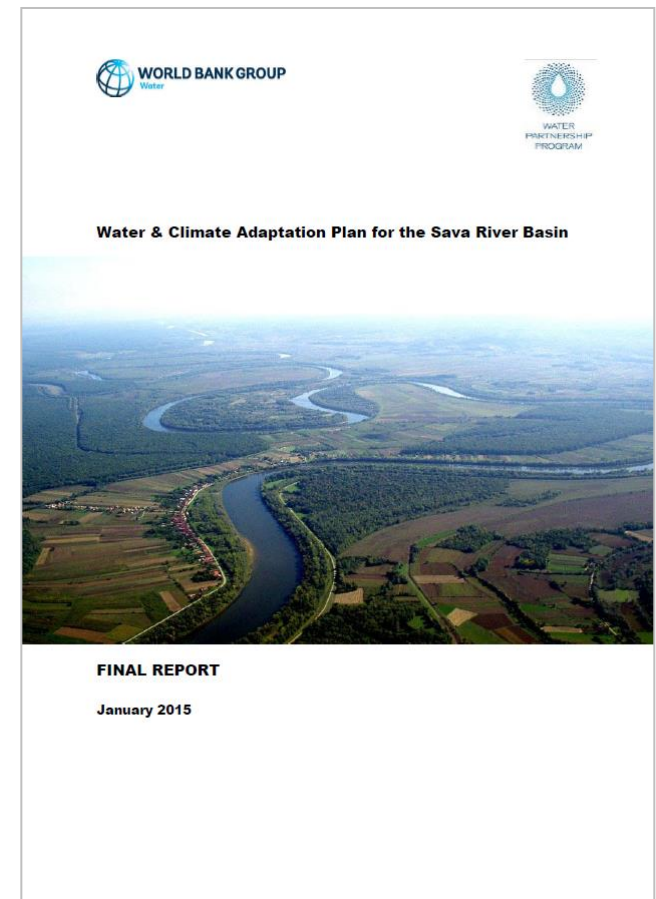


# **Guidance Note on Inland Navigation and Adaptation to Climate Change in the Sava River Basin**

Dusko Isakovic, ISRBC

# Introduction

- **Water and Climate Adaptation Plan** for the Sava River Basin
  - **Analysis of historic climate trends**
  - **Climate and hydrological modelling**
  - **Main report + Guidance notes**
    - Navigation
    - Hydropower
    - Agriculture
    - Flood protection
    - Economic evaluation of CC impacts
- **All outcomes posted on the ISRBC web-site** (Sept. 2015)



## PARTNERS

- The WATCAP was prepared utilizing a combination of World Bank staff and external consultants.
- The main beneficiaries of the final report are the International Sava River Basin Commission (ISRBC) and the relevant riparian governments of Bosnia and Herzegovina (BiH, involving the entities of Republika Srpska [RS] and Federation BiH [FBiH]), Croatia, Montenegro, Serbia, and Slovenia.

## Financing

- World Bank's Water Partnership Program (**WPP**), a multi-donor trust fund that promotes water security for inclusive green growth
- Trust Fund for Environmentally & Socially Sustainable Development (**TFESSD**)

# Consultations (with peer reviewers)

- ISRBC
- World Bank
- HEIS, Bosnia and Herzegovina

# Final report

- The final report was prepared by COWI of Norway and includes contributions from multiple authors
- The final WATCAP report was presented at the Fifth Meeting of the Parties in Zagreb, held at the Croatian Water Offices on December 2, 2014.

# Climate modelling

- **5 GCM/RCM outputs** for A1B IPCC/SRES scenario (ENSEMBLES FP6 project, <http://ensemblesrt3.dmi.dk/>)
  - 1961-1990 (Baseline)
  - 2011-2040 (Near future)
  - 2041-2070 (Distant future)

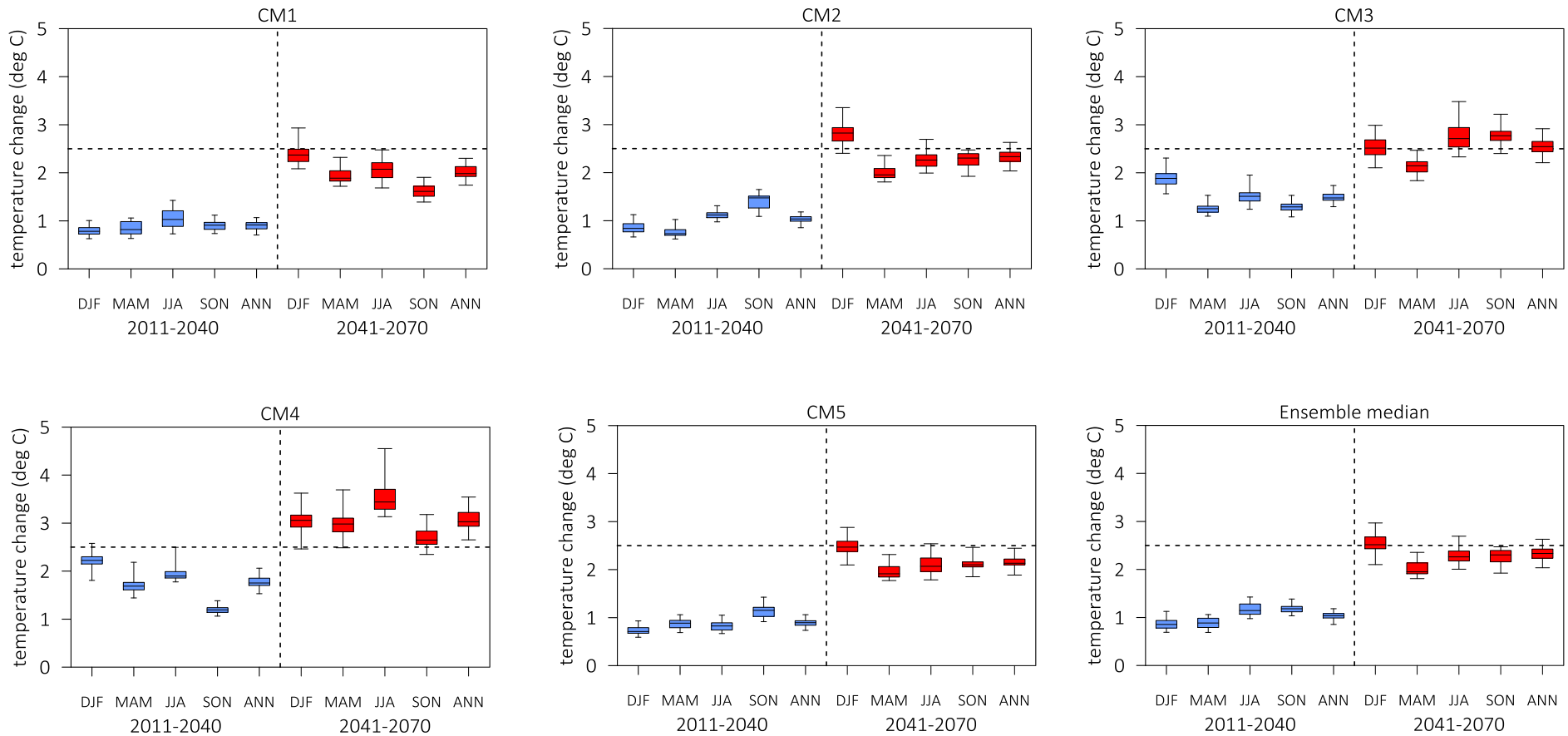
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<b>Climate model</b>	<b>GCM</b>	<b>RCM</b>
CM1	ECHAM5r3	RACMO
CM2	ECHAM5r3	REMO
CM3	HadCM3Q0	CLM
CM4	HadCM3Q0	HadRM3Q0
CM5	ECHAM5r3	RegCM3

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# Climate modelling

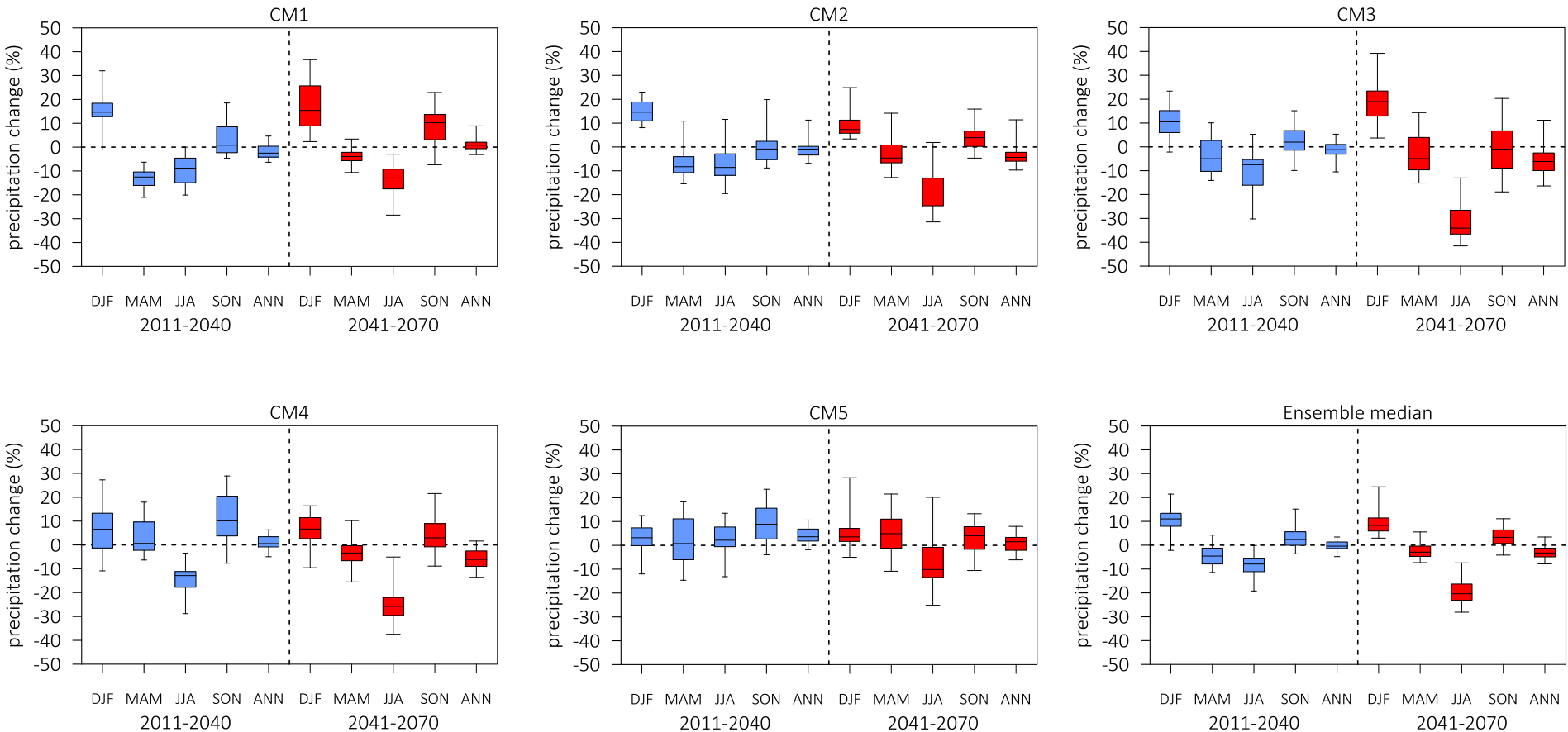
- Temperature scenarios**





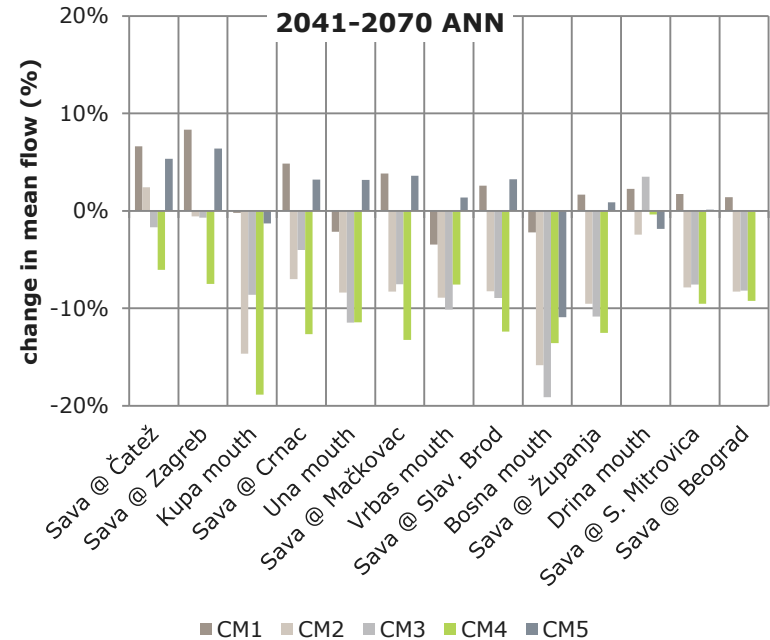
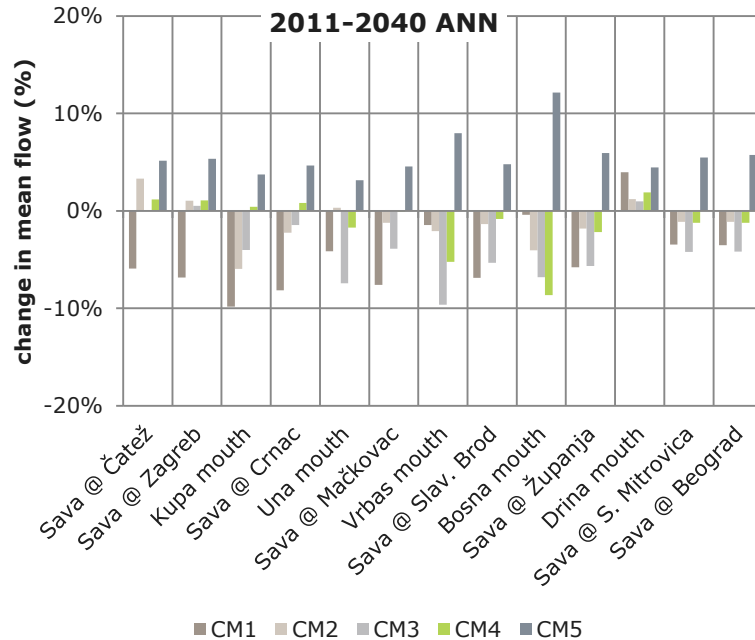
# Climate modelling

- Precipitation scenarios**



# Hydrologic modelling

- **Change in mean annual runoff**  
at selected locations for five climate scenarios

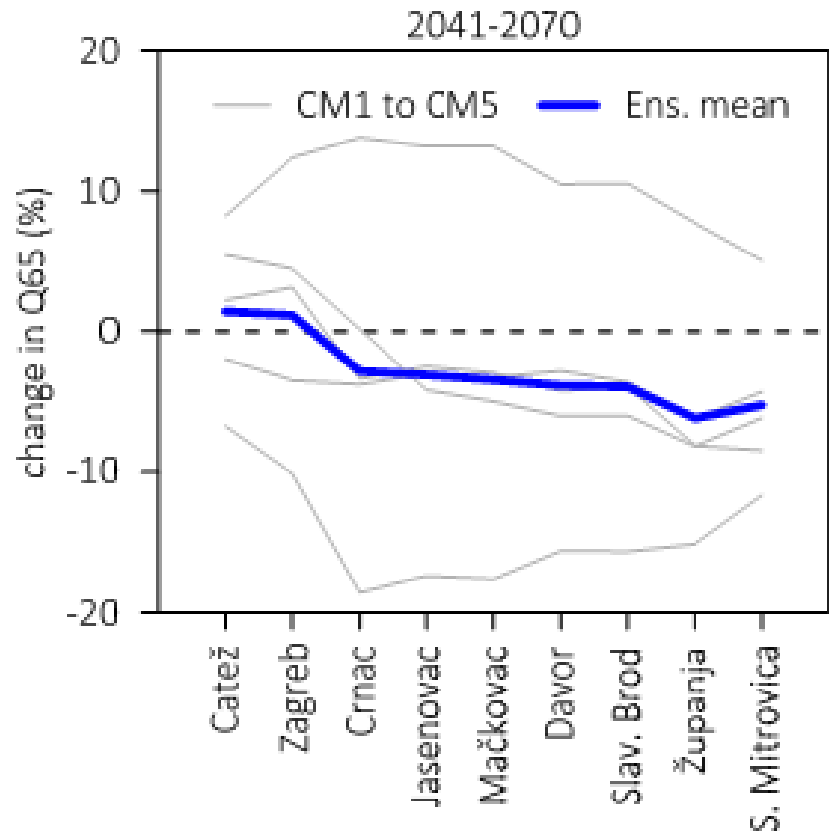
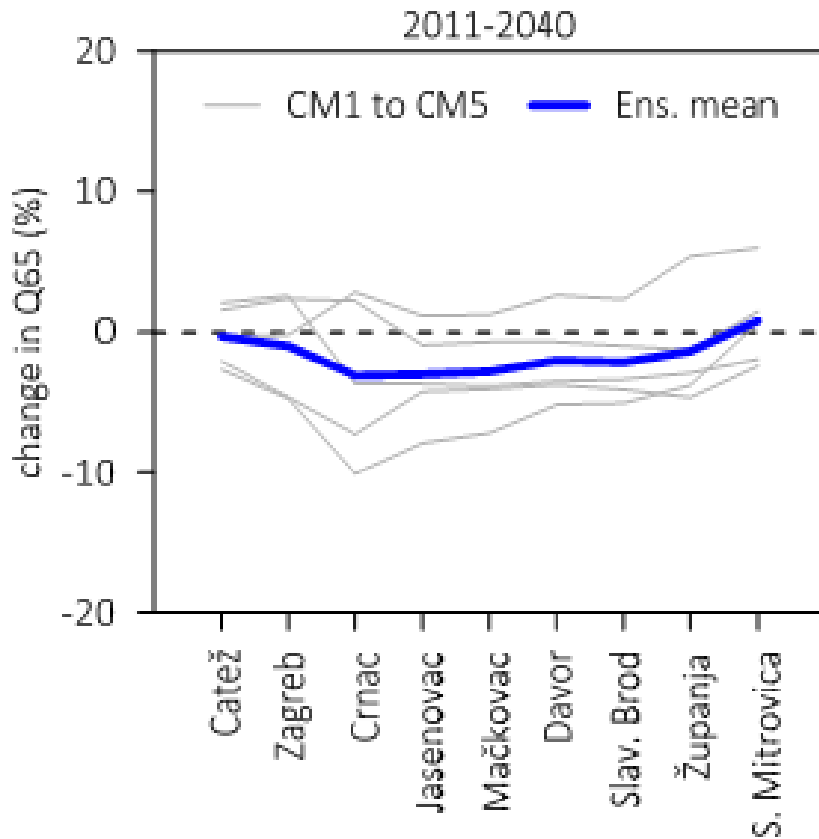


# Potential CC impacts

- **Climate-related restrictions of inland navigation** are due to:
  - Low flows (hydrologic regime)
  - High flows (hydrologic regime)
  - River ice (hydrologic regime, water temperatures)
  - Visibility – fog (air humidity, air temperatures)
- **Changes may affect the number of days per year** that waterways can be used without restriction

# Assessment of CC impacts

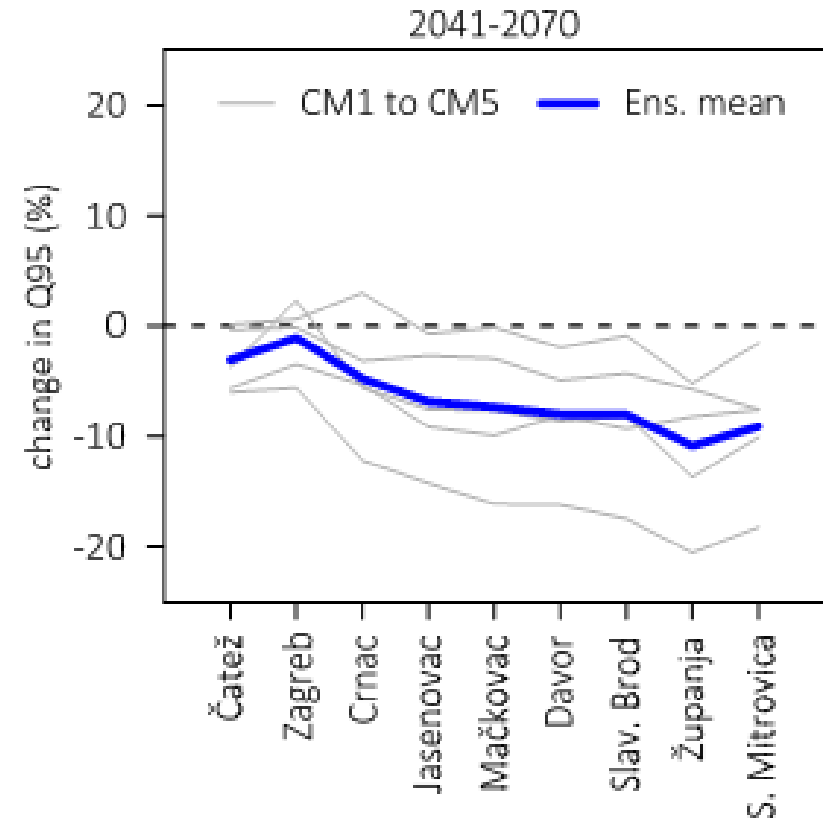
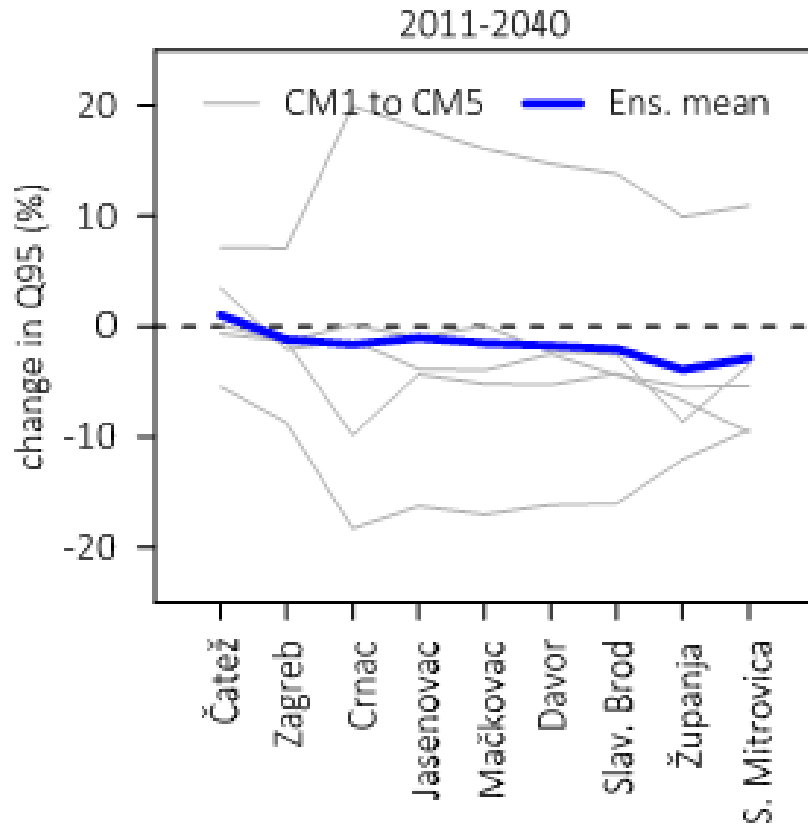
- **Low flows:**
  - Q65 (Navigation with maximum draft)



# Assessment of CC impacts

- Low flows:**

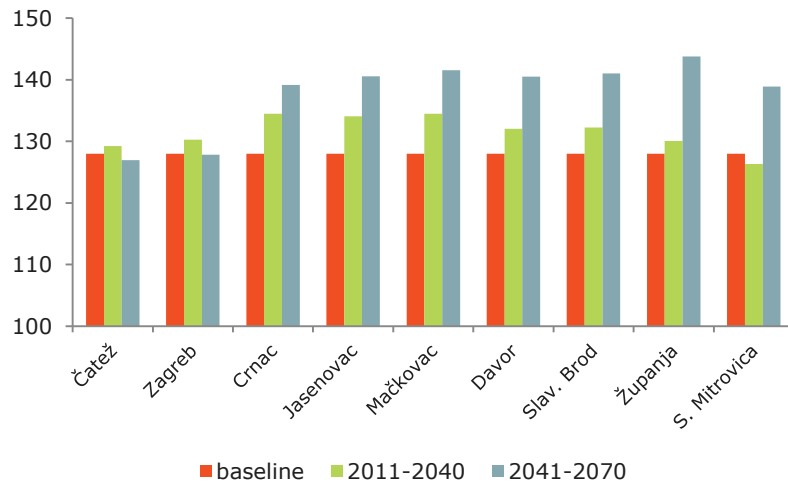
- Q95 (Navigation with a reduced draft) --- Low navigable level



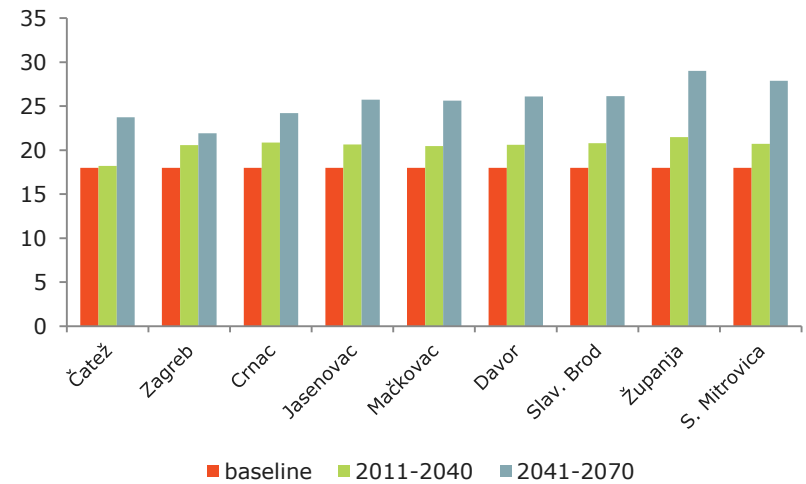
# Assessment of CC impacts

- **Low flows:** increase of number of days below standard levels

**Number of days with flows below Q65(1961-1990)**

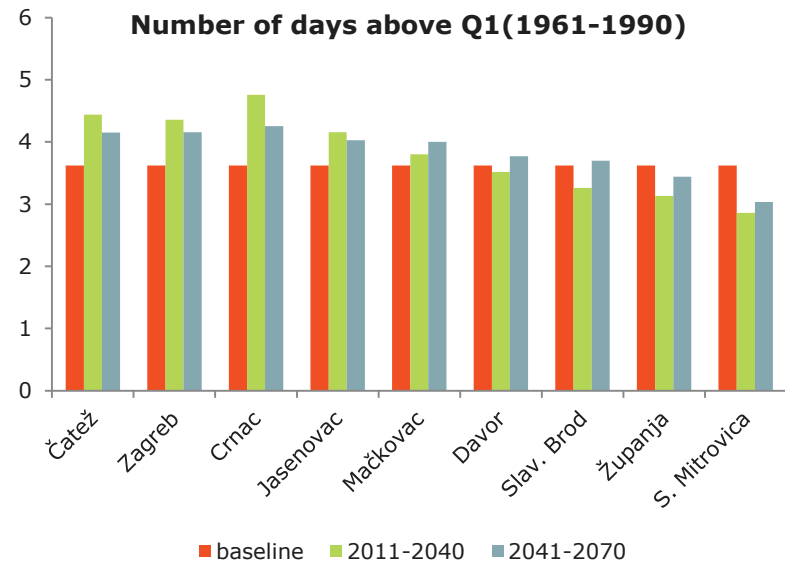
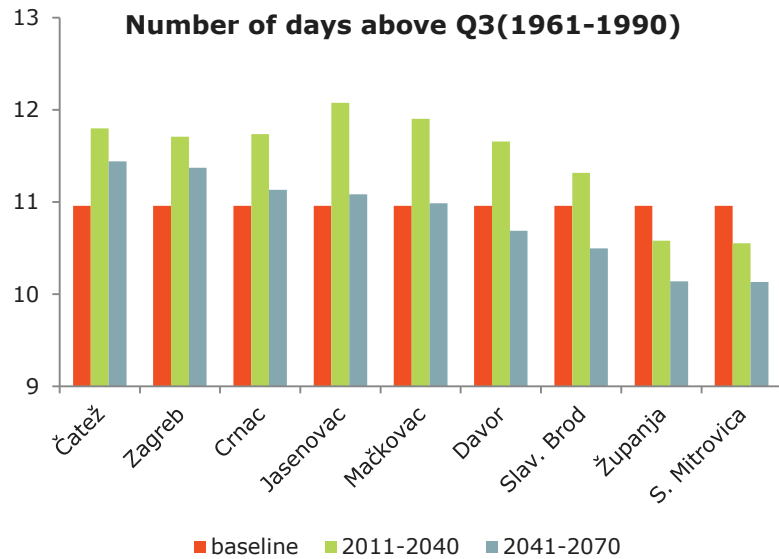


**Number of days with flows below Q95(1961-1990)**



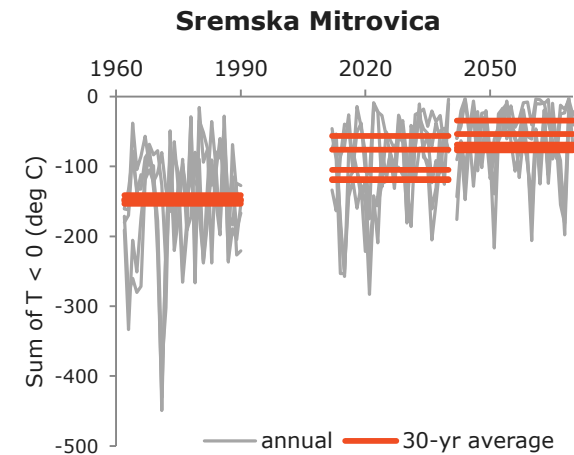
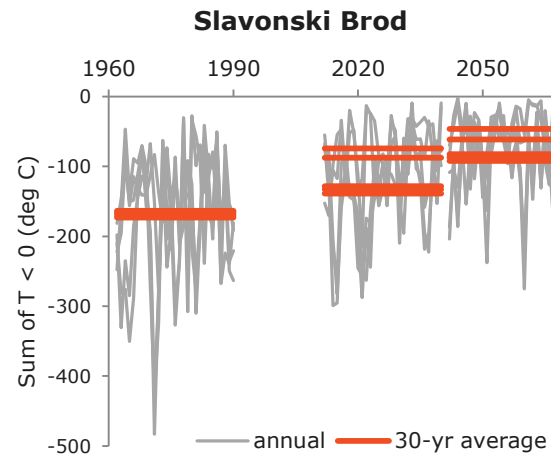
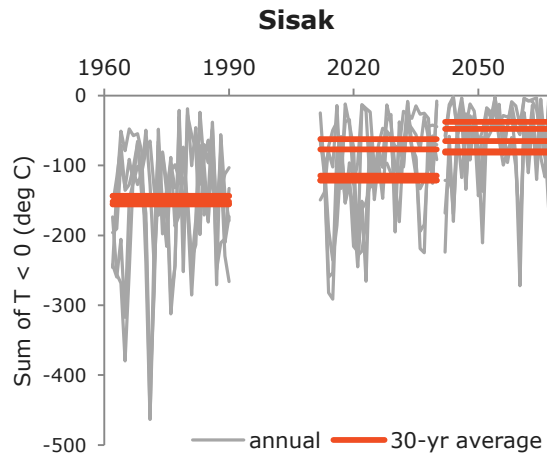
# Assessment of CC impacts

- **High flows:** no change



# Assessment of CC impacts

- **Ice:** reduction of days with ice

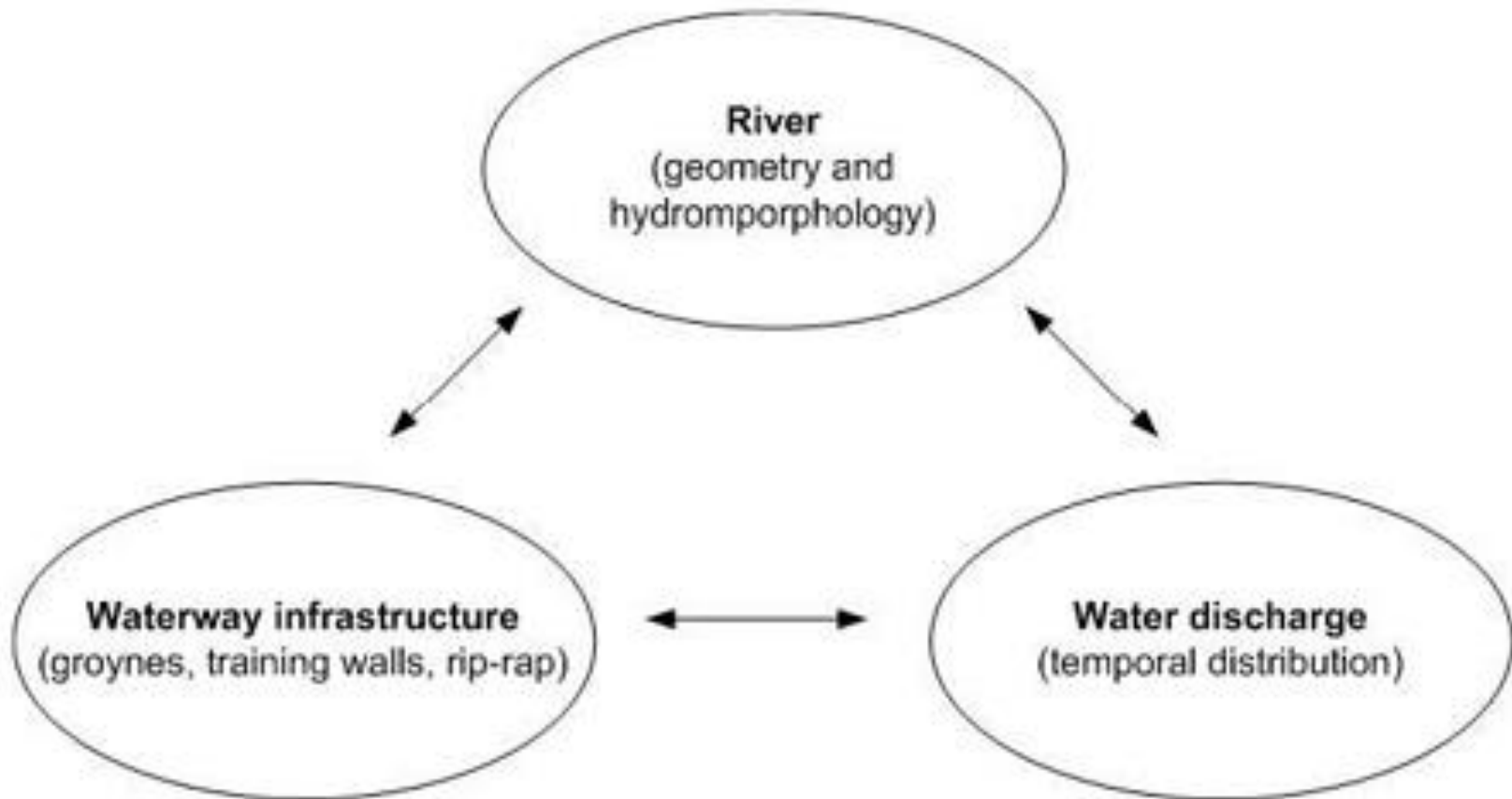


sum of air temperatures below 0°C



# Possible adaptation approaches

Interconnection of factors relevant for navigation and fairway parameters



# Possible adaptation approaches

Area of Intervention	Response (measure)	Additional Information
Waterway design and maintenance	<ul style="list-style-type: none"> <li>• Creation of water storage</li> <li>• Deepening of channels instead of widening</li> </ul>	<ul style="list-style-type: none"> <li>• (Upstream) reservoirs needed for flood mitigation can also be used to improve navigation</li> </ul>
Waterway operation	<ul style="list-style-type: none"> <li>• Managing water flow</li> <li>• Improving forecast of water level</li> <li>• Improved queuing procedures</li> <li>• Implement River Info System (RIS)</li> <li>• Provide up to date electronic charts</li> </ul>	<ul style="list-style-type: none"> <li>• Store water in times of high water flow and release in times of low flow</li> <li>• Better information and decision support systems and automation of queuing will help overcome capacity restriction</li> <li>• RIS in general support safe and efficient navigation</li> <li>• Better information to optimise use of vessels</li> </ul>
Transport management	<ul style="list-style-type: none"> <li>• Chartering additional vessels</li> <li>• Increasing daily operation times</li> <li>• Cooperation with other transport modes</li> <li>• Increasing storage of goods</li> </ul>	<ul style="list-style-type: none"> <li>• Contractual arrangements with road and rail transport companies can be made for time of reduce navigability</li> </ul>
Vessel operation	<ul style="list-style-type: none"> <li>• Using state of the art electronic chart display and info system (ECDIS)</li> </ul>	<ul style="list-style-type: none"> <li>• Provide always up to date information</li> </ul>
Vessel design	<ul style="list-style-type: none"> <li>• Reduction of weight</li> <li>• Increasing width</li> </ul>	<ul style="list-style-type: none"> <li>• Using alternative design/material or install lighter equipment</li> <li>• Wider vessels need less draught</li> </ul>

# Priority adaptation measures

- **Preparing for adaptation**

- Better monitoring of water levels
- Improved hydrological forecasting

- **General measures**

- Promoting river transport on Sava will enhance the competitiveness of river transport relative to other modes of transportation
- Providing sufficient water depth in times of low water flow

- **Ecosystem based measures**

- Definition of navigation fairway conditions according to ecological needs
- Combining any increased water storage to support navigation infrastructure with habitat creation initiatives

# Priority adaptation measures

- **Management measures**

- Low flows augmentation by better reservoir management
- Increasing the share of river transport in total transport of goods
- Look to changes in industrial production leading to lower transport requirements, or shifting transport towards the season with higher river levels

- **Technological measures**

- Adaptation / creation / modernisation of waterways and ports
- Support container shipping with shallow draft vessels
- Fleet modernisation



**Thank you for your attention!!!**

**Duško Isaković, ISRBC**