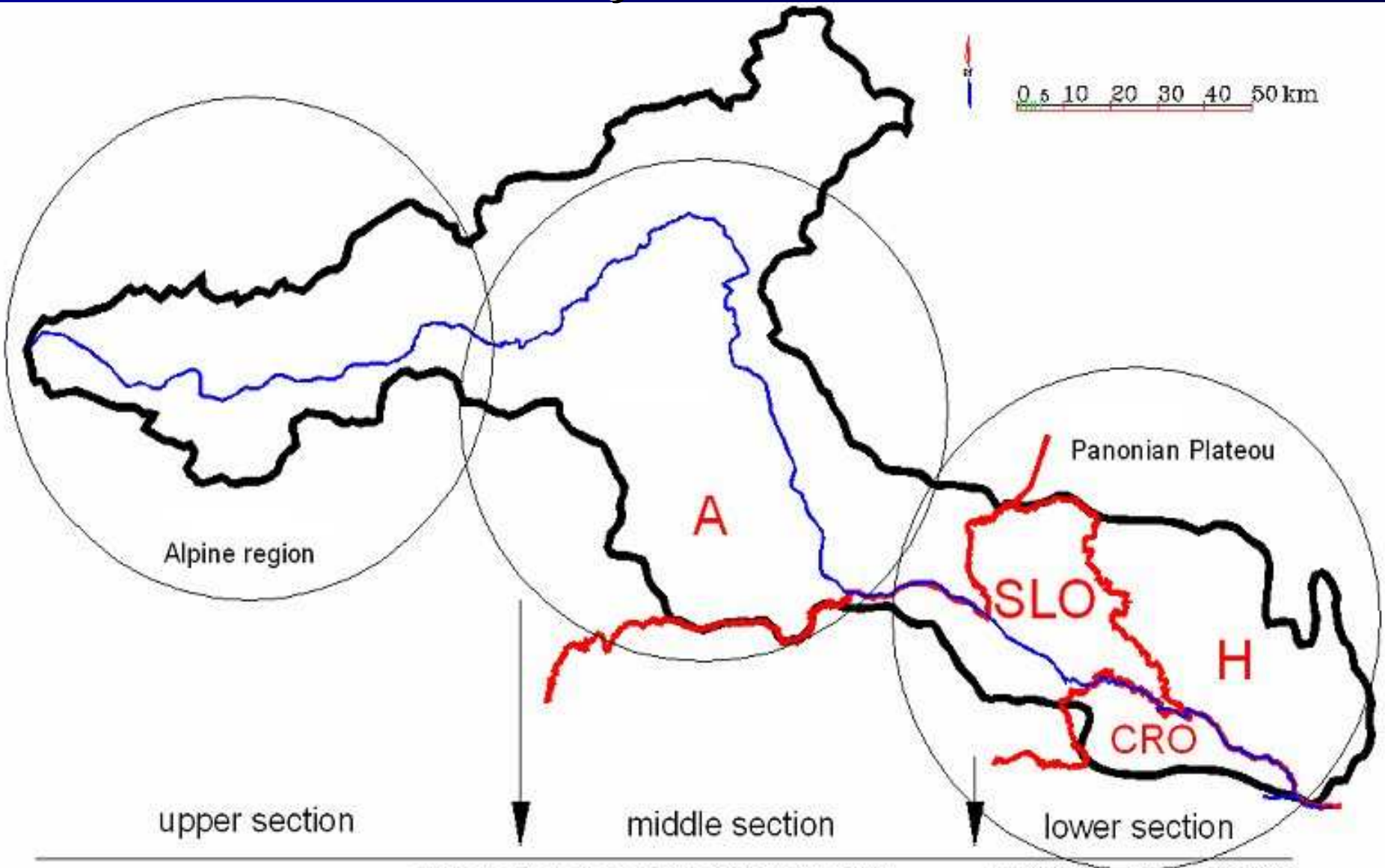
Mura

Drava

Sarajevo, 19 May 2009
Tanja Cegnar

Mura River - tributary of the Drava River



average river slope: 2.1m/1000m (0.21%)		1m/1000m	0.6m/1000m
average discharge:	150 m3/s	170 m3/s	
high water Q 1% probab.:	1800 m3/s		
Q 95%:	60 m3/s	65 m3/s	

Hydroelectric power plants in Austria straightening of river flow – much faster flow

- Altered sediment transport
- Deeper river bed (consequences for low and average flow levels)
- Enlargement of main channel and reduction in connectivity with floodplain area
- Flood protection dykes (Slovenia-Croatia)
- Lowering of ground water level – the most drought prone area in Slovenia
- Increase in alien spices and reduction in native tree spices
- Intensive drainage of wetland areas for agriculture

- Linear trends of annual average discharges and minimal discharges are negative
- Some indicators of increasing frequency of high waters
- The average ground water level close to the river indicate 30 cm lower levels, far from the river greater decrease
- Substantial water abstraction and controlled drainage of water in tributary streams stimulated extensive lowering of the river bed and increased bed erosion
- Large reduction of the natural storage capacity
- Levels of ground weather and water in the channel are mutually dependent
- Backwaters and oxbows have no connection with the river waters

Drava river
Weiden
Plzeň
Kutná Hora
Olomouc
POLAND
Jasło
Sanok
Mannheim
Nürnberg
CZECH REPUBLIC
PLZEŇSKY
Nowy Targ
Karlsruhe
Crailsheim
Strakonice
Přerov
ZILINSKY
ŽILINSKY
Regensburg
České Budějovice
Brno
SLOVAKIA
Humenné
GERMANY
Deggendorf
Znojmo
Martin
Košice
Reutlingen
Ingolstadt
Neukirchen vorm Wald
Trenčín
Uzhhorod
Banská Bystrica
Augsburg
Passau
Trnava
Ózd
Ulm
Munich
Linz
Vienna
Bratislava
Salgótarján
Miskolc
Villingen-Schwenningen
Wels
Amstetten
Schaffhausen
Kempten
Nové Zámky
Nyíregyháza
Salzburg
Sopron
Frauenfeld
Budapest
Győr
Zürich
Vaduz
Innsbruck
AUSTRIA
Székesfehérvár
Oradea
Graz
Szolnok
Veszprém
Kecskemét
ALPS
Lienz
Drava
Békéscsaba
SWITZ.
Bolzano
Bozen
Klagenfurt
Zalaegerszeg
HUNGARY
Adda
Murska Sobota
Maribor
Kaposvár
Szeged
Arad
LOMBARDY
Trento
Ljubljana
Celje
Pécs
46°
ROMANIA
Bergamo
Brescia
VENETO
Vicenza
SLOVENIA
Zagreb
Timişoara
Milan
Trieste
CROATIA
VOJVODINA
Verona
Padua
Venice
Kočevje
Osijek
Reşiţa
Novi Sad
Piacenza
Cremona
Sava
Parma
Ferrara
Novi Grad
Banja Luka
Belgrade
Genoa
Modena
Bologna
ITALY
Ravenna
BOSNIA AND HERZEGOVINA
SERBIA
Forlì
Rimini
44°
Carrara
Pistoia
Kragujevac
Lucca
San Marino
Livorno
Florence
Ancona
Sarajevo
Neretva
Niš
TUSCANY
MARCHE
Split
Perugia
DINARIC ALPS
Bastia
Foligno
Ascoli Piceno
MONTENEGRO
Grosseto
Teramo
Spoleto
Priština

Drava is a river in southern Central Europe, a tributary of the Danube.

It begins in Toblach, Italiy, and flows east through East Tirol and Carinthia in Austria, into Slovenia (145 km), and then southeast, passing through Croatia and forming most of the border between Croatia and Hungary, before it joins the Danube near Osjek.

Length: 749 km,

Source elevation: 1450 m

Basin area: 11.828 km^2

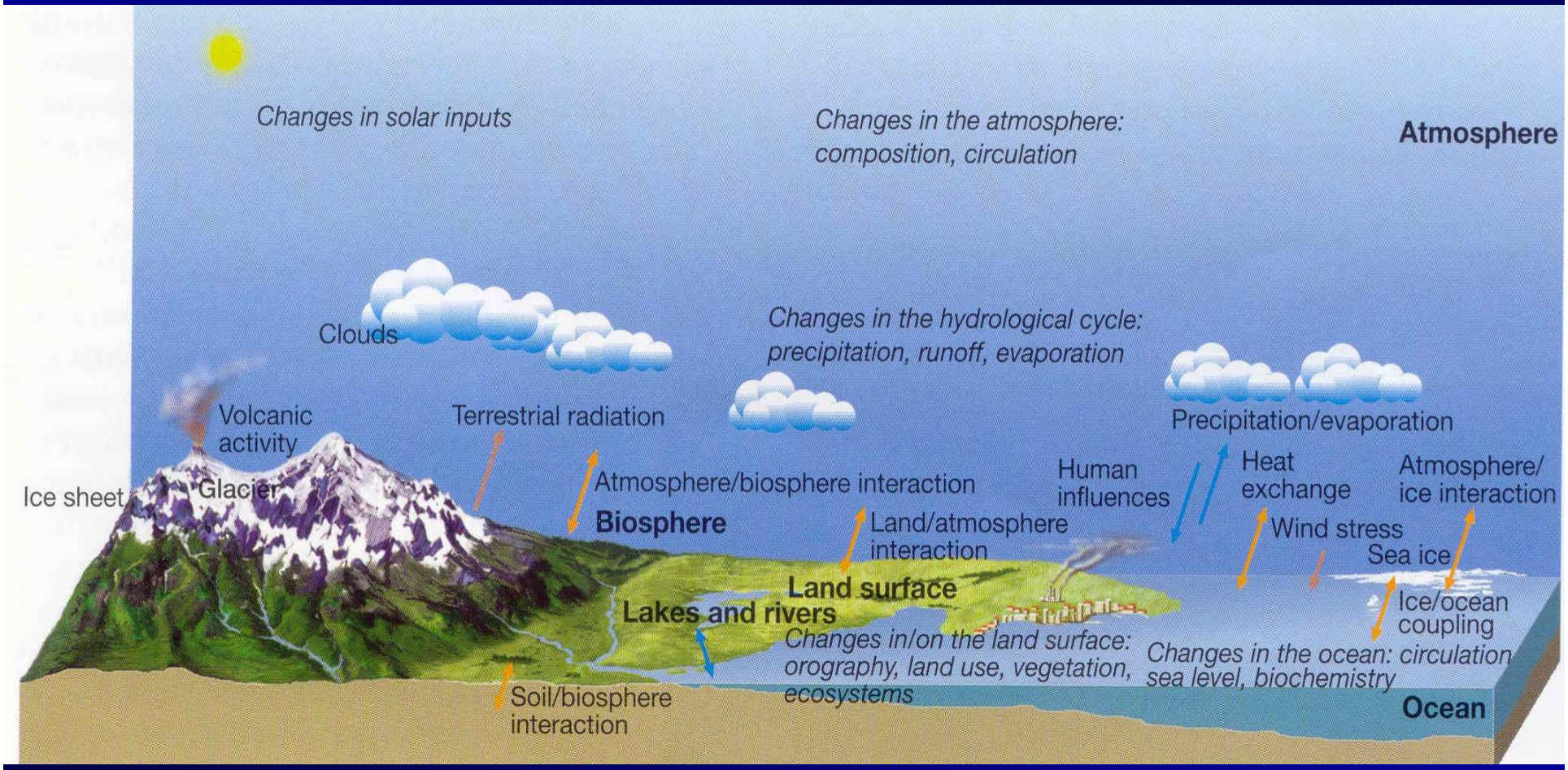
The Drava is the most important river in Slovenia in terms of its energy value.

It connects several countries and large bio-geographical regions with its specific water flow, suitable for intensive use and with a living environment worth maintaining.

Climate impact on river discharge

- Variety of climatic conditions in river basin
- Variability over time (annual cycle)
- Extreme events (climatic and weather)
- Climate change affecting water availability and consumption
- Strong interaction between climatic variables, amplification of impacts (also human induced component)
- CC results not only in trends, but also in increased variability

Complexity

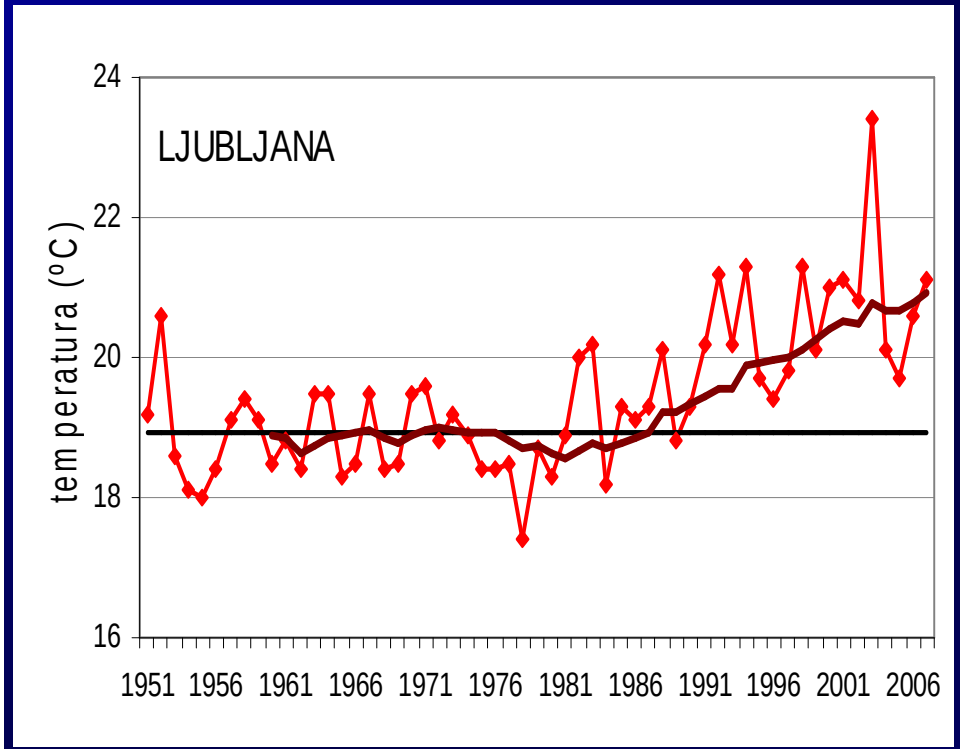

Changes in solar inputs
Changes in the atmosphere: composition, circulation
Atmosphere
Clouds
Changes in the hydrological cycle: precipitation, runoff, evaporation
Volcanic activity
Terrestrial radiation
Precipitation/evaporation
Ice sheet
Glacier
Atmosphere/biosphere interaction
Biosphere
Human influences
Heat exchange
Atmosphere/ ice interaction
Land/atmosphere interaction
Wind stress
Sea ice
Land surface
Lakes and rivers
Ice/ocean coupling
Changes in/on the land surface: orography, land use, vegetation, ecosystems
Changes in the ocean: circulation sea level, biochemistry
Soil/biosphere interaction
Ocean

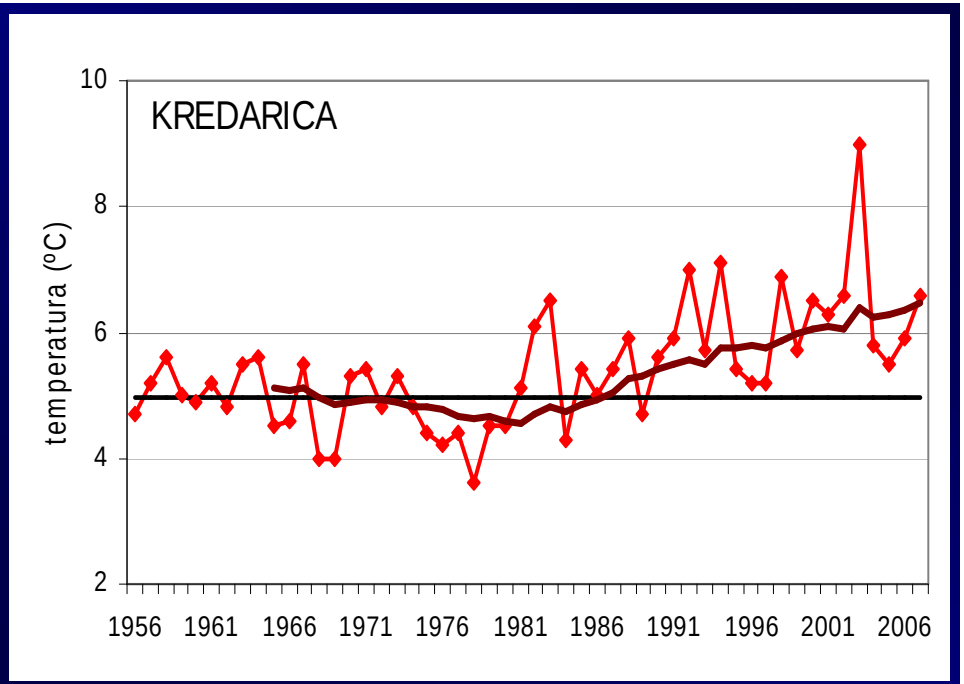
Glaciers as indicators of CC.

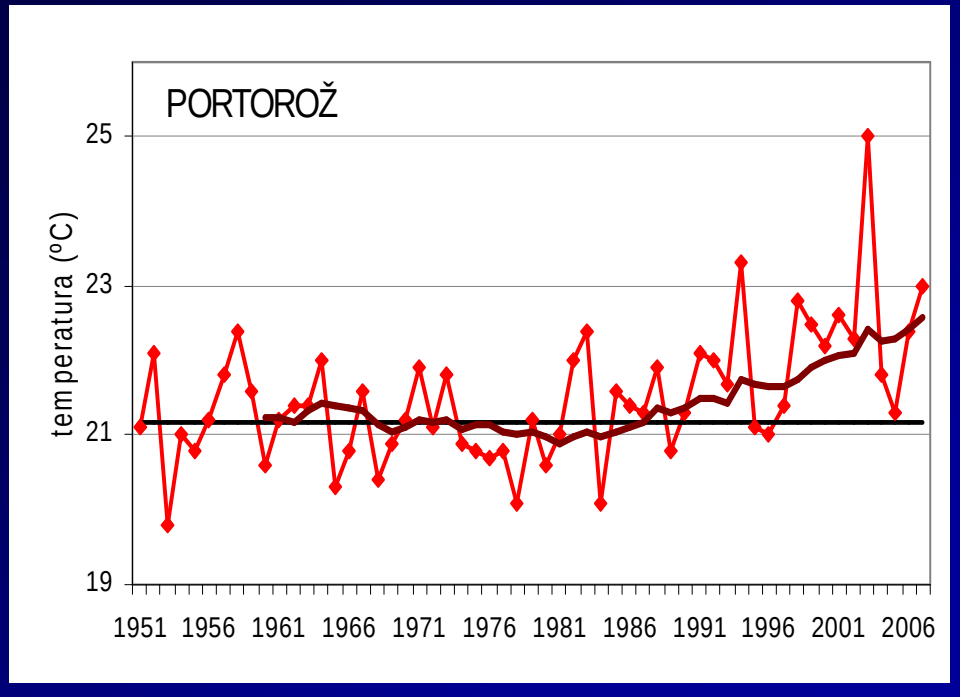
Impact of changes in precipitation, insolation and temperature on water regime (changes already observed)

Not only in spot, also at the source

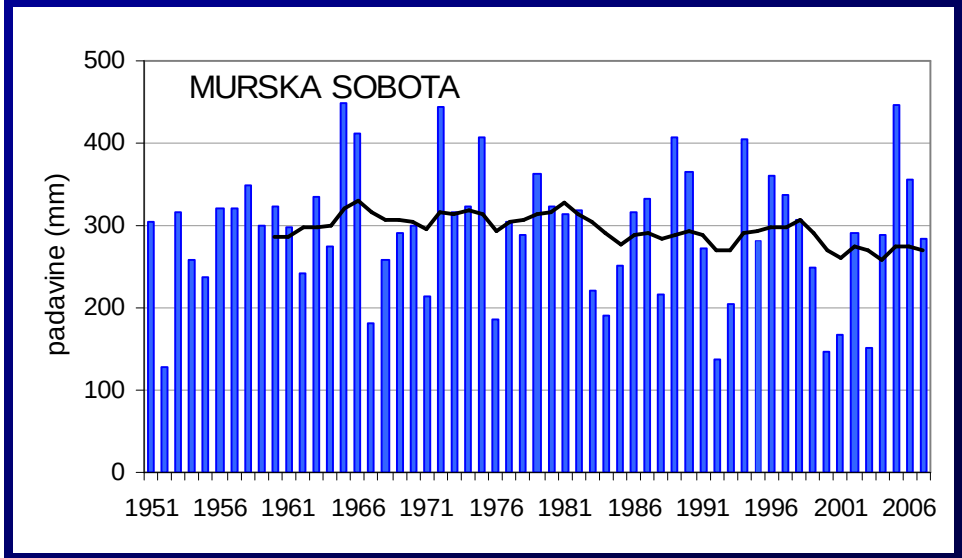
Summer temperature

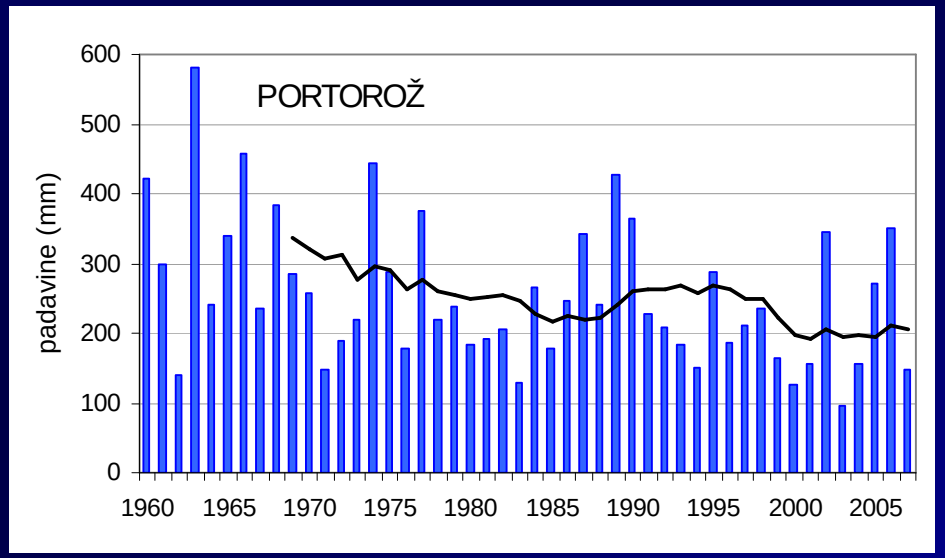


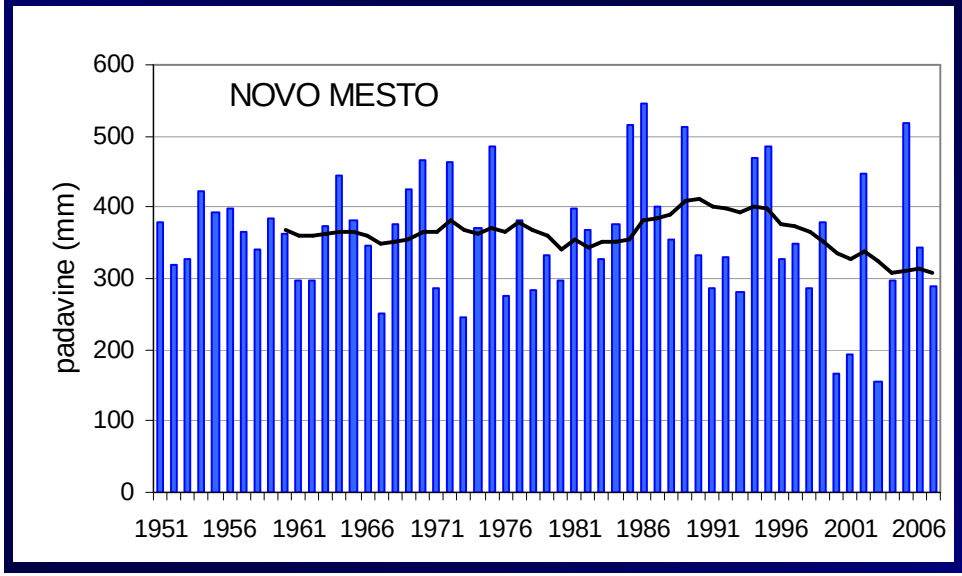


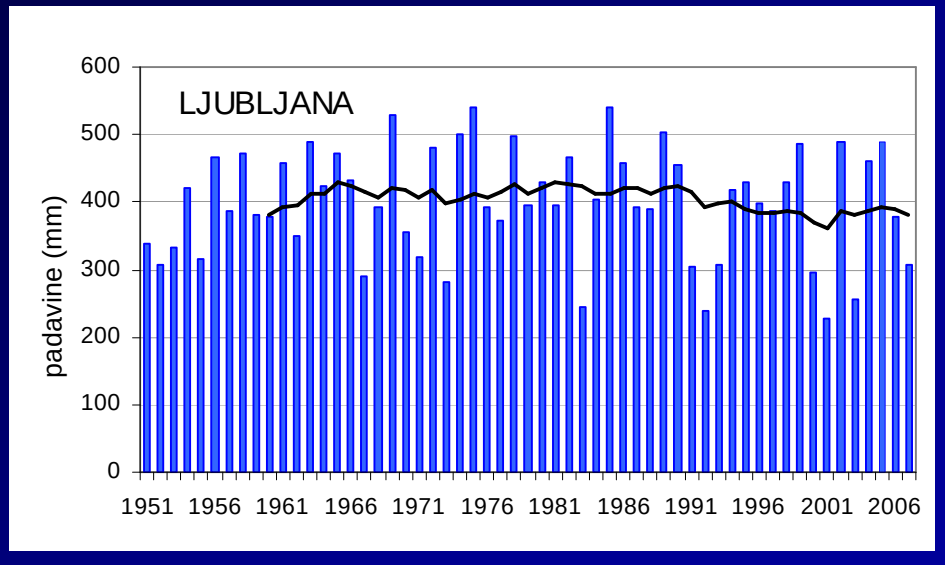


Summer precipitation





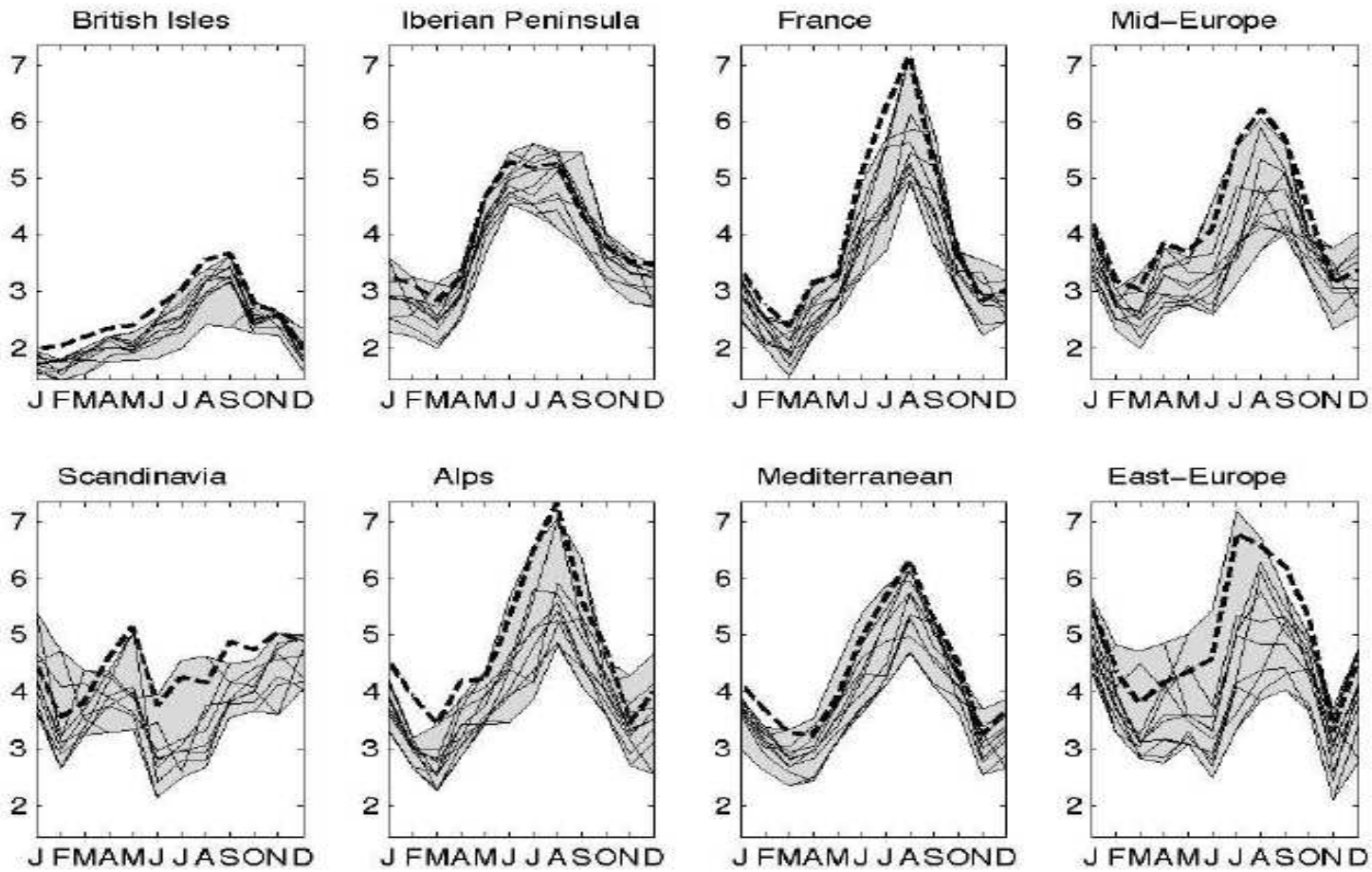




Which scenario?

Updating!!! ENSAMBLES!

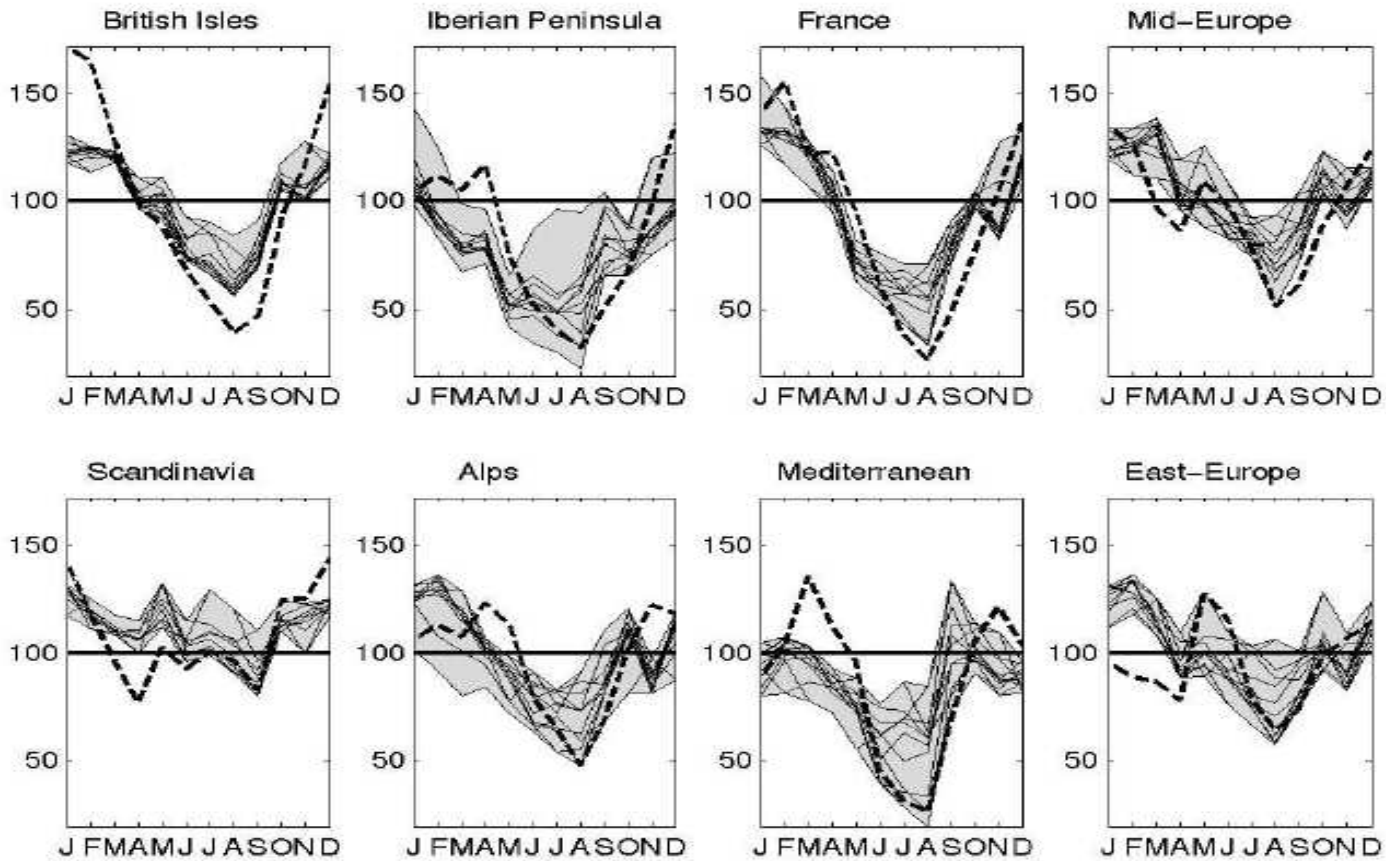
PRUDENCE: Signal in 2m-Temperature
2071-2100 minus 1961-1990, A2



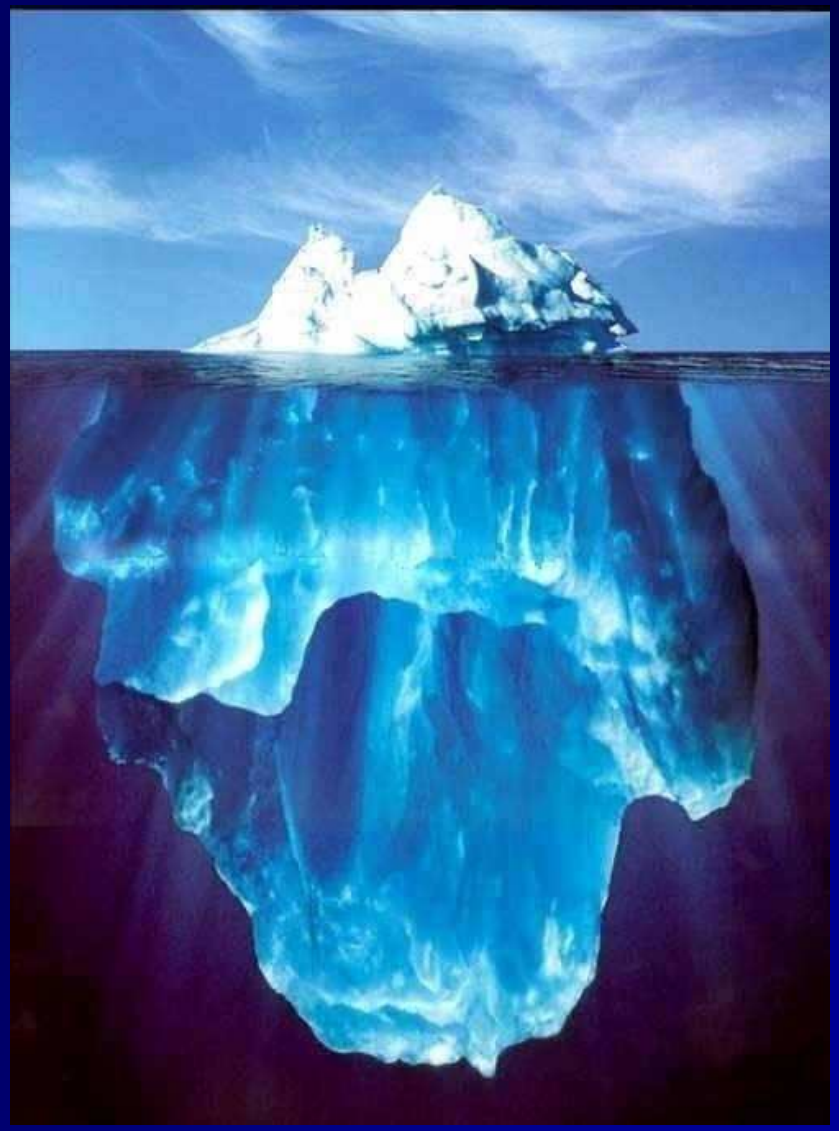
How to deal with uncertainty,

increased variability?

PRUDENCE: Signal in Precipitation 2071-2100 minus 1961-1990, A2



Observed impacts



What future will bring

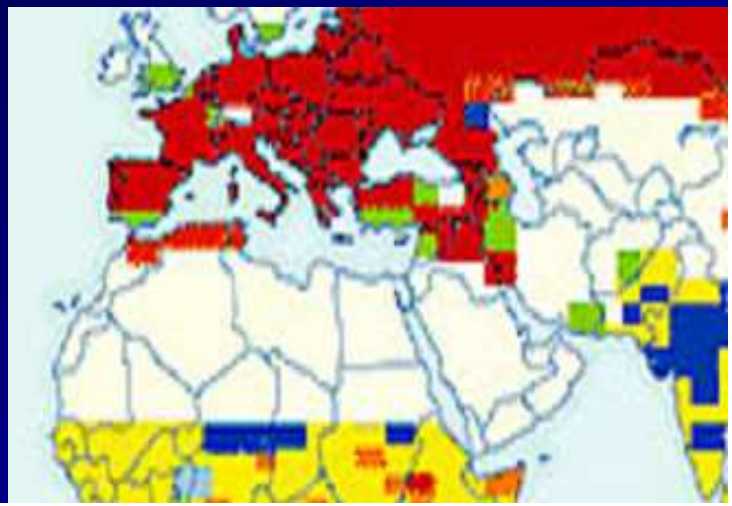
Who shall be concerned about CC?

- Water managment sector (adaptation begins with WM!)
- Farmers
- Climatologists
- Politicians
- NGOs
- Economists
- General public
- Media
- Everybody

WATER MANAGMENT and CC

Impacts (holistic approach?)
Interpretation
Feedbacks and links
Uncertainty and risk
Manipulation and information distortion
Partiality

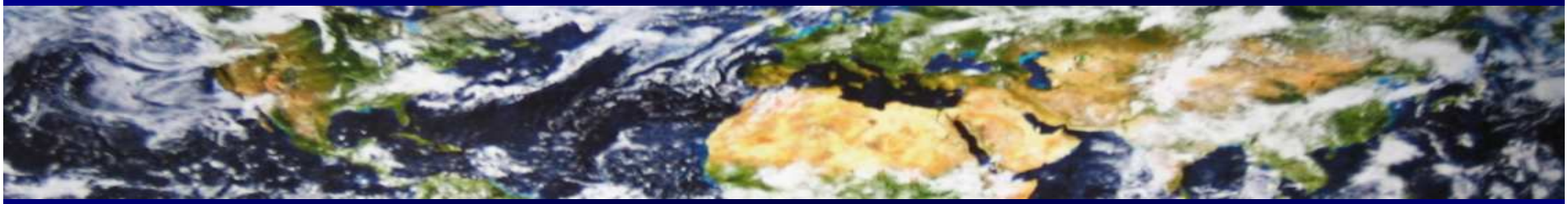
Selected information



Mitigation? Adaptation?

Today? Tomorrow?

How?



Too many info

Responsability

Decide among options

Cross sector coordination

Setting priorities

- Uncertainty about future climate should not lead into inaction
- No regret/low regret strategy
- Determine vulnerability of our environment, economy and society to climate change and identify adaptation options
- Sava River is a good example of mainstreaming of adaptation in policies of all sectors; local communities are the driving force

Adaptation?

Just wait
Persist at any price
Look for new opportunities
Give up
New technologies and new activities
Subventions
Inovative solutions and best use of exhisting resurces in new conditions
Combine resources – cooperate!

Adaptation (time scale?)

Short term measures (now and here – early warning systems)

Mid term measures (new technologies, irrigation, urbanisation,)

Long term measures (second half on this century) for long lasting infrastructure

Mainstreaming adaptation into policy at all levels and all sectors:

Integrated in all sectors, at all political levels, all regions and local communities

Natural disasters

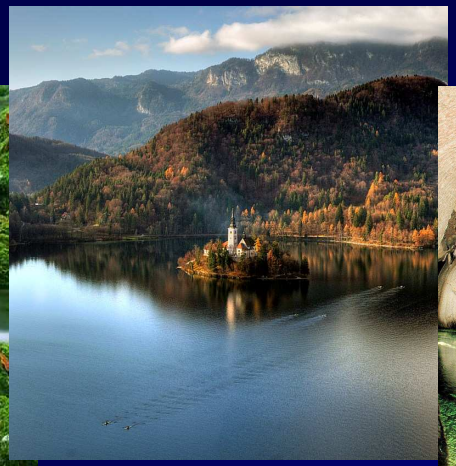
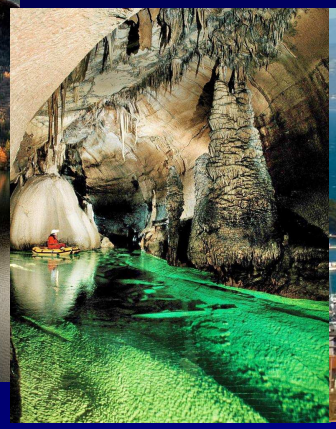
flood, draught, pollution

Under the umbrella of WMO and WMO RA VI good cooperation of NHMSs, also Sava Commission plays and important role in coordination and information exchange

Immediate measures during the adverse weather

Use media to rise the general awareness - long term measures to attenuate the effect of CC

Make use of already exhisting structures and institutions (improve their performance)

Maintenance:

- Refresh memory at the beginning of the season each year
- Continue with education process
- Keep media interested - press communications at each event,
- Performance assessment
- Science articles
- Efficiency assessment in number of savings and life quality
- Cost benefit analysis

Long-term measures:

- Education
- Rise the awareness
- Robust infrastructure
- Keep political interest vivid
- New technologies and integrated approach

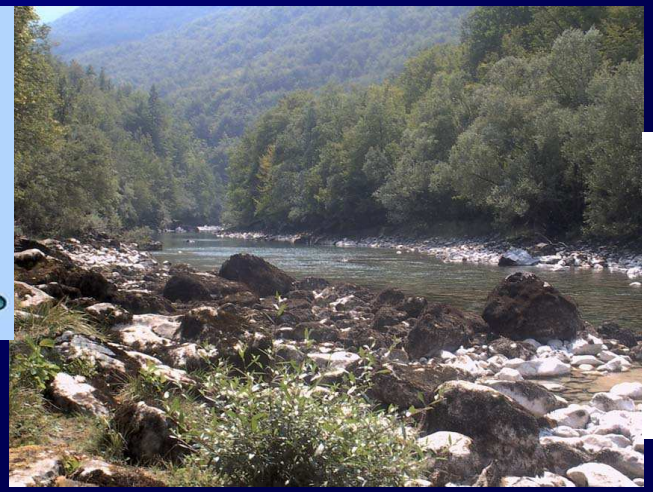
Water

Different sectors will compete for water

Priorities (water provision)

Sharing, compromise

Water Quality



- If there is a low water level also the quality of water is poor
- Due to warm weather the temperature of surface waters increase
- In summer (drought periods) the level of groundwater decrease

Need to adapt
Time to adapt is NOW

Adaptation Strategies

- Improved water use efficiency
- Diversification of economic activities
- Improve the accessibility and more tailored information for water managment
- Adaptation and integration

Interdisciplinary research:

- to identify the vulnerability to adverse impacts of climate change on water;
- to review current measures, technologies, policies and barriers to improving the adaptive capacity to climate change;
- to identify the most appropriate measures, technologies and policies and the most effective approaches to implementation in order to successfully adapt to climate change;
- to provide estimates of the benefits of specific strategies or combinations of strategies for adaptation for vulnerable segments under different climate change scenarios; and
- to estimate the costs (due to climate-related damage and the implementation of adaptive measures) and benefits (both of climate change and of adaptation strategies) including co-benefits independent of climate change.

Conclusions

- Coherence
- Flexibility
- Phased approach (step-by-step)
- Adaptation deficit
- Objectives (set prioroties)
- Measures of progress
- Partnership and cooperation
- Integration into development
- Taking stock
- Creative thinking and analysis

Messages

- Coordinated transbundary actions
- Adaptation is mandatory
- Coherence between sectors
- Platforms to share experience and knowledge (examples of good practice!)
- Vertical and horizontal coordination
- Communication is crutial; involve all stakeholders from an early stage of project