linked.

Major Boundary Conditions

No	Type	Branch	Chainage		Description	Constant value (m3/s) / File Name
1	Inflow	TU_M	296006.3		US End of TU_M	0.001
2	Inflow	TU_MOC	46835.17		US End of TU_MOC	0.001
3	Inflow	TU_POP	45685.94		US End of TU_POP	MSherkovo_Out_Instream.dfs0
4	Inflow	TU_SIN	1256.52		US End of TU_SIN	0.001
5	Inflow	TU_ASE	19671.63		US End of TU_ASE	Asenovets_Out_Instream.dfs0
6	Q-H	TU_M	0		DS End of TU_M	N/A
7	Regulating Structure	TU_M	263780.6		Instream flow to DS River from Koprinka Res.	Koprinka_Out_Instream.dfs0
8	Regulating Structure	TU_M	190649		Instream flow to DS River from Zhrebchevo Res.	Zhrebchevo_Out_Instream.dfs0
9	Inflow	TU_M	190649	205955	Off stream flow from Zhrebchevo Res.	Zhrebchevo_Out_Offstream.dfs0
10	Inflow	TU_M	263780	271243	Off stream flow from Koprinka Res.	Koprinka_Out_Offstream.dfs0
11	Inflow	TU_M	170500		Abstracted Water for Irrigation after HPP at Zhrebchevo Res	Zhrebchevo_AbstIRR.dfs0
12	Inflow	TU_M	95600		Abstracted Water by Hanovo PS	HanovoPS.dfs0

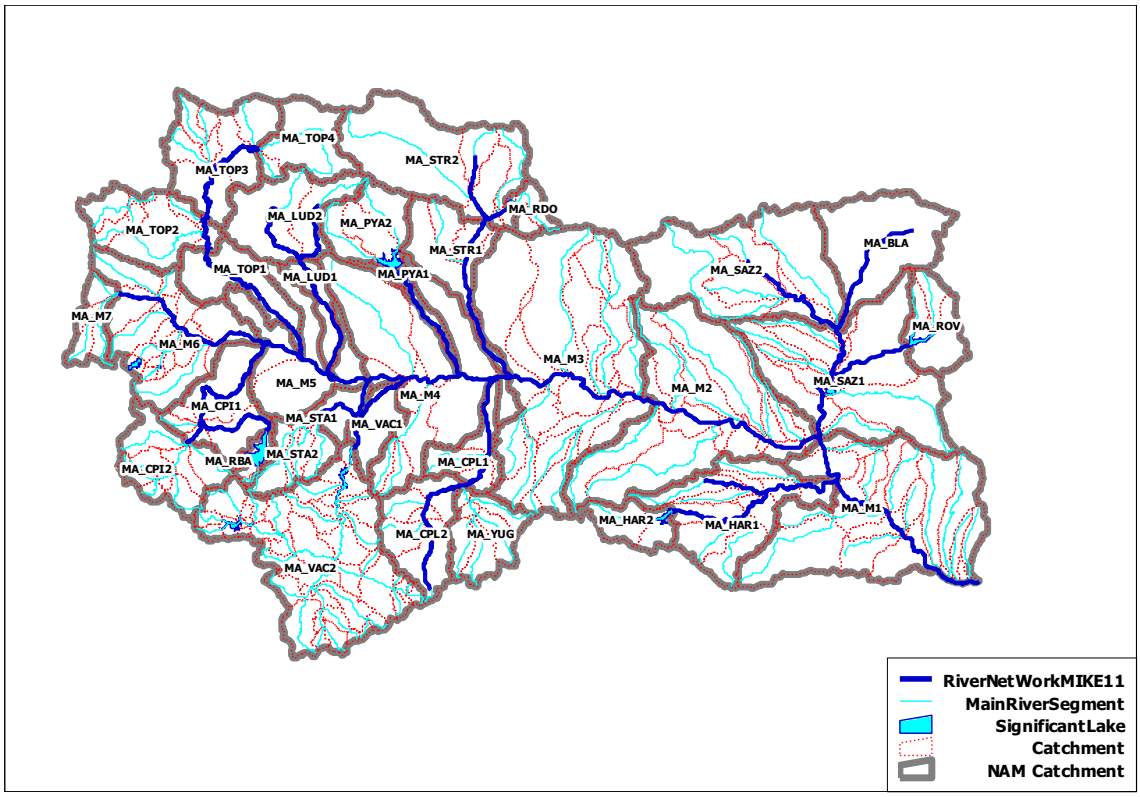
Other Boundary Conditions

Item	Description	Constant Value / File Name
Total Abstracted Water Amount in NAM catchment	For each NAM catchment	Tundzha_AbstW.dfs0
Distributed Domestic Discharge in NAM catchment	For each NAM catchment	Tundzha_DisW.dfs0
Domestic Discharge from towns whose PE is more than 2000	For each point	Constant
Industrial Discharge	For each point	Constant

5. Maritsa River Basin

Outline of Model Setting

- Total Modeling Catchment Area = 21272.27km^2
- Number of Rainfall-Runoff (NAM) Catchment = 34
- Total Length of Modeling River Network = 954.98 km
- Number of Branch = 20



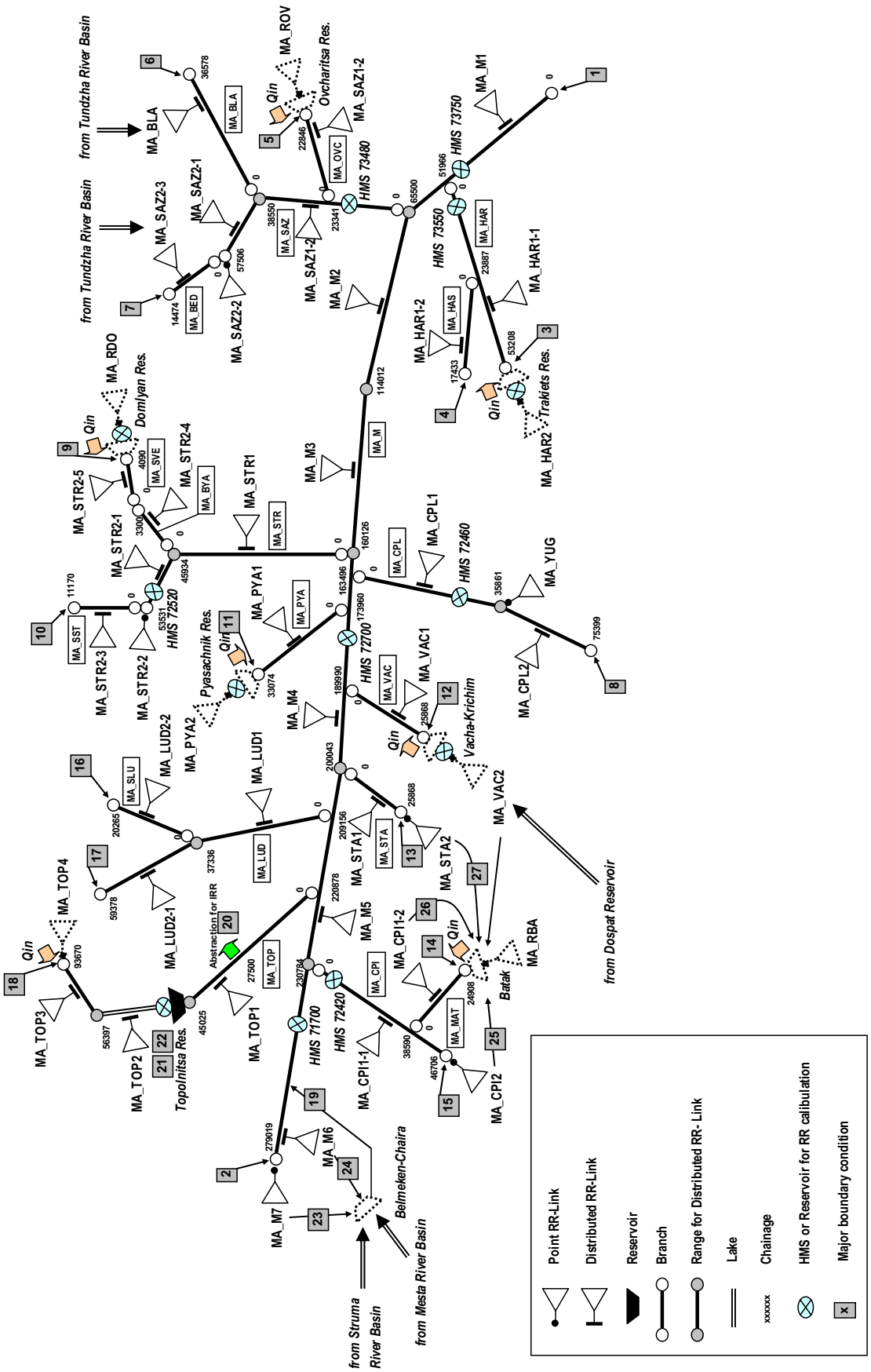
Summary Table of Branch

Branch Name	Length (m)	Main (M) or Tributary (T)	Connection	
			Branch	Chainage (m)
MA_BLA	36578.14	T	MA_SAZ	38550.22
MA_CPI	46706.41	T	MA_M	230784.5
MA_HAR	53208.67	T	MA_M	51966.29
MA_M	279019.9	M		
MA_OVC	22846.7	T	MA_SAZ	23341.14
MA_TOP	93670.73	T	MA_M	220877.7
MA_PYA	33074.18	T	MA_M	173960.4
MA_VAC	25868.11	T	MA_M	189989.9
MA_STA	22486.67	T	MA_M	200043.3
MA_MAT	24908.36	T	MA_CPI	38590.92
MA_LUD	59378.07	T	MA_M	209155.9
MA_SLU	20265.44	T	MA_LUD	37336.22
MA_HAS	17433.6	T	MA_HAR	23886.95
MA_CPL	75399.84	T	MA_M	163496.2
MA_STR	53531.5	T	MA_M	160215.5
MA_SST	11170.08	T	MA_STR	53531.5
MA_BED	14474.61	T	MA_SAZ	57506.51
MA_SAZ	57506.51	T	MA_M	65500.09
MA_BYA	3360.426	T	MA_STR	45934.69
MA_SVE	4090.802	T	MA_BYA	3360.426

Summary Table of NAM Catchment

NAM Catchment	Area (km^2)	Average Elevation (m)	Meteo St. for Temperature	Remarks
MA_BLA	642.01	188	43010	
MA_CPI1	464.14	891	15628	
MA_CPI2	443.09	1395	15628	
MA_CPL1	241.83	757	15628	
MA_CPL2	441.68	1300	15628	
MA_HAR1	761.82	234	43010	
MA_HAR2	201.07	433	43010	
MA_LUD1	150.49	308	15628	
MA_LUD2	523.94	738	15628	
MA_M1	1621.50	224	43010	
MA_M2	1603.51	218	43010	
MA_M3	2258.69	289	43010	
MA_M4	1357.30	373	15628	
MA_M5	606.53	340	15628	
MA_M6	858.53	965	15628	Modified Degree Day Coefficient
MA_M7	173.41	1576	15628	Modified Degree Day Coefficient
MA_PYA1	86.19	237	15628	
MA_PYA2	366.99	556	15628	
MA_RBA	70.33	1245	15628	
MA_RDO	104.52	656	15628	
MA_ROV	291.59	192	43010	
MA_SAZ1	1289.20	184	43010	
MA_SAZ2	1143.25	306	43010	
MA_STA1	124.77	367	15628	
MA_STA2	271.16	1145	15628	
MA_STR1	417.44	321	15628	
MA_STR2	969.06	819	15628	
MA_TOP1	341.20	484	15628	
MA_TOP2	487.23	768	15628	
MA_TOP3	609.06	826	15628	
MA_TOP4	337.69	1125	15628	
MA_VAC1	182.65	600	15628	
MA_VAC2	1496.50	1390	15628	
MA_YUG	333.90	1204	15628	

Note: 43010 - Haskovo, 15628 - Pazardjik



Schematic Drawing for Model Setting

RR – Link (1/2)

Link Name	NAM Catchment	Area (km^2)	Branch	US Chainage	DS Chainage
MA_SAZ2-3	MA_SAZ2	134.33	MA_BED	0	14474
MA_BLA	MA_BLA	642.01	MA_BLA	0	36578
MA_STR2-4	MA_STR2	112.01	MA_BYA	0	3360
MA_CPI1-1	MA_CPI1	314.17	MA_CPI	0	46706
MA_CPI2	MA_CPI2	443.09	MA_CPI	46706	46706
MA_CPL1	MA_CPL1	241.83	MA_CPL	0	35862
MA_YUG	MA_YUG	333.90	MA_CPL	35862	35862
MA_CPL2	MA_CPL2	441.68	MA_CPL	35862	75399
MA_HAR1-1	MA_HAR1	581.40	MA_HAR	0	53208
MA_HAR2	MA_HAR2	201.07	MA_HAR	53208	53208
MA_HAR1-2	MA_HAR1	180.42	MA_HAS	0	17433
MA_LUD1	MA_LUD1	150.49	MA_LUD	0	37336
MA_LUD2-1	MA_LUD2	348.07	MA_LUD	37336	59378
MA_M1	MA_M1	1621.50	MA_M	0	65500
MA_M2	MA_M2	1603.51	MA_M	65500	114013
MA_M3	MA_M3	2258.69	MA_M	114013	160216
MA_M4	MA_M4	1357.30	MA_M	160216	200043
MA_M5	MA_M5	606.53	MA_M	200043	230784
MA_M6	MA_M6	858.53	MA_M	230784	279019
MA_M7	MA_M7	173.41	MA_M	279019	279019
MA_CPI1-2	MA_CPI1	149.98	MA_MAT	0	24908
MA_RBA	MA_RBA	70.33	MA_MAT	24908	24908
MA_SAZ1-2	MA_SAZ1	355.28	MA_OVC	0	22846
MA_ROV	MA_ROV	291.59	MA_OVC	22846	22846
MA_PYA1	MA_PYA1	86.19	MA_PYA	0	33074
MA_PYA2	MA_PYA2	366.99	MA_PYA	33074	33074
MA_SAZ1-1	MA_SAZ1	933.92	MA_SAZ	0	38550
MA_SAZ2-1	MA_SAZ2	430.85	MA_SAZ	38550	57506
MA_SAZ2-2	MA_SAZ2	578.07	MA_SAZ	57506	57506
MA_LUD2-2	MA_LUD2	175.87	MA_SLU	0	20265

RR – Link (2/2)

Link Name	NAM Catchment	Area (km^2)	Branch	US Chainage	DS Chainage
MA_STR2-3	MA_STR2	98.30	MA_SST	0	11170
MA_STA1	MA_STA1	124.77	MA_STA	0	22486
MA_STA2	MA_STA2	271.16	MA_STA	22486	22486
MA_STR1	MA_STR1	417.44	MA_STR	0	45935
MA_STR2-1	MA_STR2	118.41	MA_STR	45935	53531
MA_STR2-2	MA_STR2	619.53	MA_STR	53531	53531
MA_STR2-5	MA_STR2	20.81	MA_SVE	0	4090
MA_RDO	MA_RDO	104.52	MA_SVE	4090	4090
MA_TOP1	MA_TOP1	341.20	MA_TOP	0	45048
MA_TOP2	MA_TOP2	487.23	MA_TOP	45048	56397
MA_TOP3	MA_TOP3	609.06	MA_TOP	56397	93670
MA_TOP4	MA_TOP4	337.69	MA_TOP	93670	93670
MA_VAC1	MA_VAC1	182.65	MA_VAC	0	25868
MA_VAC2	MA_VAC2	1496.50	MA_VAC	25868	25868

Note:

MA_HAR2, MA_ROV, MA_VAC2, MA_RBA, MA_TOP4, MA_PYA2, MA_RDO are not linked.

Major Boundary Conditions

No	Type	Branch	Chainage		Description	Constant value (m3/s) / File Name
1	Q-h	MA_M	0		DS End of MA_M	N/A
2	Inflow	MA_M	279019.89		US End of MA_M	0.001
3	Inflow	MA_HAR	53208.67		Instream Flow formTrakiets Res.	Trakiets_Out_Instream.dfs0
4	Inflow	MA_HAS	17433.60		US End of MA_HAS	0.001
5	Inflow	MA_OVC	22846.70		Instream Flow form Ovchevitsa Res	Ovchevitsa_Out_Instream.dfs0
6	Inflow	MA_BLA	36578.14		US End_MA_BLA	0.001
7	Inflow	MA_BED	14474.61		US End_MA_BED	0.001
8	Inflow	MA_CPL	75399.84		US End_MA_CPL	0.001
9	Inflow	MA_SVE	4090.80		Instream Flow form Domlyan Res.	Domlyan_Out_Offstream.dfs0
10	Inflow	MA_SST	11170.08		US End_MA_SST	0.001
11	Inflow	MA_PYA	33074.18		Instream Flow form Pyasachnik Res	Pyasachinik_Out_Offstream.dfs0
12	Inflow	MA_VAC	25868.11		Instream Flow form Vacha Res.	Vacha_Out_Offstream.dfs0
13	Inflow	MA_STA	22486.67		US End_MA_STA	0.001
14	Inflow	MA_MAT	24908.36		Instream Flow form Batak Res.	Batak_Out_Instream.dfs0
15	Inflow	MA_CPI	46706.41		US End_MA_CPI	0.001
16	Inflow	MA_SLU	20265.44		US End_MA_SLU	0.001
17	Inflow	MA_LUD	59378.07		US End_MA_LUD	0.001
18	Inflow	MA_TOP	93670.73		Instream Flow form Tailing pond in Toplnitsa River	Tpond_Topolnitsa_Out_Instream.dfs0
19	Inflow	MA_M	248306	256387	Instream Flow form Belmeken Res	Belmeken_Out_Instream.dfs0
20	Inflow	MA_TOP	27500		Abstraction for IRR after Topolnitdsa Res	Topolnitsa_AbstIRR.dfs00
21	Inflow	MA_TOP	45048	56397	Offstream Flow form Topolnitsa Res	Topolnitsa_Out_Offstream.dfs0
22	Regulating Structure	MA_TOP	45048.24		Instream Flow form Topolnitsa Res	Topolnitsa_Out_Instream.dfs0
23	Inflow	MA_M	279019		Transfer from MA_M7	Transfer_MA_M7.dfs0
24	Inflow	MA_M	230784	279019	Transfer from MA_M6	Transfer_MA_M6.dfs0
25	Inflow	MA_CPI	46706		Transfer from MA_CPI2	Transfer_MA_CPI2.dfs0
26	Inflow	MA_MAT	0		Transfer from MA_CPI1	Transfer_MA_CPI1.dfs0
27	Inflow	MA_TOP	22486		Transfer from MA_STA2	Transfer_MA_STA2.dfs0

Other Boundary Conditions

Item	Description	Constant Value / File Name
Total Abstracted Water Amount in NAM catchment	For each NAM catchment	Maritsa_AbstW.dfs0
Distributed Domestic Discharge in NAM catchment	For each NAM catchment	Maritsa_DisW.dfs0
Domestic Discharge from towns whose PE is more than 2000	For each point	Constant
Industrial Discharge	For each point	Constant

Annex 5

Practical Guideline

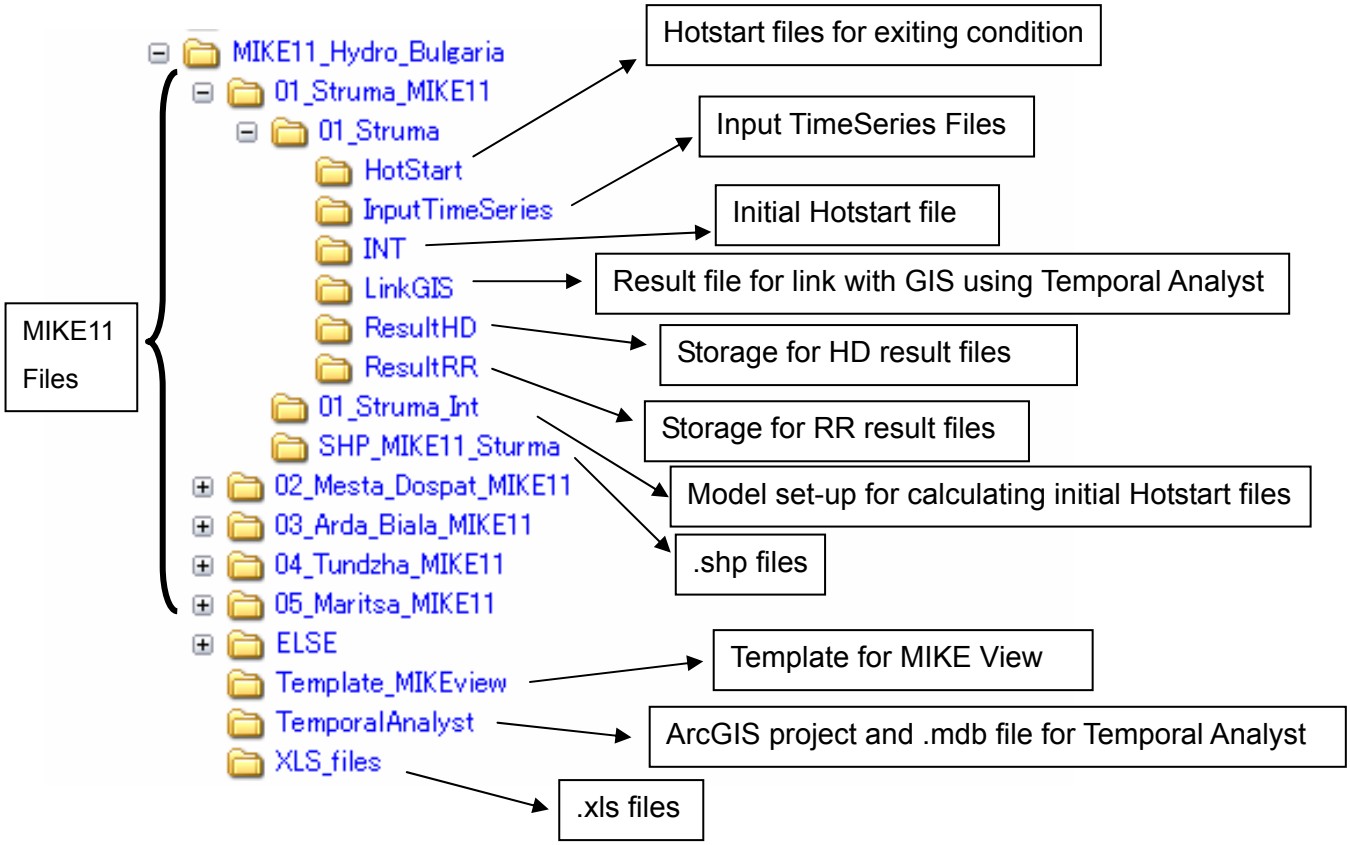
for

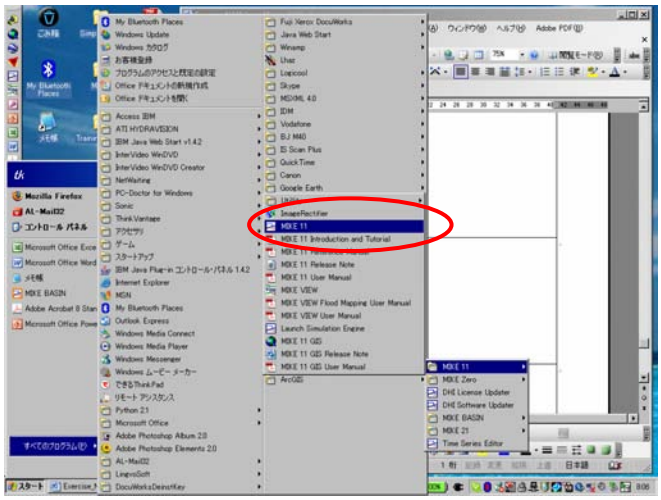
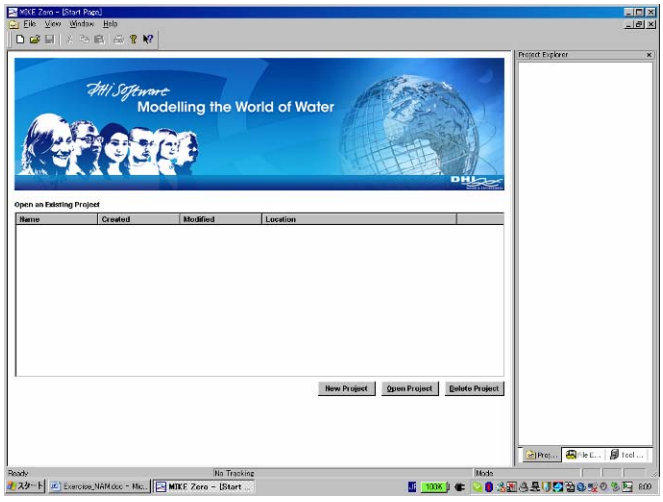
Use of MIKE11 Water Quantity Model

JICA Study Team

1. Preparation

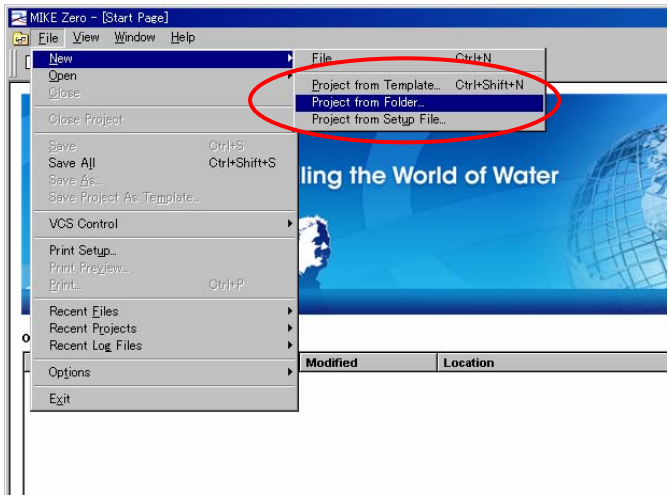
Contents of Material



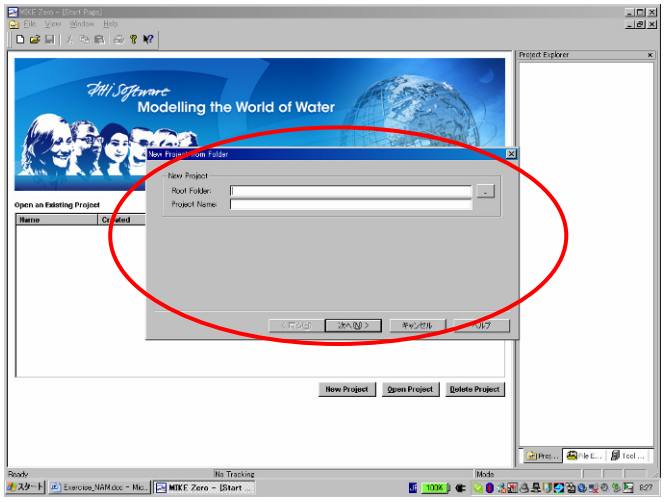
Copy the folder “**MIKE11_Hydro_Bulgaria**” from CD, which includes material, to hard disk in your computer.	
Start MIKE11 from “start menu”.	
Now, MIKE11 with MIKE ZERO platform started.	

Making a new project

File -> New -> Project from Folders



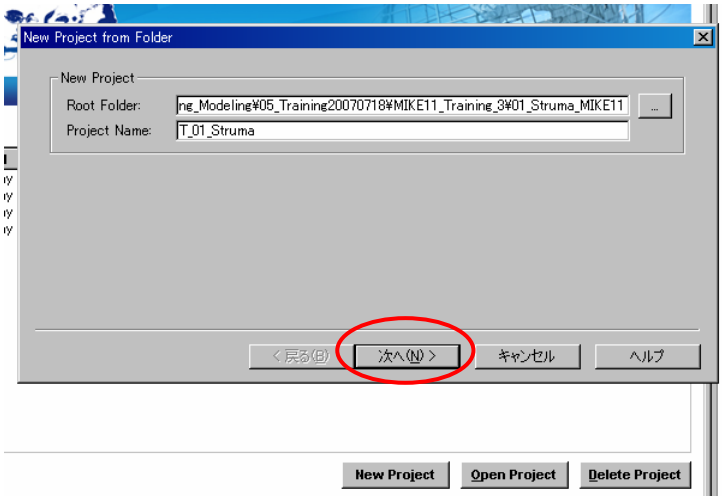
Dialog “New Project from Folder” appears.

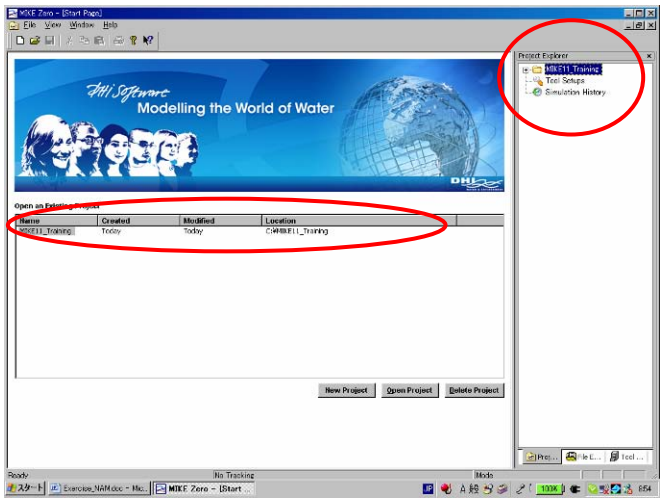


Browse the folder ” MIKE11_Hydro_Bulgaria / 01_Struma” which was copied to the hard disk in your computer.

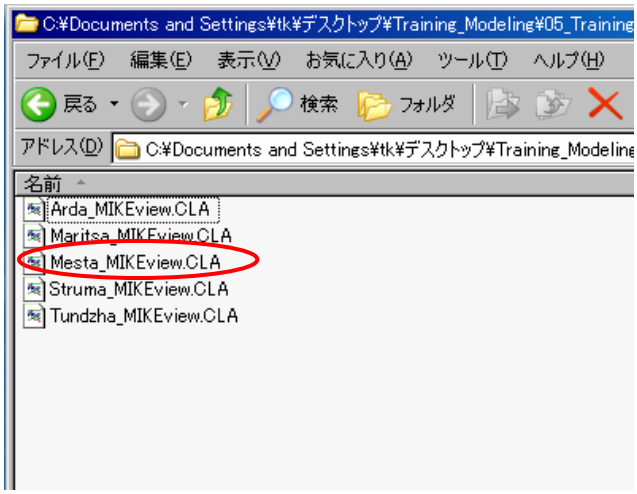
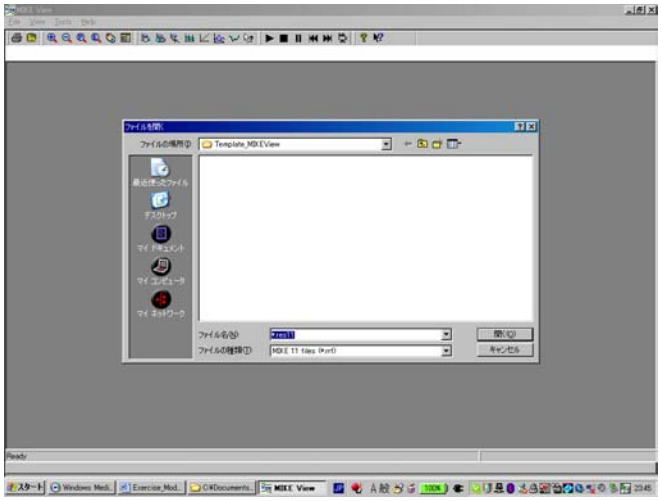
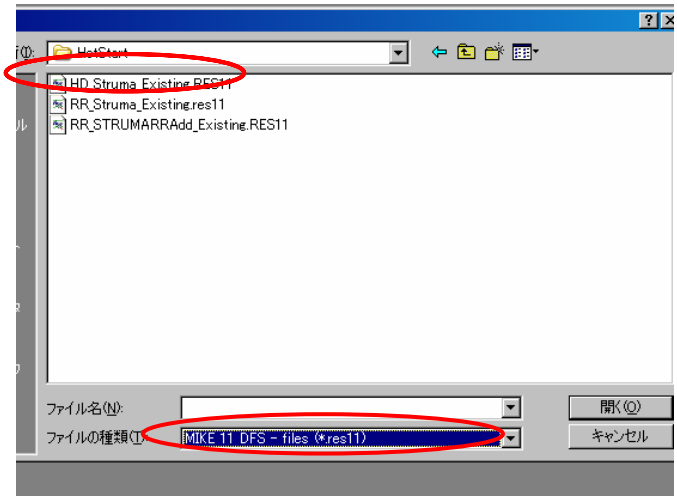
Enter Project Name “T_01_Struma”

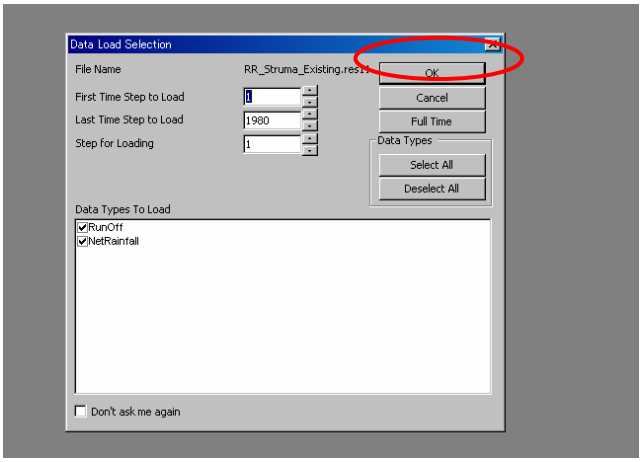
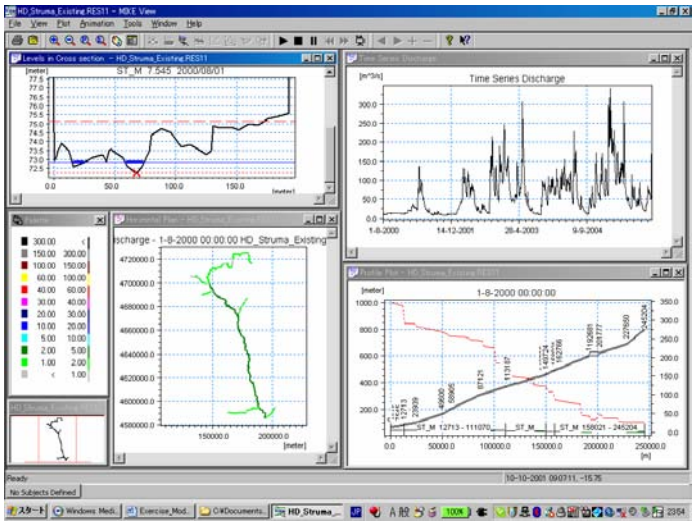
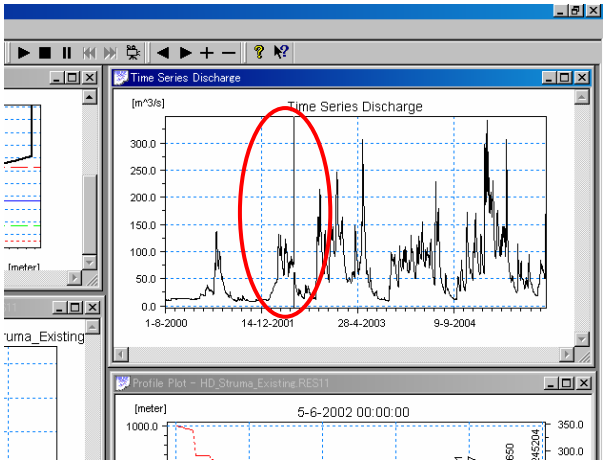
Then, click “Next (N)”.

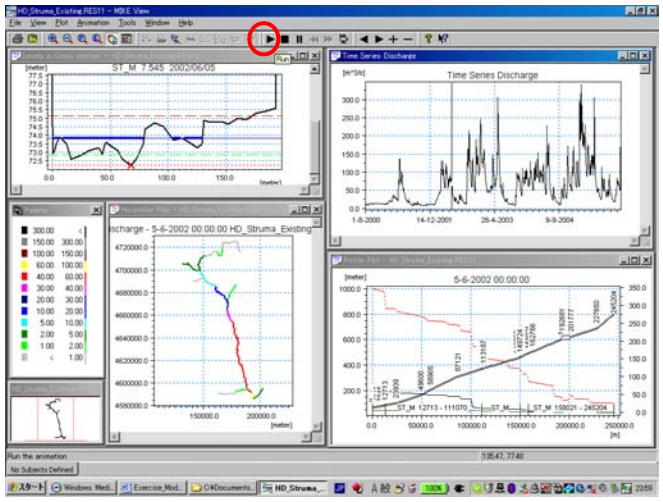
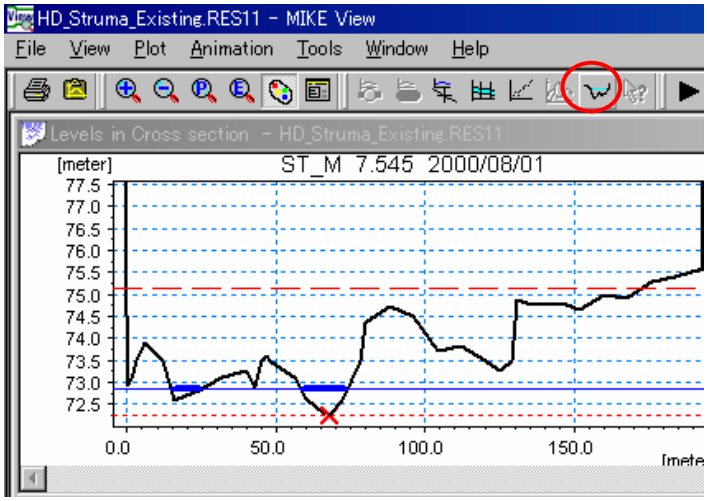
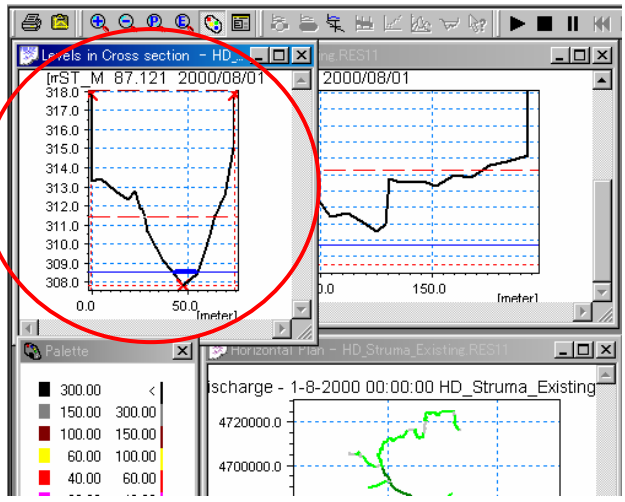


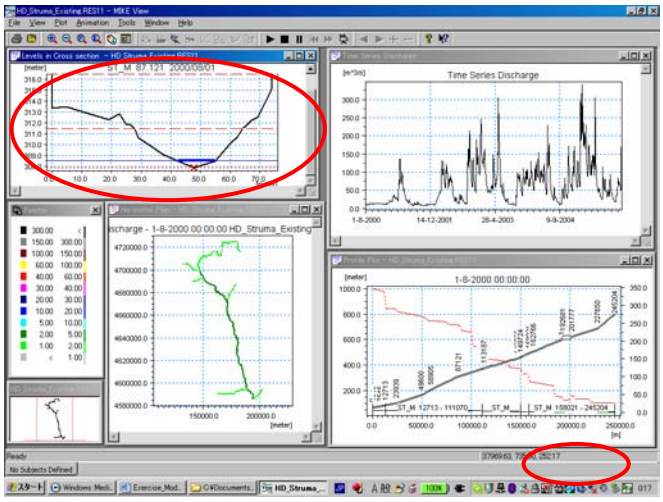
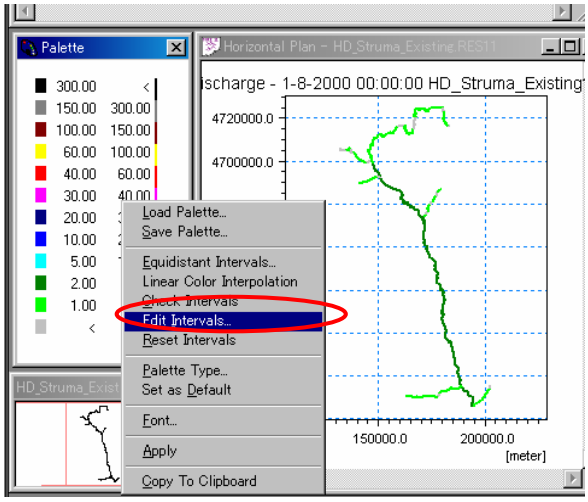
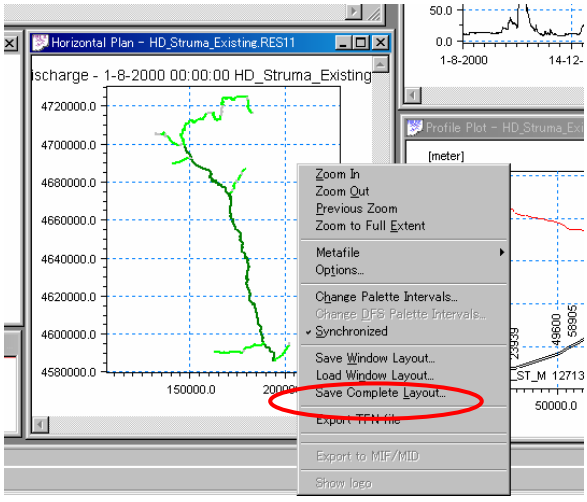
Make sure all are checked in check boxes. Then click “complete”.	
New project opened. Please select option “show all”, so that files inside the project are visible. (refer to previous exercise)	
Make other new projects for **“02_Mesta_Dospat”-** **---> “T_02_Mesta”** **“03_Arda_Biala”** **---> “T_03_Arda”** **“04_Tundzha”** **---> “T_04_Tundzha”** **“05_Maritsa”** **---> “T_05_Maritsa”**	

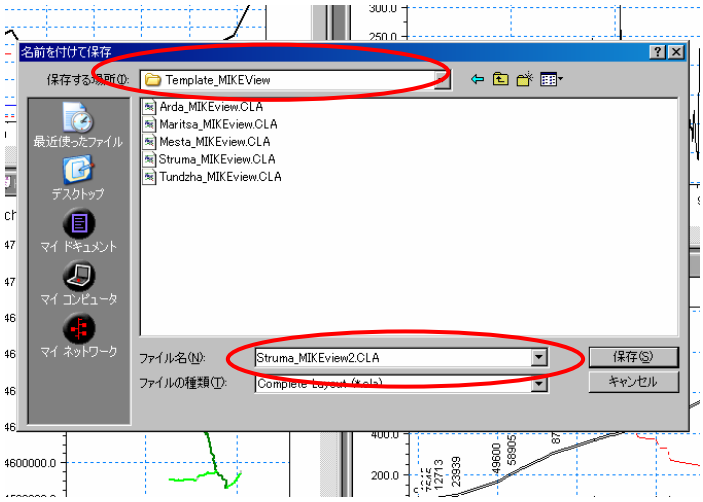
2. MIKE View Template for Animation of MIKE11 results

Browse "/ MIKE11_Hydro_Bulgaria / Template_MIKEView". Open "Struma_MIKEview.CLA" by double click.	
MIKE View opened. You have to specify the file to be opened.	
Change file type to ".res11" Browse"/01_Struma/Hotstart/HD_Struma_Existing.res11" (This is a result file for existing condition.) Click to open it.	

Dialog “Data Load Selection” appears. Click “OK”	
You can see pre-defined layout for visualization.	
On “Time Series Discharge”, click anywhere. Then, you can see a vertical line. The location of the line shows the elapsed time. The results in other windows also change when the location of the vertical line changes.	

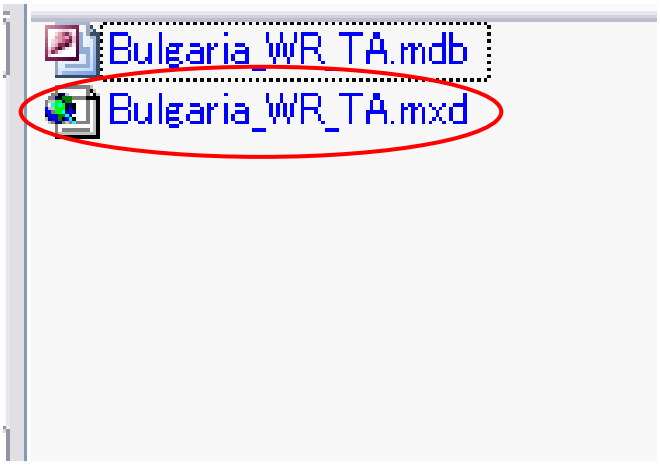
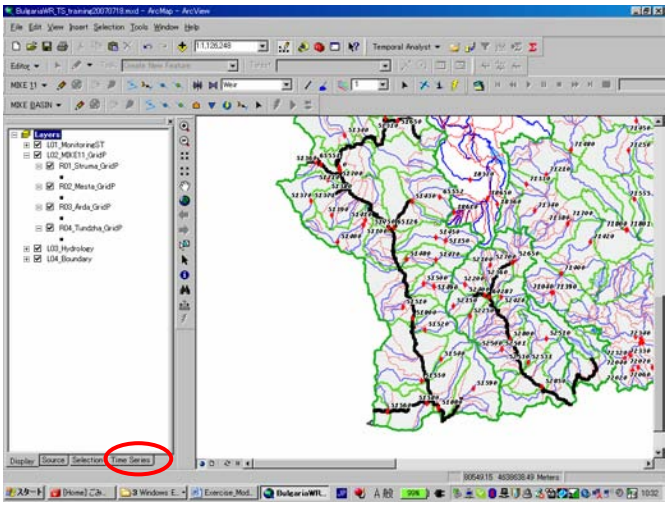
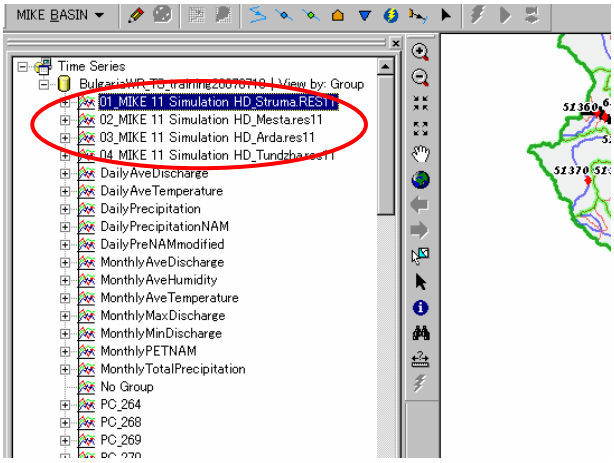
Press  “Run” button. You can see animation. To stop animation, Press  “Stop” button.	
If you want to change cross-section, press “Cross-section animation” button, then on “Horizontal Plan “window, locate cursor to where the cross-section you want to see locates and click there.	
New cross-section appears. Close the previous cross-section, and adjust the window for new cross-section.	

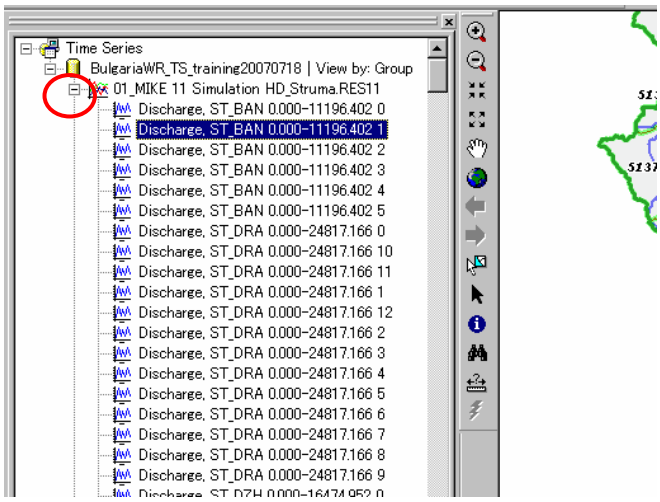
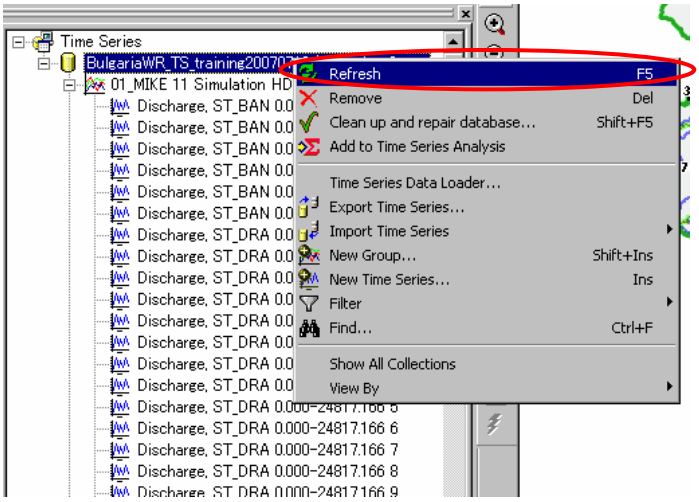
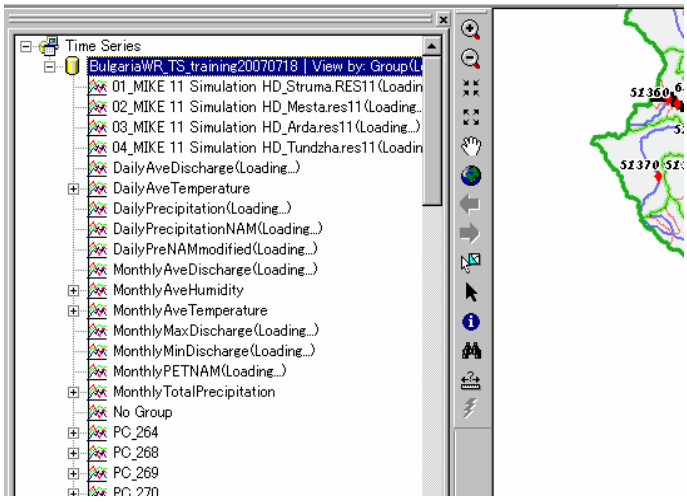
Window for new cross-section is placed.	
If you want to change color palette, place cursor on the window”Palette”, and right click. A dialog appears. Select “Edit intervals”. Adjust your color palette.	
If you want to save your new layout template, place cursor on window “Horizontal Plan”, then right click. A dialog appears. Select “Save Complete Layout”.	

Specify location and file name for the template. Click “Save”. You can use new template when you next start MIKE View.	
Try other rivers.	
For the detail of MIKE View functionality, please refer to MIKE VIEW manual.	

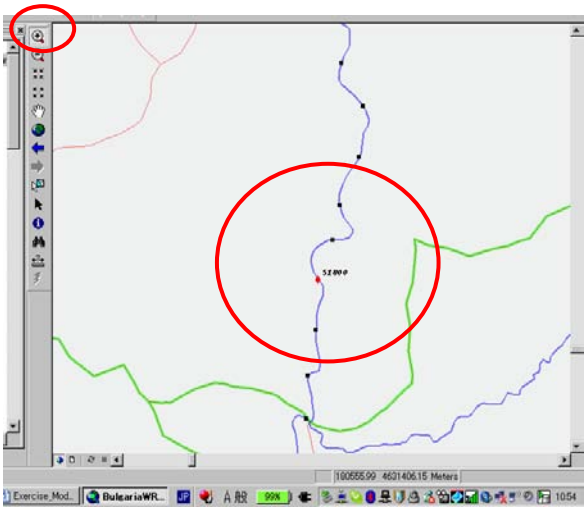
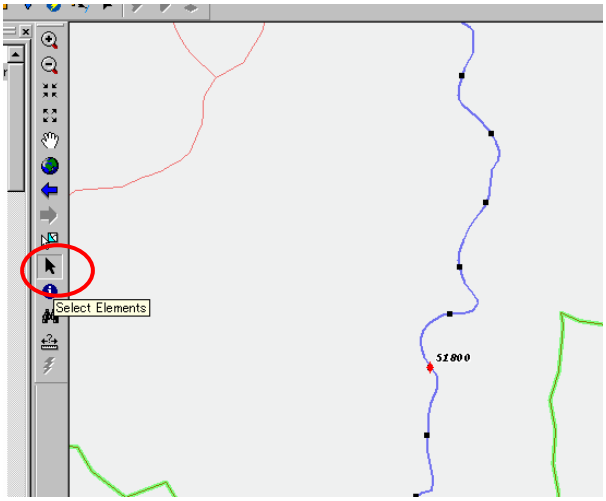
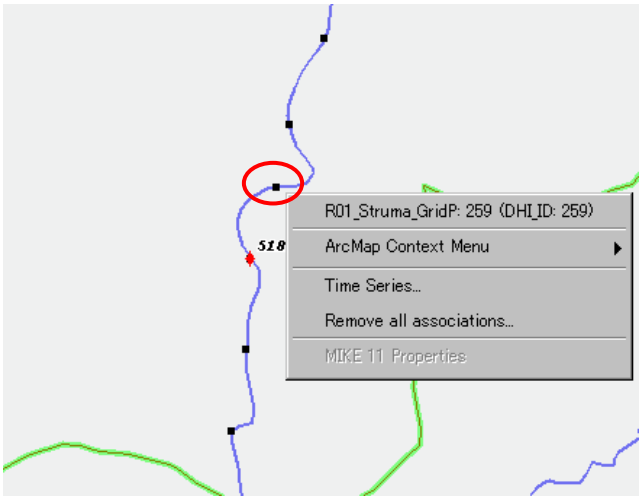
3. Post-Processing using Temporal Analyst

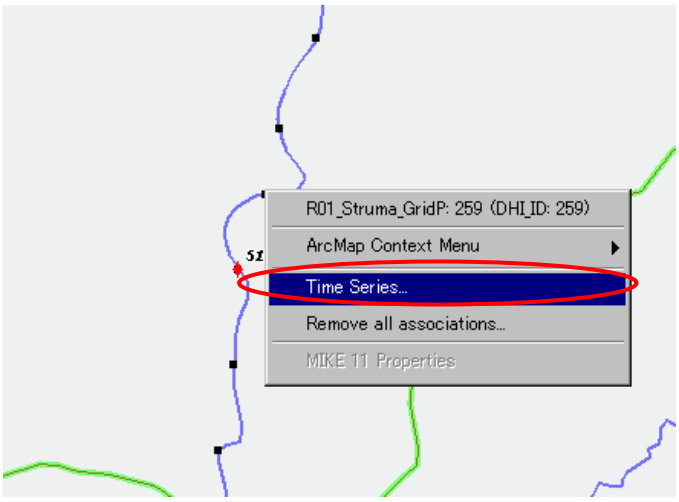
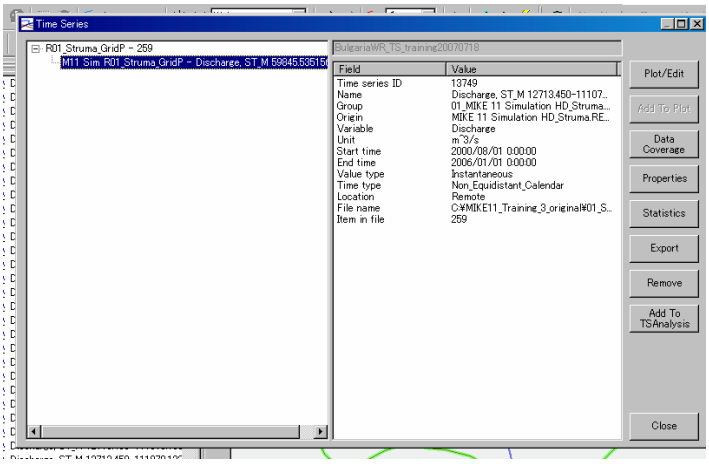
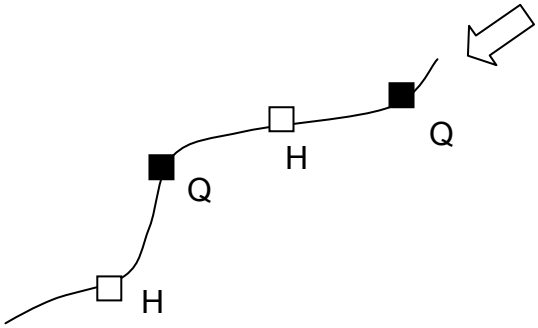
Note: For this exercise, ArcGIS 9.1 and Temporal Analyst have to be installed in your computer.

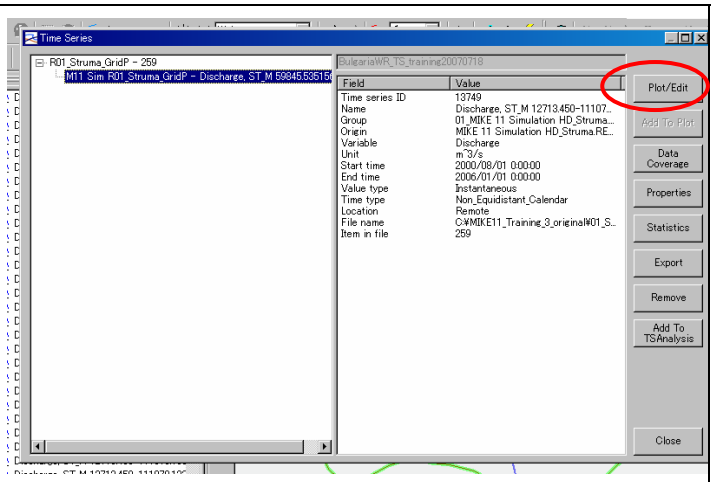
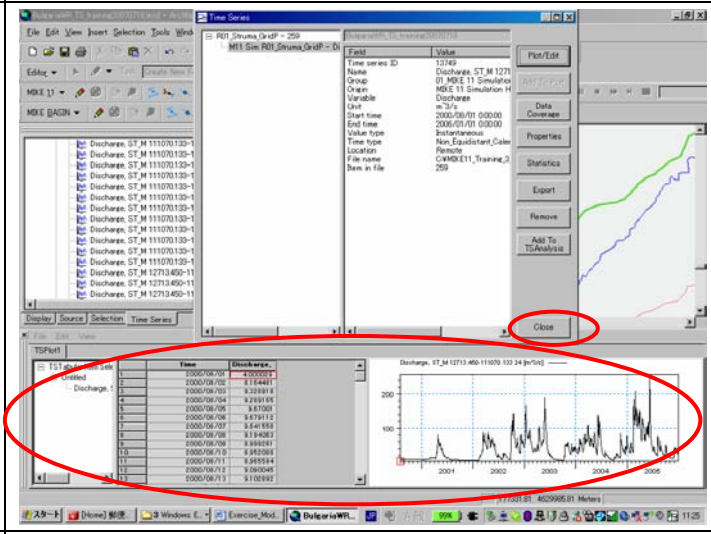
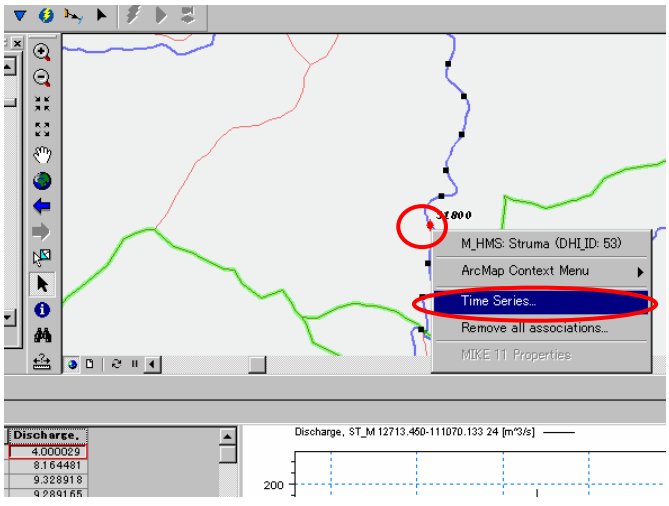
Open "/ MIKE11_Hydro_Bulgaria / TemporalAnalyst/ Bulgaria_WR_TA.mxd"	
ArcGIS started. Object "R01_Struma_Grid" represents calculation points for MIKE11. Select tab"TimeSeries"	
You can see time series files for results of MIKE11 simulation. These time series are linked to the file "/LinkGIS/HD_XXXX.res11" in MIKE11 folder for each river.	

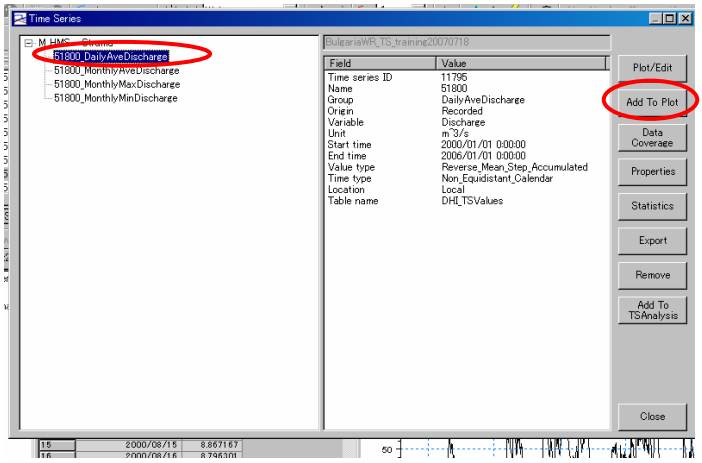
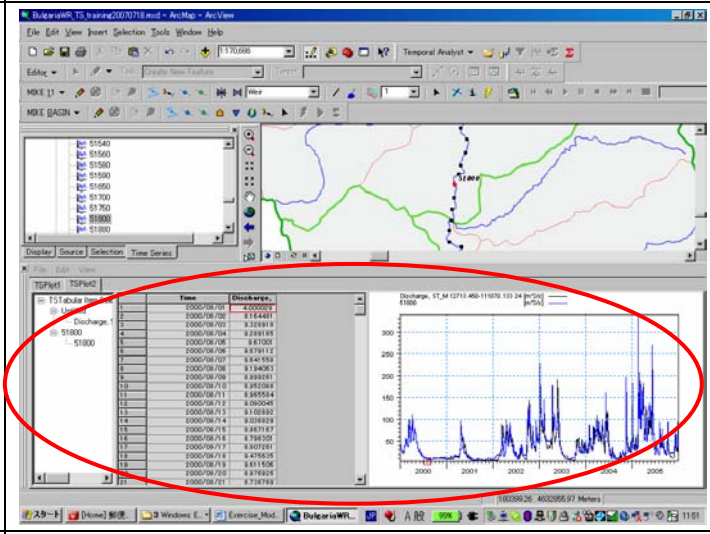
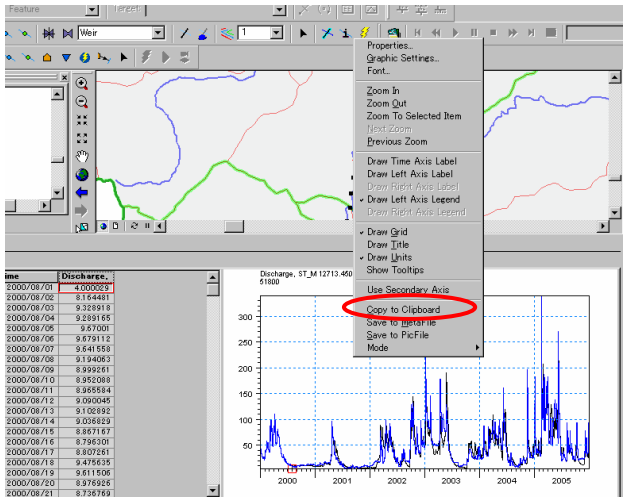
Click “+”, then you can see all of time series files. All of time series files are connected to spatial objects of grid points for MIKE11 calculation.	
The time series are just linked. To ensure that the linked files reflect to the latest condition, you have to refresh the connection. Place cursor on “Bulgaria_WR_TA”, and then right click. Select “Refresh”	
Time series files are re-loaded.	

Exercise-1 ***Comparison of simulated result and observed data***

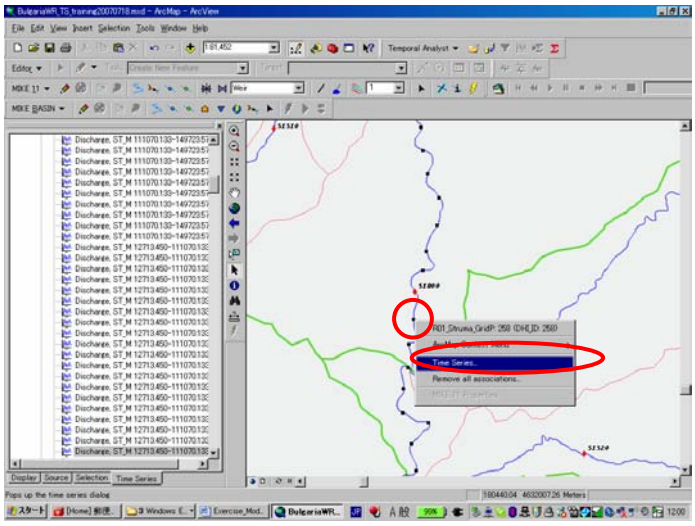
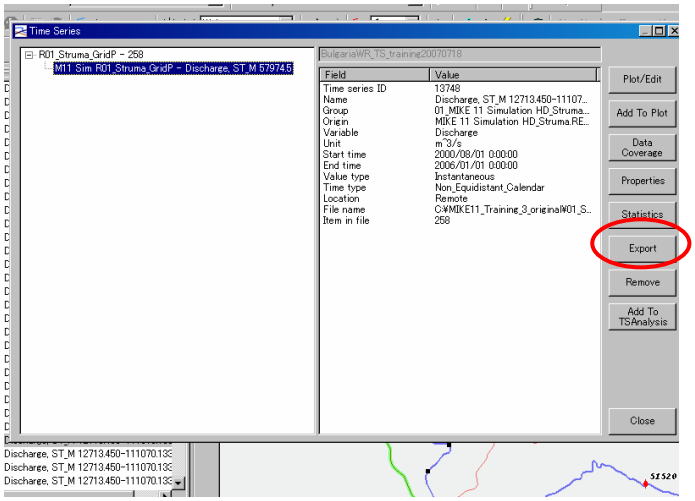
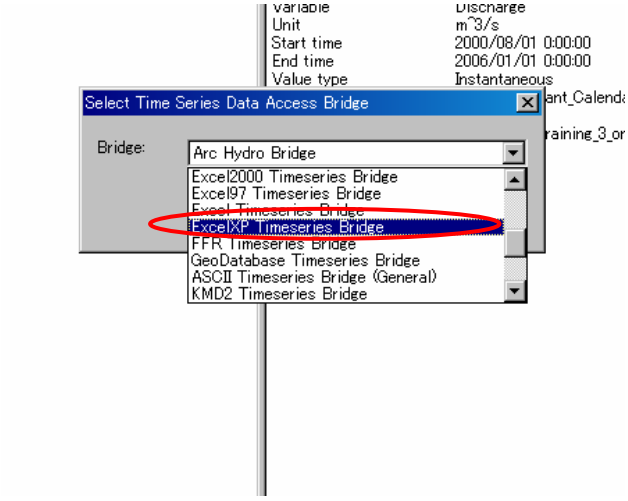
Zoom in to HMS51800 using  tool.	
Press “Select Element” button.	
Place cursor on a point object for grid point for MIKE11 calculation points, which is next to HMS51800, then right click. Small dialog appears.	

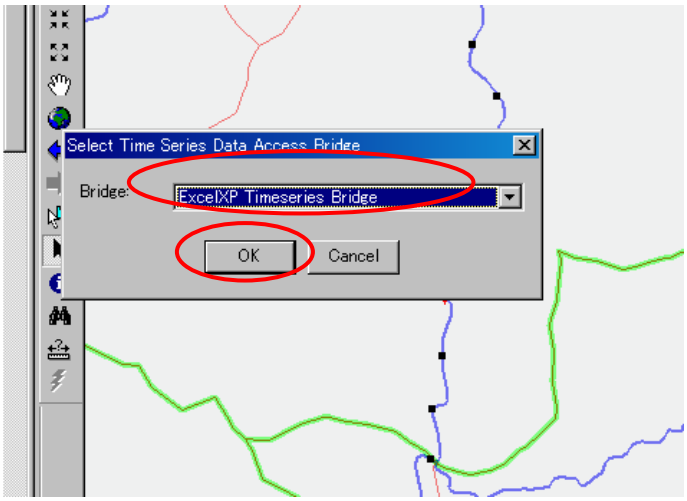
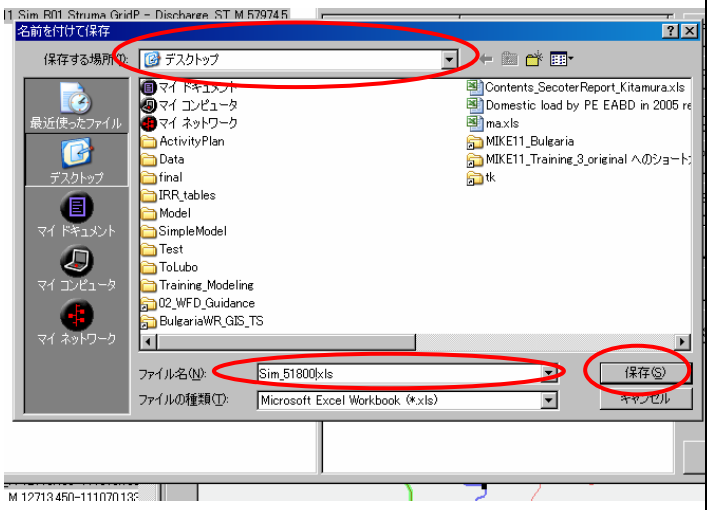
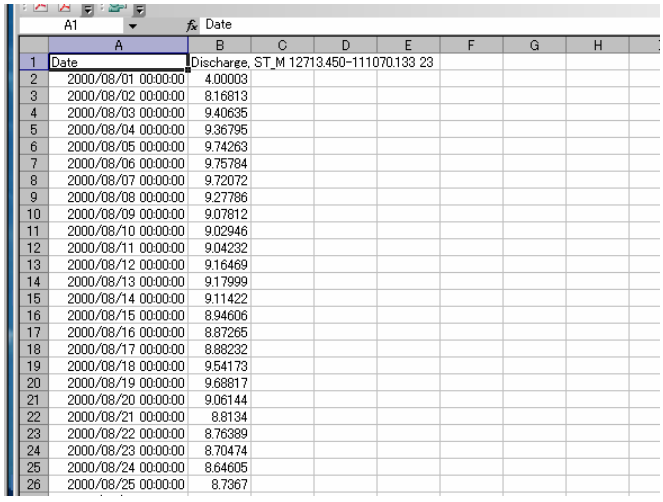
Select “Time Series..”	
Dialog “Time Series” appears. You can see the information on time series file. In this grid point, time series file is for simulated discharge.	
Note: Gird points for MIKE11 calculation consists of H and Q points alternatively along river. At Q points, you can see the results for discharge (water quantity). At H points, you can see the results for water level.	

Click “Plot/Edit”	
You can see time series plot. Click “Close” on dialog “Time Series”.	
Place cursor on a point object for HMS51800, then right click. After small dialog appears, select “Time Series…”.	

Several observed time series data are stored. Select “51800_DailyAveDischarge”. Click “Add To Plot”.	
Now, observed data are plotted together with the simulated result.	
Place cursor on the graph are of time series plot, then right click. Small dialog appears. You can change the style of graphic. If you want to use the graphic in you report, click “copy to clipboard”. You can paste the copied to your word processor.	

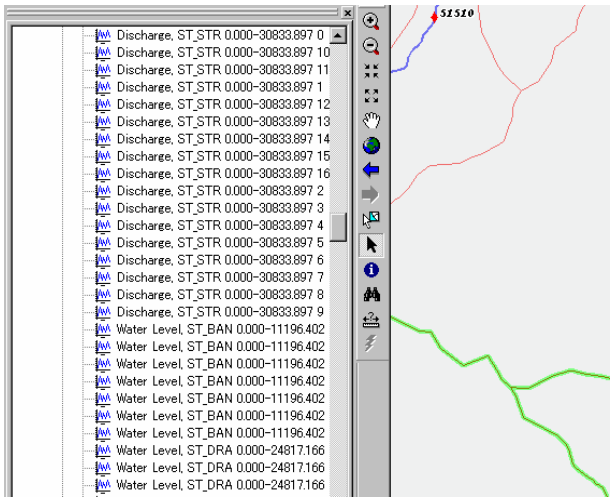
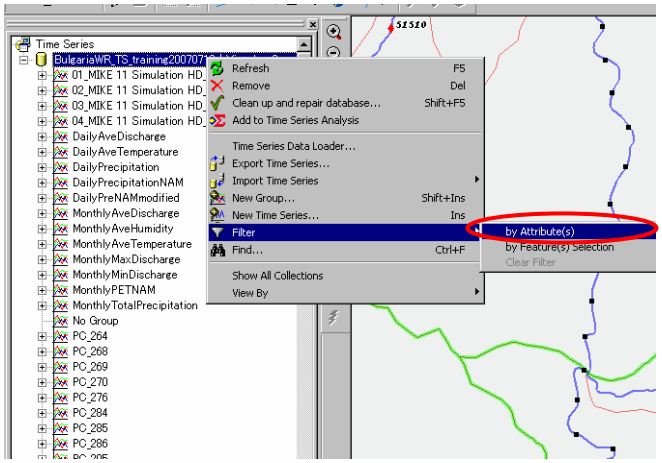
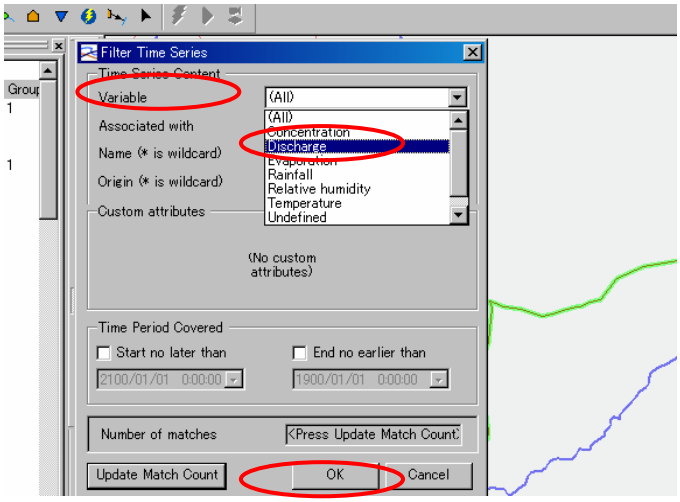
Exercise-2 ***Export the simulated results to Excel file***

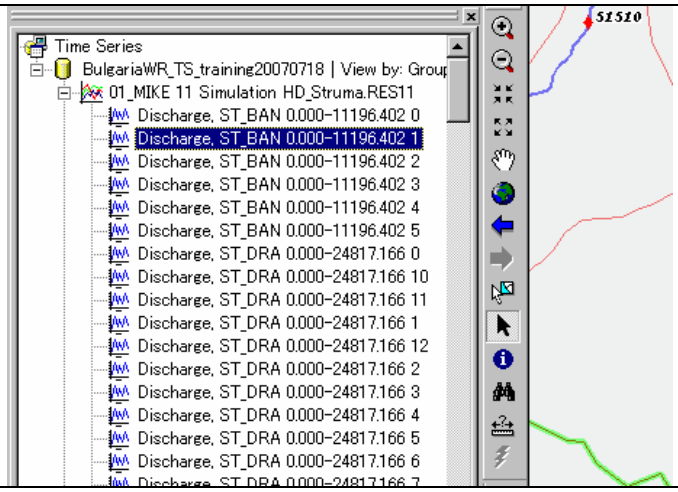
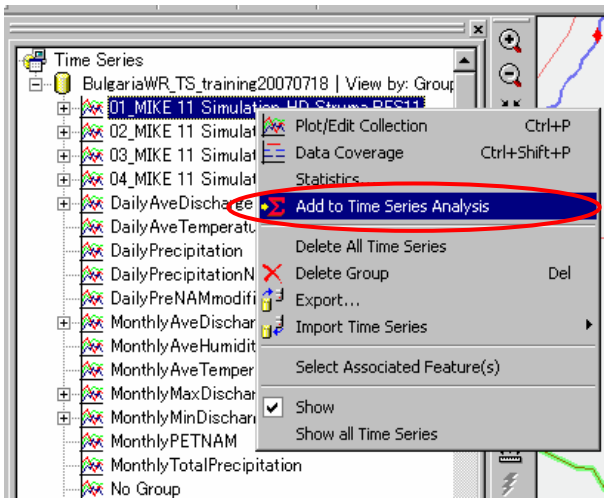
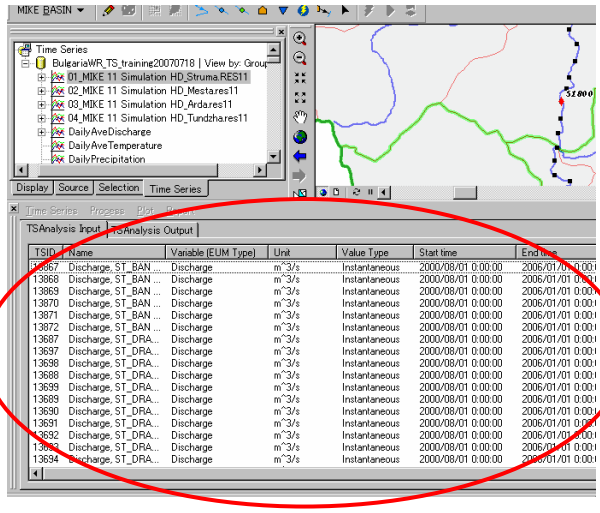
Place cursor on a point object where you want to export time series data, then right click. After small dialog appears, select "Time Series…".	
Dialog "Select Time Series" appears. Select "Export".	
Dialog "Select Time Series Data Access Bridge" appears. Select "ExcelXP Timeseries Bridge".	

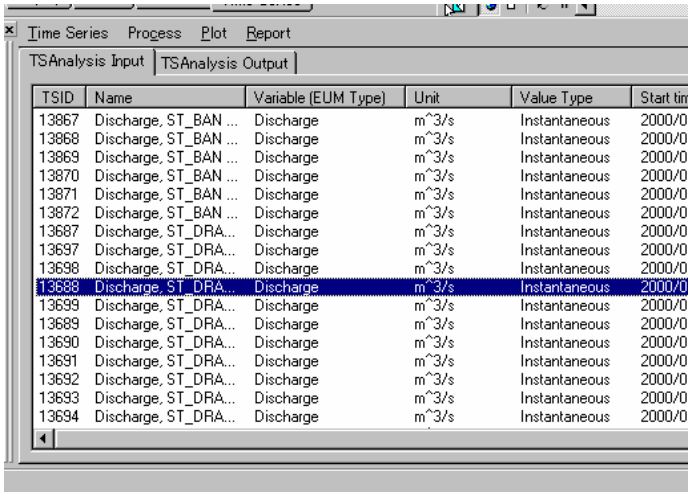
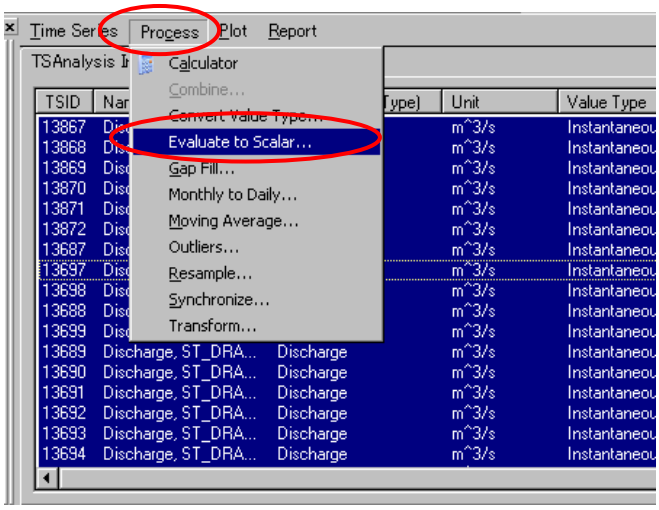
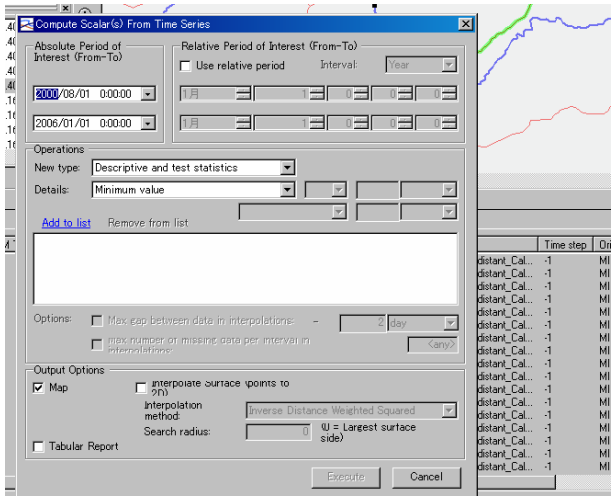
Click “OK”.	
Specify the file name and location to be saved. Click “Save”.	
You will have the .xls file which contains time series data.	

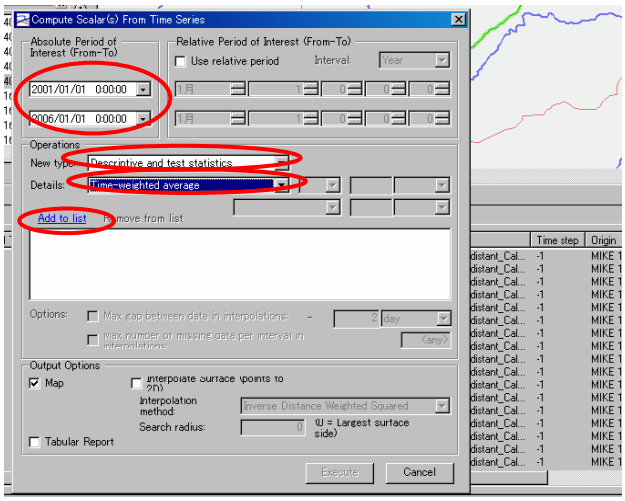
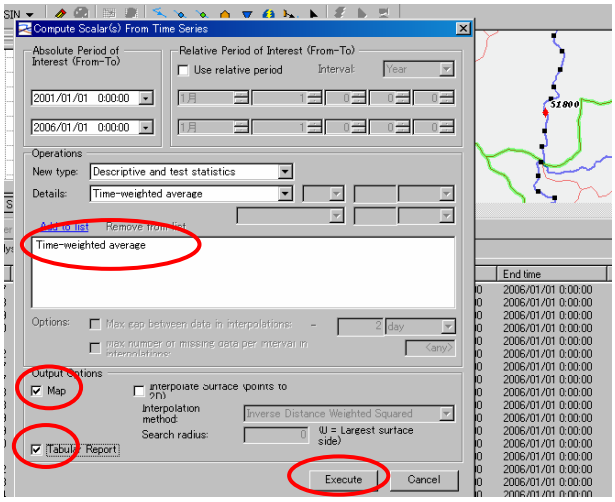
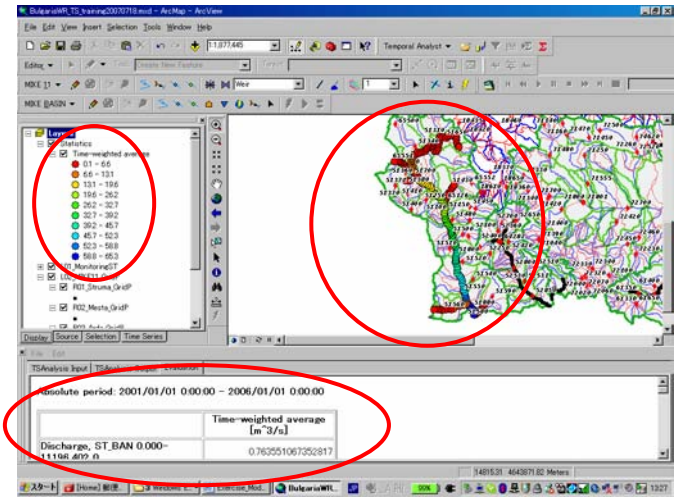
Exercise-3 ***Batch Statistic Analysis for Simulated Results***

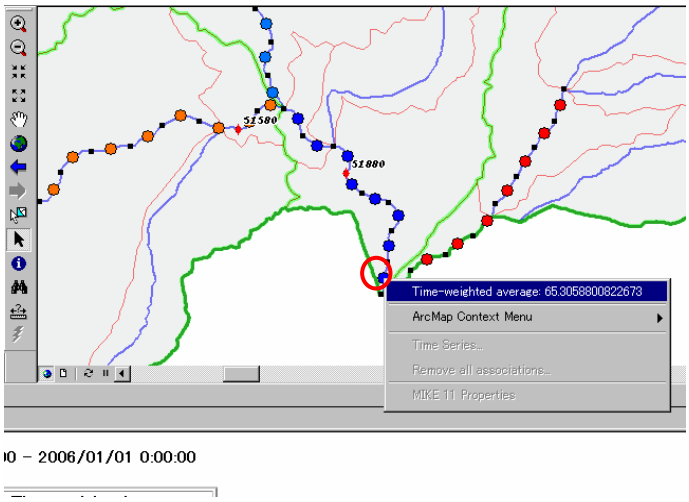
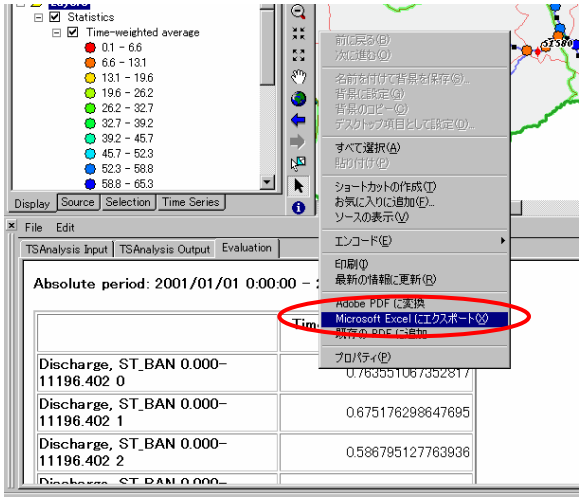
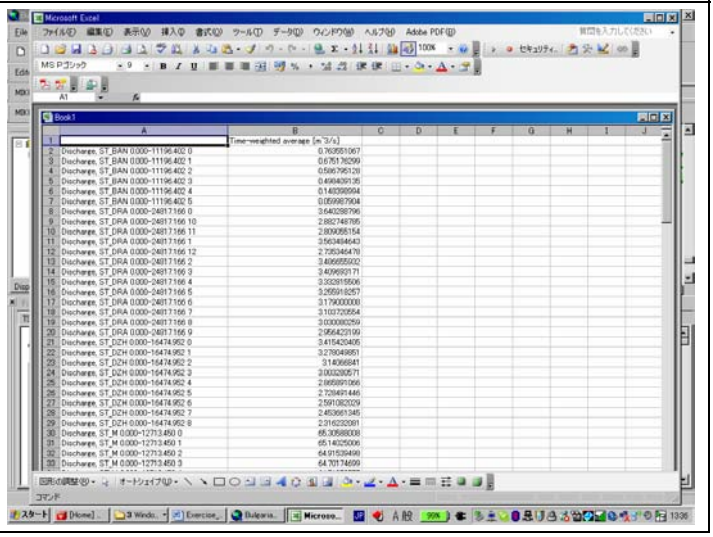
Spatio-temporal data to spatial data

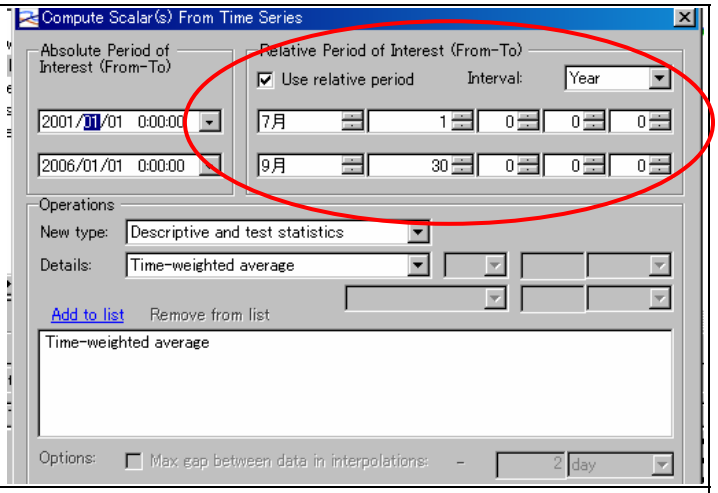
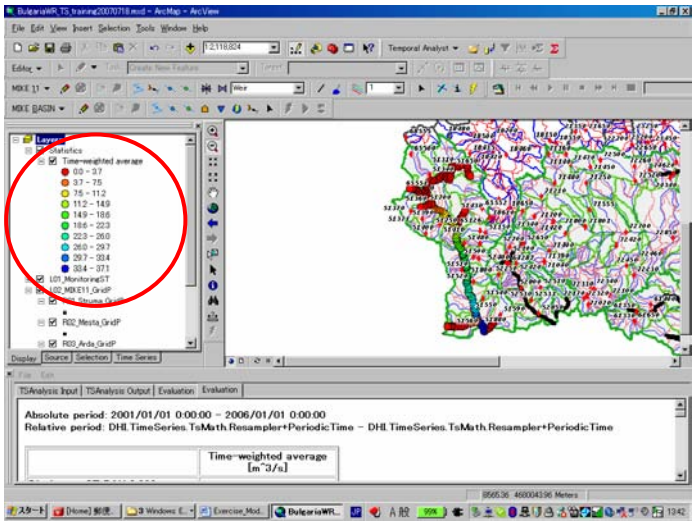
Group "01_MIKE 11 Simulation HD_Struma.RES11" includes both discharge and water level data. Let's firstly filter out water level data.	
Place cursor on "Bulgaria_WR_TA", then right click. Select Filter -> by Attribute	
Dialog "Filter Time series "appears. Select "Discharge" from Variable filed. Click "OK".	

Now, only time series which has variable type “Discharge” is visible and selectable.	
Place cursor on “01_MIKE11_Simulation…”, then right click. Select “Add to Time Series Analysis”.	
Time series data in group “01_MIKE11_Simulation…”, (only filtered) are now ready to be analyzed.	

Click one time series. CTRL + A Then, you can select all of the time series.	
Click “Process” Select “Evaluate to Scalar..”	
Dialog “Compute Scalar8s) from Time Series” appears. Let’s calculate average value during 2001/01/01 to 2006/01/01.	

Set parameters as follows. Absolute Period of Interest 2001/01/01 0:00:00 2006/01/01 0:00:00 Operations New type: Descriptive and test statistics Details: Time-weighted average Then, click “Add to list”.	
“Time-weighted average “ appears in window. Check “MAP” and “ Table Report”. Click “Execute”.	
After the calculation completes, you can see two new objects. 1) New point object of grid points which include statistical results (You can see different color.) 2) Summary table for statistical analysis in .html format.	

Zoom in to a grid point which you are interested in. Place cursor on it, then right click. You can see time-weighted average value in small dialog.	
If you want to export the summary table to Excel, place cursor on the table and then right click. Select “Export to Excel”.	
The summary table is exported to Excel.	

Next, let's calculate average value of July to September during 2001/01/01 to 2006/01/01. In this case, you should check "Use relative period" and specify the period of interest.	
After the calculation completes, you can see the results. In this case, the point object which includes the statistical results do not change. Only statistical values change.	
Try for other rivers by your self.	

4. Trial Simulation by Changing Input file

Exercise -1 Tundzha River Effect of Water Transfer from Zhrebchevo Reservoir

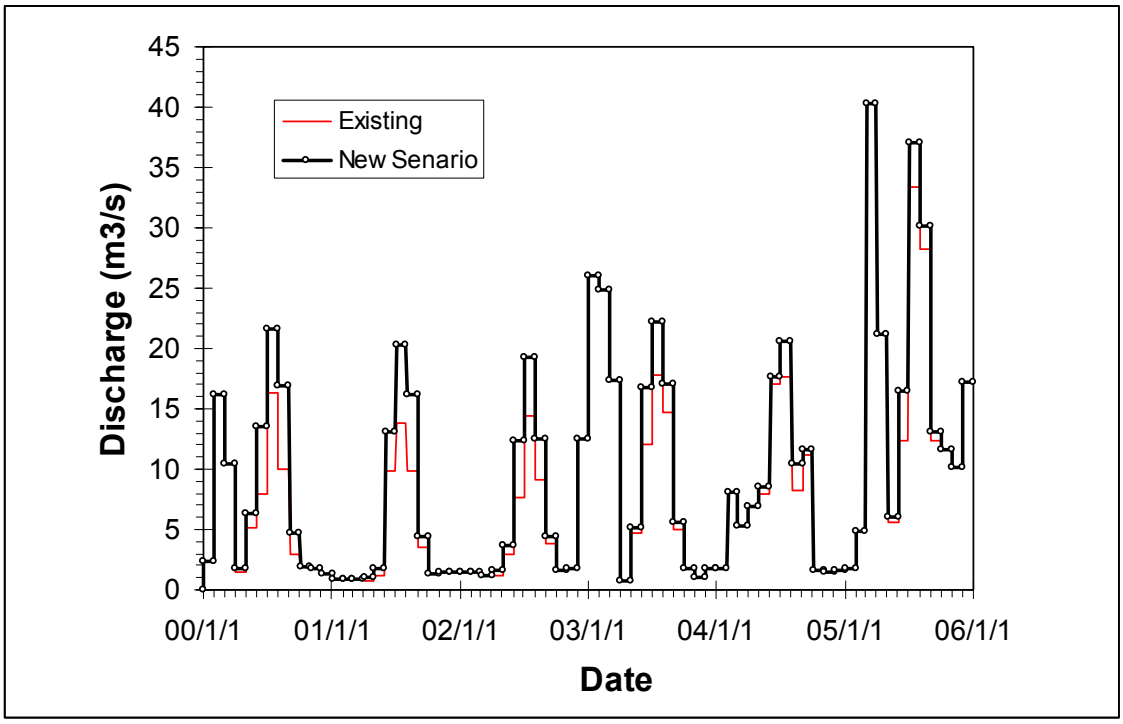
In Tundzha river basin, huge amount of water is transferred to Maritsa river basin. Also, abstraction of water for irrigation at downstream of Zhrebcevo reservoir also gives significant impact on river environment.
To improve this situation, the following scenario is examined.

Scenario:
The water transferred to Maritsa river basin from Zhrebcehvo reservoir supposes to be used for irrigation purpose in Nova Zagora area. However, if there is no need to use so much water in Nova Zagora area, such water can be used for other purposes. For example, if more water is used for HPP in Zhrebchevo reservoir, the water can be introduced to Tundzha river after HPP. This may give benefit for both energy production and river environment.
So, let's simulate the condition if the amount of water transferred to Maritsa river basin from Zhrebchevo reservoir is zero and the existing transferred water amount is introduced to Tundzha river.

In this case, you have to change input files.
Use the following files instead of the files which set for the simulation for the existing condition.
In all of the new files, water amount is set based on the above-mentioned scenario.

As for model setting, please refer "Draft MIKE11 Water Quantity Model Setting for EABD &WABD Rivers".

No	Type	Description	File Name for existing condition	File Name for new case
8	Regulating Structure	Instream flow to DS River from Zhrebchevo Res.	Zhrebchevo_Out_Instream.dfs0	Zhrebchevo_Out_Instream_C1.dfs0
9	Inflow	Off stream flow from Zhrebchevo Res.	Zhrebchevo_Out_Offstream.dfs0	Zhrebchevo_Out_Offstream_C1.dfs0



Instream Flow from Zhrebchevo reservoir

Exercise -2 Mesta River Effect of Feeder channels

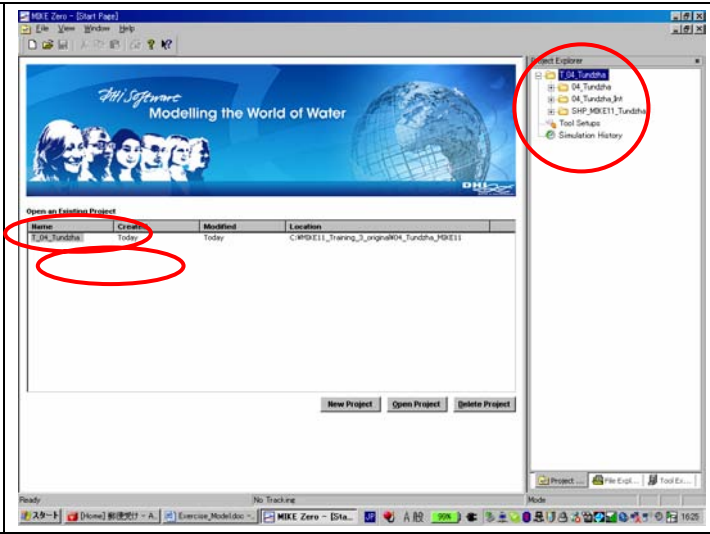
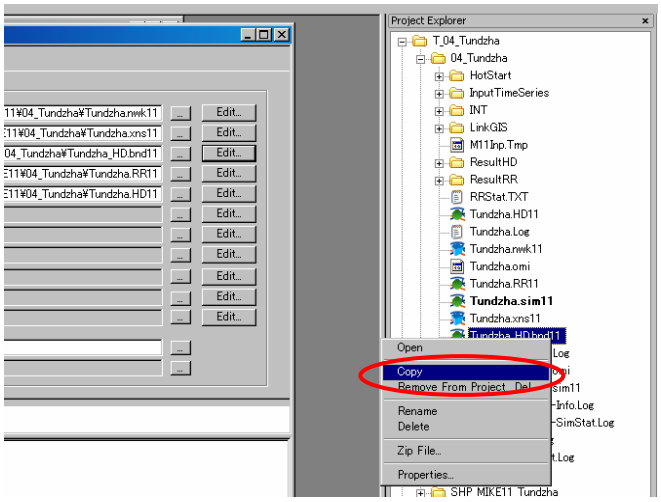
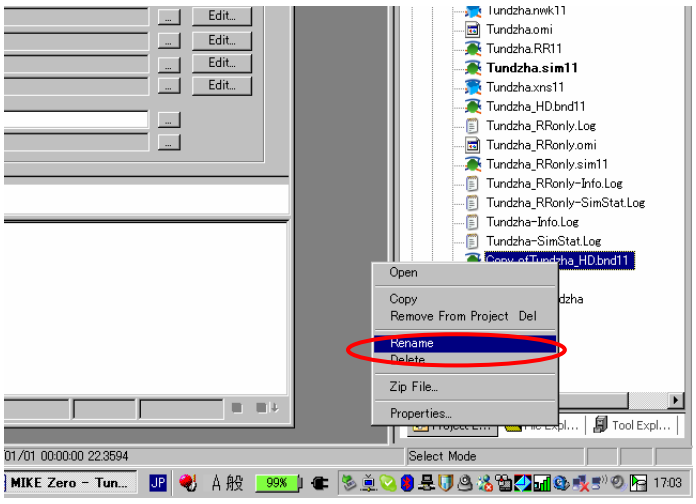
In Mesta river basin, there are many feeder channels to transfer water to other river basins.
If there are no those feeder channels, what would happen in Mesta river?
Let's simulate the condition without the feeder channels.

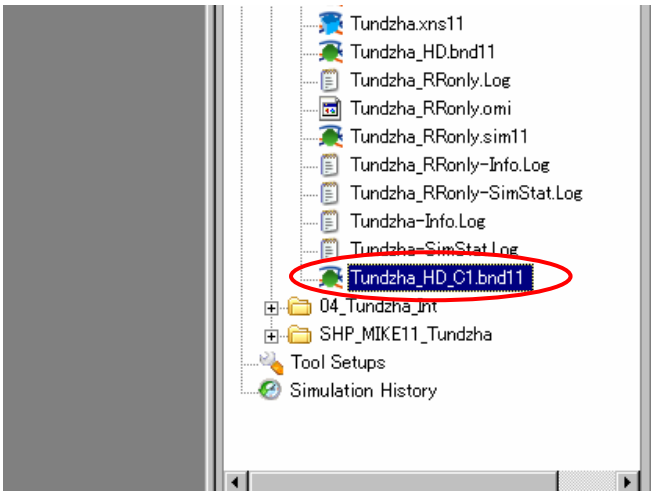
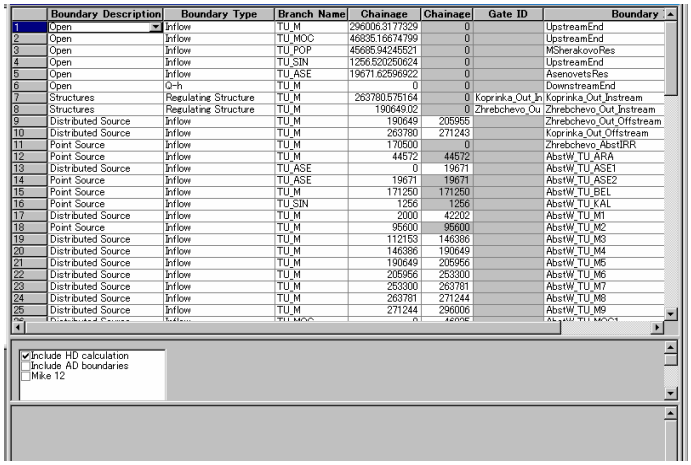
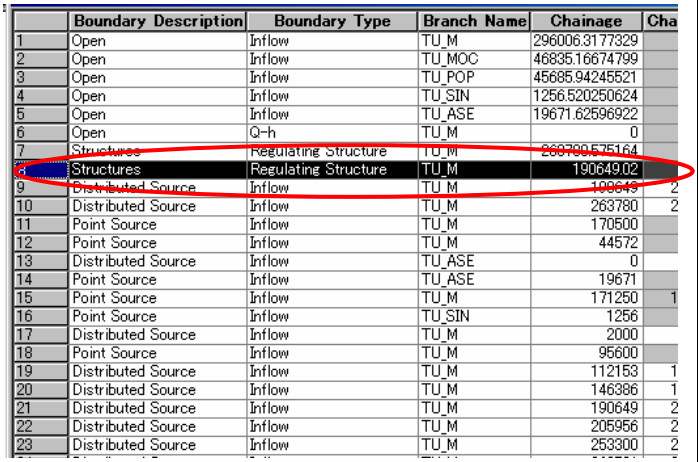
In this case, you have to change input files.
Use the following files instead of the files which set for the simulation for the existing condition.
In all of the new files, abstracted water amount is set to zero.

As for model setting, please refer "Draft MIKE11 Water Quantity Model Setting for EABD &WABD Rivers".

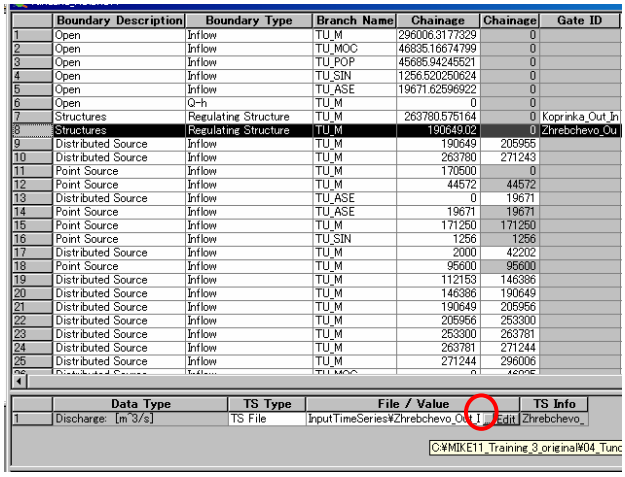
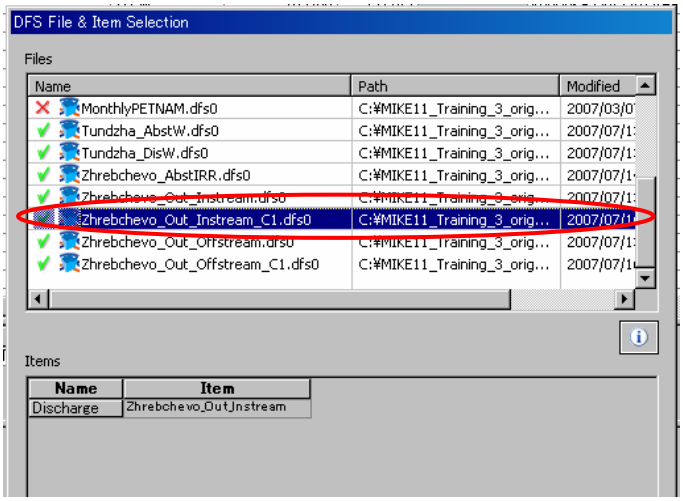
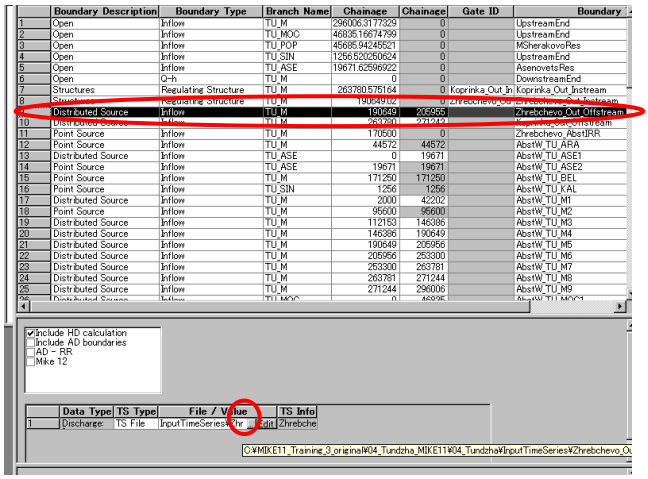
No	Type	Description	File Name for existing condition	File Name for new case
6	Inflow	Abstracted Water by feeder channel in ME_M6	Mesta_Trans_ME_M6.dfs0	Mesta_Trans_ME_M6_C1.dfs0
7	Inflow	Abstracted Water by feeder channel in ME_M5	Mesta_Trans_ME_M5.dfs0	Mesta_Trans_ME_M5_C1.dfs0
8	Inflow	Abstracted Water by feeder channel in ME_KAN	Mesta_Trans_ME_KAN.dfs0	Mesta_Trans_ME_KAN_C1.dfs0
9	Inflow	Abstracted Water by feeder channel in ME_M1	Mesta_Trans_ME_M1.dfs0	Mesta_Trans_ME_M1_C1.dfs0

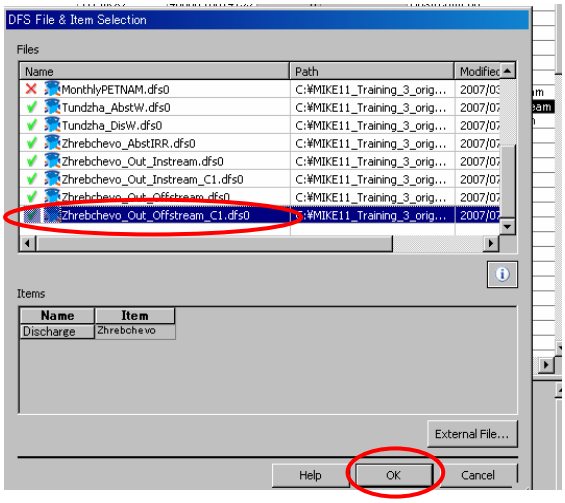
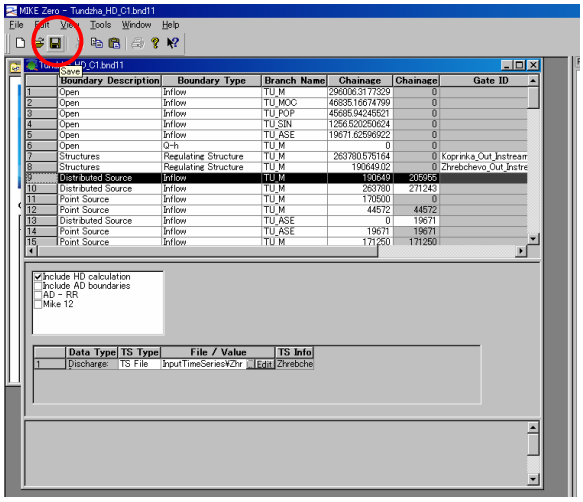
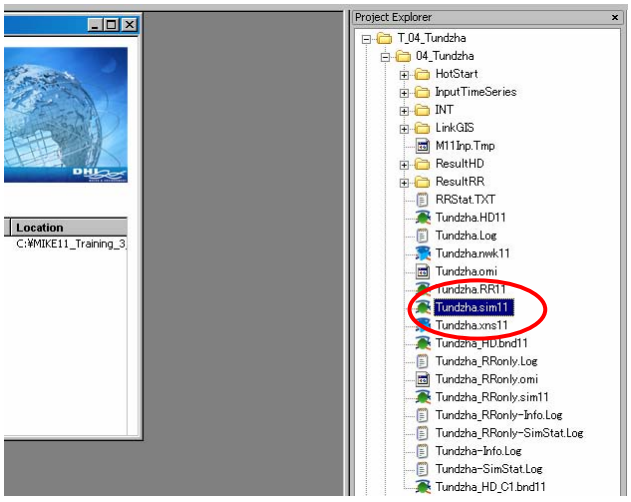
Step by step procedure is shown for the case on Tundzha river basin. Procedure for the case on Mesta river basin is basically same.

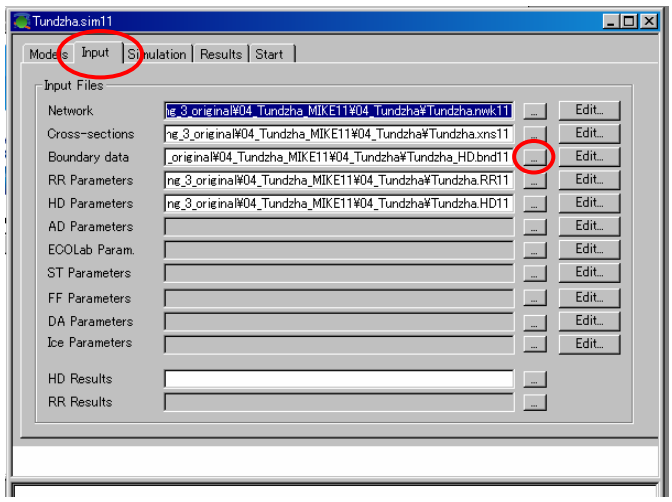
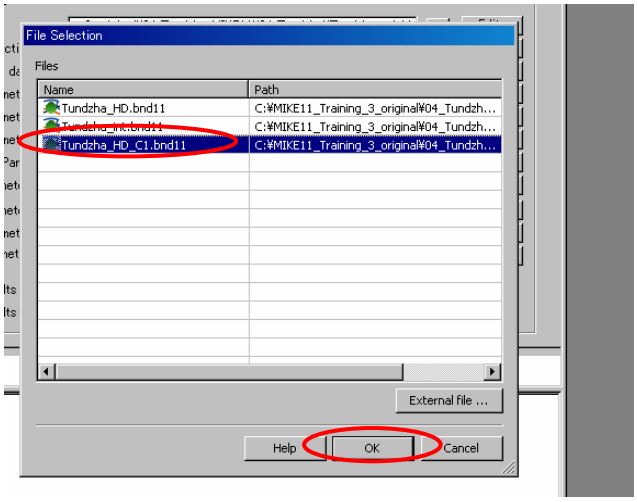
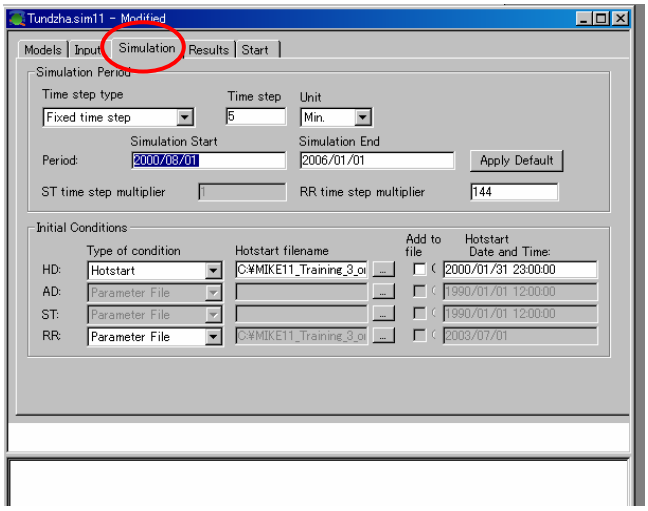
Open project”T_04_Tundzha”	
Place cursor on “Tundzha_HD.bnd11”, then right click. Select “Copy”.	
Place cursor on “Copy of Tundzha_HD.bnd11”, then right click. Select “Rename”. Rename “Copy of Tundzha_HD.bnd11” To “ Tundzha_HD_C1.bnd11”	

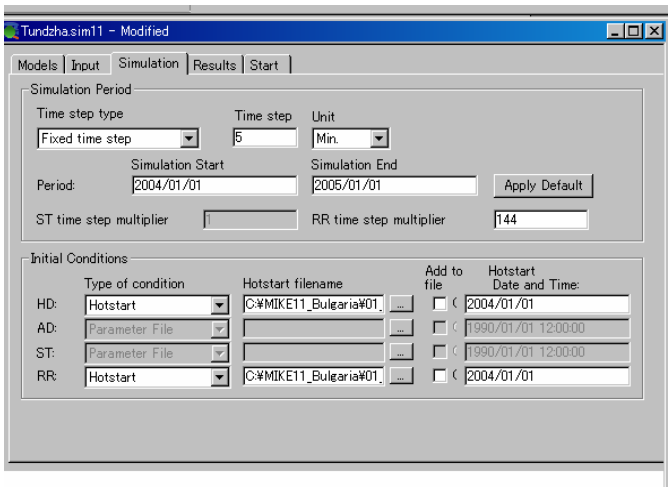
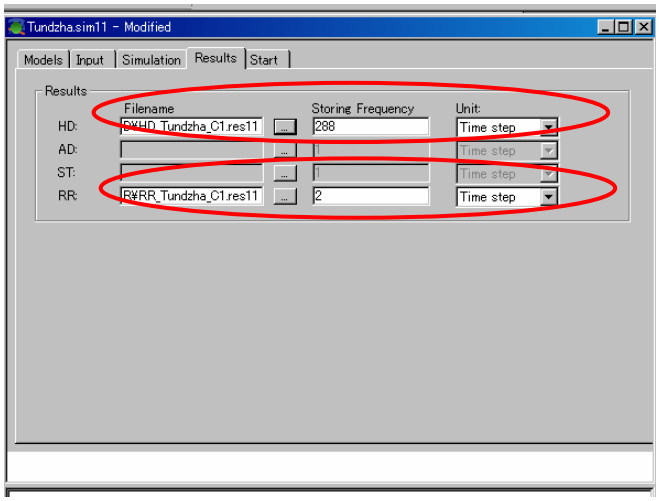
Open “ Tundzha_HD_C1.bnd11”	
“Boundary editor” appears.	
Select “Boundary Item:8”.	

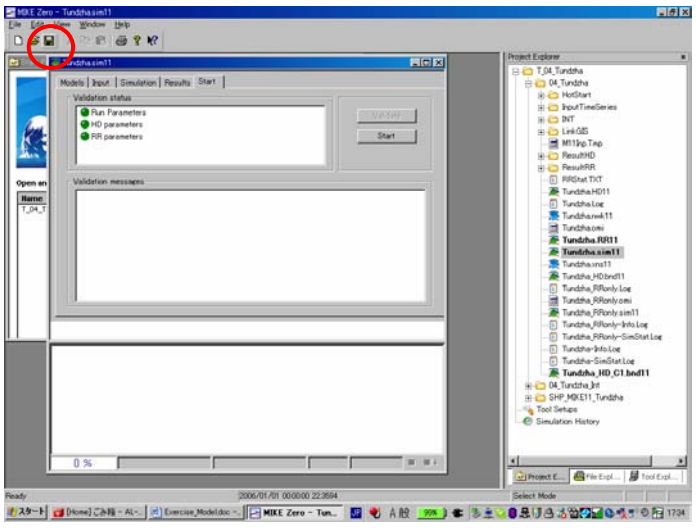
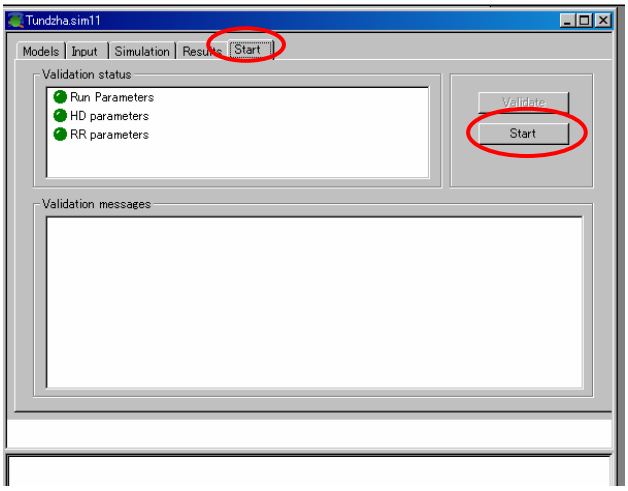
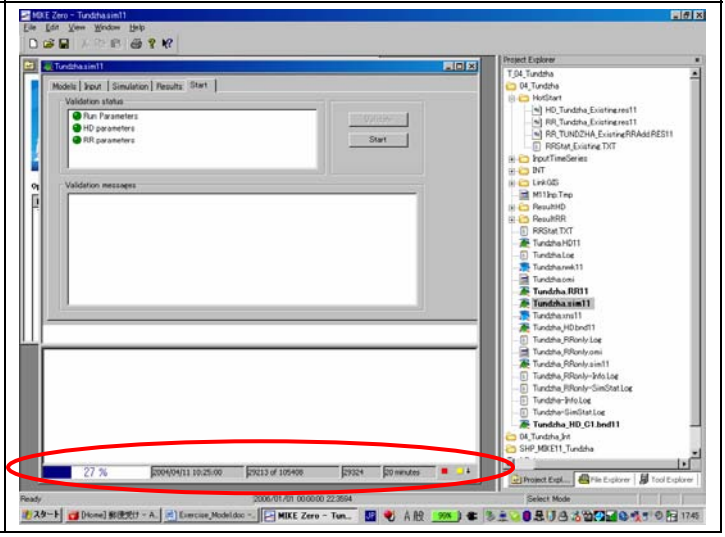
	Boundary Description	Boundary Type	Branch Name	Chainage	Cha
1	Open	Inflow	TU_M	296006.3177329	
2	Open	Inflow	TU_MOC	46835.16674799	
3	Open	Inflow	TU_POP	45685.94245521	
4	Open	Inflow	TU_SIN	1256.520250624	
5	Open	Inflow	TU_ASE	19671.62596922	
6	Open	Q-h	TU_M	0	
7	Structures	Regulating Structure	TU_M	263780.575164	
8	Structures	Regulating Structure	TU_M	190649.02	
9	Distributed Source	Inflow	TU_M	190649	2
10	Distributed Source	Inflow	TU_M	263780	2
11	Point Source	Inflow	TU_M	170500	
12	Point Source	Inflow	TU_M	44572	
13	Distributed Source	Inflow	TU_ASE	0	
14	Point Source	Inflow	TU_ASE	19671	
15	Point Source	Inflow	TU_M	171250	1
16	Point Source	Inflow	TU_SIN	1256	
17	Distributed Source	Inflow	TU_M	2000	
18	Point Source	Inflow	TU_M	95600	
19	Distributed Source	Inflow	TU_M	112153	1
20	Distributed Source	Inflow	TU_M	146386	1
21	Distributed Source	Inflow	TU_M	190649	2
22	Distributed Source	Inflow	TU_M	205956	2
23	Distributed Source	Inflow	TU_M	253300	2

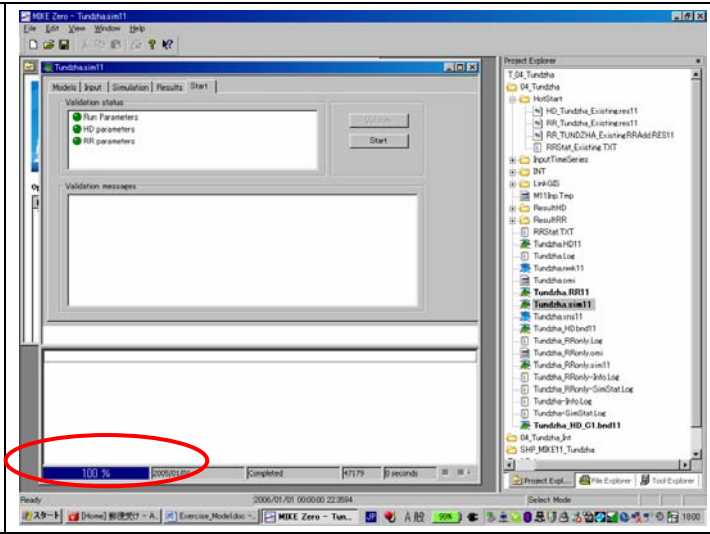
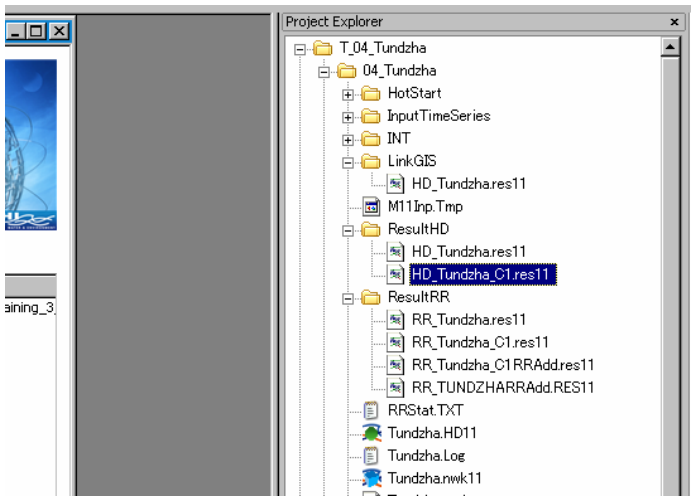
Click “…” for File / Value	
In dialog ”DFS File & Item Selection”, select “Zhrebchevo_Out_Instream_C1. dfs0” Click “OK”.	
Select “Boundary Item:9”. Click “…” for File / Value	

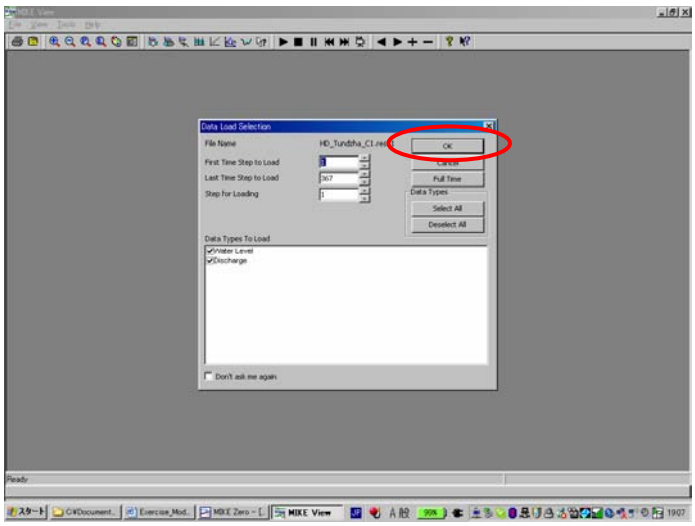
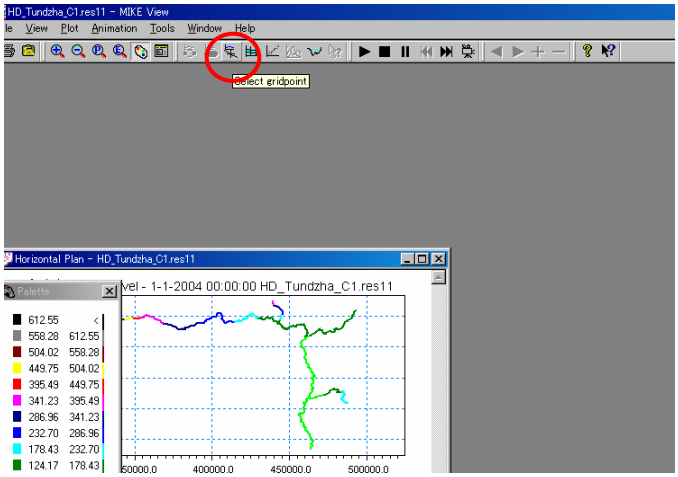
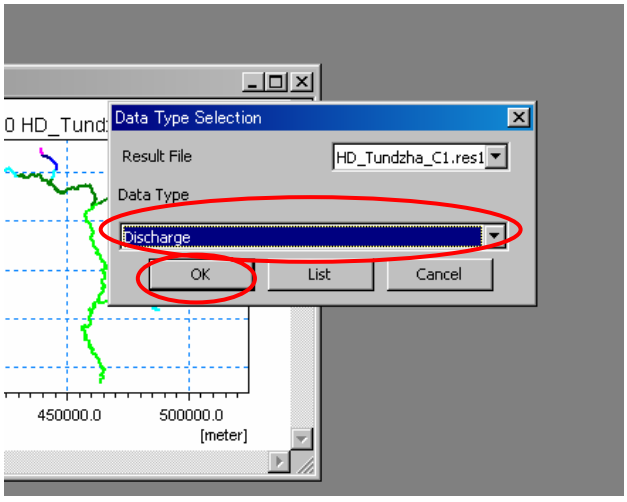
In dialog ”DFS File & Item Selection”, select “Zhrebchevo_Out_Offstream_C1.dfs0” Click “OK”.	
Save .bnd11 file	
Open “Tundzha.sim11”	

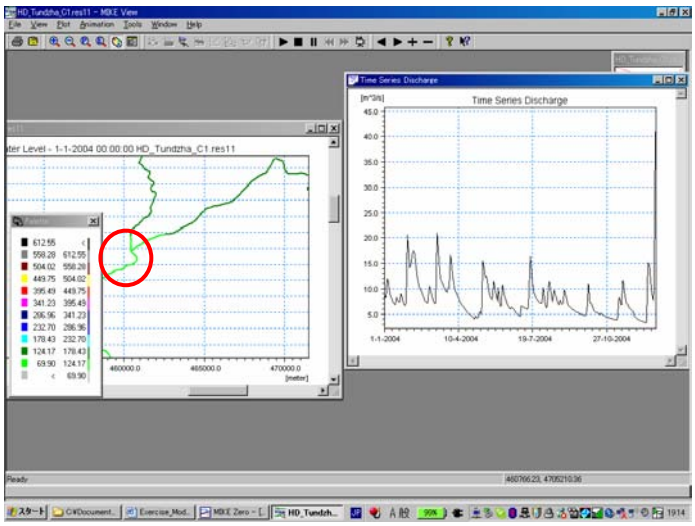
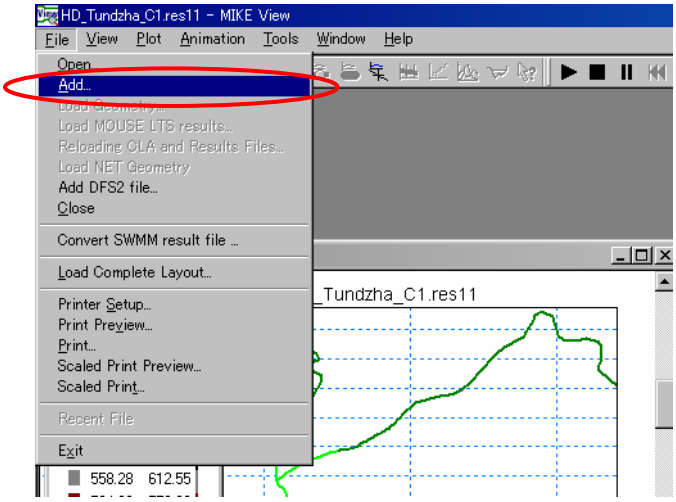
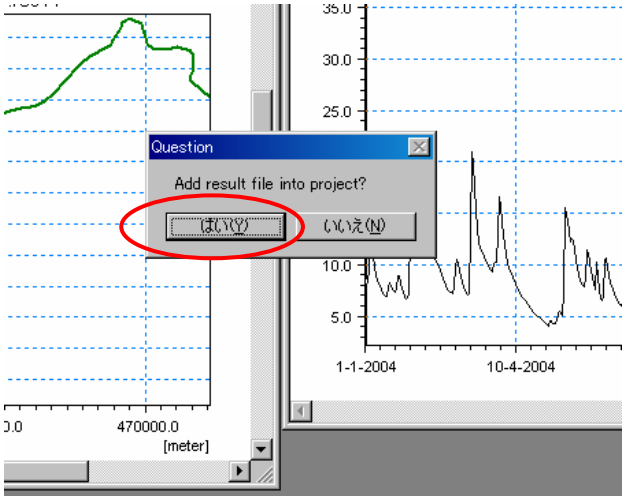
Select tab ”Input”. Click “…” for boundary data.	
Select “Tundzha_HD_C1.bnd11” Click “OK”	
Select tab ”Simulation”.	

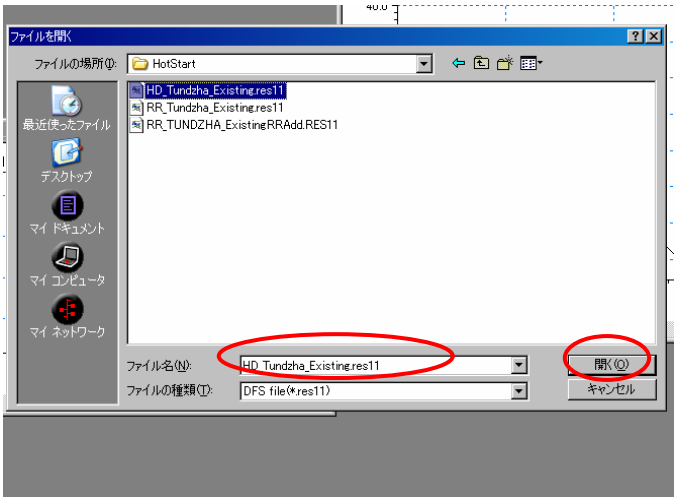
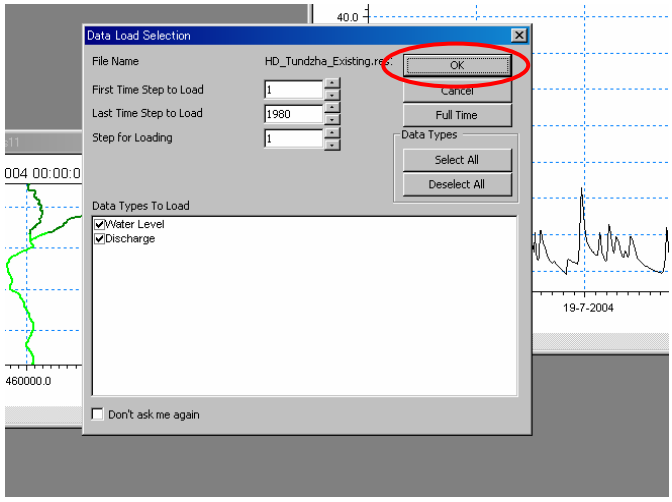
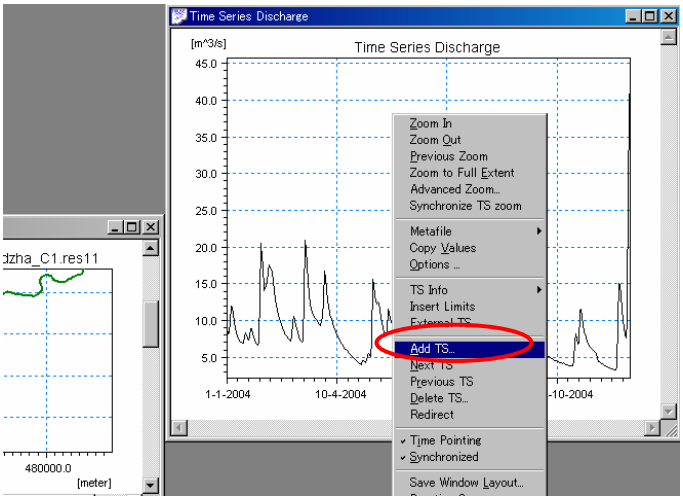
Set Simulation period Start : 2004/01/01 End: 2005/01/01 Set Initial Conditions as follows. HD: “Hotstart” Filename: “/04_Tundzha/Hotstart/HD_Tundzha_Existing.res11” Date and Time: “2004/01/01” RR: “Hotstart” Filename: “/04_Tundzha/Hotstart/RR_Tundzha_Existing.res11” Date and Time: “2004/01/01”	
Select tab “Results”. Set Results filename etc. as follows. For HD Filename: “/04_Tundzha/ResultHD/HD_Tundzha_C1.res11” Storing Frequency and Unit “288” and “time step” For RR Filename: “/04_Tundzha/ResultRR/RR_Tundzha_C1.res11” Storing Frequency and Unit “2” and “time step”	

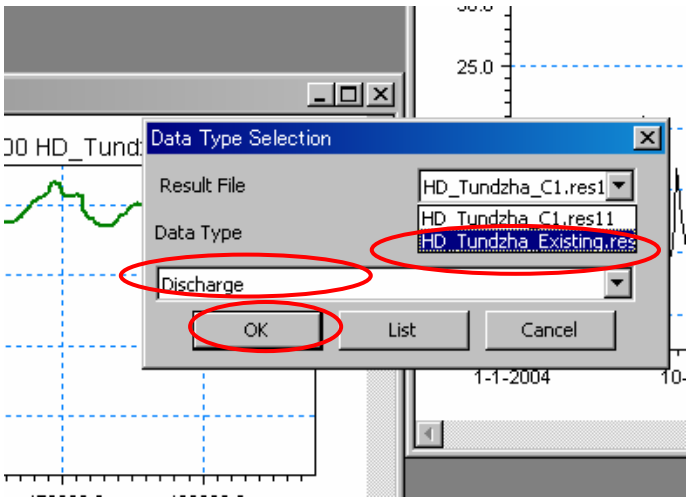
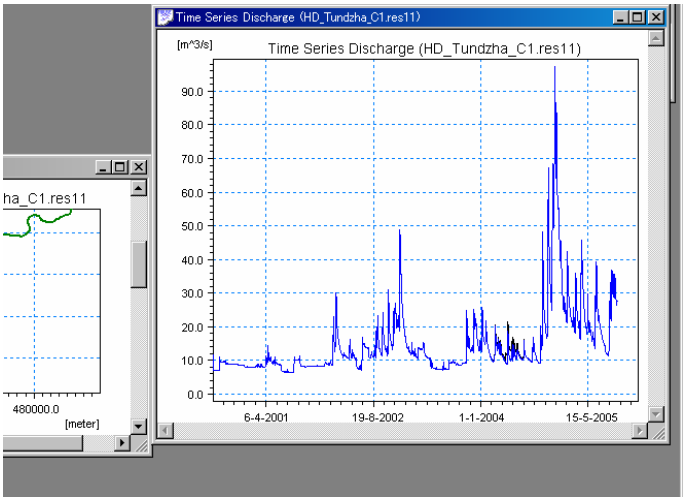
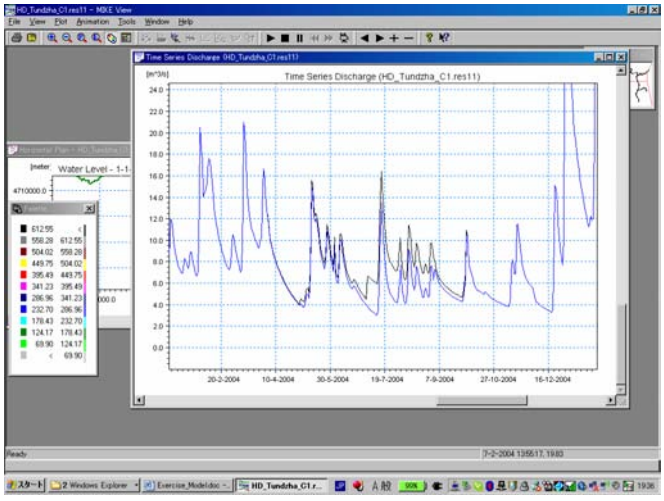
Save .sim11 file.	
Select tab “Start”. Click “Start”.	
On the bottom of simulation editor, you can check the progress of the simulation.	

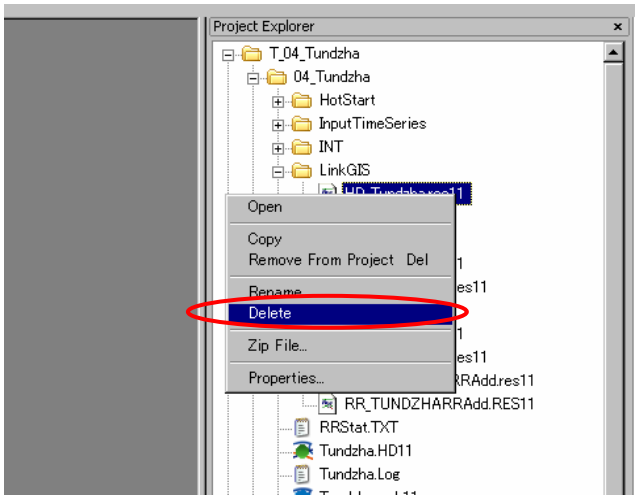
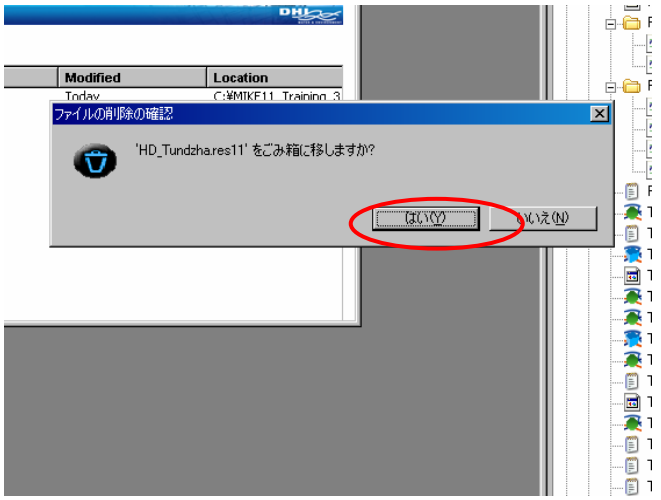
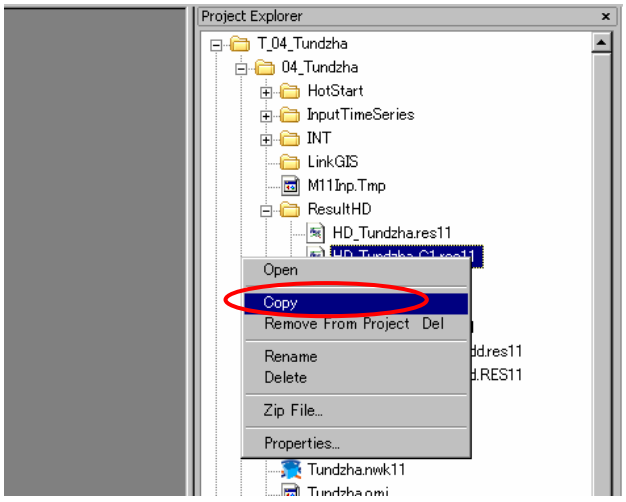
When “100%” appears, the simulation is completed.	
In folder ResultHD, there should be “HD_Tundzha_C1.Res11” In folder ResultRR, there should be “RR_Tundzha_C1.Res11” and “RR_Tundzha_C1RRAdd.Res11”	

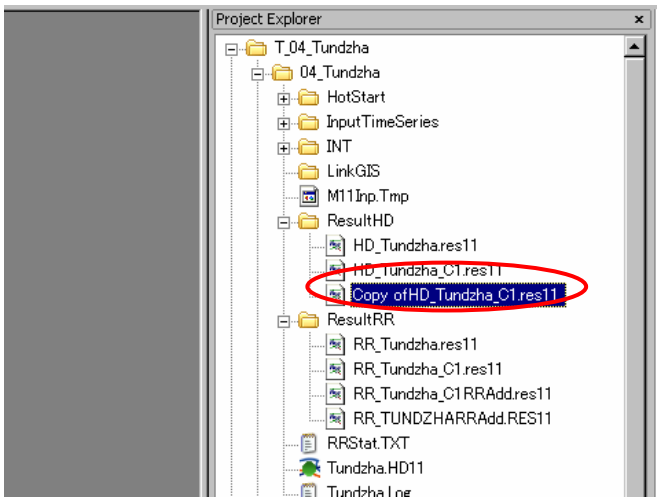
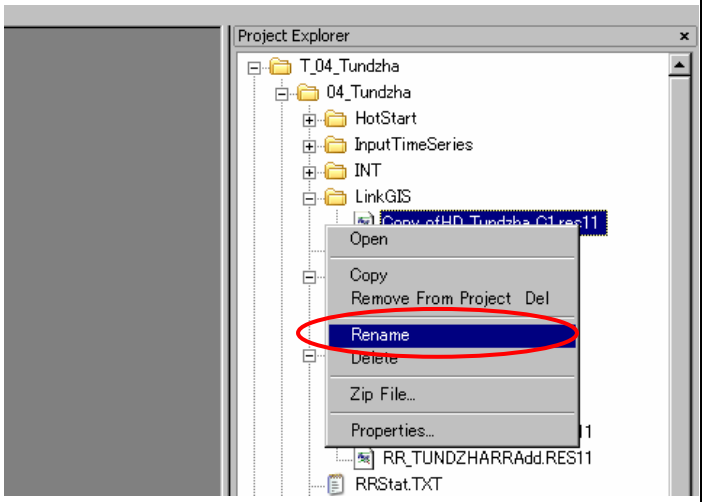
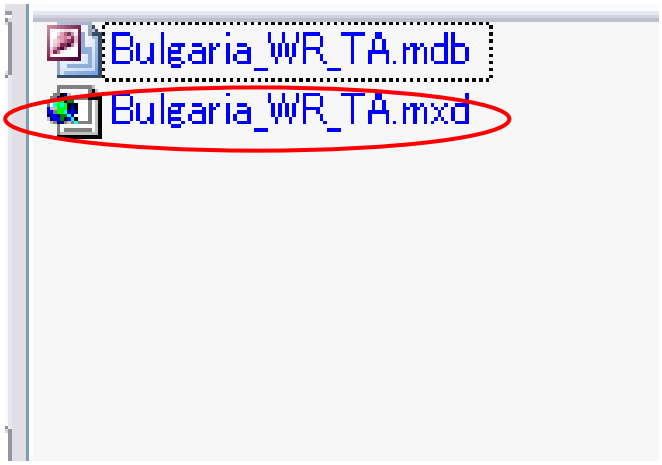
Checking the results by MIKE View Open MIKE View by double clicking “HD_Tundzha_C1.res11” Click ”OK”	
Click “Select grid point”	
Select “Discharge” for “Data Type“ field.	

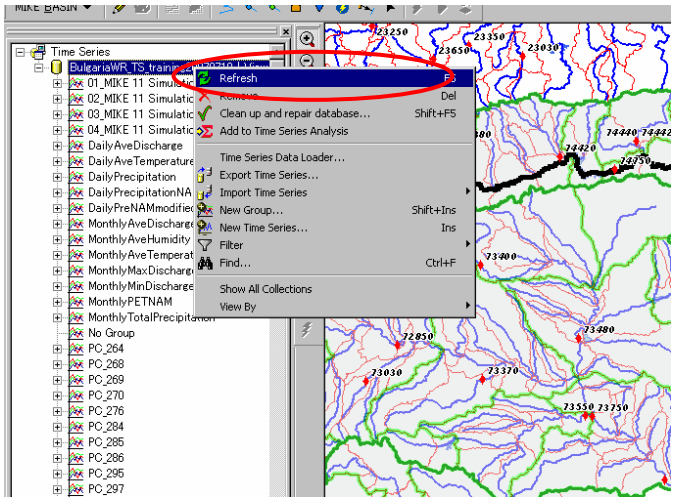
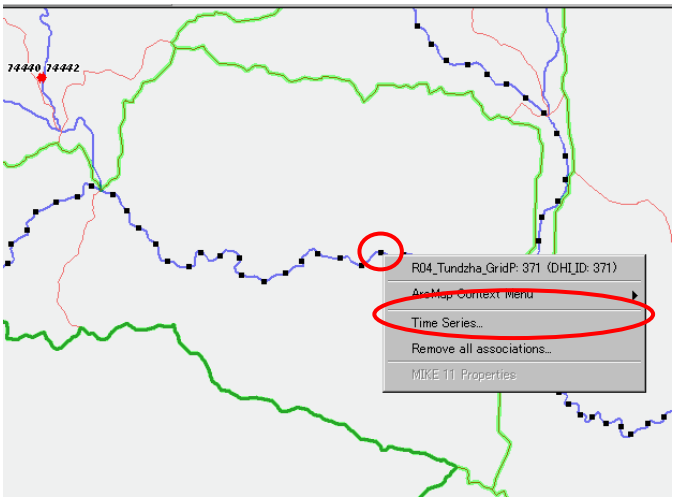
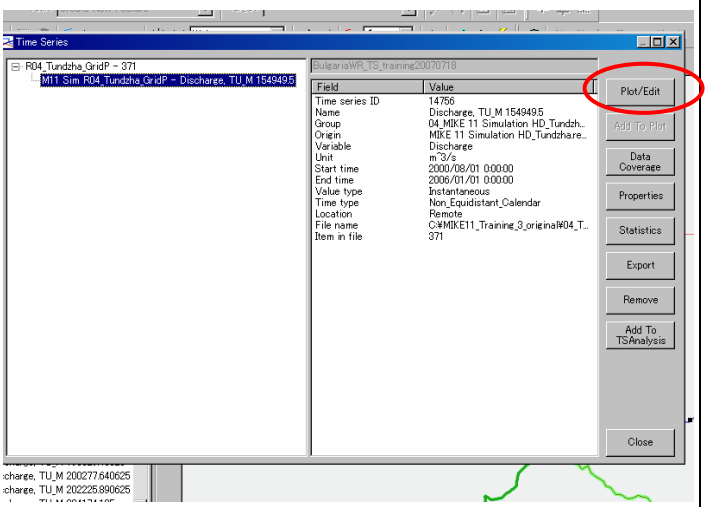
Place cursor near Yambol, and click there. You can see the time series plot for new scenario.	
File -> Add	
Click “OK”.	

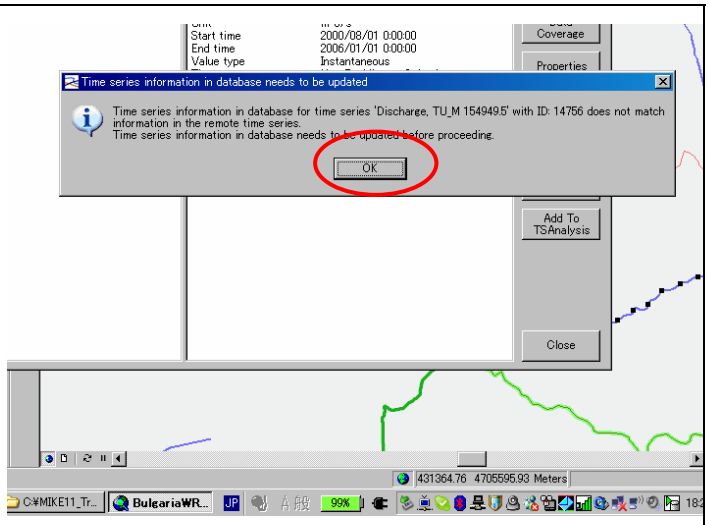
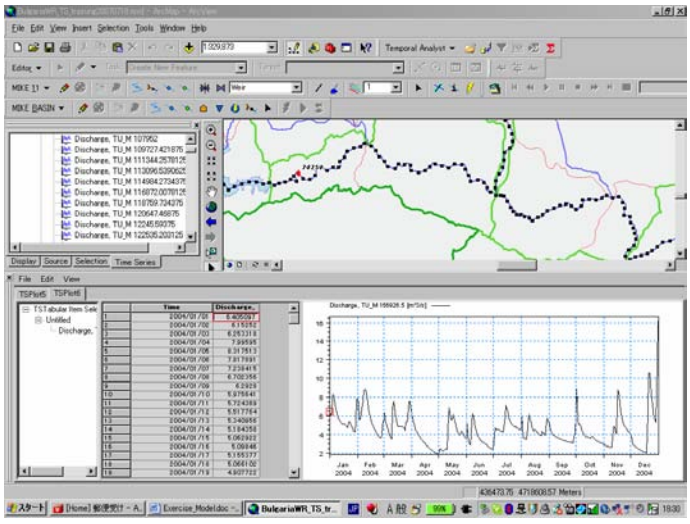
Select “04_Tundzha/Hotstart/HD_Tundzha_Existing.res11” Click “Open”	
Click “OK”	
Place cursor on “time series plot”, then right click. Small dialog appears. Select “Add TS”	

Select “HD_Tundzha_Existing.res11” In Result File field. Select “Discharge” in Data Type field. Click “OK”	
Place cursor near Yambol, and click there. You can see the time series plot for the existing condition too.	
Zoom in to year 2004. You can see the difference.	

Checking the results in Temporal Analyst Select "/04_Tundzha/LinkGIS/ HD_Tundzha.res11" Right click, and select "delete"	
Click "OK".	
Select "/04_Tundzha/ResultHD/ HD_Tundzha_C1.res11" Right click, and select "copy"	

Click “Copy of HD_Tundzha_C1.res11”, and move it to the folder “LinkGIS”.	
Rename “Copy of HD_Tundzha_C1.res11” To “HD_Tundzha” Now, you can link this new file to Temporal Analyst	
Open “Bulgaria_WR.mxd”	

After starting the ArcGIS Project, select tab"TimeSereis". Refresh the time series data.	
Right click a point object for grid points for MIKE11 calculation. Select "Timeseries"	
Click "Plot/ Edit".	

Warning appears, because Time series connection is not updated. Click “OK”. Timeseries connection will be updated.	
You can see the time series plot.	
Try statistical analysis.	

End of Exercise