RIVER FLOW SUSTAINABILITY DUE TO CLIMATE CHANGE IMPACTS ON SNOW COVERING IN MEDITERRANEAN RIVER CATCHMENTS

By

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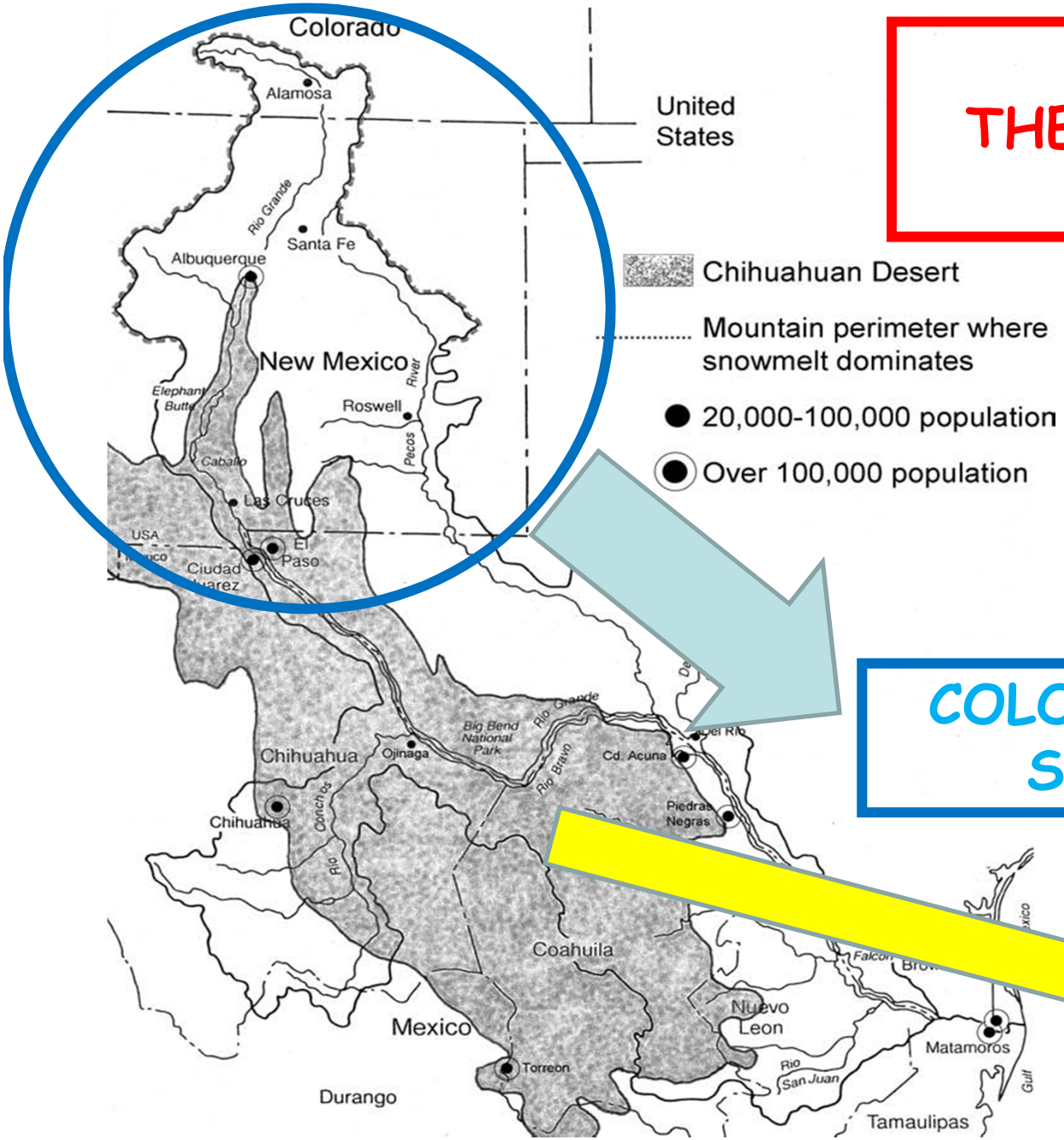
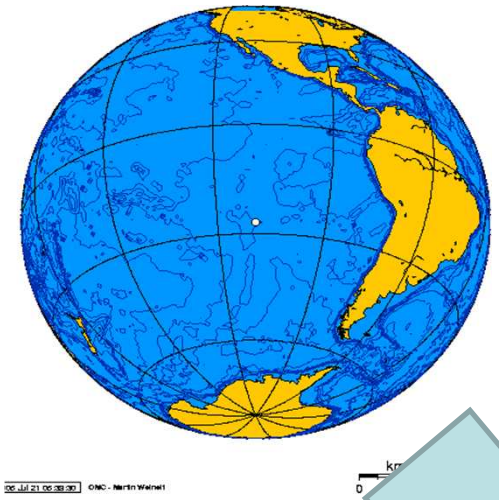
http:// www.inweb.gr

A GOOD EXAMPLE
THE RIO GRANDE BASIN
US-MEXICO

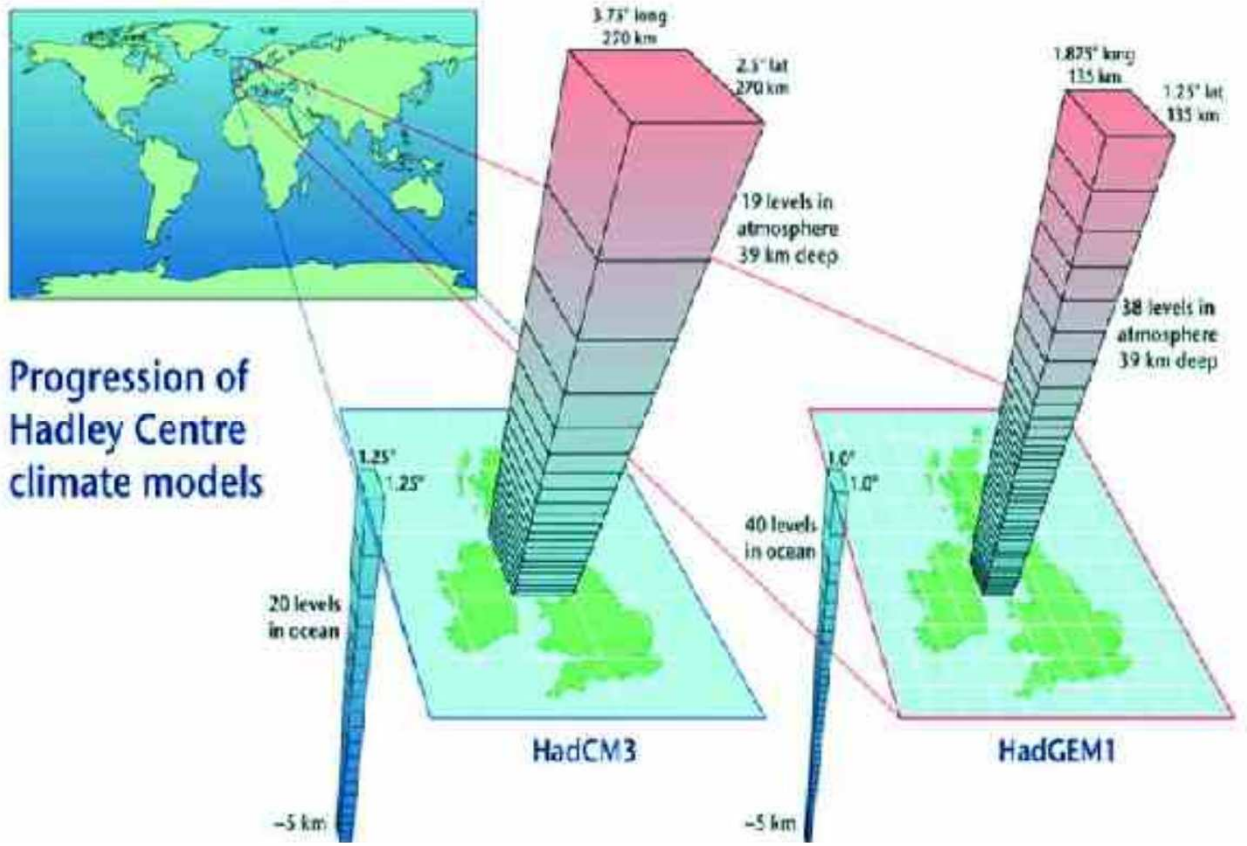


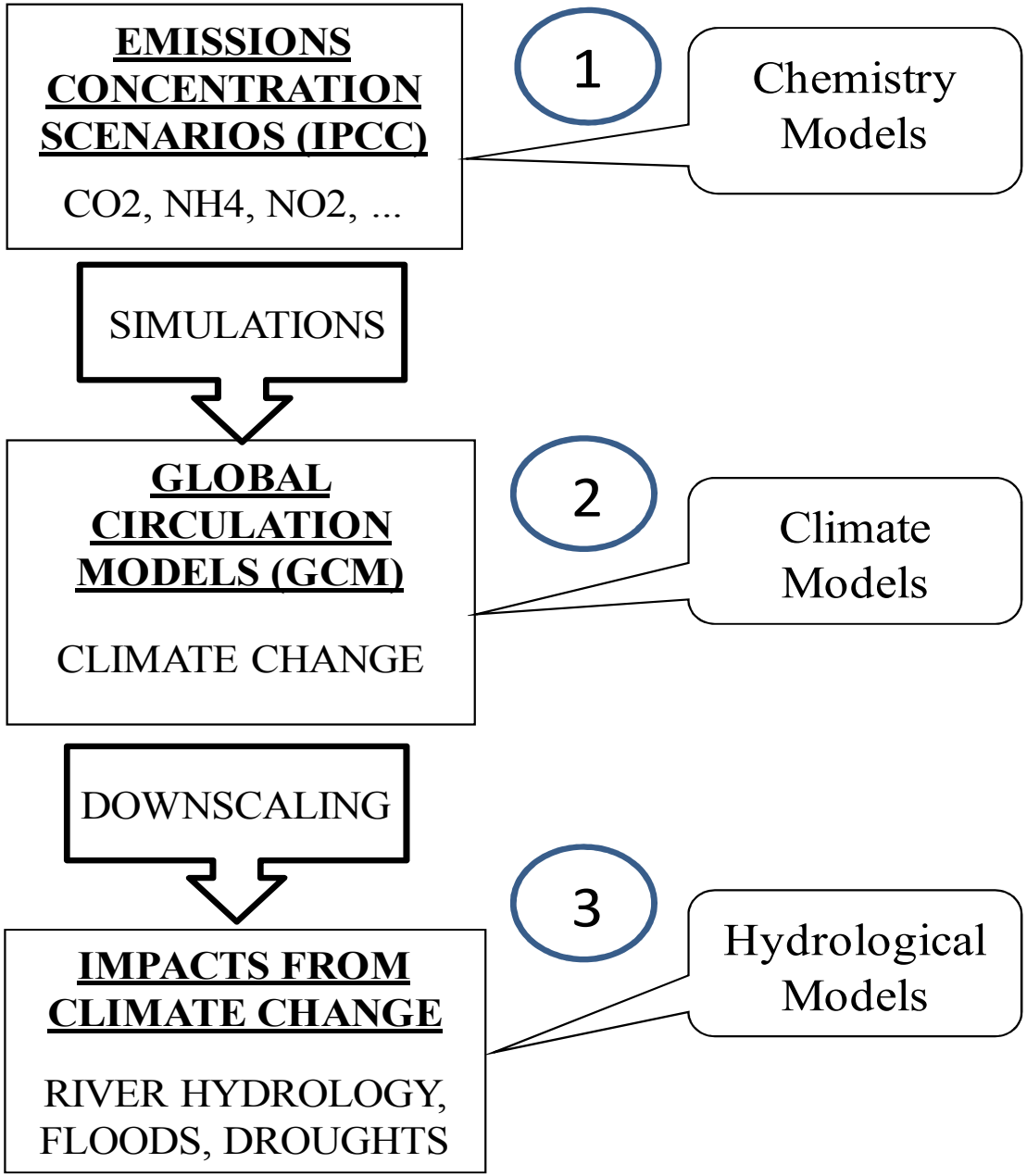
COLORADO/NEW MEXICO SNOWPACK AREAS

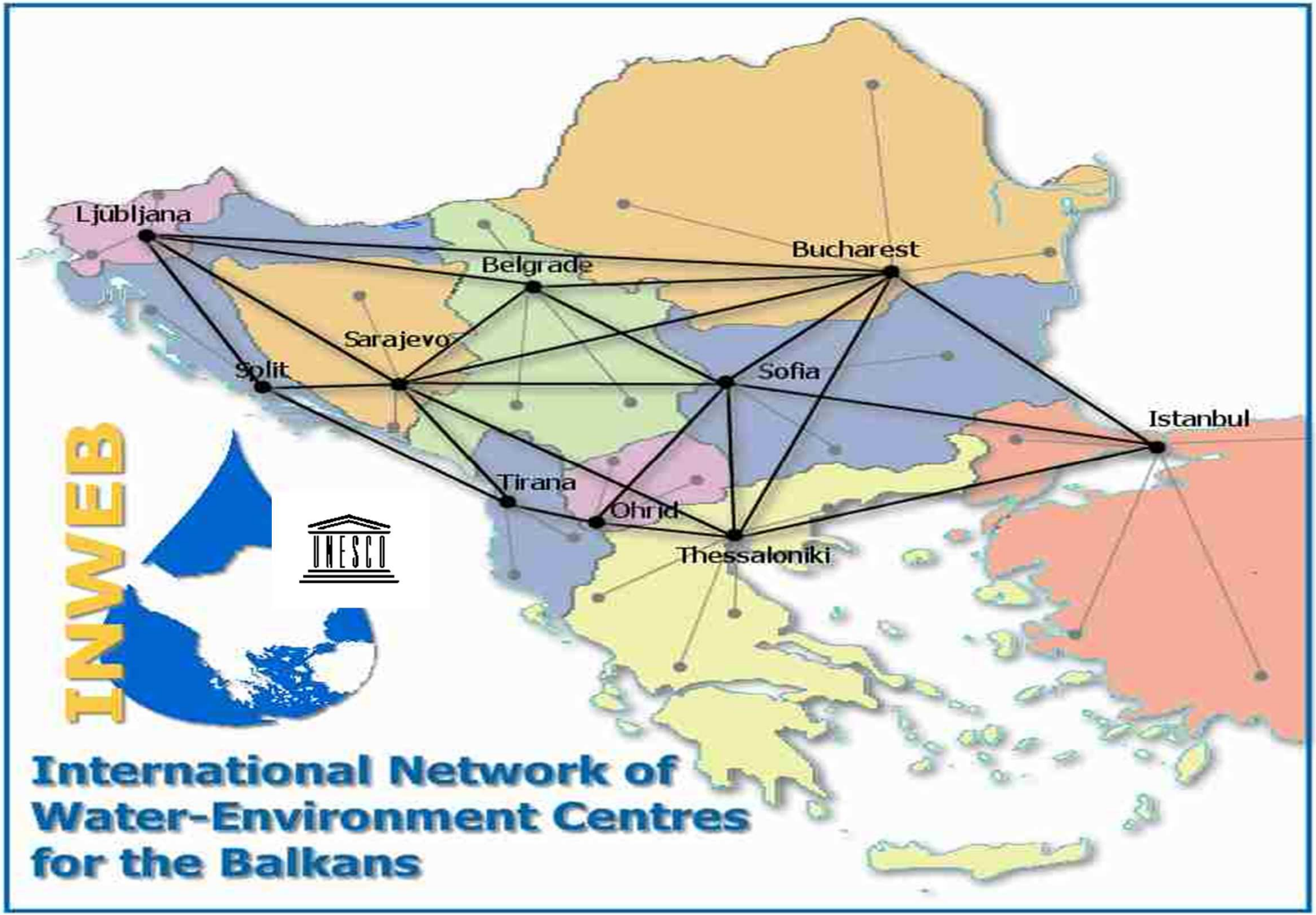
DESERT

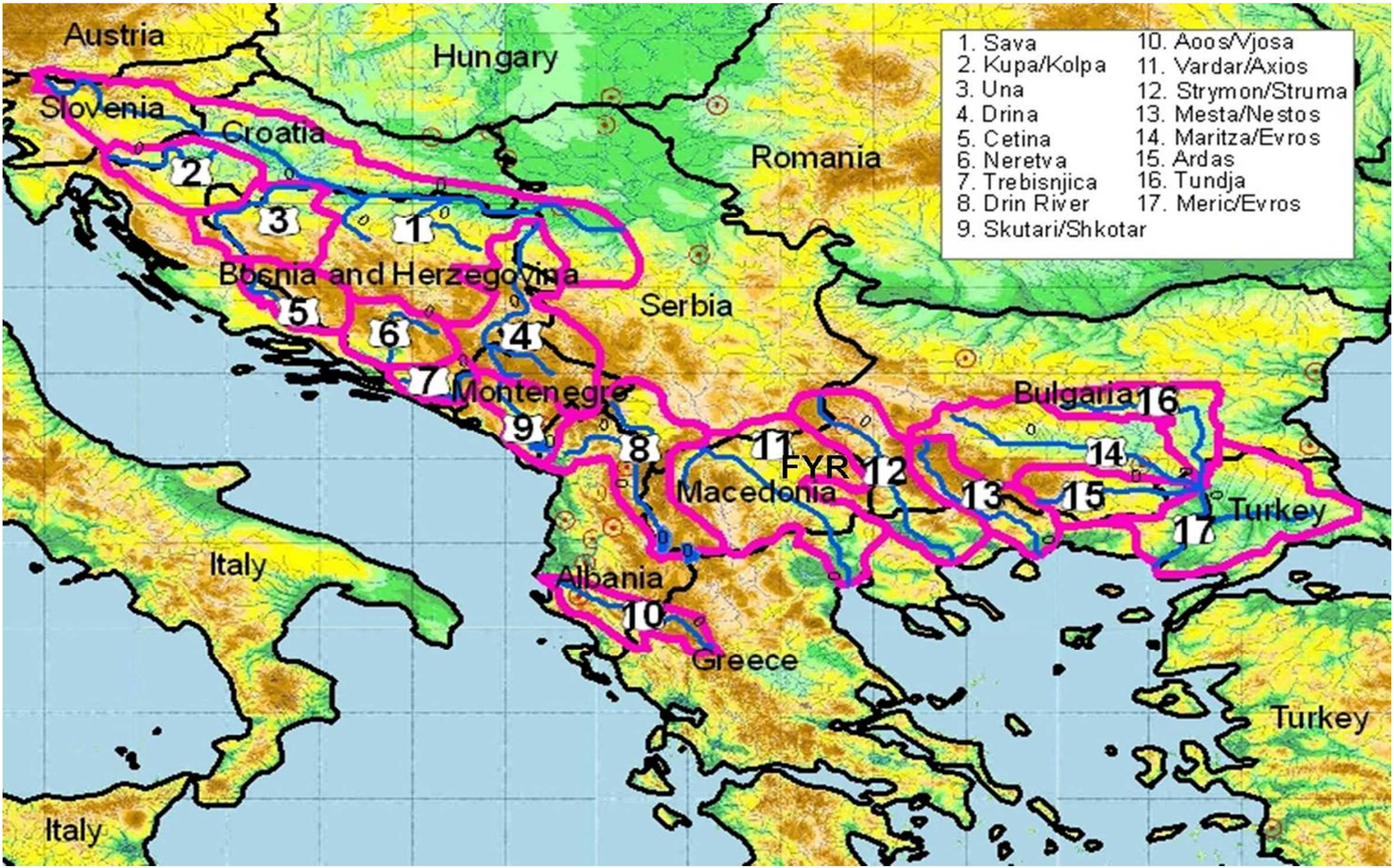


DOWNSCALING:
GCM(200-500 Km)
LCM(1-5 Km)
HYDROLOGICAL (100-500m)



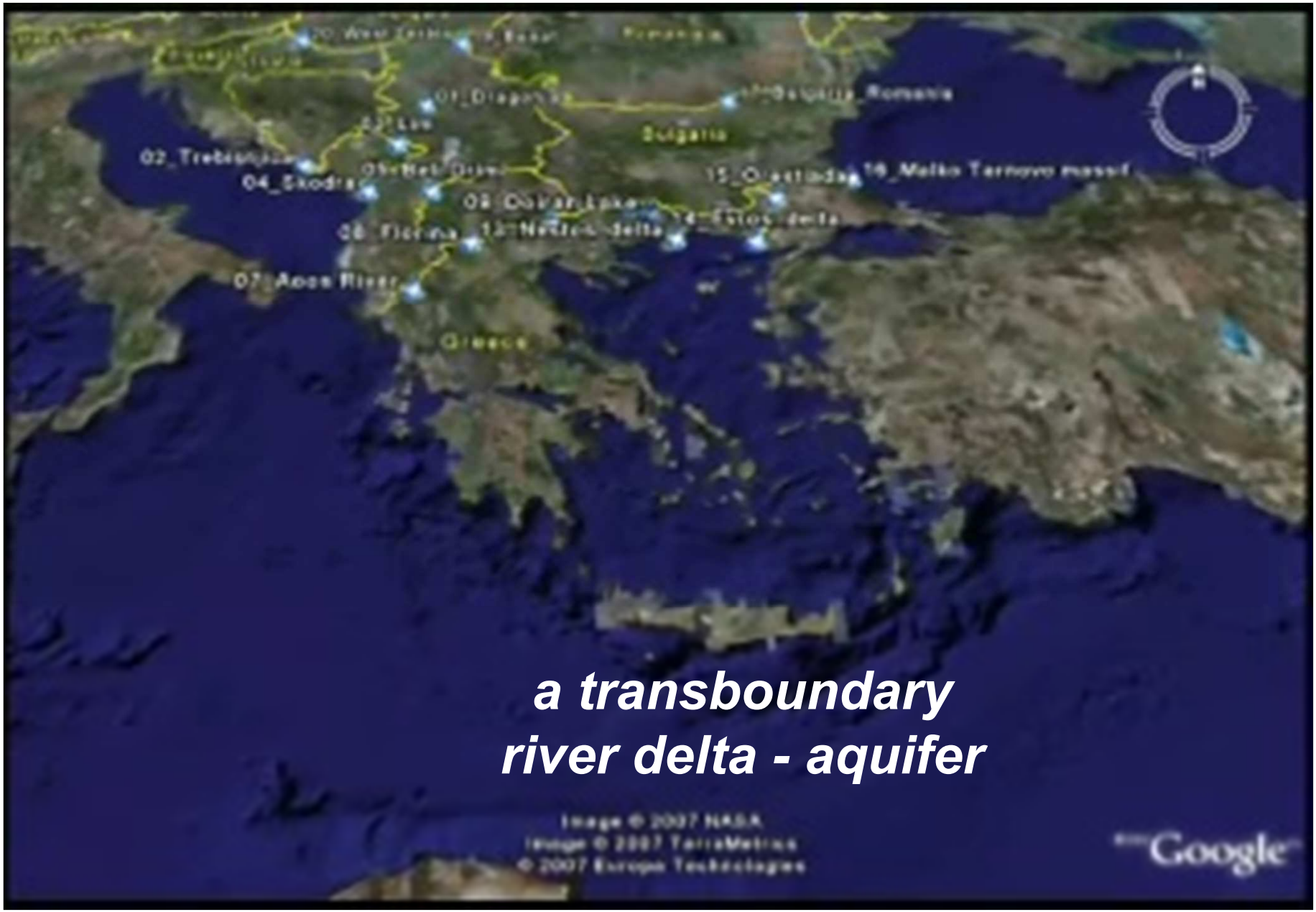

EMISSIONS CONCENTRATION SCENARIOS (IPCC)
CO2, NH4, NO2, ...
1
Chemistry Models
SIMULATIONS
GLOBAL CIRCULATION MODELS (GCM)
CLIMATE CHANGE
2
Climate Models
DOWNSCALING
IMPACTS FROM CLIMATE CHANGE
RIVER HYDROLOGY, FLOODS, DROUGHTS
3
Hydrological Models


Ljubljana
Belgrade
Bucharest
Sarajevo
Split
Sofia
Istanbul
Tirana
Ohrid
Thessaloniki
INWEB
UNESCO
International Network of
Water-Environment Centres
for the Balkans

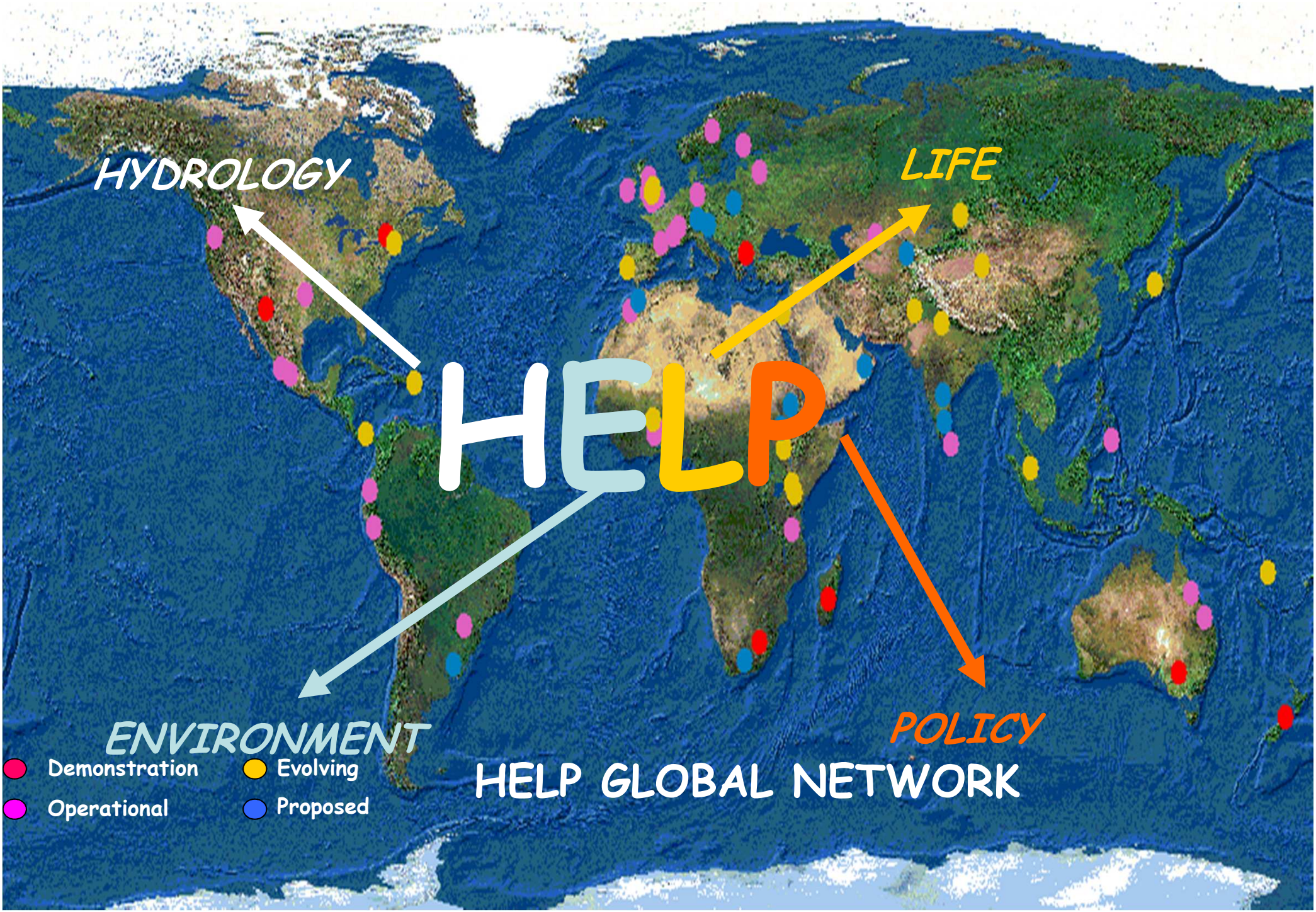

Austria
Hungary
Slovenia
Croatia
Romania
Bosnia and Herzegovina
Serbia
Montenegro
Bulgaria
FYR Macedonia
Albania
Greece
Turkey
Italy
Italy
1. Sava
2. Kupa/Kolpa
3. Una
4. Drina
5. Cetina
6. Neretva
7. Trebisnjica
8. Drin River
9. Skutari/Shkotar
10. Aoos/Vjosa
11. Vardar/Axios
12. Strymon/Struma
13. Mesta/Nestos
14. Maritza/Evros
15. Ardas
16. Tundja
17. Meric/Evros

A UNESCO-HELP CASE STUDY

a transboundary river - dam



a transboundary river delta - aquifer


HYDROLOGY
LIFE
HELP
ENVIRONMENT
POLICY
Demonstration
Evolving
Operational
Proposed
HELP GLOBAL NETWORK

From Potential Conflict

to Co-operation Potential

Water for Peace

a contribution to

World Water Assessment Programme

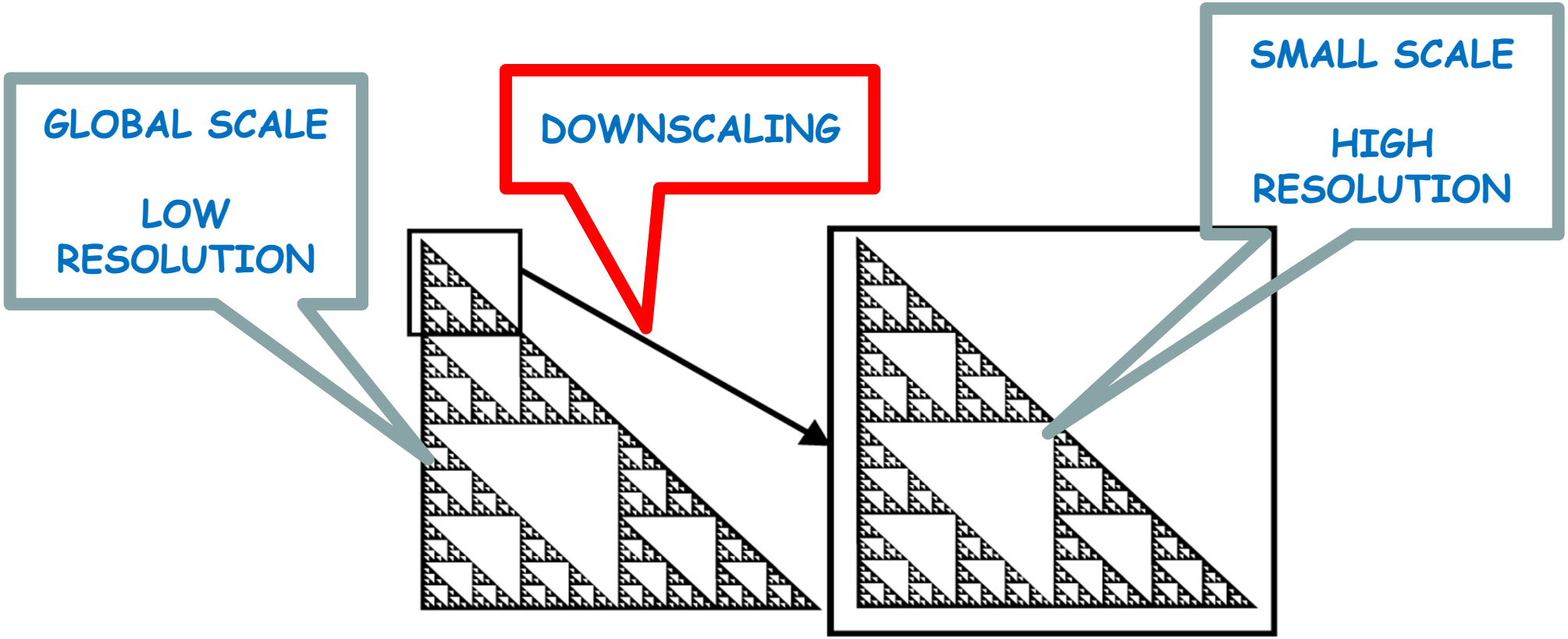
UNESCO

World Water Assessment Programme
www.unesco.org/water/wwap

GREEN CROSS International

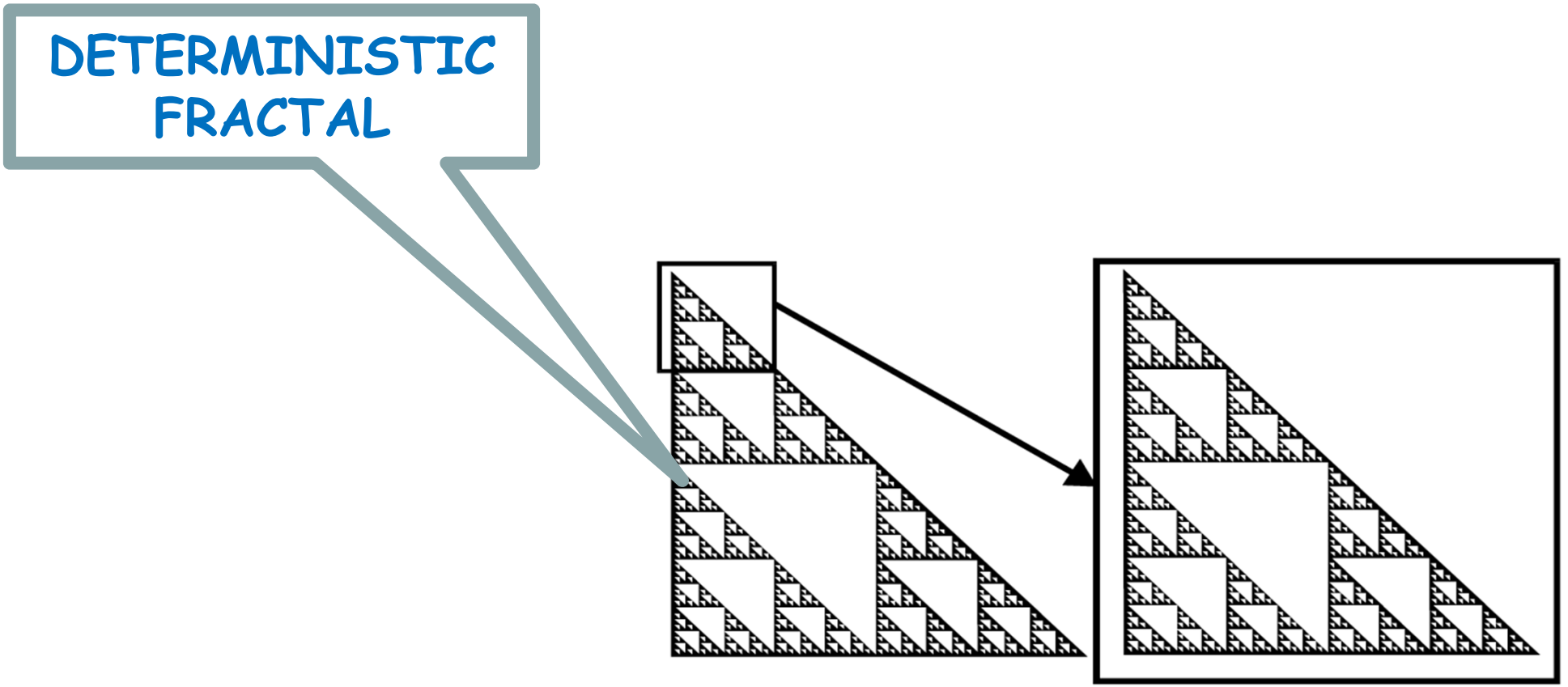
SCALING:

The value of a property/variable/equation
depends on the resolution/scale
at which it is considered



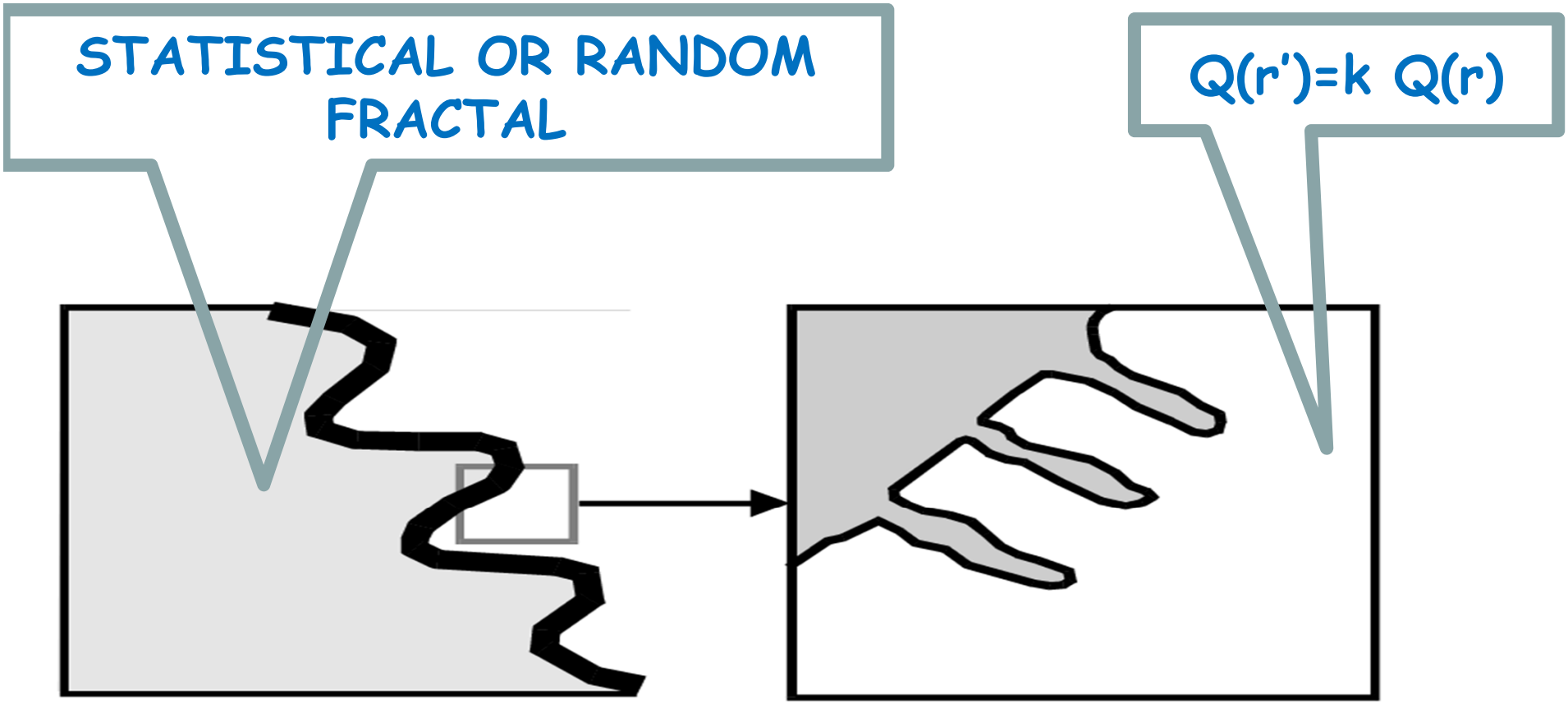
GEOMETRICAL SELF-SIMILARITY

A piece of an object is the exact copy of the whole object



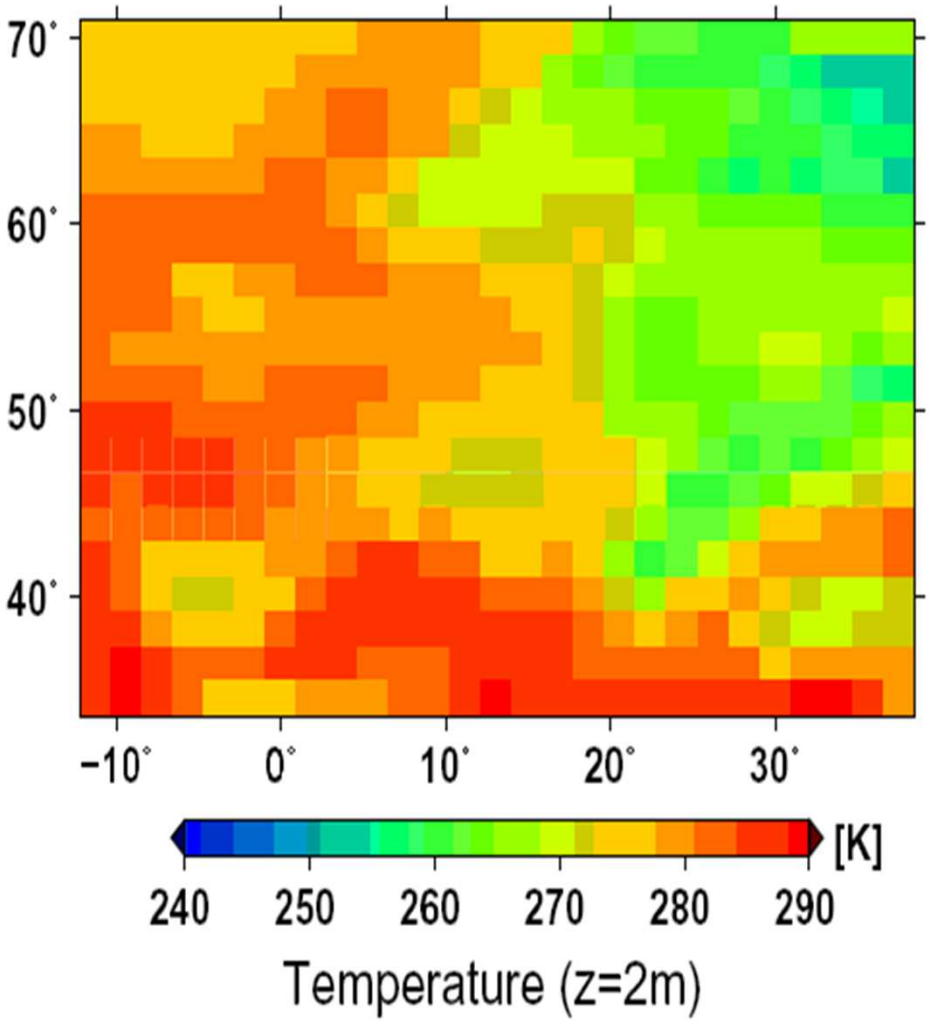
STATISTICAL SELF-SIMILARITY

The property Q(r) at resolution r is proportional to the value Q(r') at resolution r'

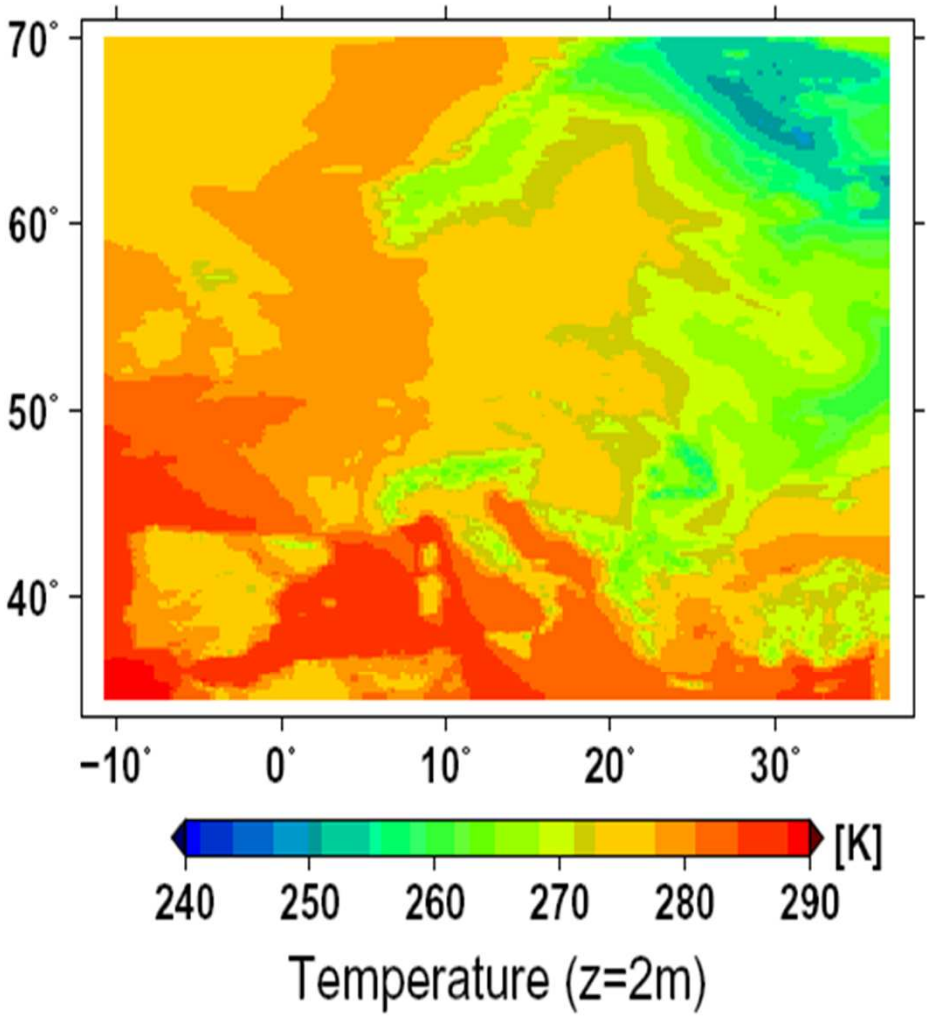


DYNAMIC DOWNSCALING

Results from ECHAM5/MPIOM

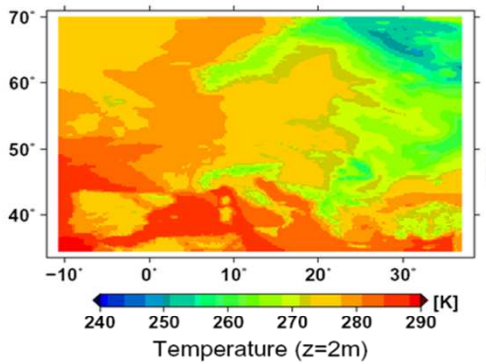


Results from CLM



HYDROLOGICAL DOWNSCALING

LOCAL CLIMATE SCALE

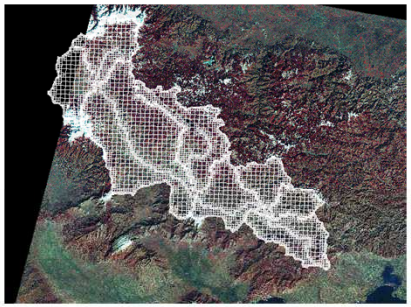


ECHAM5/EMPIOM
LOCAL CLIMATE MODEL
(CLM)
20 x 20 Km

- TEMPERATURE
- PRECIPITATION
- WIND
- HUMIDITY
- RADIATION

DOWN
SCALING

RIVER CATCHMENT SCALE

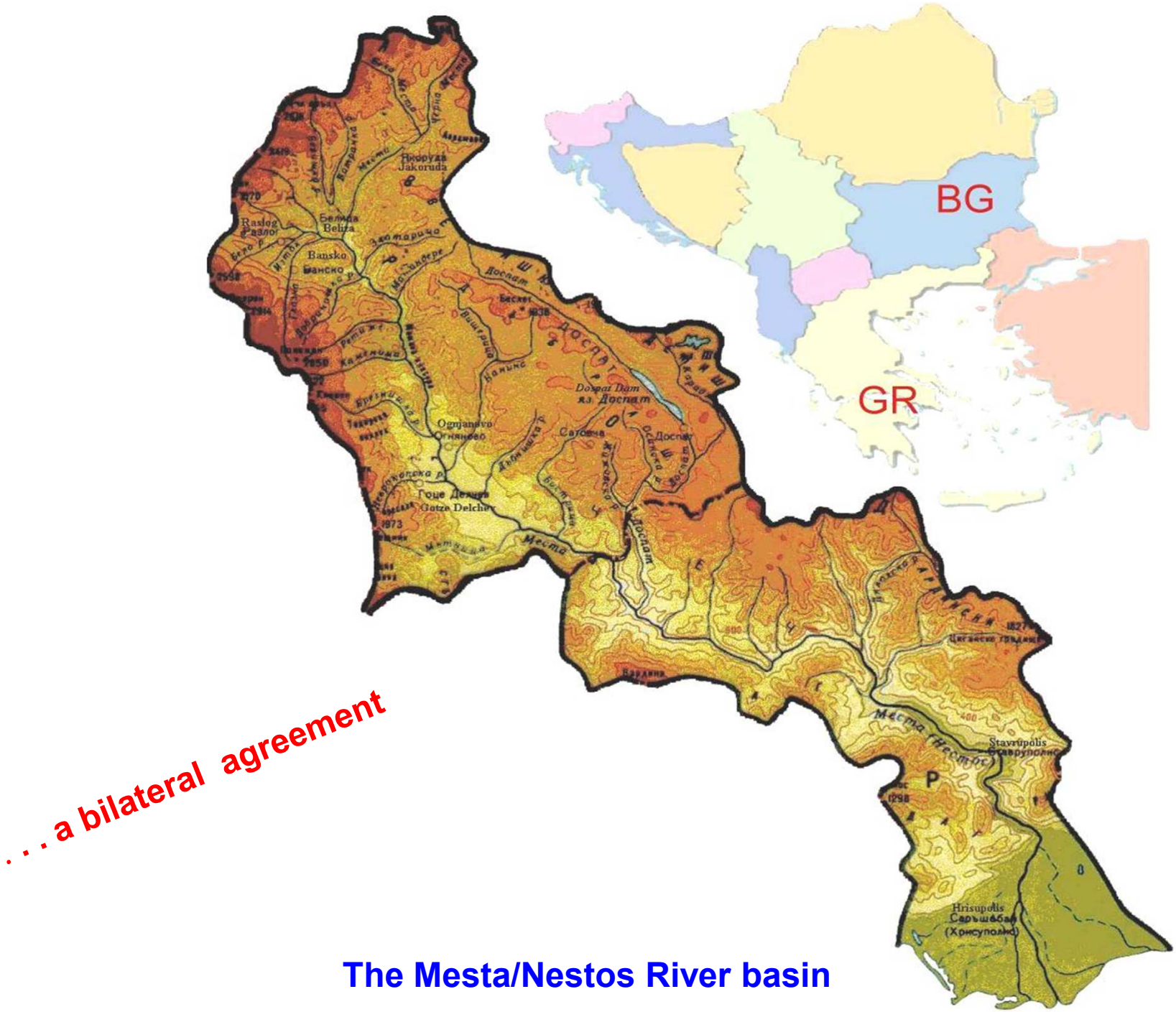


- OROGRAPHY
- LAND USE
- GEOLOGY
- HYDROGRAPHY
- SOILS

MODSUR/NEIGE
DISTRIBUTED
HYDROLOGICAL MODEL
250 m to 2 Km

- RIVER FLOW
- INFILTRATION
- EVAPOTRANS
  PIRATION


The Mesta/Nestos River Basin
WWW.GREEKLANDSCA
SATELLITE IMAGE C



. . . a bilateral agreement

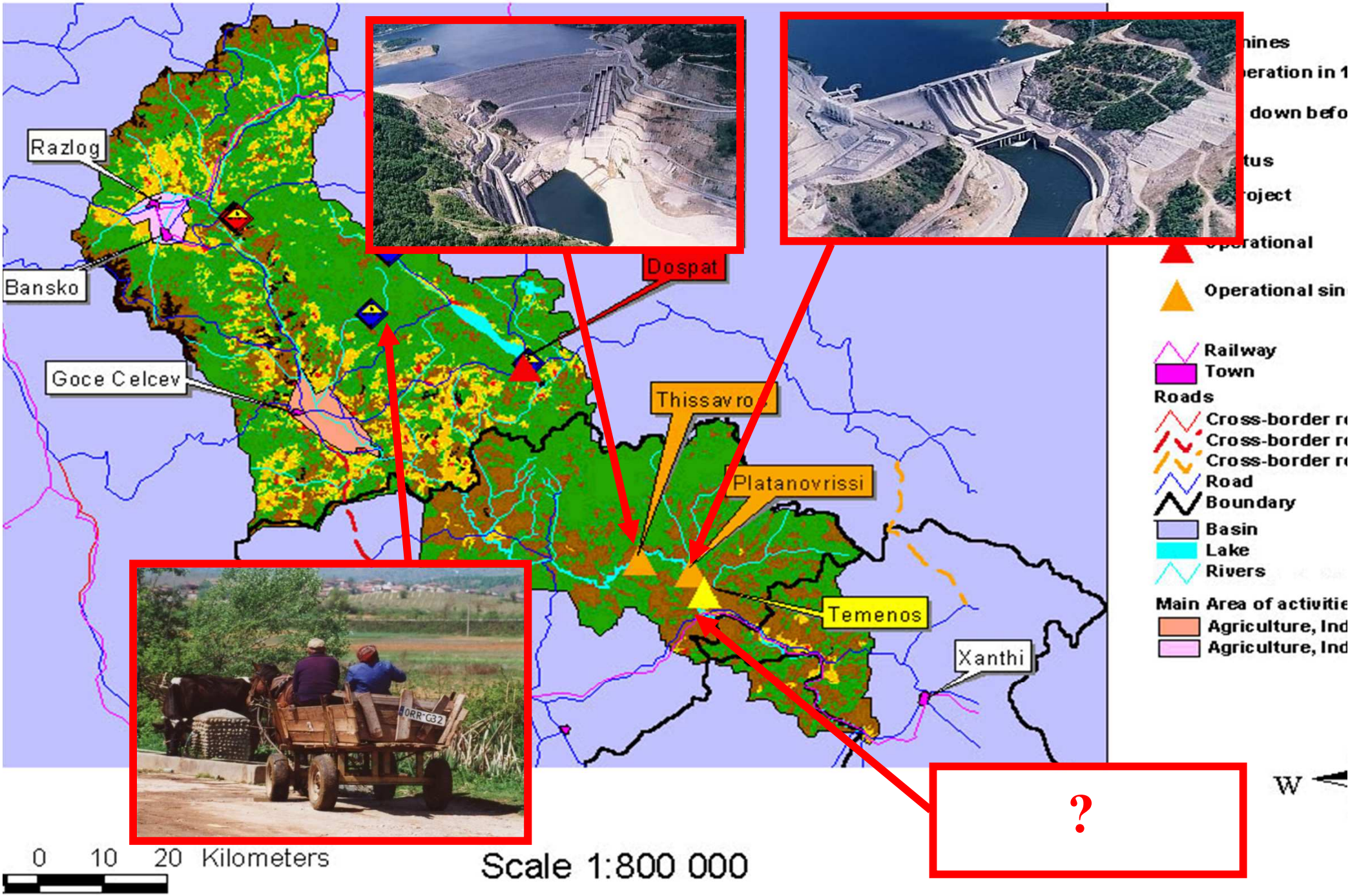
The Mesta/Nestos River basin

THE MESTA/NESTOS RIVER BASIN

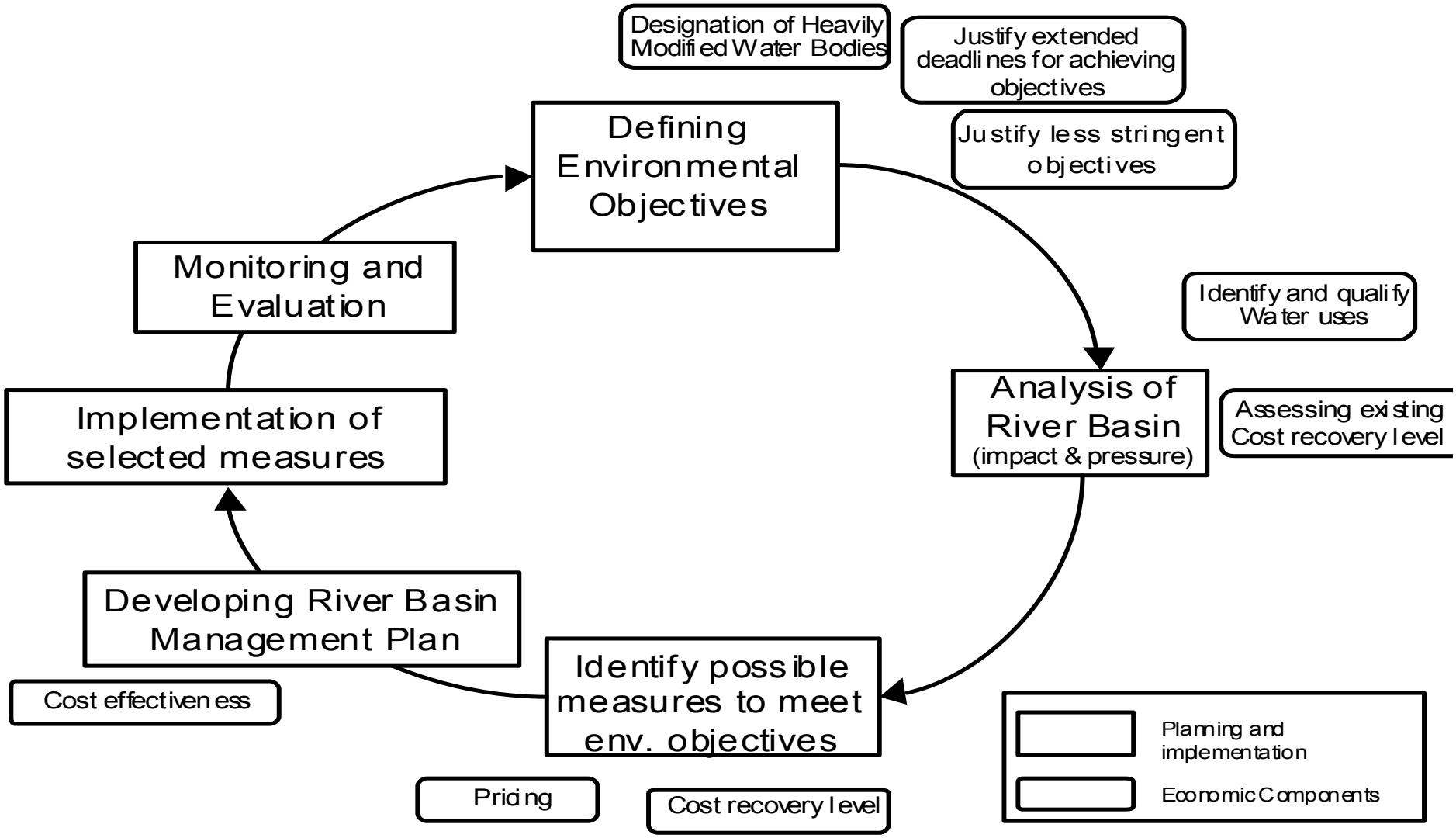
Extensive construction activities

Nationalpark Pirin

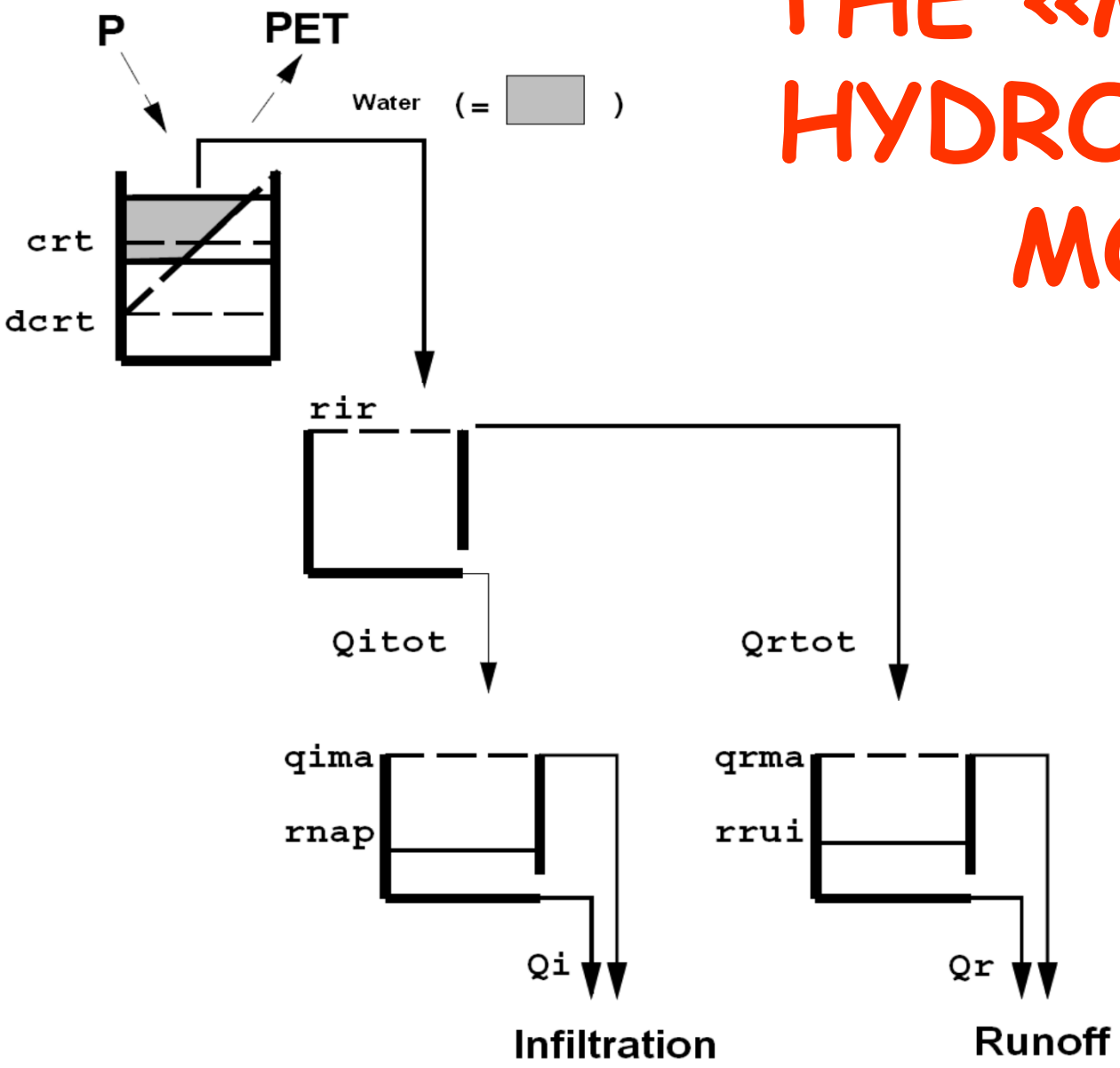
Extensive agricultural activities


Razlog
Bansko
Goce Celcev
Dospat
Thissavros
Platanovrissi
Temenos
Xanthi
?
Railway
Town
Roads
Road
Boundary
Basin
Lake
Rivers
Operational sin
0 10 20 Kilometers
Scale 1:800 000

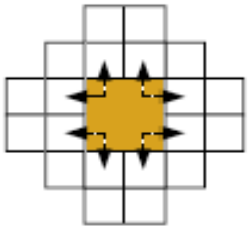
Main Steps of the WFD Process & Role of Socio-Economics

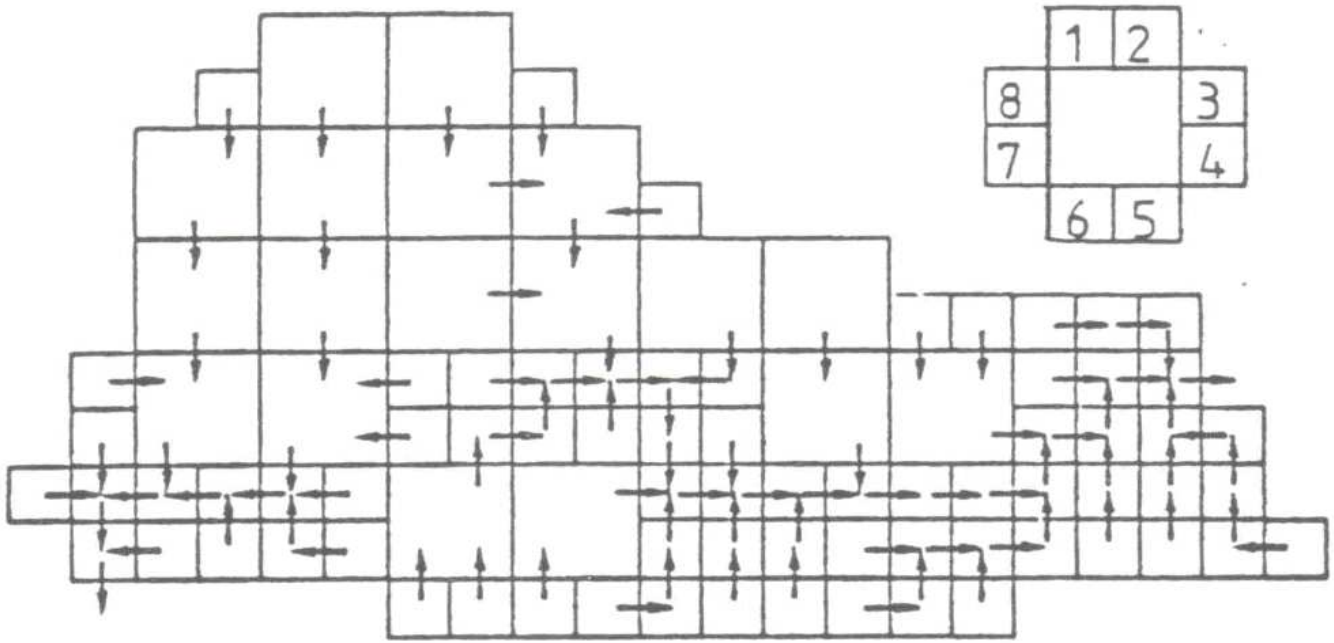


THE «MODCOU» HYDROLOGICAL MODEL

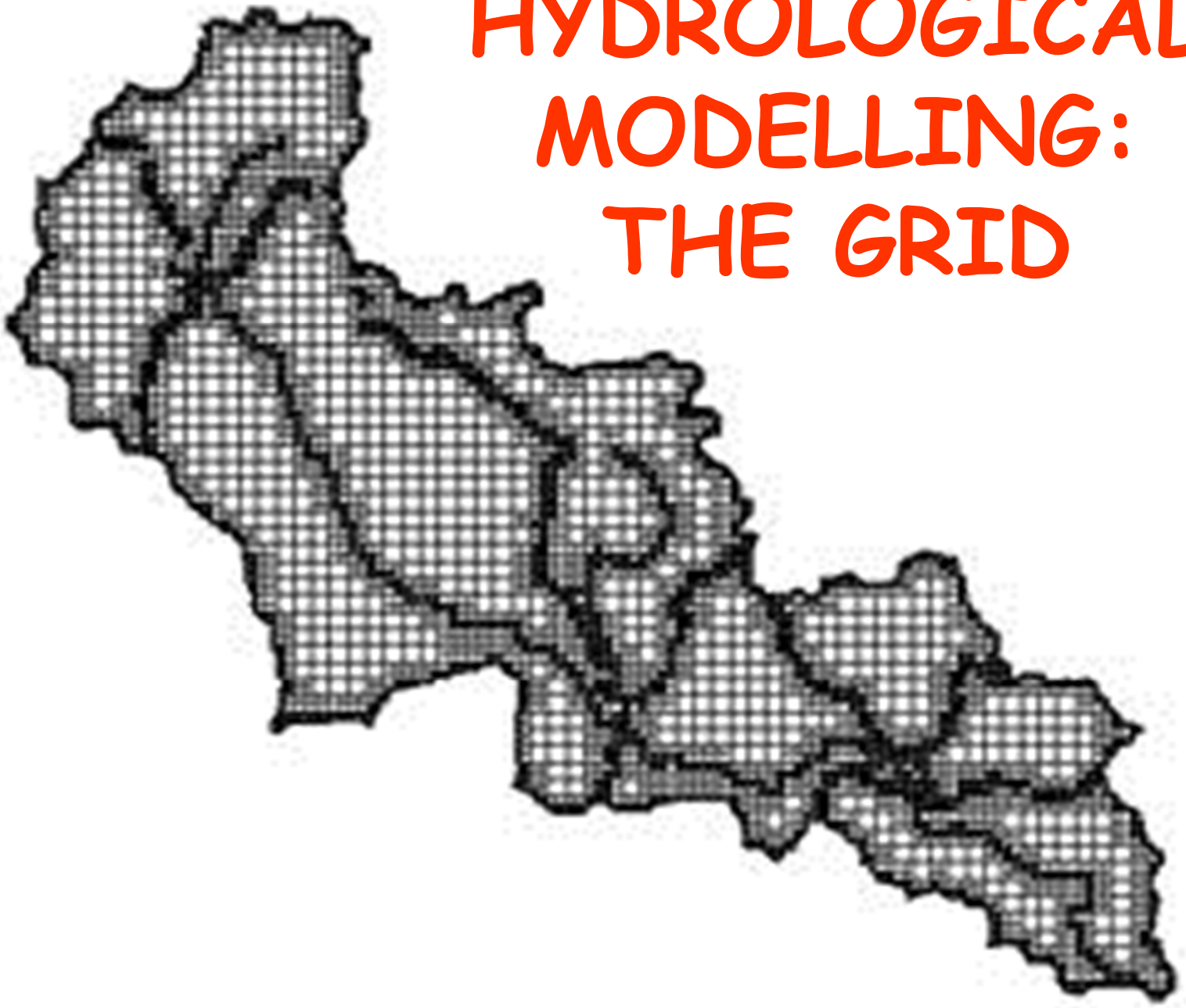


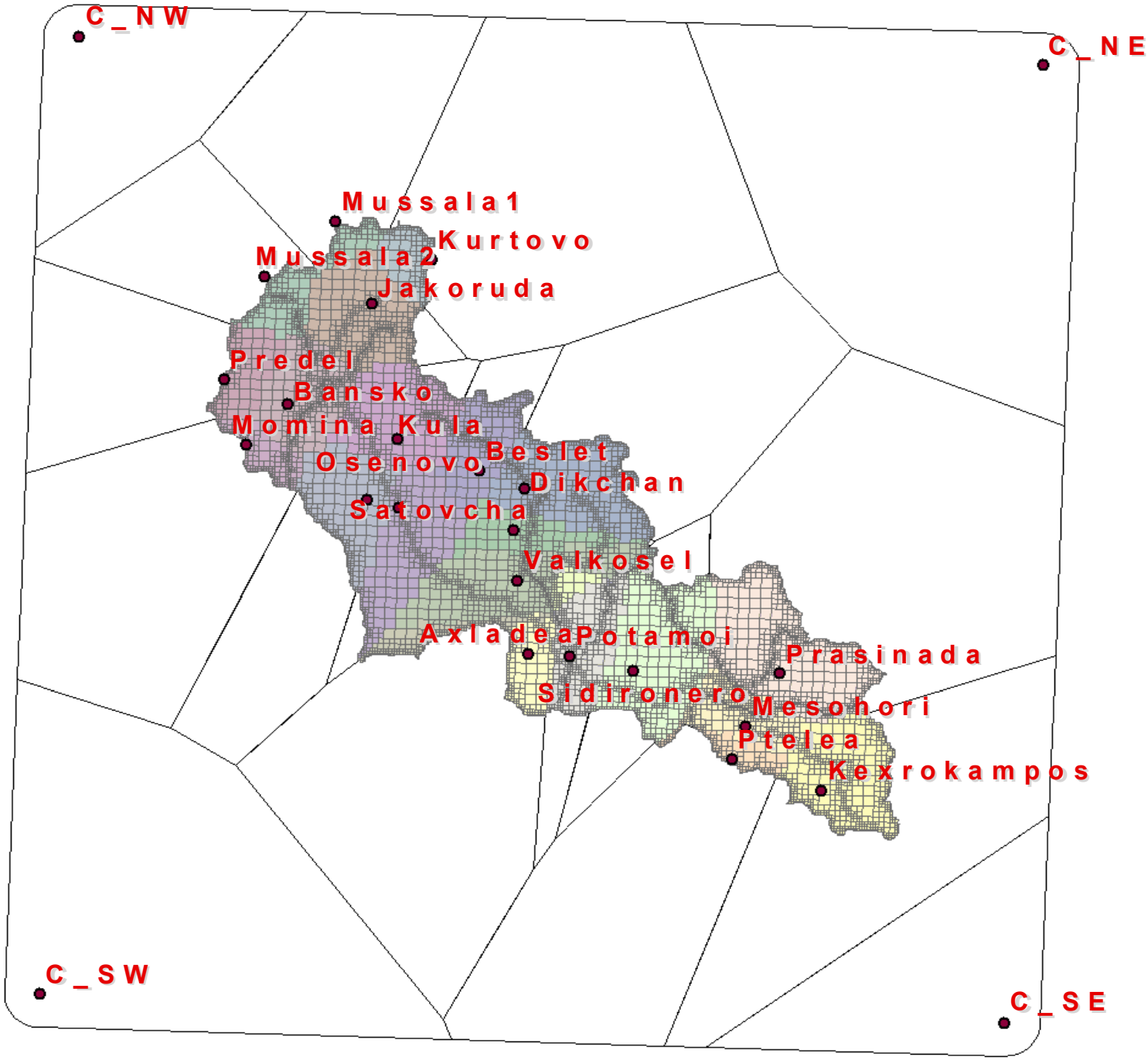
THE «MODCOU» GRID



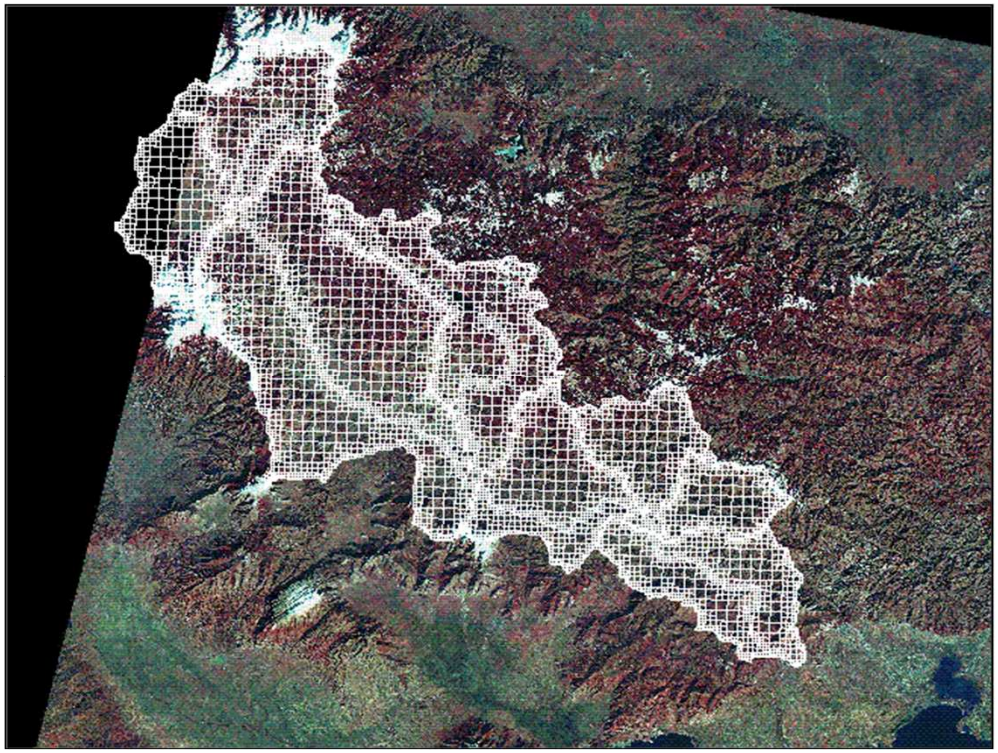


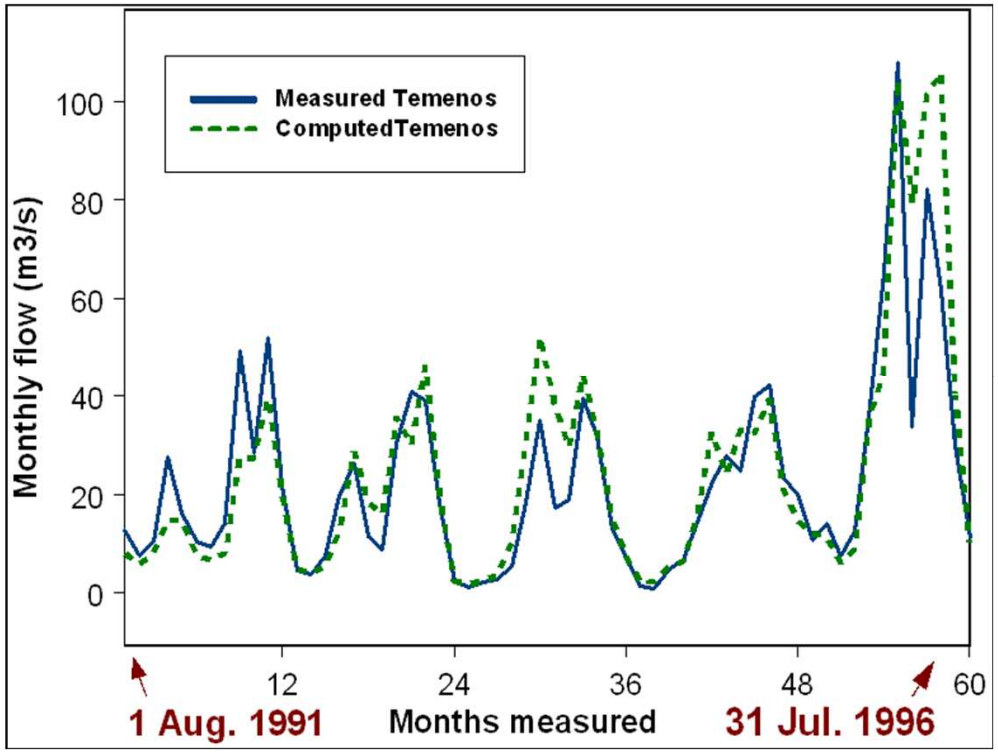
HYDROLOGICAL MODELLING: THE GRID

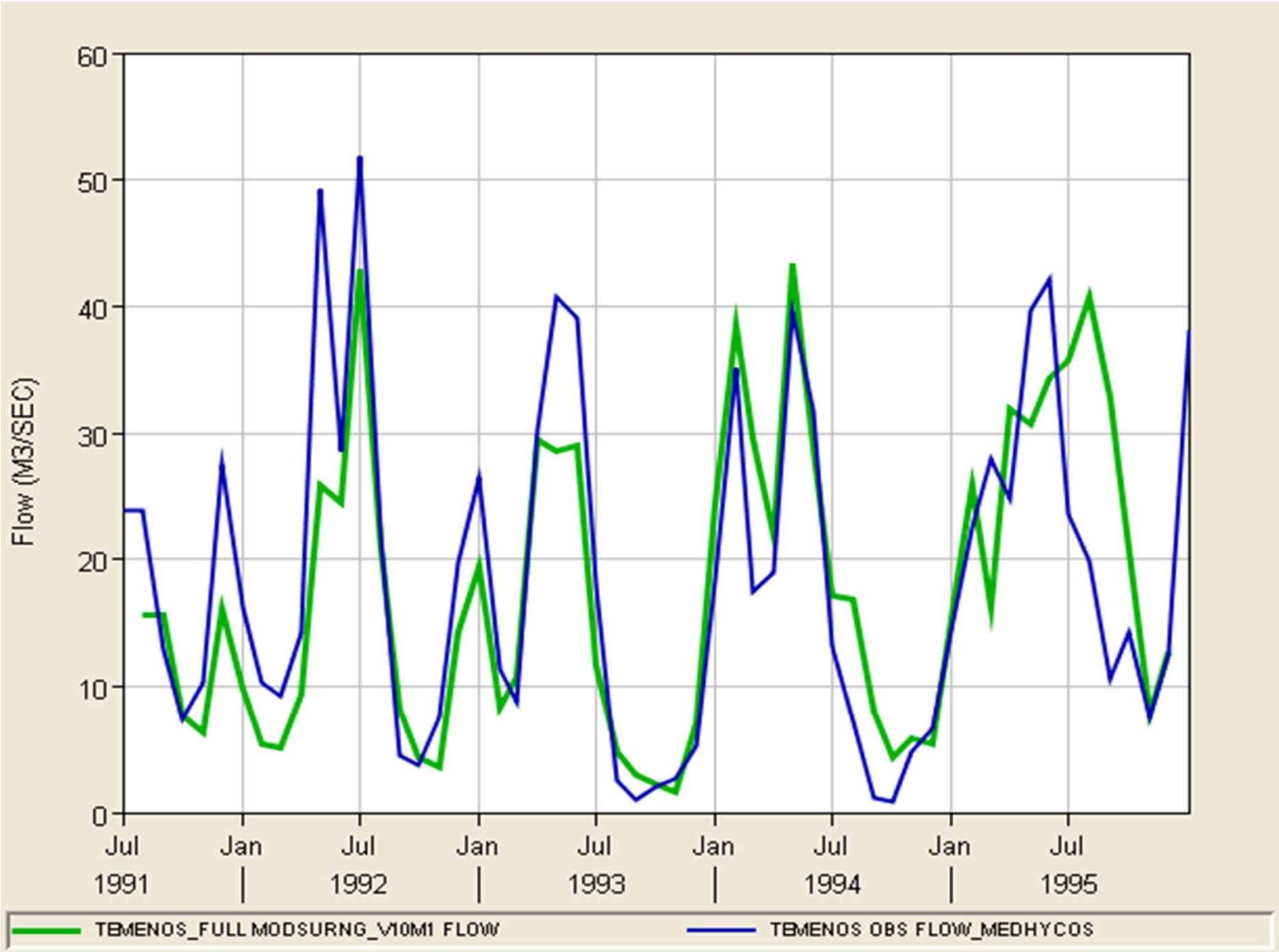


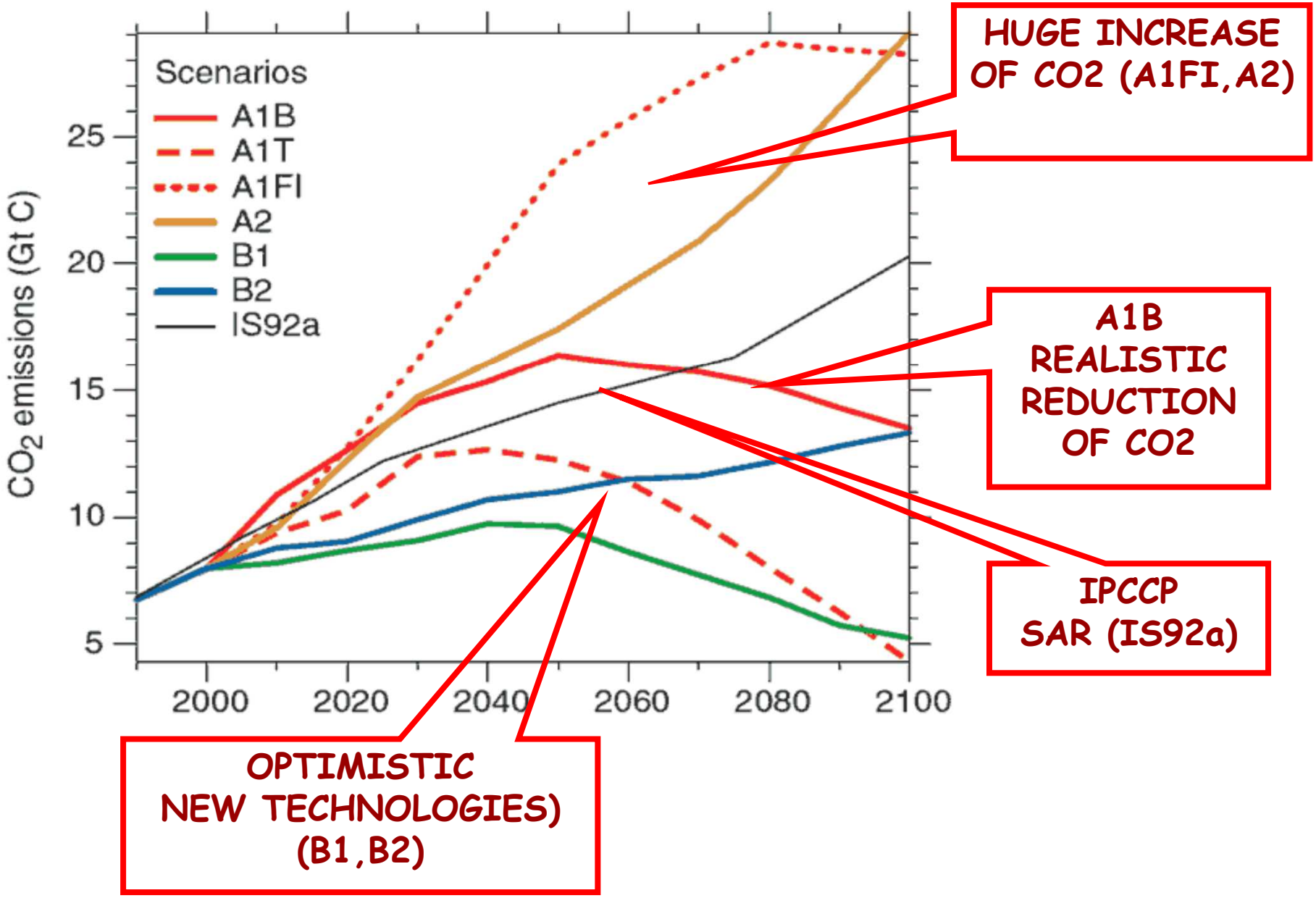

C_NW
C_NE
Mussala1
Kurtovo
Mussala2
Jakoruda
Predel
Bansko
Momina Kula
Beslet
Osenovo
Dikchan
Satovcha
Valkosel
AxladeaPotamoi
Prasinada
Sidironero
Mesohori
Ptelea
Kexrokampos
C_SW
C_SE

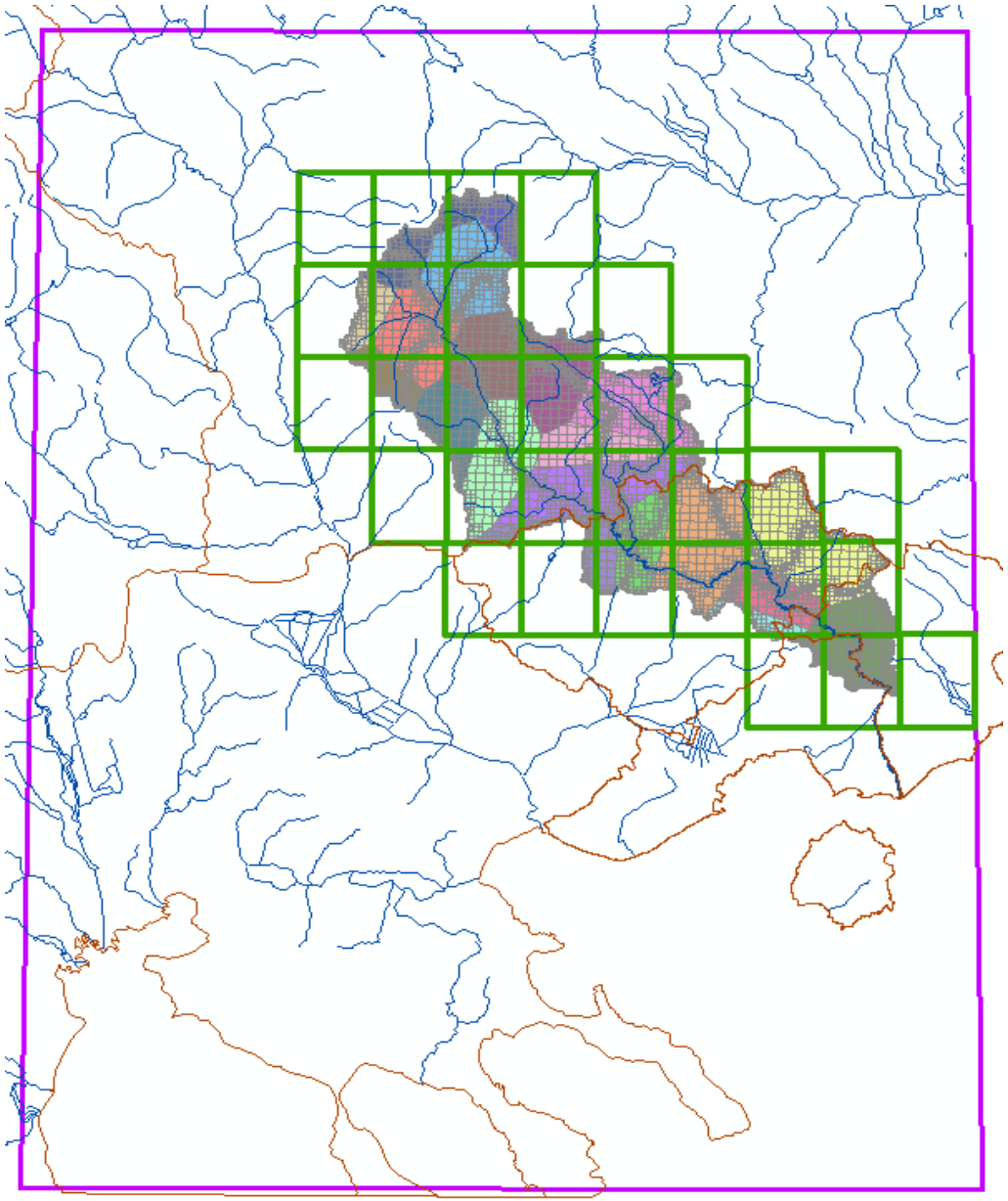
HYDROLOGICAL MODEL CALIBRATION

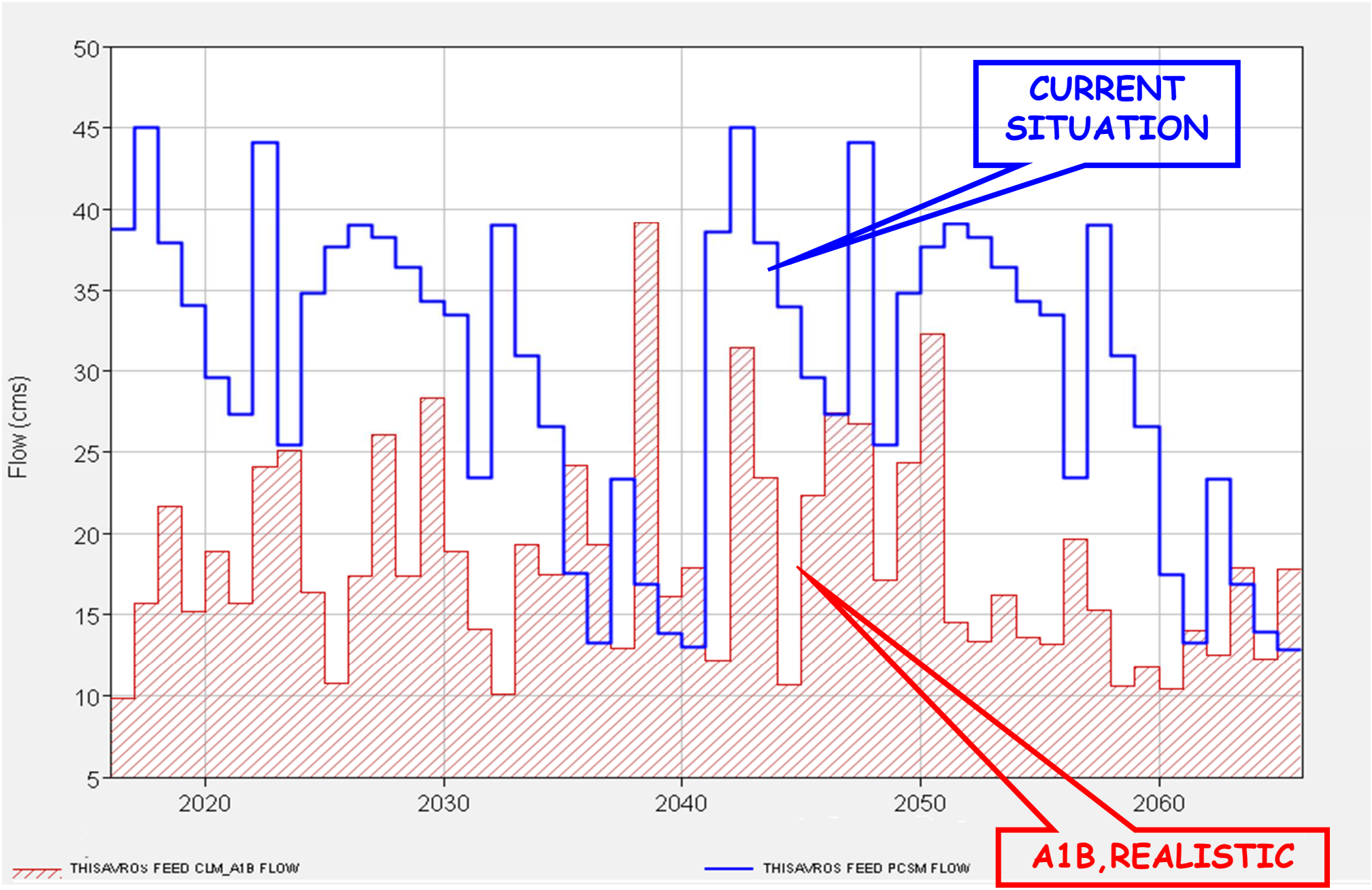


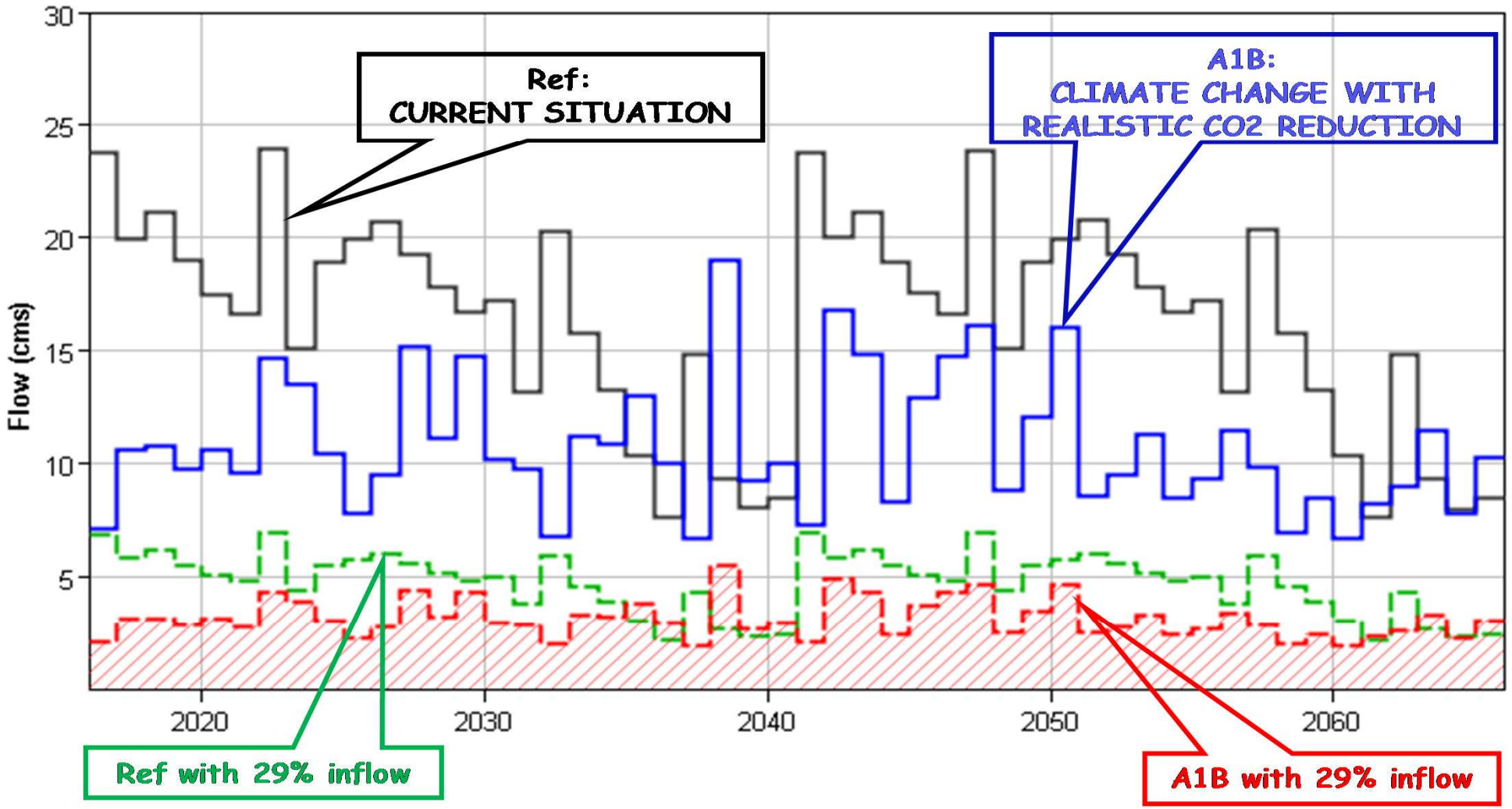



60
50
40
30
20
10
0
Flow (M3/SEC)
Jul
1991
Jan
Jul
1992
Jan
Jul
1993
Jan
Jul
1994
Jan
Jul
1995
TBMENOS_FULL MODSURNG_V10M1 FLOW
TBMENOS OBS FLOW_MEDHYCOS


Scenarios
A1B
A1T
A1FI
A2
B1
B2
IS92a
CO_2 emissions (Gt C)
25
20
15
10
5
2000
2020
2040
2060
2080
2100
HUGE INCREASE OF CO2 (A1FI,A2)
A1B REALISTIC REDUCTION OF CO2
IPCCP SAR (IS92a)
OPTIMISTIC NEW TECHNOLOGIES) (B1,B2)




CURRENT SITUATION
A1B,REALISTIC
Flow (cms)
50
45
40
35
30
25
20
15
10
5
2020
2030
2040
2050
2060
THISAVROS FEED CLM_A1B FLOW
THISAVROS FEED PCSM FLOW

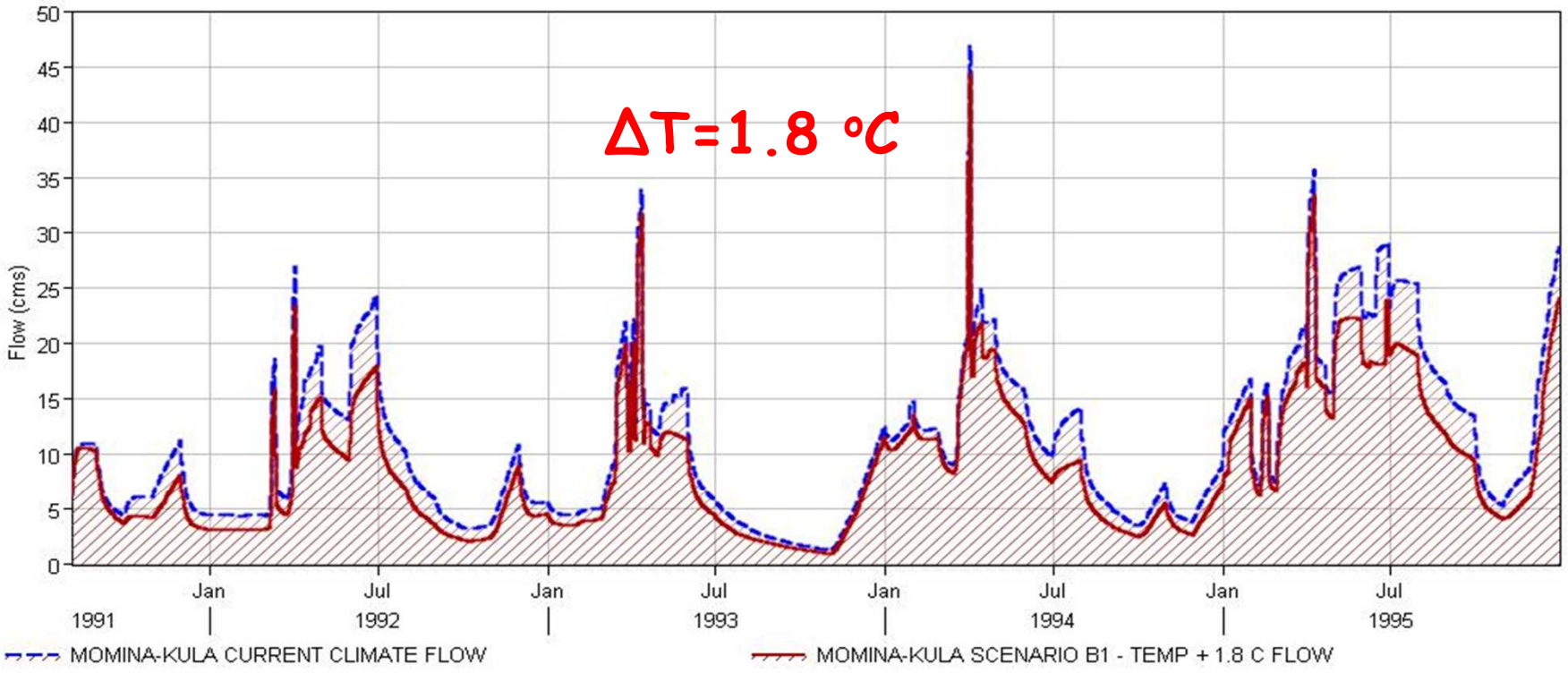

Ref:
CURRENT SITUATION
A1B:
CLIMATE CHANGE WITH
REALISTIC CO2 REDUCTION
Flow (cms)
30
25
20
15
10
5
2020
2030
2040
2050
2060
Ref with 29% inflow
A1B with 29% inflow

Temperature elevations in climate change scenarios applied in MODSUR NEIGE model

Projected global average surface warming and sea level rise at the end of the 21st century.

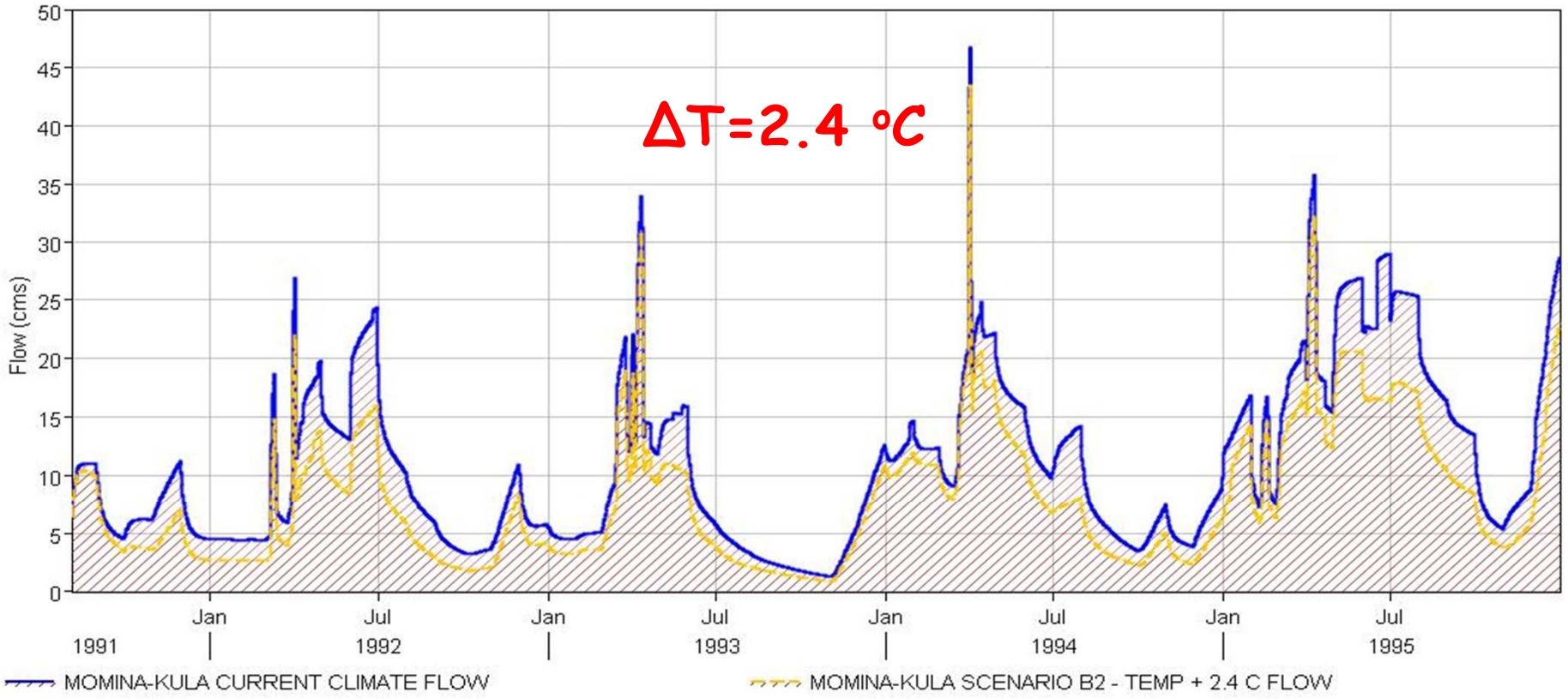
Case	Temperature Change (°C at 2090-2099 relative to 1980-1999)[a] Best estimate	*Likely* range	Sea Level Rise) (m at 2090-2099 relative to 1980-1999) Model-based range excluding future rapid dynamical changes in ice flow
Constant Year 2000 concentrations	0.6	0.3 – 0.9	NA
B1 scenario	1.8	1.1 – 2.9	0.18 – 0.38
A1T scenario	2.4	1.4 – 3.8	0.20 – 0.45
B2 scenario	2.4	1.4 – 3.8	0.20 – 0.43
A1B scenario	2.8	1.7 – 4.4	0.21 – 0.48
A2 scenario	3.4	2.0 – 5.4	0.23 – 0.51
A1FI scenario	4.0	2.4 – 6.4	0.26 – 0.59

Comparison current climate with B1 temperature elevation



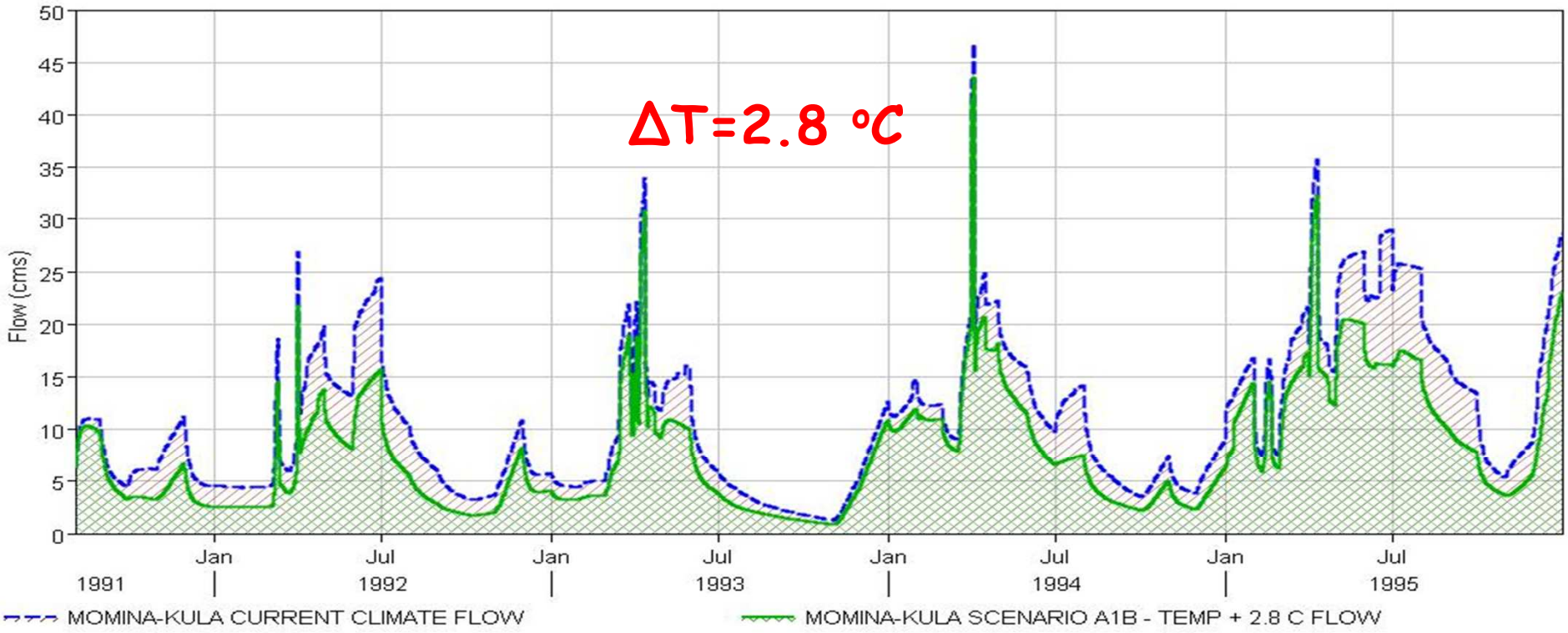
	Minimum Flow(m^3/s)	Mean Flow (m^3/s)	Max Flow (m^3/s)
Simulation 91-95	1.3	10.82	46.78
Scenario B1	1.02	8.65	44.3

Comparison current climate with B2 temperature elevation



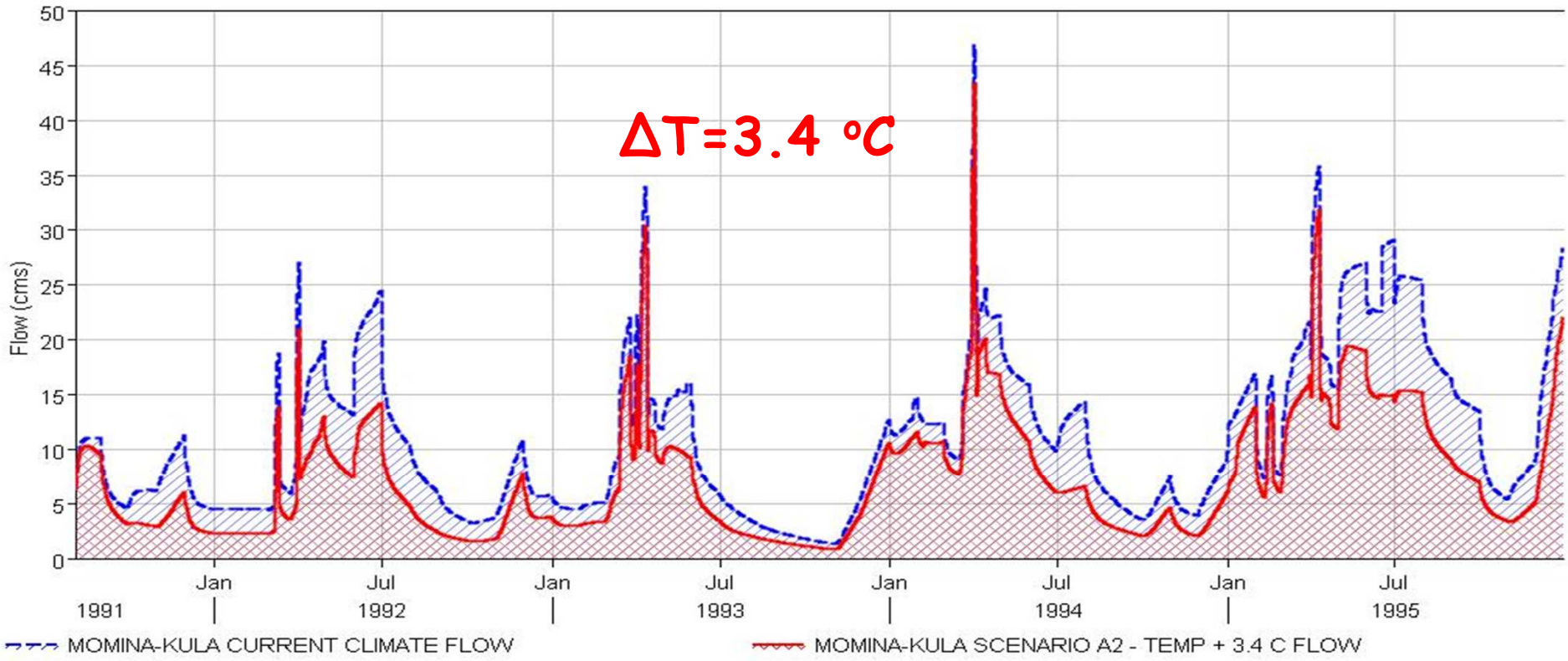
	Minimum Flow(m^3/s)	Mean Flow (m^3/s)	Max Flow (m^3/s)
Simulation 91-95	1.3	10.82	46.78
Scenario B2	0.9	7.87	43.6

Comparison current climate with A1B temperature elevation



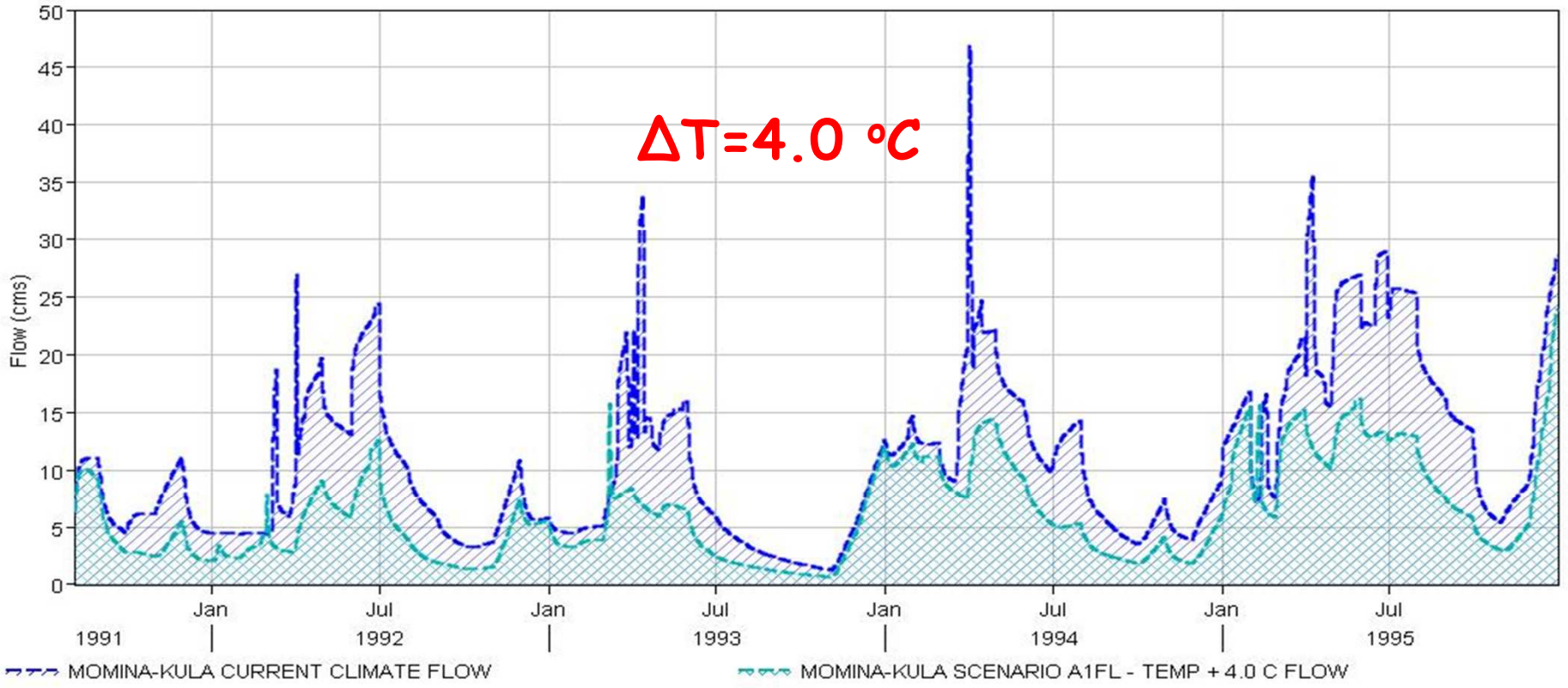
	Minimum Flow(m^3/s)	Mean Flow (m^3/s)	Max Flow (m^3/s)
Simulation 91-95	1.3	10.82	46.78
Scenario A1B	0.88	7.73	43.6

Comparison current climate with A2 temperature elevation



	Minimum Flow(m^3/s)	Mean Flow (m^3/s)	Max Flow (m^3/s)
Simulation 91-95	1.3	10.82	46.78
Scenario A2	0.81	7.2	43.26

Comparison current climate with A1FI temperature elevation



	Minimum Flow(m^3/s)	Mean Flow (m^3/s)	Max Flow (m^3/s)
Simulation 91-95	1.3	10.82	46.78
Scenario A1FI	0.65	6.2	23.89

CONCLUSIONS

- CLIMATE CHANGE, SNOWMELT AND ENERGY PRODUCT

IN TRANSBOUNDARY RIVERS:

A VERY CHALLENGING ISSUE

- IMPORTANCE OF SNOW FOR SUSTAINING RIVER FLO\

AND REGIONAL SOCIO-ECONOMICS

(example: the "HELP" Mesta/Nestos Case)


Thank you!
Ευχαριστώ !