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Water resources availability under changing climate: a case study on Tranceboundary Rivers Struma/Strimon and Mesta/Nestos

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OBJECTIVES:

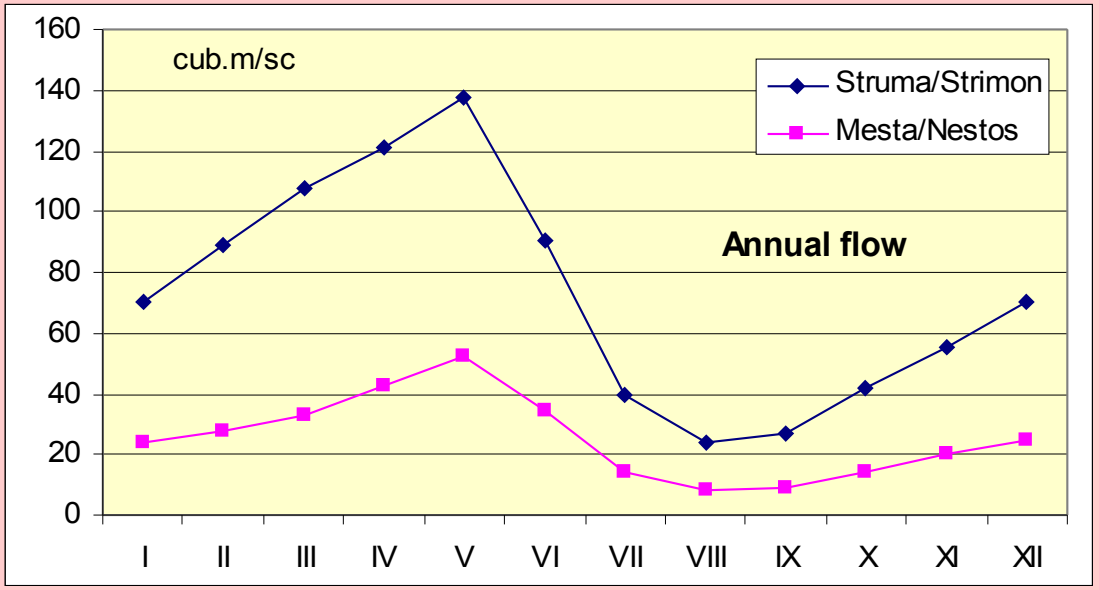
- To present the water resources availability in current conditions and under climate change impact towards 2025 and 2050 years.
- The streamflow of two tranceboundary rivers with Greece Struma/Strymon and Mesta/Nestos have been developed as a case study

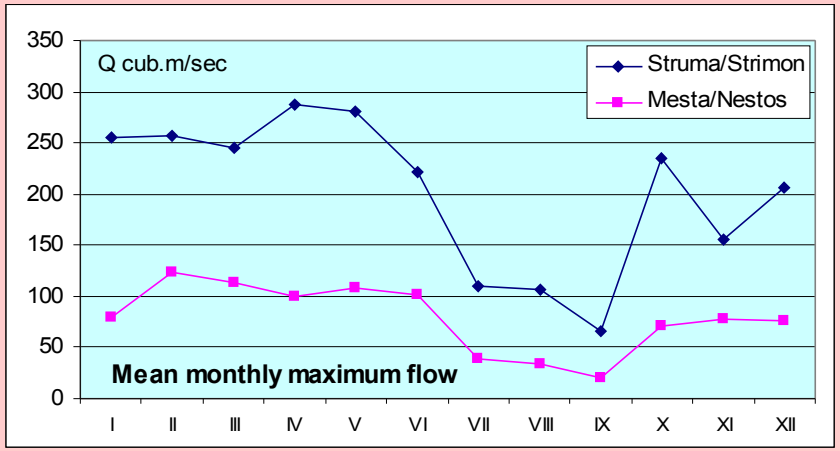
Struma/Strimon& Mesta/nestos river basin

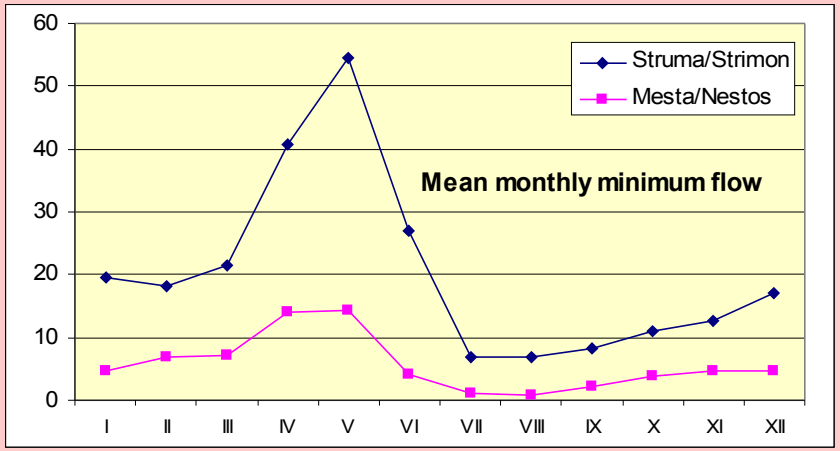
crossing - border rivers		basin area F (sq.km)	riever length (km)		
rivers	running in countries	F total	F in Bg	total	in Bg
Struma/Strimon	Bg,Gr,Serb&Macedonija	1733	10797	420	292
Mesta/Nestos	Brlgaria & Greece	5925	3400	273	126
Maritza/Evros	Bg, Greece, Turkey	53000	21084	524.6	326
Arda	Bg, Greece, Turkey	5795	5201	290	241
Tundja	Bulgaria, Turkey	7880	7784	380	350

- Struma/Strimon and especially Mesta/Nestos is placed for the study due to the fact that downstream demands for water are high and water resources generation upstream is heavily influenced by human intervention

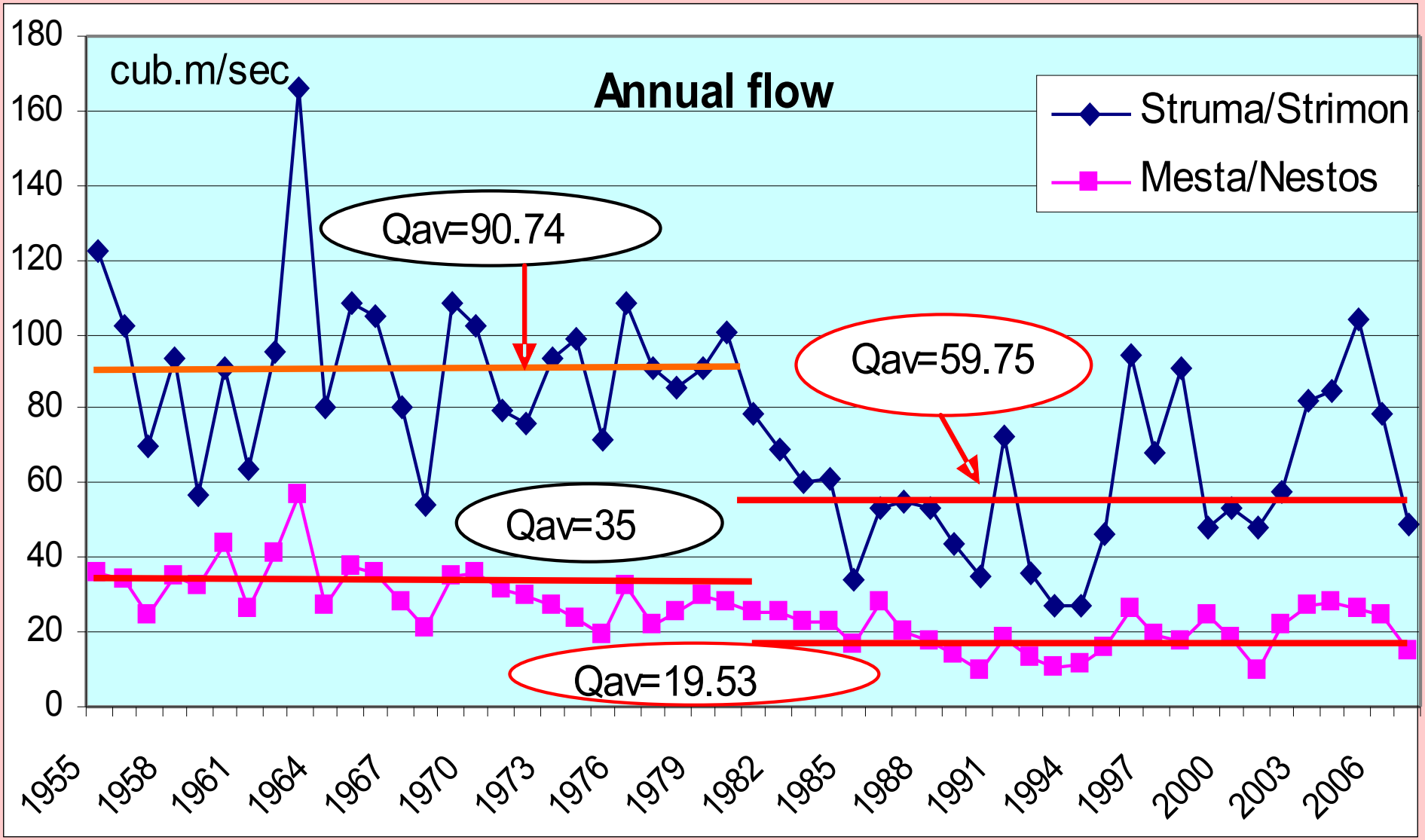
Streamflow regime of Struma/Strimon & Mesta/Nestos rivers







Variability of annual flow



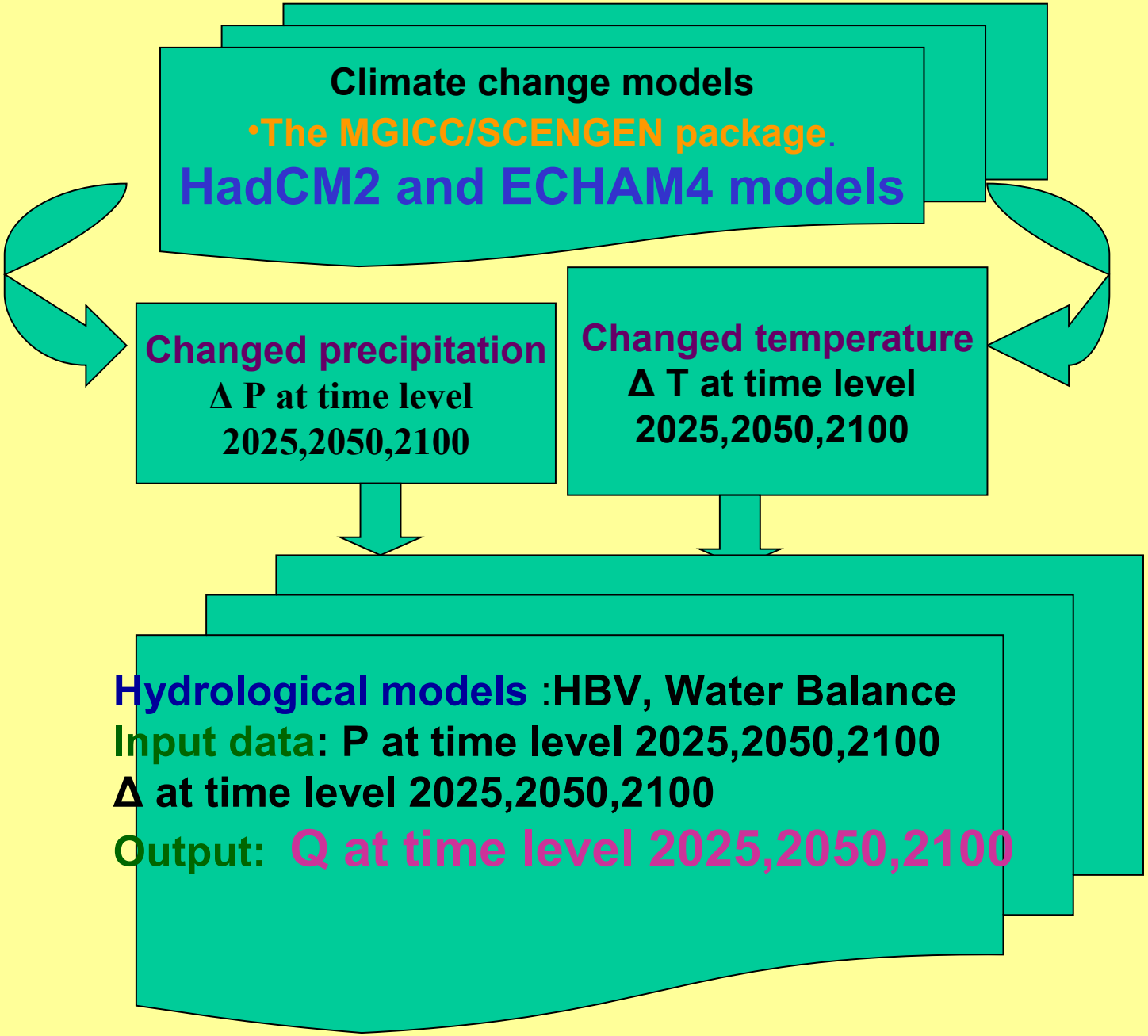
Current water recourses

period	Mesta/Nestos	%	Struma/Strimon	%
1936-1975	1222x10 m	100	2669X10 m	100
1936-1985	1202x10 m	-1.64	2600 x10 m	-2.59
1936-1995	1130 x10 m	-7.53	2477 x10 m	-7.19
1982-2000	619 x10 m	- 49.35	1604 x10 m	-39.9

The changes of climate and hydrological elements were presented as deviation toward the respective values evaluated for the basic period 1961-1990 according IPCC

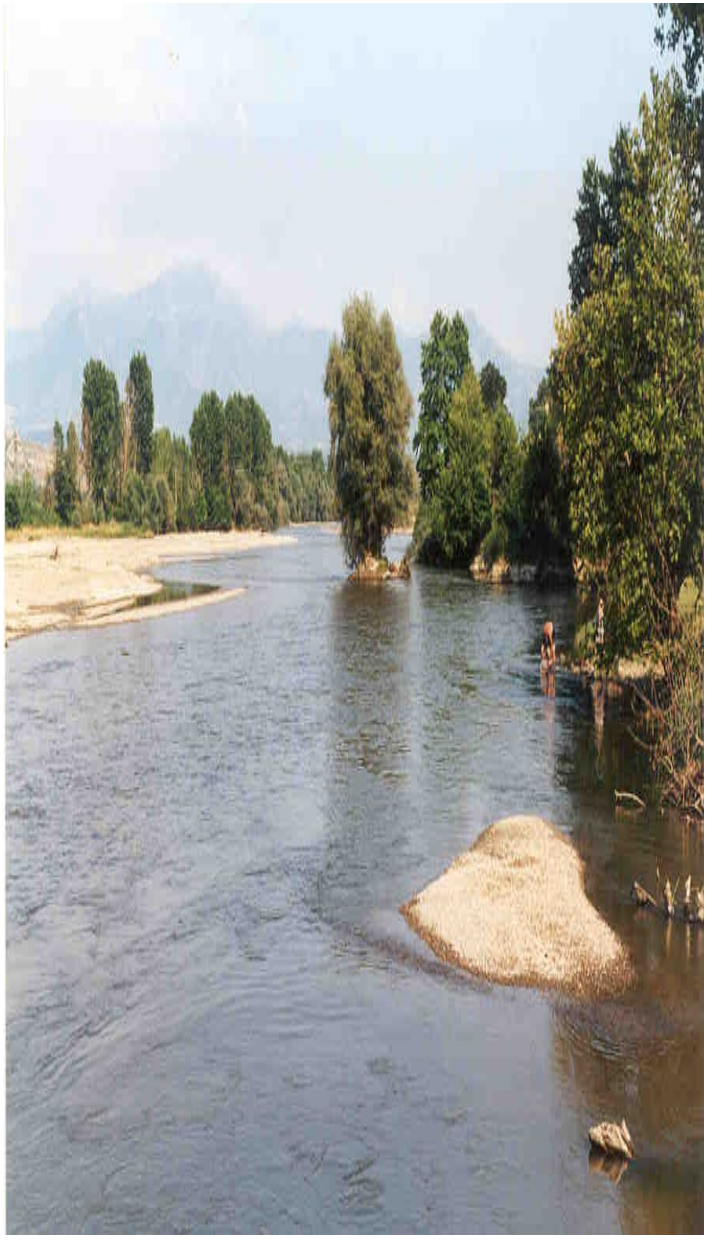
Climate changes are stipulated by A2 and B2 storylines because the both are focused on local and regional peculiarities.

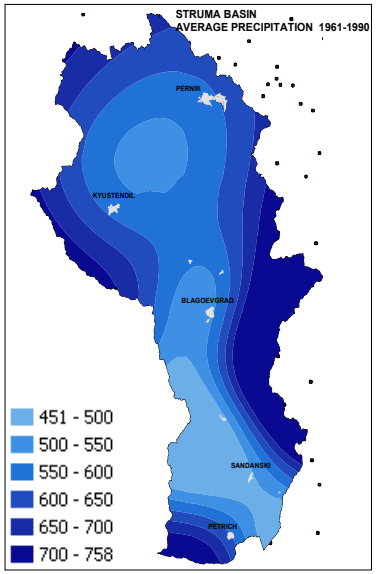
Two climate models HadCM2 and ECHAM4 have been selected and used from the MAGICC)/ SCENGEN package (Models for the Assessment of Greenhouse-gas Induced Climate Change/ SCENario GENerator.) because they are produced in Europe and are the most suitable for the European conditions.

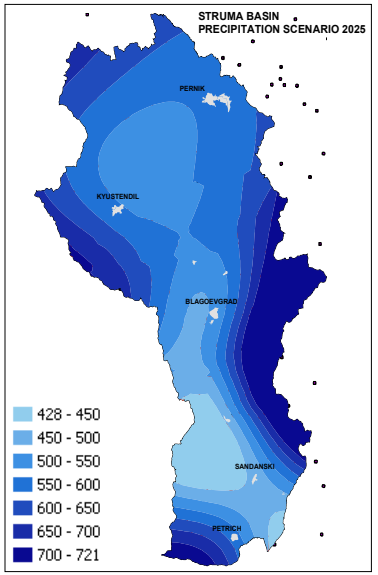

Climate change models
•The MGICC/SCENGEN package.
HadCM2 and ECHAM4 models
Changed precipitation
Δ P at time level
2025,2050,2100
Changed temperature
Δ T at time level
2025,2050,2100
Hydrological models :HBV, Water Balance
Input data: P at time level 2025,2050,2100
Δ at time level 2025,2050,2100
Output: Q at time level 2025,2050,2100

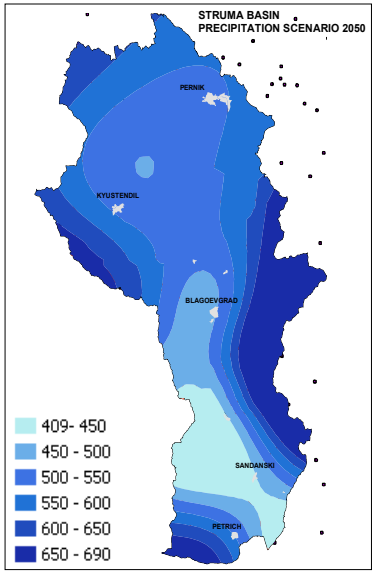
Changes of precipitation and temperature

Temperature				Precipitation		
models	Δ T 2025	Δ T 2050	Δ T Q2100	Δ P 2025	Δ P 2050	Δ P 2100
HadCM2	0.9-1.1	1.6-1.8	3.3-3-5	3-5%	6-9%	12-18%
ECHAM4	1.1-2.3	2.1-2.2	4.2-4.4	2-3%	4-5%	8-10%




STRUMA BASIN
AVERAGE PRECIPITATION 1961-1990
PERNIK
KYUSTENDIL
BLAGOEVGRAD
SANDANSKI
PETRICH
451 - 500
500 - 550
550 - 600
600 - 650
650 - 700
700 - 758


STRUMA BASIN
PRECIPITATION SCENARIO 2025
PERNIK
KYUSTENDIL
BLAGOEVGRAD
SANDANSKI
PETRICH
428 - 450
450 - 500
500 - 550
550 - 600
600 - 650
650 - 700
700 - 721


STRUMA BASIN
PRECIPITATION SCENARIO 2050
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KYUSTENDIL
BLAGOEVGRAD
SANDANSKI
PETRICH
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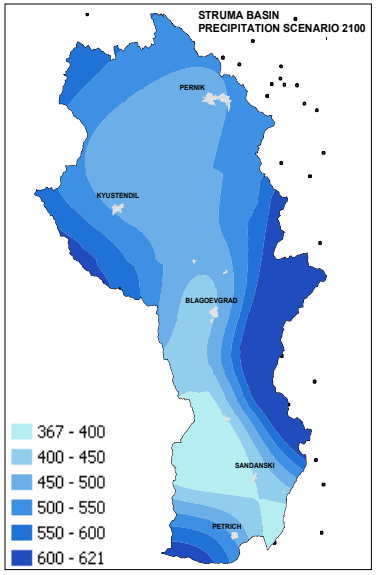
450 - 500
500 - 550
550 - 600
600 - 650
650 - 690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PRECIPITATION SCENARIO 2100
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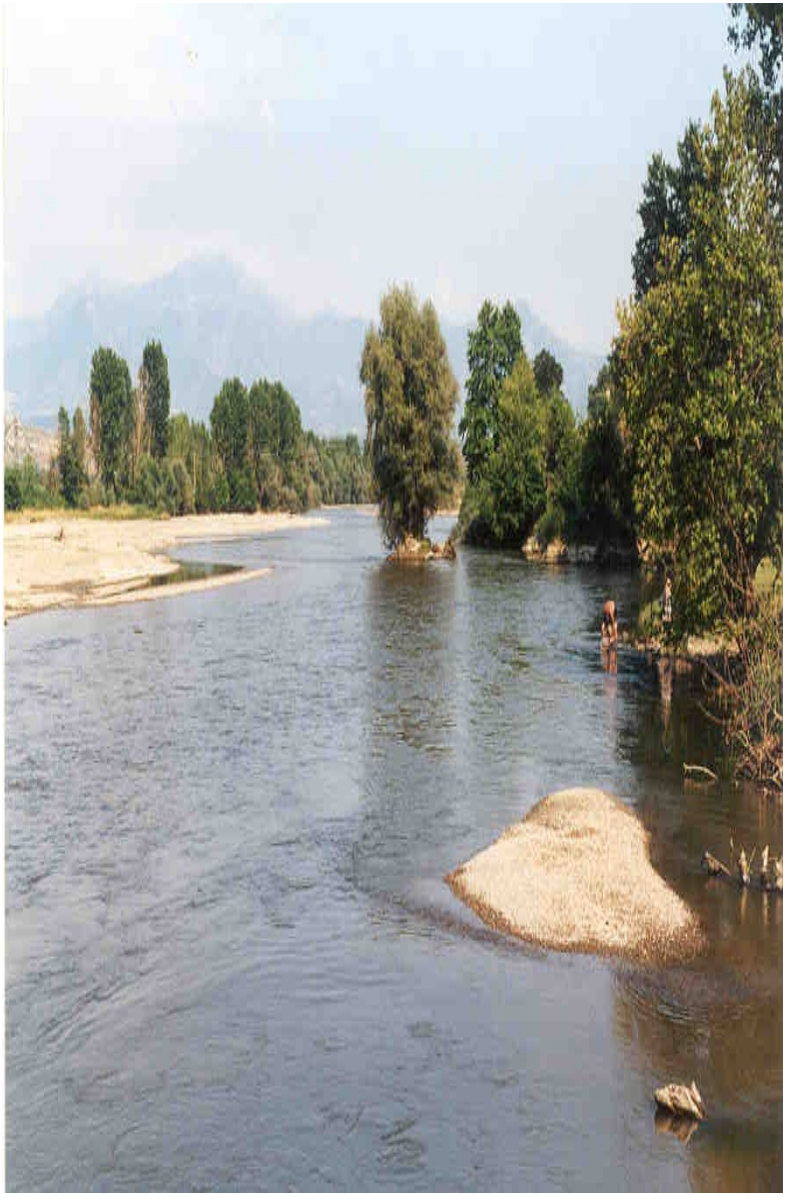
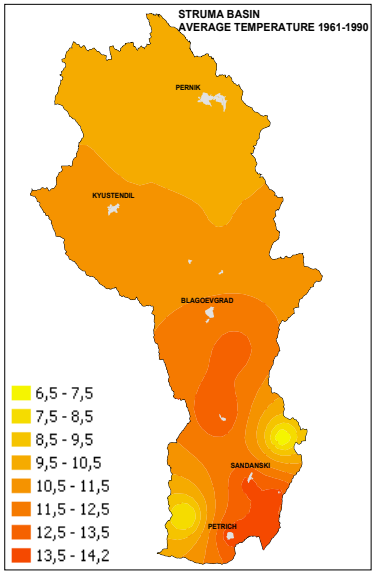
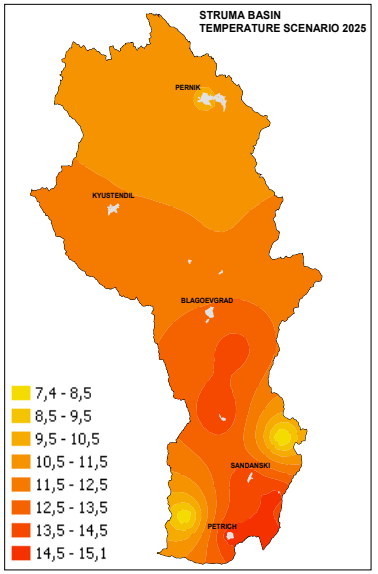
SANDANSKI
PETRICH
367 - 400
400 - 450
450 - 500
500 - 550
550 - 600
600 - 621




STRUMA BASIN
AVERAGE TEMPERATURE 1961-1990
PERNIK
KYUSTENDIL
BLAGOEVGRAD
SANDANSKI
PETRICH
6,5 - 7,5
7,5 - 8,5
8,5 - 9,5
9,5 - 10,5
10,5 - 11,5
11,5 - 12,5
12,5 - 13,5
13,5 - 14,2


STRUMA BASIN
TEMPERATURE SCENARIO 2025
PERNIK
KYUSTENDIL
BLAGOEVGRAD
SANDANSKI
PETRICH
7,4 - 8,5
8,5 - 9,5
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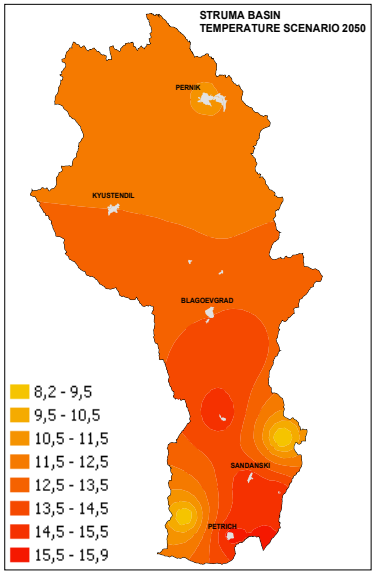
10,5 - 11,5
11,5 - 12,5
12,5 - 13,5
13,5 - 14,5
14,5 - 15,1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TEMPERATURE SCENARIO 2050
PERNIK
KYUSTENDIL
BLAGOEVGRAD
SANDANSKI
PETRICH
8,2 - 9,5
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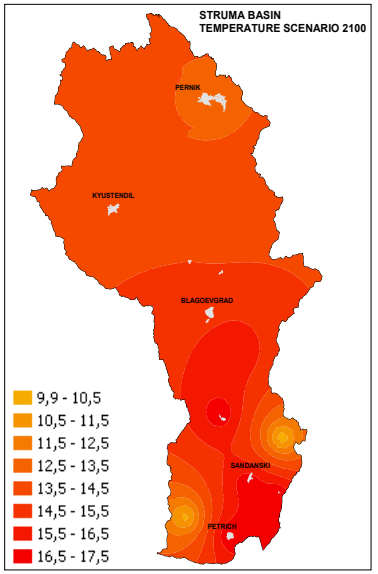
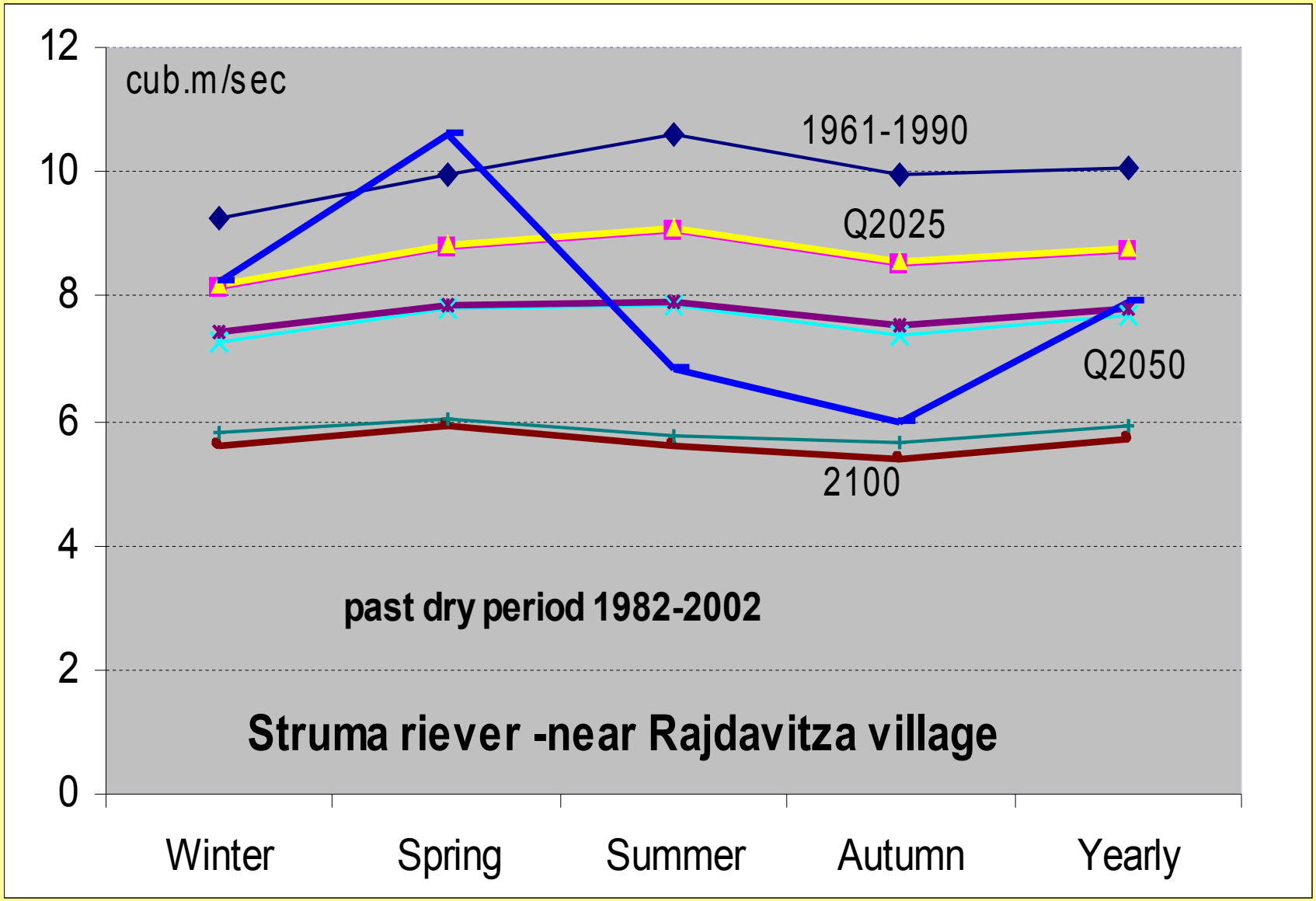
11,5 - 12,5
12,5 - 13,5
13,5 - 14,5
14,5 - 15,5
15,5 - 15,9

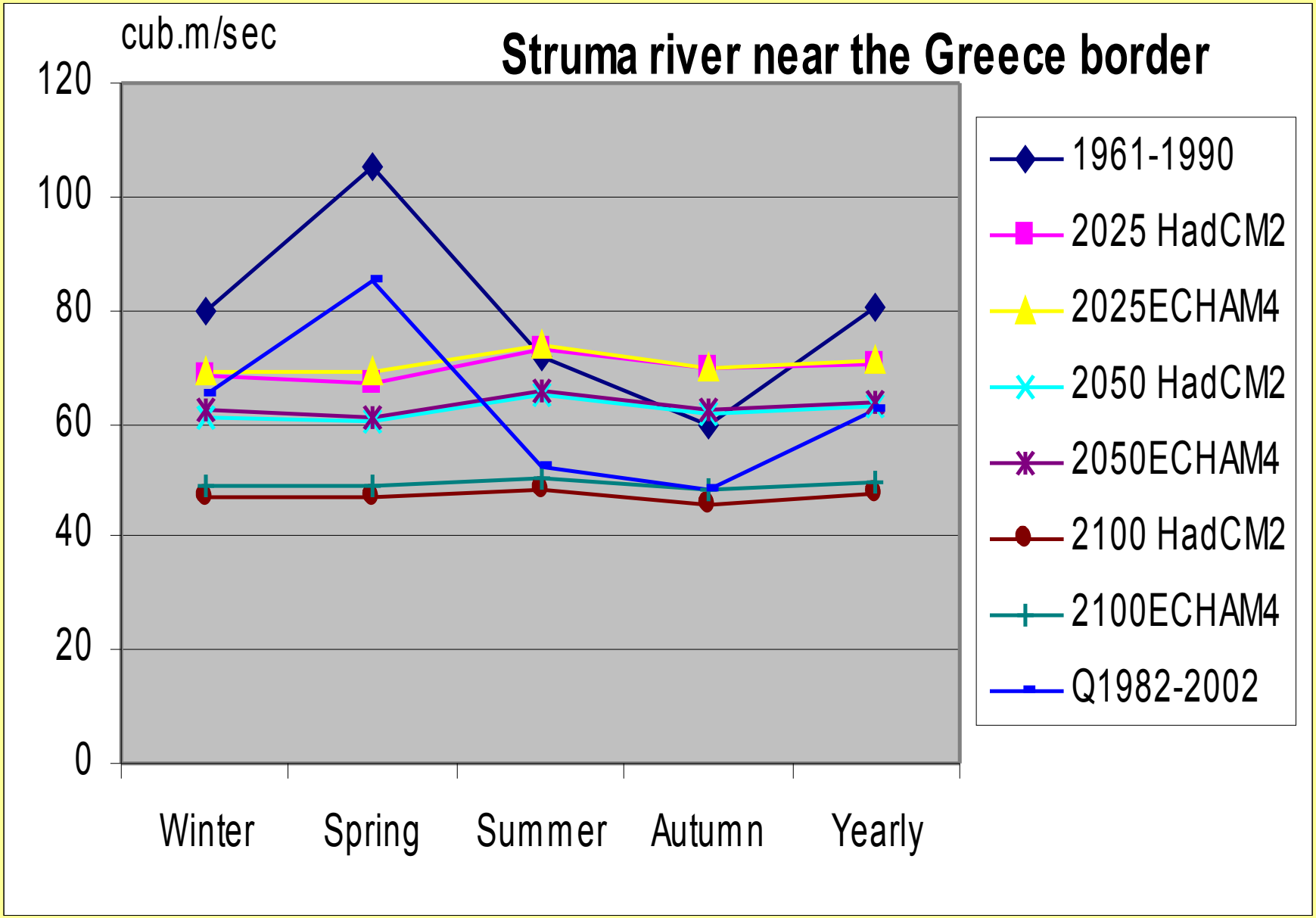

STRUMA BASIN
TEMPERATURE SCENARIO 2100
PERNIK
KYUSTENDIL
BLAGOEVGRAD
SANDANSKI
PETRICH
9,9 - 10,5
10,5 - 11,5
11,5 - 12,5
12,5 - 13,5
13,5 - 14,5
14,5 - 15,5
15,5 - 16,5
16,5 - 17,5

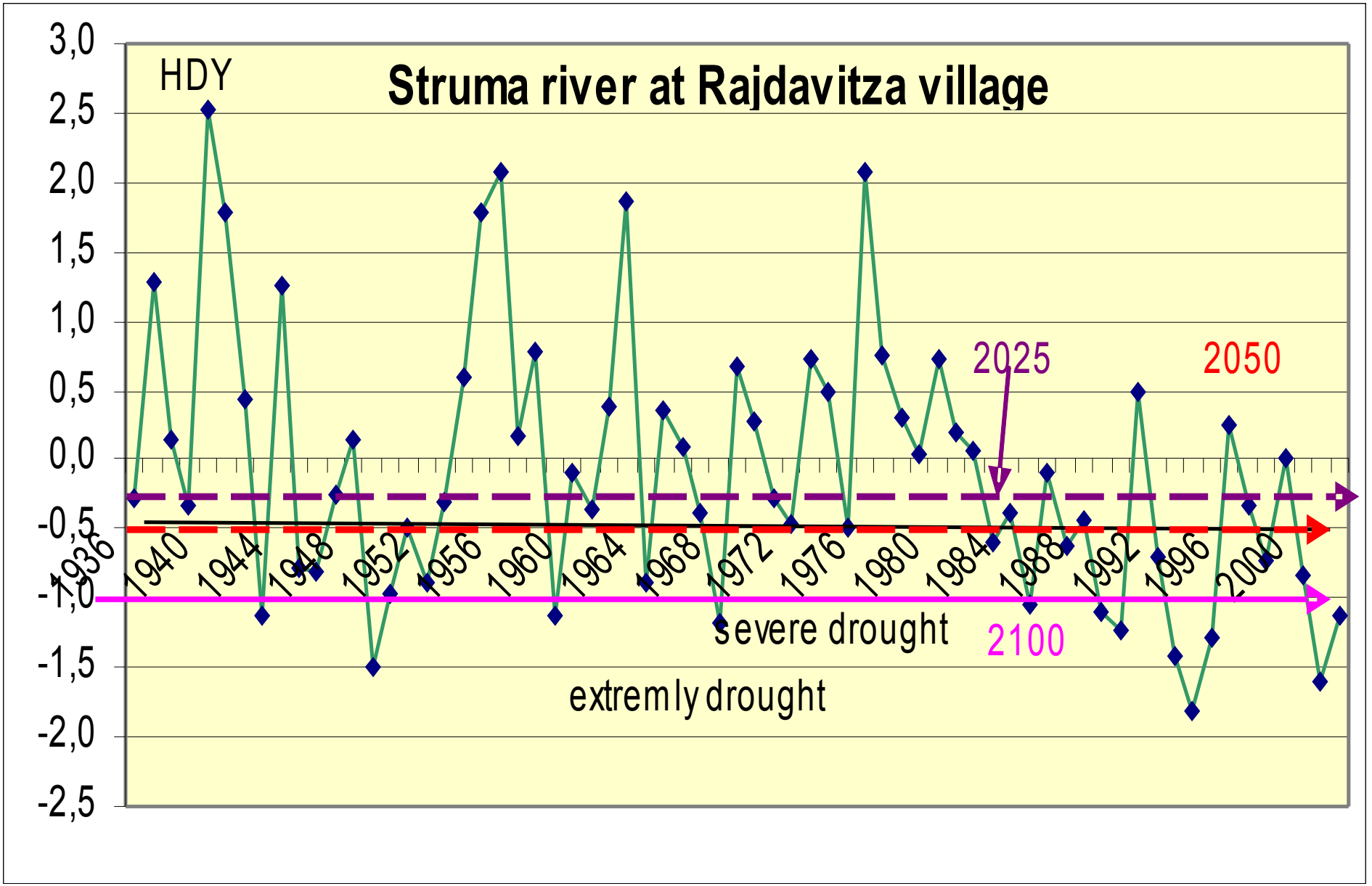
Comparison of the changes in% of runoff values obtained by two models with output data from the ECHM4 and HadCM2.

The Mesta river	Δ2025	Δ2050	Δ2100
ECHM4-WB	-7,66	-11,08	-17,93
ECHM4 -HBV	-13,43	-22,8	- 41.81
HadCM2-WB	-17,8	-20,6	- 28,2
HadCM2 -HBV	-12,8	-21,44	- 39,74

The Struma river	Δ2025	Δ2050	Δ2100
ECHM4-WB	-18,67	-23,24	- 42,1
ECHM4 -HBV	-13.43	-10.84	-24.18
HadCM2-WB	-18,59	-28,05	- 38,3
HadCM2 -HBV	-11,43	-10,14	-21,97


12
10
8
6
4
2
0
cub.m/sec
1961-1990
Q2025
Q2050
2100
past dry period 1982-2002
Struma riever -near Rajdavitza village
Winter
Spring
Summer
Autumn
Yearly


cub.m/sec
Struma river near the Greece border
120
100
80
60
40
20
0
Winter
Spring
Summer
Autumn
Yearly
1961-1990
2025 HadCM2
2025ECHAM4
2050 HadCM2
2050ECHAM4
2100 HadCM2
2100ECHAM4
Q1982-2002


Struma river at Rajdavitza village
HDY
3,0
2,5
2,0
1,5
1,0
0,5
0,0
-0,5
-1,0
-1,5
-2,0
-2,5
1936
1940
1944
1948
1952
1956
1960
1964
1968
1972
1976
1980
1984
1988
1992
1996
2000
2025
2050
2100
severe drought
extremly drought

Conclusions and recommendations

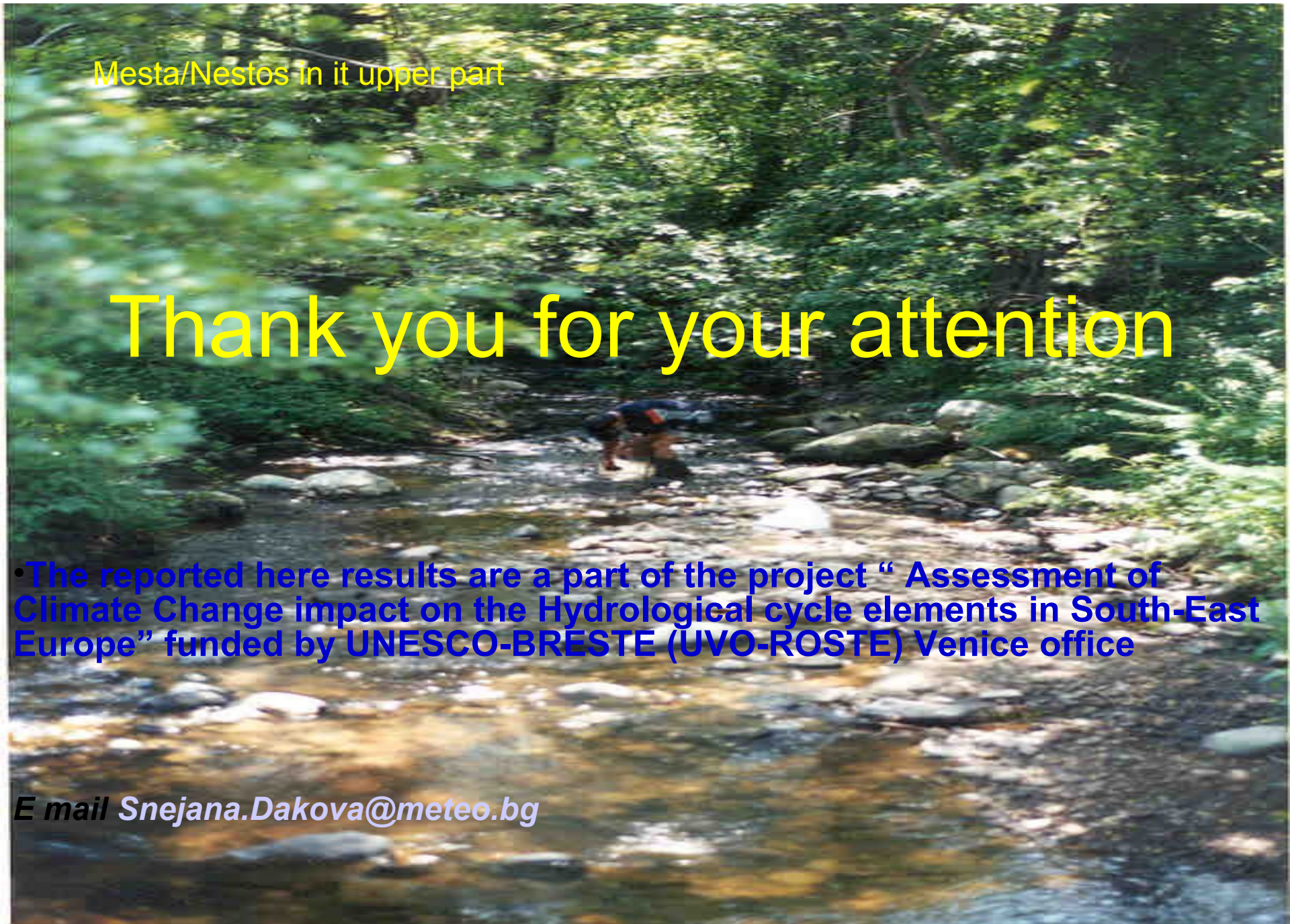
- The obtained results have to be considered what might happen if we do not adapt to changing climatic conditions. Its social significance is to guide policy-makers, agriculture, electricity producers in order to initiate a practical response for adaptation to these new conditions. It may be includes reassessment of the reservoirs and hydraulic systems, change of their working regimes, reconstruction some of them or building new ones, new dry steady agricultural vegetations, different kind of tourism services etc

Conclusions and recommendations

- The water users in a river basin are linked through the water flow, yet this link sometimes lead to sub-optimal river management, as certain activities upstream with positive impact downstream may be not economically feasible if considered in isolation. A solution is to quantify and institutionalize upstream-downstream interdependencies, whereby for example, those situated downstream compensate upstream farmers for their sustainable land use and soil and water conservation practice

Conclusions and recommendations

- Water scarcity situations encountered at river basin level have already had noticeable impacts on water supply, economy, society and environment and could be extended in the next time level 2025, 2050 years.
- Water scarcity and droughts are a transboundary issue requiring a hydrological solidarity and coordinated approaches among the countries sharing the basin



Thank you for your attention

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