



РЕПУБЛИКА СРБИЈА
Министарство пољопривреде и
заштите животне средине
REPUBLIC OF SERBIA
Ministry of Agriculture and
Environmental Protection

Task 2 and Task 3 Water sector

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*ECRAN National climate adaptation policies and legislation
Step B: Identification of adaptation options , Zagreb 3-4 June 2015*

Climate is Changing

Increased number of:

- *summer days* ($T_{\max} > 25^{\circ}\text{C}$),
- *tropical days* ($T_{\max} > 30^{\circ}\text{C}$),
- and *tropical nights* ($T_{\min} \geq 20^{\circ}\text{C}$)

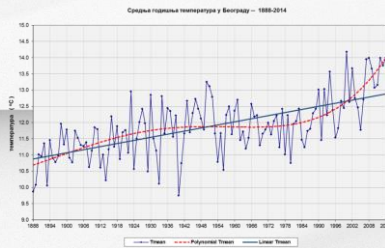
Decreased number of:

- *ice days* ($T_{\max} < 0^{\circ}\text{C}$),
- *frost days* ($T_{\min} < 0^{\circ}\text{C}$),
- and *days with strong frost* ($T_{\min} > -10^{\circ}\text{C}$)

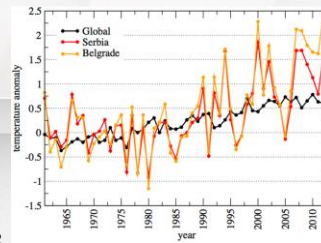
- more frequent sharp change of cold and warm weather periods within month, season or year
- more frequent intense rainfall episodes
- no significant increasing trend in annual precipitation amount

Climate is Changing

- increasing trend of air temperature 1°C from 1888-2013
- increasing trend of mean annual air temperature in Belgrade
- greater temp.increase in Belgrade and Serbia than globally
- heat waves are more frequent and last longer



1960-2012



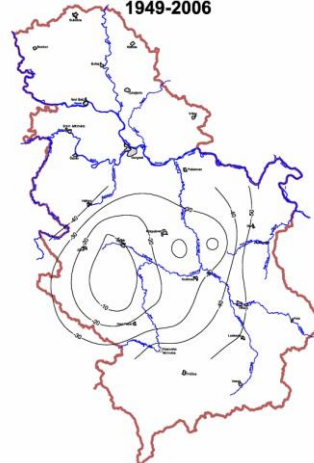
Climate is Changing

Maximum daily discharge values show a *significant downward discharge trend* almost all rivers (except the Danube and Tisza with a very slight increase) and minimum daily values have highly variable trend.

long-term average yearly hydrological trend is approximately -30%/100 years

Danube, Sava -10%/100 years

**Annual hydrological trend, (%/100 years)
1949-2006**



How much?

Temperature

2071-2100

A1B and A2 *further increase in temperature*

2011-2040 and 2041-2070

A1B: 0.5-0.9 and 1.8-2.2 °C

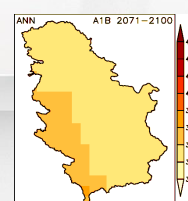
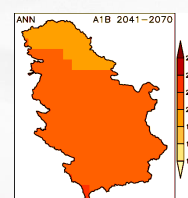
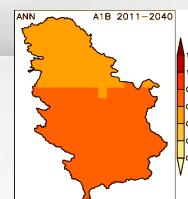
A2: 0.3-0.7 and 1.6-2.0 °C

2071-2100

A2: 3.6-4.0 °C

A1B: 3.2-3.6 °C

Warming is most pronounced during the summer and autumn season and exceeds 4.0 °C by the end of the century



GCM ECHAM5, RCM-SEEVCCC

How much?

Precipitation

According to the:

A1B, A2 we can expect *positive precip.change* for 2011-2040
2071-2100 *precip.change* is expected to become *negative*

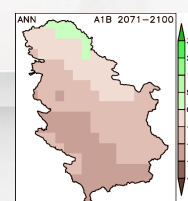
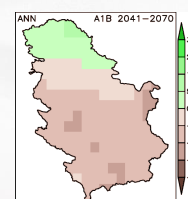
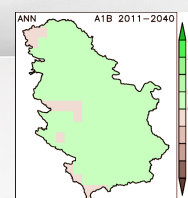
A1B:

2011-2040, 2041-2070, 2071-2100, annual precipitation is expected to be in range from + 5% to -20%

A2 scenario changes should vary from + 20% to -20%.

During the summer season deficit is most pronounced

For the summer season, less rainfall is obtained by A1B scenario compared to A2 during the period 2011-2070, while at the end of the century (2071-2100), the results obtained by A2 show a drier climate than A1B, even with a decrease over 30% in some parts of Serbia.



GCM ECHAM5, RCM-SEEVCCC

CC and Water

Project *Effects of climate change in the Kolubara and Toplica catchments*

HBV model Kolubara and Toplica rivers

A1B scenario, 2002-2030 and 2072-2100

ECHAM5/HIRHAM5, HadCM3Q0/CLM, ECHAM5/RegCM3, HadCM3Q0/HadRM3Q0, ECHAM5/RCM-SEEVCCC and ECHAM4/RCM-SEEVCCC.

CCWaterS project

groundwater resources in five pilot areas in Serbia

A1B and considered future periods were 2021-2050 and 2071-2100

VNC linear regression model - hydrological modeling

Project *Potential impacts of climate changes on water resources in Serbia*

A1B and A2, for the periods 2001-2030 and 2071-2100

VNC linear regression model

Kolubara, Mlava, Ibar and Nisava

Project *Study Water & Climate Adaptation plan for Sava river Basin – WATCAP*

Hydrological model HEC-HMS

A1B scenario, 2011-2040 and 2041-2070

ECHAM5/RACMO, ECHAM5/REMO, ECHAM5/RegCM3, HadCM3/HadRM3, HadCM3/CLM
Drina, Lim, Kolubara and Sava were analyzed.

Hydrology under Climate Change

- Different GCM+ RCM with various scenarios → input in hydrological models
- In near future period, the changes are expected to be up to 10%, but in some basins we will have the nearly equal possibility for the positive and negative changes
- 2071-2100, most of the results shows a reduction in future flows

According to obtained results:

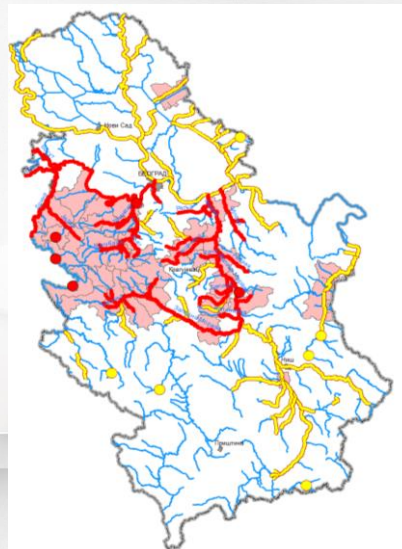
- Kolubara and Toplica River are most vulnerable with possible negative changes, 2071-2100 of about -40% compared to the referent period 1961-1990
- Drina and Lim will have moderate changes

Hydrology under Climate Change

In Serbia the sectors most affected by CC are: water sector, forestry and agriculture.
(Initial NC to the UN Framework Convention on Climate Change)

First step in the development of the *flood risk management plans* is to make a *preliminary flood risk assessment* and to determine flooding areas as areas with significant flood risk with harmful consequences for human health, the environment, economic activities and cultural heritage.

Preliminary Flood Risk Assessment (PFRA, 2012) has determine 99 significant flood areas for the territory of the RSerbia.



Potentially significant flood risk zones (APSFZ) were identified in Serbia – 99 zones

Adaptation measures

Basic adaptation measure is to implement climate change adaptation in planning documents in water sector.

The Law on Water of the Republic of Serbia calls for the development of a Water Management Strategy and River Basin Management Plans

The *Water Management Strategy*:

- Is long-term direction of water management (period is 20 years)
- harmonized with other strategic documents at the national level
- final stages of preparation and formal adoption is expected in 2015

According to the Law on Water:

- *River Basin Management Plans* are to be developed for a period of six years
- need to be adopted for the Danube River Basin and other six water districts

All planning documents, primarily the Water Management Strategy, anticipate developments, define possible solutions for all water sector segments, and consider climate and other changes

Adaptation measures

Specific measurements:

Water use:

1. Increase in efficiency of water supply systems (NR, MT) including:
2. Application of best available techniques in irrigation and cooperation with upstream countries (bilateral commissions, ICPDR, ISRBC), with respect to water quantity (LR, CLT);
3. Reduction in specific water use by industry and irrigation, especially for new industrial and irrigation systems (NR, MT);
4. Transferring water from water-abundant regions to water-deficient areas (TEAR, LT)

Water quality:

1. Wastewater treatment plants for all settlements with more than 2000 inhabitants and industrial centers (NR/LR, CLT), many of them based on priorities (NR, ST);
2. Best available techniques applied for diffuse sources of pollution that mainly originate from agriculture (LR, CLT);
3. Increase in wastewater tariffs (LR, MT).

no regrets - NR, low regret - LR, techno-economic analyses required - TEAR, short term-ST, medium term-MT, long term-LT, contlong term - CLT

Adaptation measures

Protection against the adverse effects of water:

- Development of flood protection plans for international rivers and large river basins (Danube, Sava, Tisa, etc.) (LR, ST);
- Regular maintenance and retrofit of flood protection infrastructure and drainage systems (LR, CLT);
- Increase in water storage capacity within river basins by constructing flood cells and retentions in flood-prone areas (TEAR, LT);
- Restricting building and infrastructure development in flood-prone areas (NR, MT);
- Improved flood safety, especially for high-value areas, largest industrial centers, biggest thermal power plants, etc. (LR, CLT);
- Integrated approach and harmonized activities of institutions and organizations in charge at local, regional and national levels (LR, ST/MT)

Multi-purpose measures:

- Increase in water storage capacity (TEAR, CLT);
- Transferring water from water-abundant regions to water-deficient areas (TEAR, LT)

no regrets - NR, low regret - LR, techno-economic analyses required - TEAR, short term-ST, medium term-MT, long term-LT, contlong term - CLT

Adaptation measures

Monitoring and research:

- Improving monitoring and other non-structural measures to combat droughts (LR, CLT)
- Hydrological monitoring network improvement (NR, CLT)
- Improvement of the early warning systems for extreme climate and hydrological events (NR, CLT)
- Establishment of database on extreme meteorological and hydrological events and disasters (NR, ST)
- Research improvement in the field of numerical modeling of hydrological processes (LR, CLT)
- Reinforcing research of climate change impacts on water resources (NR, CLT)
- Reinforcing multidisciplinary research of climate change impacts (LR, CLT)

no regrets - NR, low regret - LR, techno-economic analyses required - TEAR, short term-ST, medium term-MT, long term-LT, conlong term - CLT

Gaps and constrains:

The Law on Water does not explicitly address climate change impacts and adaptation measures

- Article 30: Contents of Water Management Strategy.
- Article 33: Content of water management plan and
- Article 41: Separate water management plan
- Article 49: Flood Risk Management Plans
- Article 81: Ensuring minimum sustainable flow

Other laws, Incorporate climate change adaptation measures in:

- Environmental Protection Law
- Law on Strategic Environmental Impact Assessment
- Law on Environmental Impact Assessment
- Law on Planning and Construction
- Regulation on the contents, method and procedure for the development of planning documents