Climate Change in the Tisza River Basin

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EU Legislation – December 2009 River Basin Management Plans - agreed

Climate Change analysis and measures – not included

Danube River Basin Commission ICPDR
– Tisza Analyses Report 2008 - Climate Change included
– Tisza River Basin Management Plan 2010 - Climate Change included

Tisza River Basin Analyses Report 2008

Table IV.1. Climate sensitive type parameters (highlighted in red in the table)

	Rivers	Lakes
Obligatory factors	latitude	altitude
	longitude	latitude
	geology	longitude
	size	depth
		geology
		size
Optional factors	distance from river source	mean water depth
	energy of flow	lake shape
	mean water width	residence time
	mean water depth	mean air temperature
	mean water slope	air temperature range
	form and shape of main river bed	mixing characteristics
	river flow category	acid neutralising capacity
	valley shape	background nutrient status
	transport of solids	mean substratum composition
	acid neutralising capacity	water level fluctuation
	mean substratum composition	
	chloride	
	air temperature range	
	mean air temperature	
	precipitation	

Conclusions related to the Tisza River Basin

Significant impacts on the Tisza and Danube water systems are expected, in particular*:*

Reduced average water flow
Increase in extreme events
Significant regional and local variations
Impacts on water uses not known
Changes is water quality and ecological status likely but not investigated

Practical research needs to prepare a River Basin Management Plan (scenarios):

Quantify the impacts of climate change on water quality/classification of surface and groundwater
Quantify the impacts of climate change on water quantity, its spatial-temporal distribution including extreme events such as floods and droughts
Assess the availability of surface and groundwaters under different scenarios and for different uses
Evaluate the associated costs of adaptation and the effectiveness of different protection/adaptation measures in transnational river basins
Evaluate the impacts of climate change on the re-mobilisation and re-distribution of contaminants as a result of extreme events

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Climate change in the TRB

The current chapter aiming at to highlight how the predicted climate change will impact water related ecosystems (climate change scenarios). Problems should be emphasised via TRB wide studies. The present chapter shall investigate climate proof/climate checked measures which will have positive impact on the water related ecosystems – on both water quantity/quality in the TRB. Chapter 8.5 shall take into account the relevance of climate change when listing possible integrated measures with positive impacts on the water status (on both water quality and quantity).

Climate change, including changes in temperature, precipitation and snow cover, is intensifying the hydrological cycle. In the same time, other factors such as land-use changes, water management practices and extensive water withdrawals have considerably changed the natural flows of water, making it difficult to detect climate change-induced trends in hydrological variables. It is however already clear that it is likely that extreme events such as floods and droughts will occur more frequently and with greater intensity. The impacts on low water flow may be particularly problematic. It is also known that a healthy aquatic ecosystem is more resilient to climate change impacts.

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Reasons for integrating climate change adaptation issues into river basin planning

The European Commission's White Paper "Adapting to climate change: Towards a European framework for action" (2009) calls for the promotion of "strategies which increase the resilience to climate change of health, property and the productive functions of land, inter alia by improving the management of water resources and ecosystems". It also sees a need for investigating the potential for policies and measures to boost ecosystem storage capacity for water, and for the development of guidance to ensure that River Basin Management Plans are climate proof in 2015.

In preparation for the DRBM Plan, an international conference on Climate Change in the Tisza River Basin was held in Vienna in December 2007. The conclusions from the Conference are also relevant for the Tisza River Basin

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Climate change scenarios – information on the results of climate impacts studies for the Tisza River Basin

Until the end of 2009 the results of the first climate change scenarios for the Tisza River Basin have already been reported. The following paragraphs introduces the results of the CLAVIER[1] project as well as a study on *`The Changing Annual Distribution of Rainfall in the Drainage Area of the River Tisza during the Second Half of the 21st Century`*[2]

Results of the CLAVIER project

The transient model simulations were carried out in the period of 1951 - 2050. The validation was related to the period of 1984 - 2000. The sub-basin temperature and precipitation projections were analysed together with the investigation of the impact on the flow conditions.

Mean areal precipitation and temperature

Analysing the mean areal precipitation and temperature values, computed based on the A1B scenario (periods 1961-1990 and 2021-2050), for each of the sub-basins within the Tisza River Basin the following projections can be made:

A general increase of the mean annual 2m air temperature for all of the subbasins, with 1.4 ÷ 1.6 ℃, wi th smaller changes for the spring period (0.8 ÷ 1.2 ℃) and greater changes for the other seasons, especially winter (1.5 ÷ 2 ℃);

Great spatial variability in tendencies is foreseen for the annual precipitation with a slight increase up to 3.5% in Upper Tisza mountainous catchments and overall decrease in other sub-basins with 3 ÷ 10 %, while definite increase for winter periods (14 ÷17% in Upper Tisza), and general decrease in all other seasons with some exceptions in the highly elevated parts of the Upper Tisza.

Annual and seasonal changes in the temperature and precipitation values for the Tisza River Basin are presented in **Annex 15.**

From the analysis of the mean areal precipitation and temperature values, computed based on the A1B scenario, for each of the sub-basins within the Mures, the following potential climate change can be assumed:

- A general increase of the mean annual 2m air temperature for all the basins, with 1.4 – 1.6 ℃, with sma ller changes for the spring period (1 – 1.2 ℃) and greater changes (1.5 – 2 ℃) for the other seaso ns (see Fig. 14-18);
- general decrease of the annual precipitation with -3 ÷ -5.5 %, but with an increase of 5.5 ÷ 8 % in Mures Basin in winter, and general decrease in all the sub-basins for the other seasons, going up to – 15 ÷ -25 for some sub-basins in the spring and summer months mainly (**Annex 15**).

Hydrological results - *Changes in mean flow and seasonal distribution*

REMO5.7-ERA40 (1961 – 2000) and REMO5.7-A1B (1951 – 2050) data produced by the Max Planck Institute for Meteorology, Hamburg were used as climate change scenario. These climate change simulations were first pre-processed to fit the needs of the hydrological models[3] The hydrological simulations were produced in “natural flow” conditions, without taking into account the influence of the reservoirs. The hydrological model parameters reflect the present day land used – land cover influence on the basins hydrological response. Model calibration was performed using observed historical data and regional parameters to some adjustments using the ERA40 data.

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For Tisza River and its tributaries the following are assumed

slight increase in Upper Tisza and tributaries (less than 5%) (Fig. 34-38);

No change or general decrease of the mean annual discharges, down to 15 % for Central Tisza and southern basins (Fig. 39);

The mean seasonal discharges are increasing only in winter season, in all the basins but with significant variations (3 ÷ 42 %);

For the spring – autumn period, the hydrological simulations indicate a decrease of the mean discharges for most of the catchments in southern basins between -15 ÷ -20 % (Fig. 40).

In order to estimate the A1B climate change scenario impact on the hydrological regime the variations of the **mean monthly simulated discharges** for some selected 30 years periods (1961 – 1990 as reference period and 2001 – 2030, 2011 – 2040, 2021 – 2050 as representative periods for the future) were also analysed.

The preliminary results in most cases indicate slight decrease of annual mean flow throughout the region (Fig. 46), with significant spatial variability and even some increase for the high elevation zones in the Upper Tisza sub-catchments (Fig. 47). The decrease of spring runoff is compensated by the flow resulting from thaw during late winter.

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Floods - No clear picture can be drawn about possible changes in the flood conditions. While more frequent winter floods are expected, the decrease of mean flow in some seasons is not followed by the decrease of flood peaks. Torrential type of flood events may occur even more frequently, while the frequency of floods with long duration and large volume may become lower.

Figures 50-67 show the results of statistical analyses of the annual maximum discharges for the following rivers: Upper Tisza (Fig. 50-51), Lower Tisza (Fig. 52-53), Szamos (Fig. 54-55), Sajó (Fig. 56-57), Hármas-Körös (Fig. 58-59), Aries (Fig. 60-61), Tarnava (Fig. 62-63), Mures (Fig. 64-65), Dambovita (Fig. 66-67).

Low water conditions - The study of the Lower Danube low water conditions indicates the possibility of more expressed and longer low flow periods. Some 25% increase of low water levels/discharges is possible to cause problems for the users who require considerable amount of water. The other problem is limitation of water intake. The navigability of the river section may also deteriorate to a certain extent. Figures 68, 69 and 70 present the number of low water occurrences for Mures, Lower Tisza and Lower Tisza, respectively.

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Responses to climate change

Climate changes strategies in national level in the Tisza River Basin

HUNGARY: Hungary adopted a climate change law in June 2007. On the basis of the provisions of this act Hungary is preparing a National Climate Change Strategy for the period 2008-2025. New element in this strategy in comparison with other climate change strategies is that it tries to deal with the goal of emission reduction and adaptation in a balanced and integrated manner. The strategy can provide methodological tools for other countries as well as lessons in preparation of an integrated climate change strategy.

In spring 2008 Hungary—among the very first ones in the international stage—passed a middle-term National Climate Change Strategy, which determines both the national tasks in order to reduce greenhouse gas emissions, and sectorial tasks of the adaptation to the ongoing climate change for the period of 2008–2025.

ROMANIA: In July 2005, the Government of Romania adopted, by Governmental Decision no. 645/2005, the first National Strategy for Climate Change (NSCC). By means of this Strategy, Romania is taking the first steps towards a concerted and coordinated national effort to implement policies in the field during the period of 2005-2007 with a view to limiting greenhouse gas emissions and preparing measures to adapt to the potential impacts of climate change.

According to the provisions of the NSCC, a National Action Plan on Climate Change (NAPCC) was developed. NSCC includes concrete actions meant to ensure attainment of the general and specific objectives presented in the NSCC during 2005- 2007.

SERBIA: In Serbia there is no adopted National Climate Strategies Document, yet. It is in plan for 2011. Some principles in this issue could be found in the National sustainable development strategy adopted by the Government of Republic of Serbia on May 9th 2008.

SLOVAKIA: The Republic of Slovakia do not have yet adopted a national strategy concerning climate changes. In the same time conforming to UN Commission on Sustainable Development Report Addressing climate change in national sustainable development strategies – common practices the National Strategy for Sustainable Development of the Slovak Republic.

UKRAINE: In Ukraine is no adopted a National Climate Strategies Document but in December 1999 in Kyiv, the Climate Change Initiative (CCI) established a project management and information center in Kyiv. The CCI Center provides information and links to international climate change programs and organizations. The CCI Center maintains a database of all climate change activities in Ukraine. The CCI focused on institutional strengthening, development of climate change policy, investment in GHG mitigation projects, and increased involvement of non-governmental organizations (NGO) and industry in climate change activities.

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Thank you