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Joint Research Centre

Danube Water Resources Outlook Until 2050

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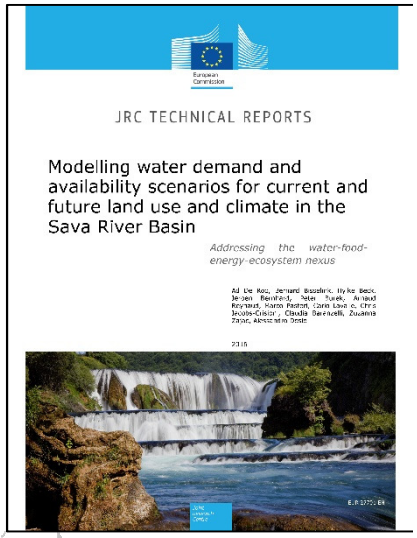
JRC's Danube Nexus studies

Water-Energy-Food-Ecosystem nexus

- The climate is changing: **water supply will change**
  - 2015 Paris agreement;
  - Used: latest Euro-CORDEX scenarios < 2 degree (bias-corrected)
    - RCP 8.5: ~2045
    - Lower emissions: later in 21st century
- Changing landuse, GDP, population: **water demand will change**
  - JRC's LUISA land use projection system > 2050
- **Measures** are and will be taken: additional change
  - WFD, FD, new CAP etc

What will the **impact be on Danube water resources?**

- Case study Sava (report published)
- **Close collaboration with ISRBC Sava Commission**
- Case study Danube (this presentation)



With help from many Danube experts!

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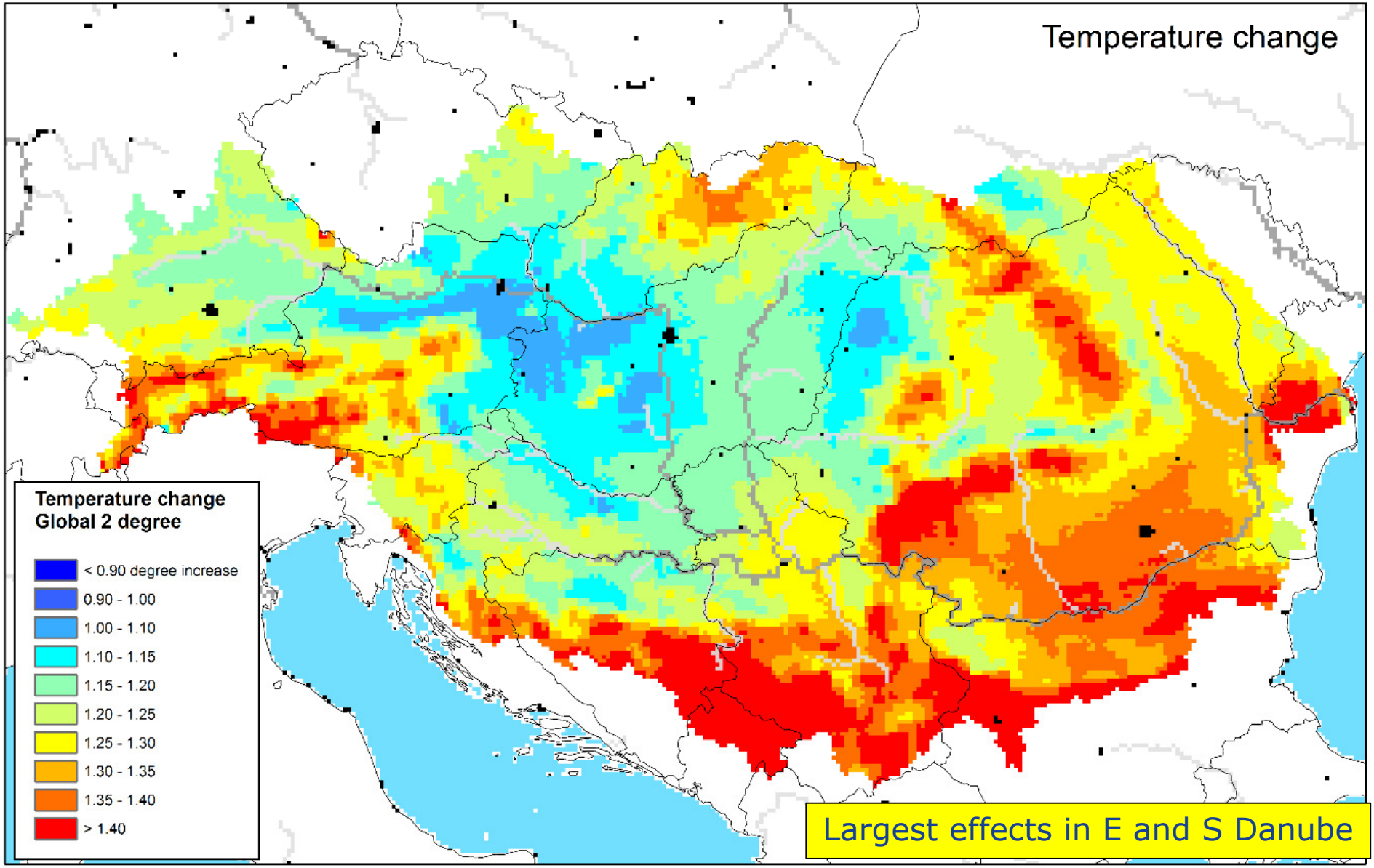
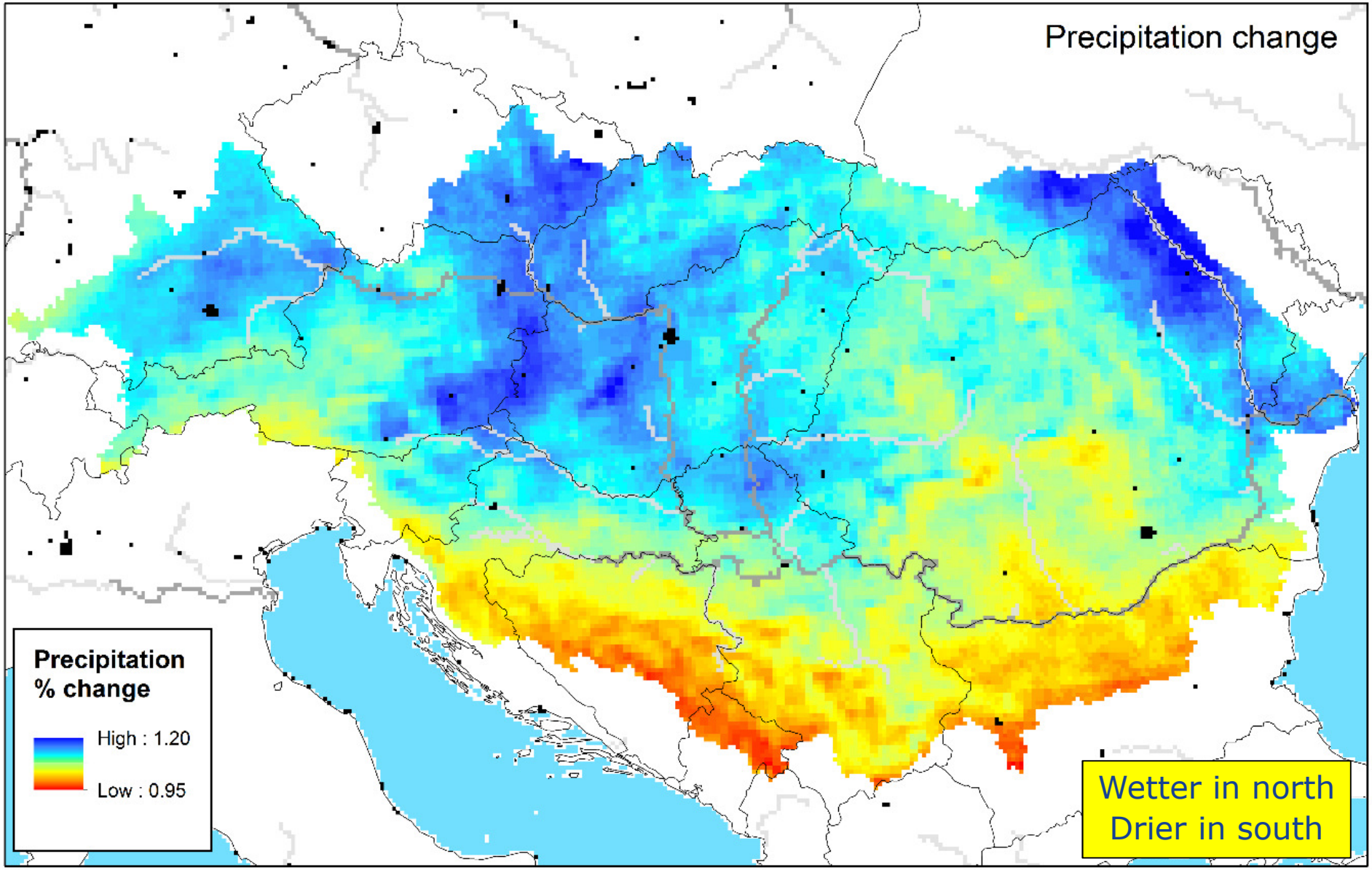
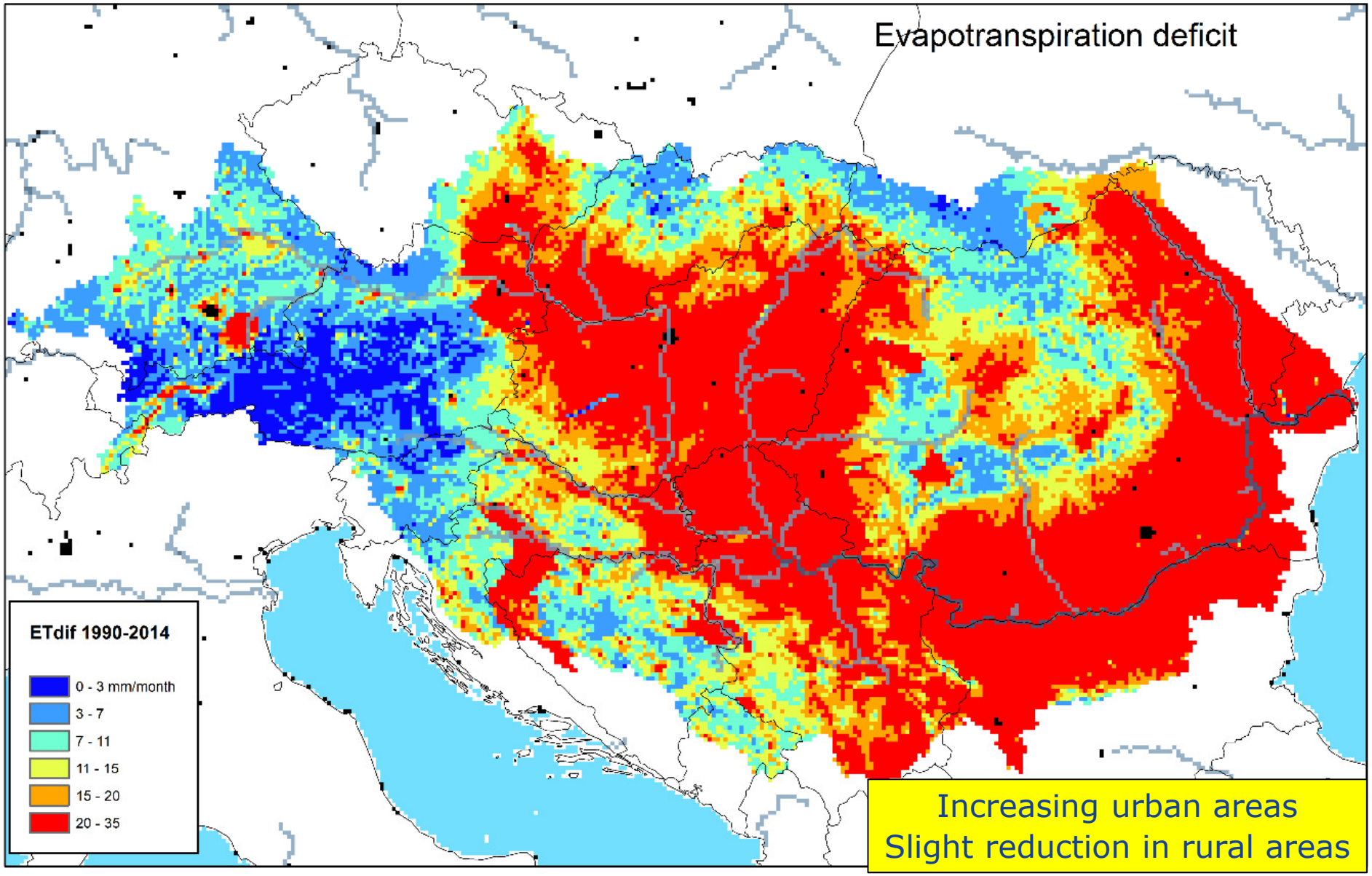
Temperature change under 2 degree global temperature increase (2 degree point <> climate 1980-2010)



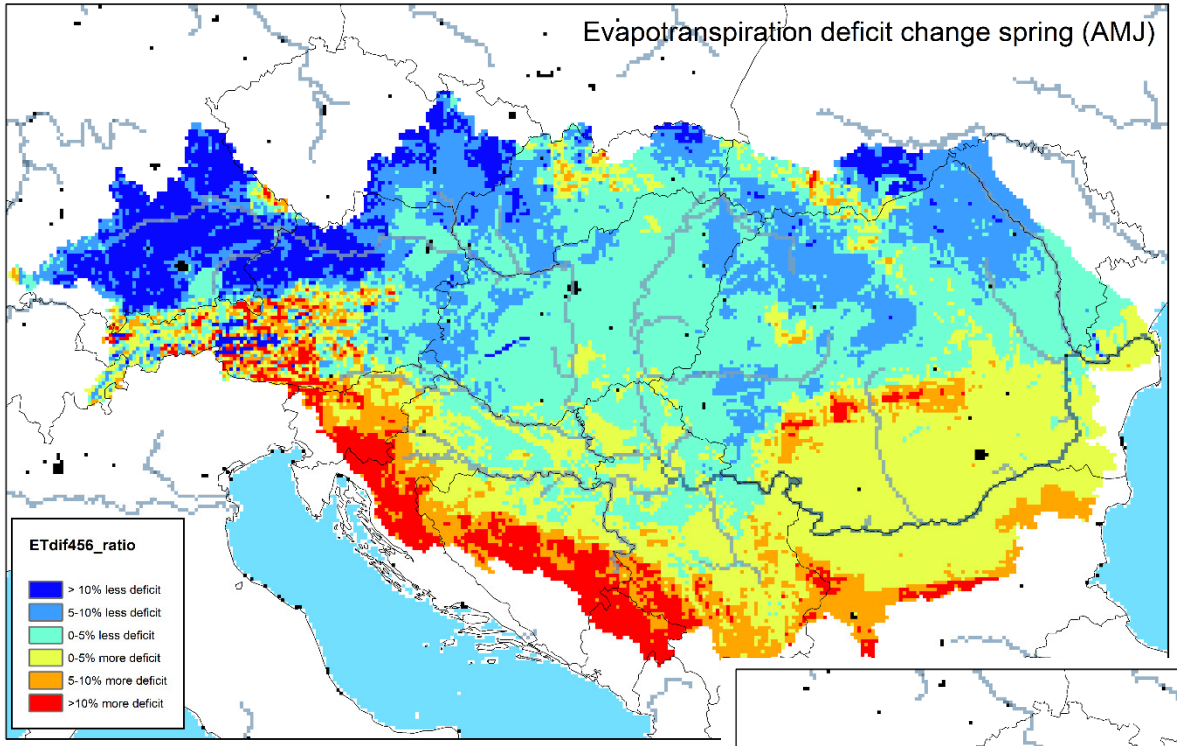
Precipitation change under 2 degree global temperature increase (2 degree point <> climate 1980-2010)

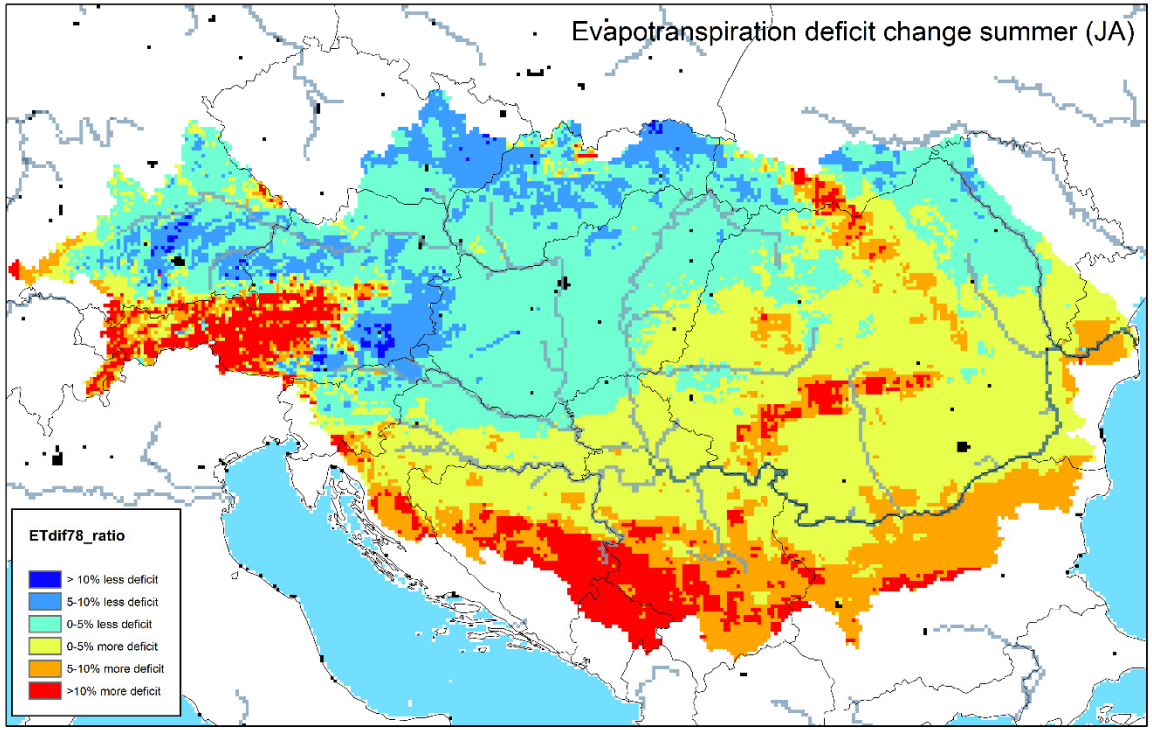


Evapotranspiration deficit (1990-2014 climate) (indicator for rainfed agriculture water shortage)

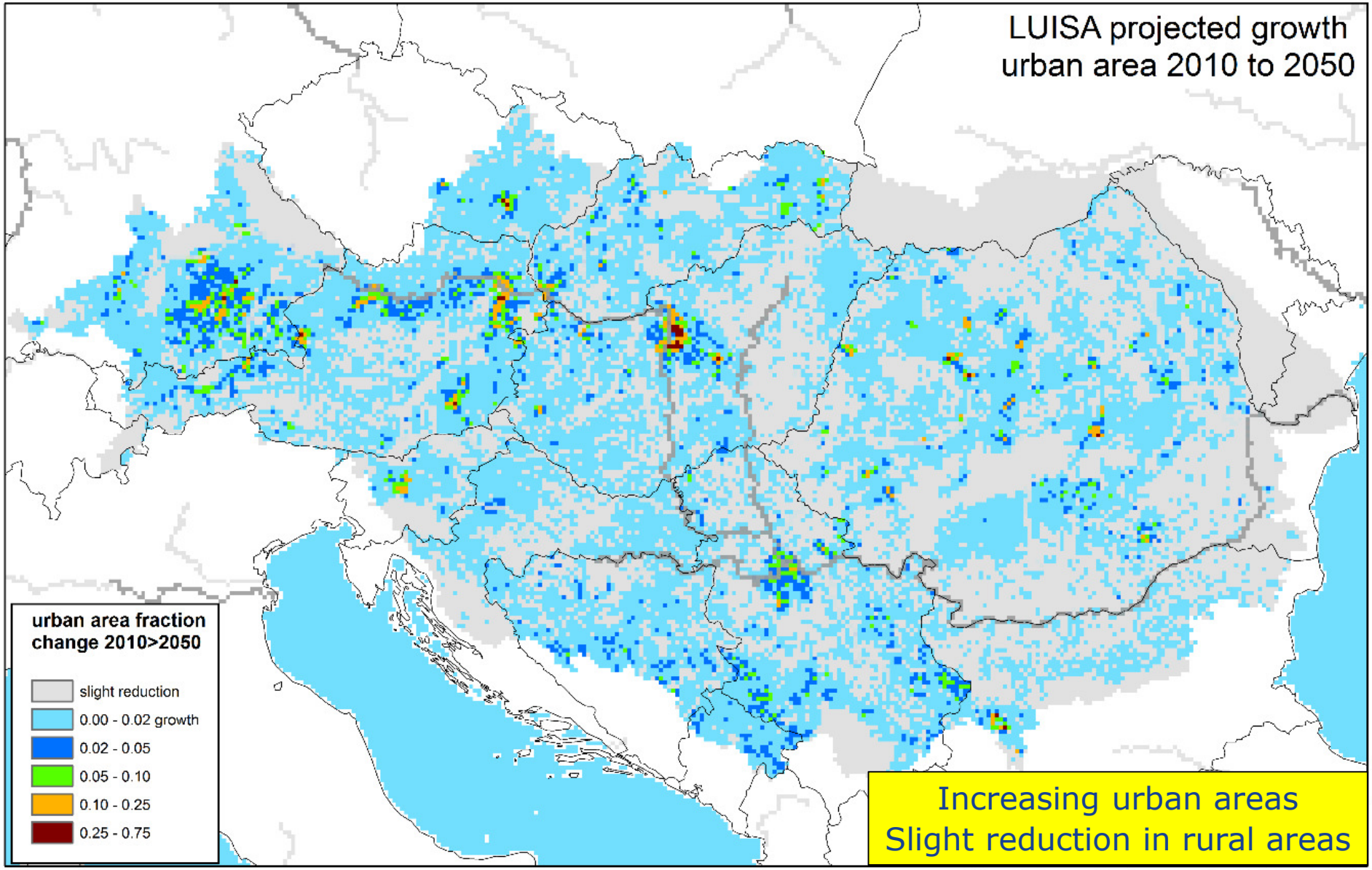


Change in evapotranspiration deficit under 2 degree global temperature change

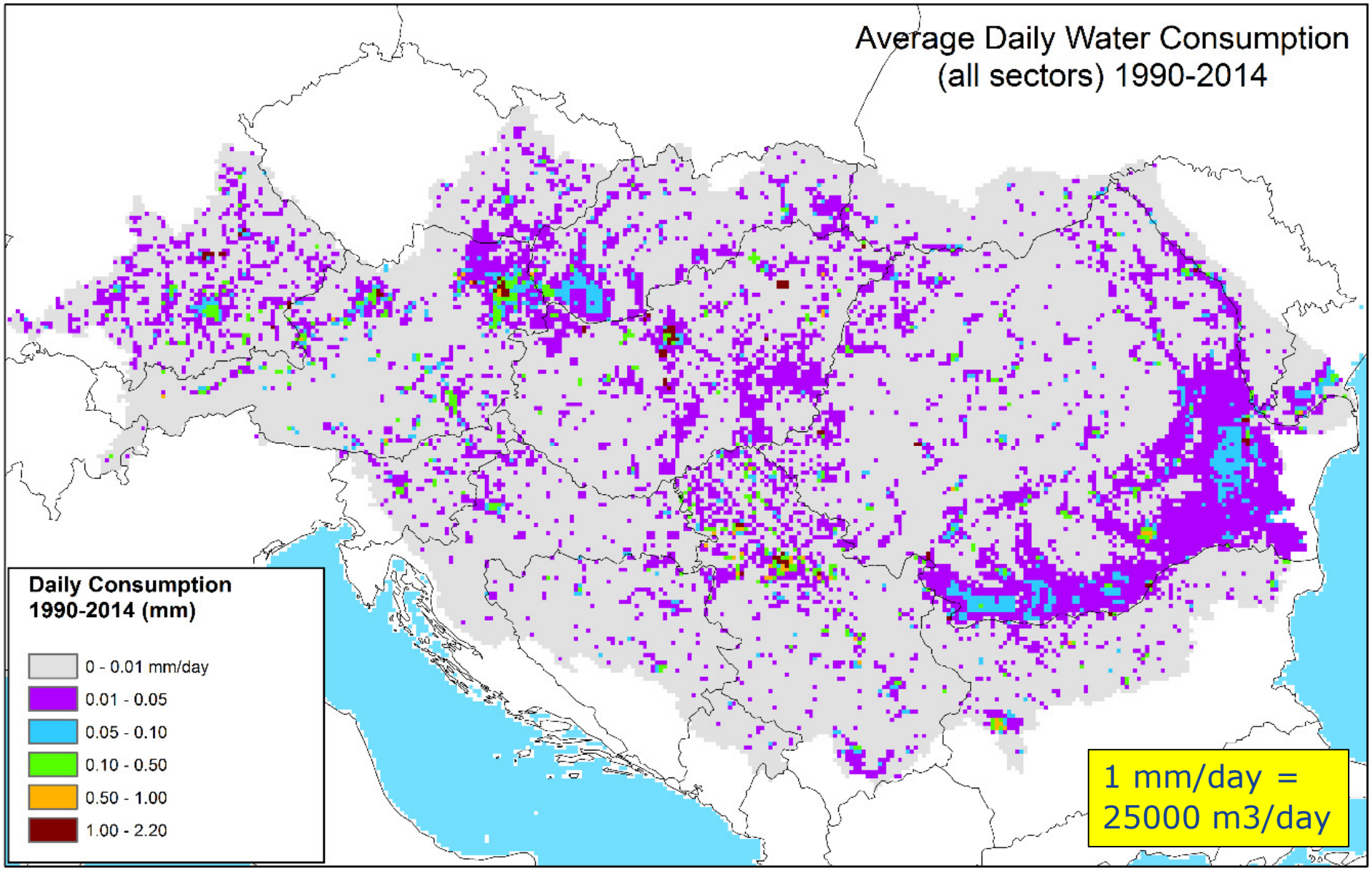




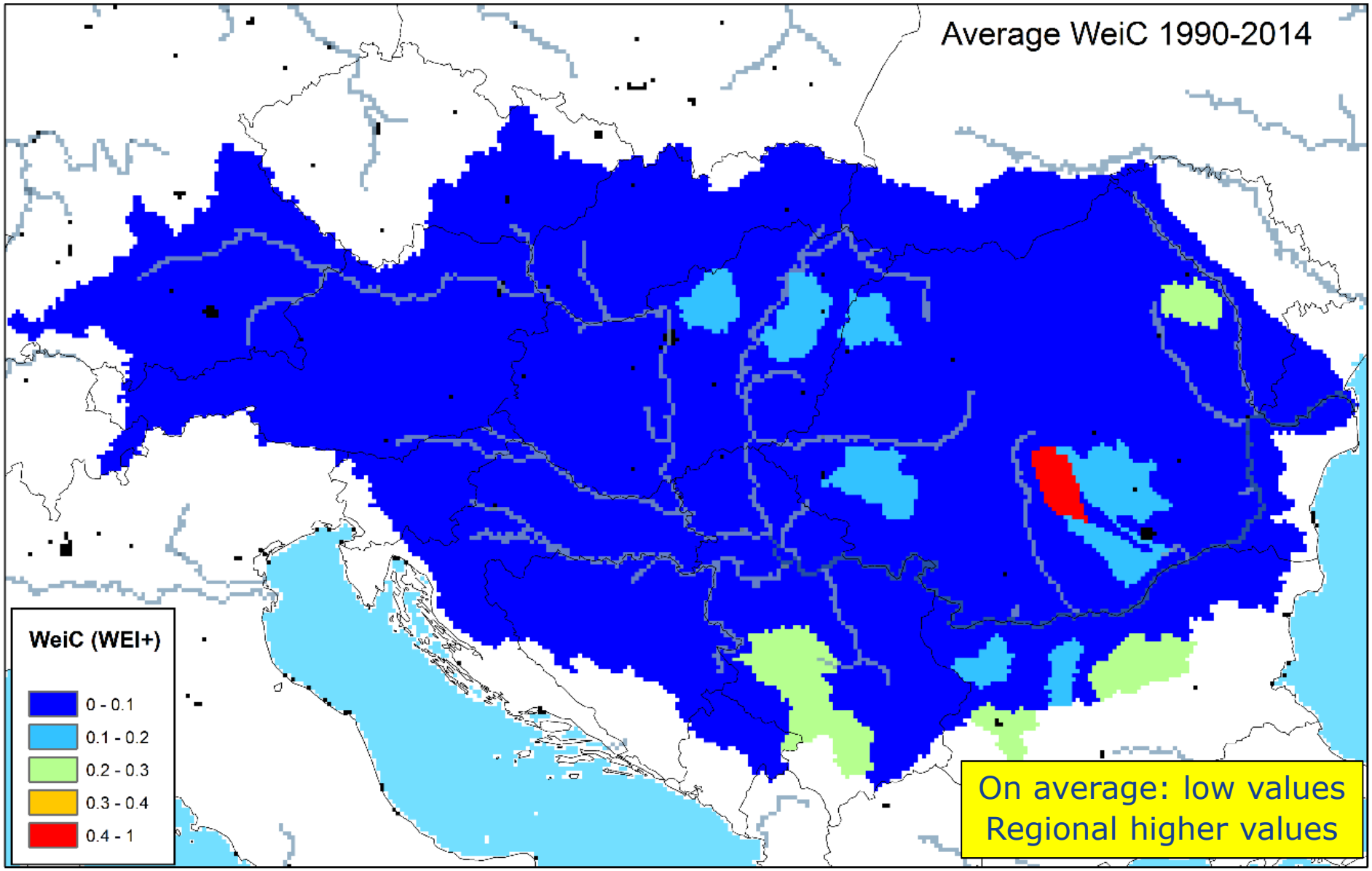
Project urban area change in Danube by 2050



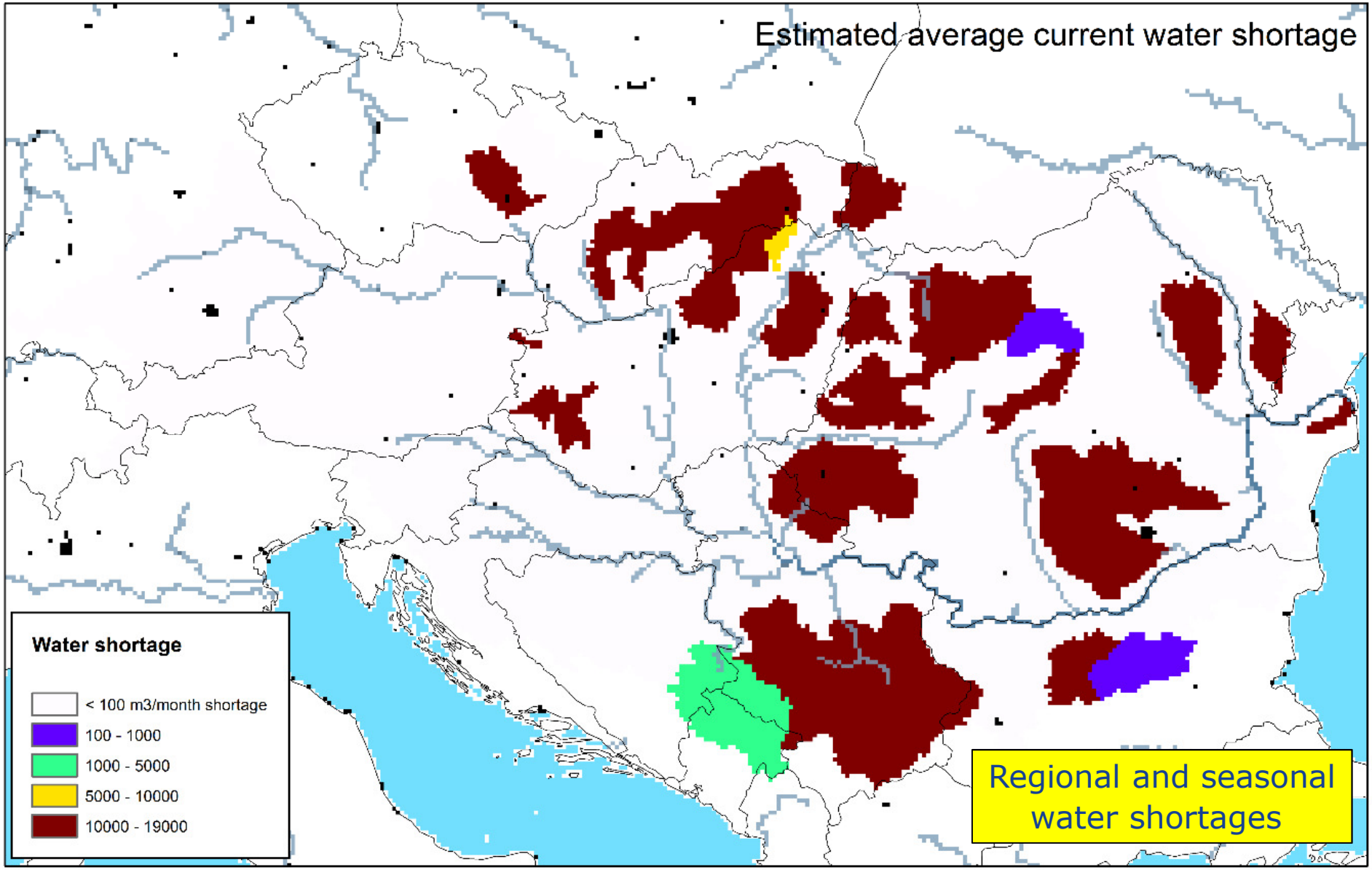
Current water consumption: all sectors (climate 1990-2014, current land use)



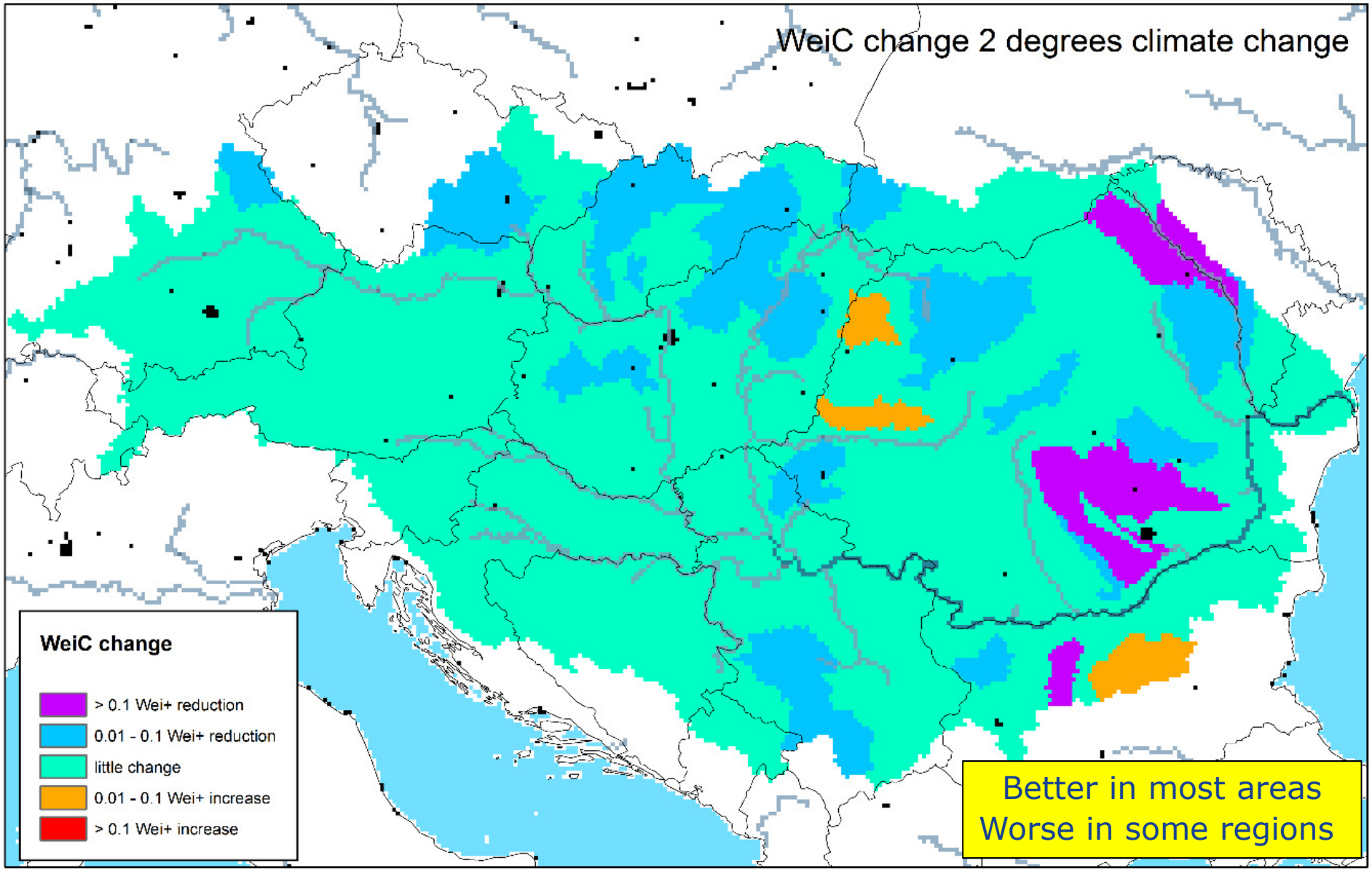
Water Exploitation Index (1990-2014 climate)



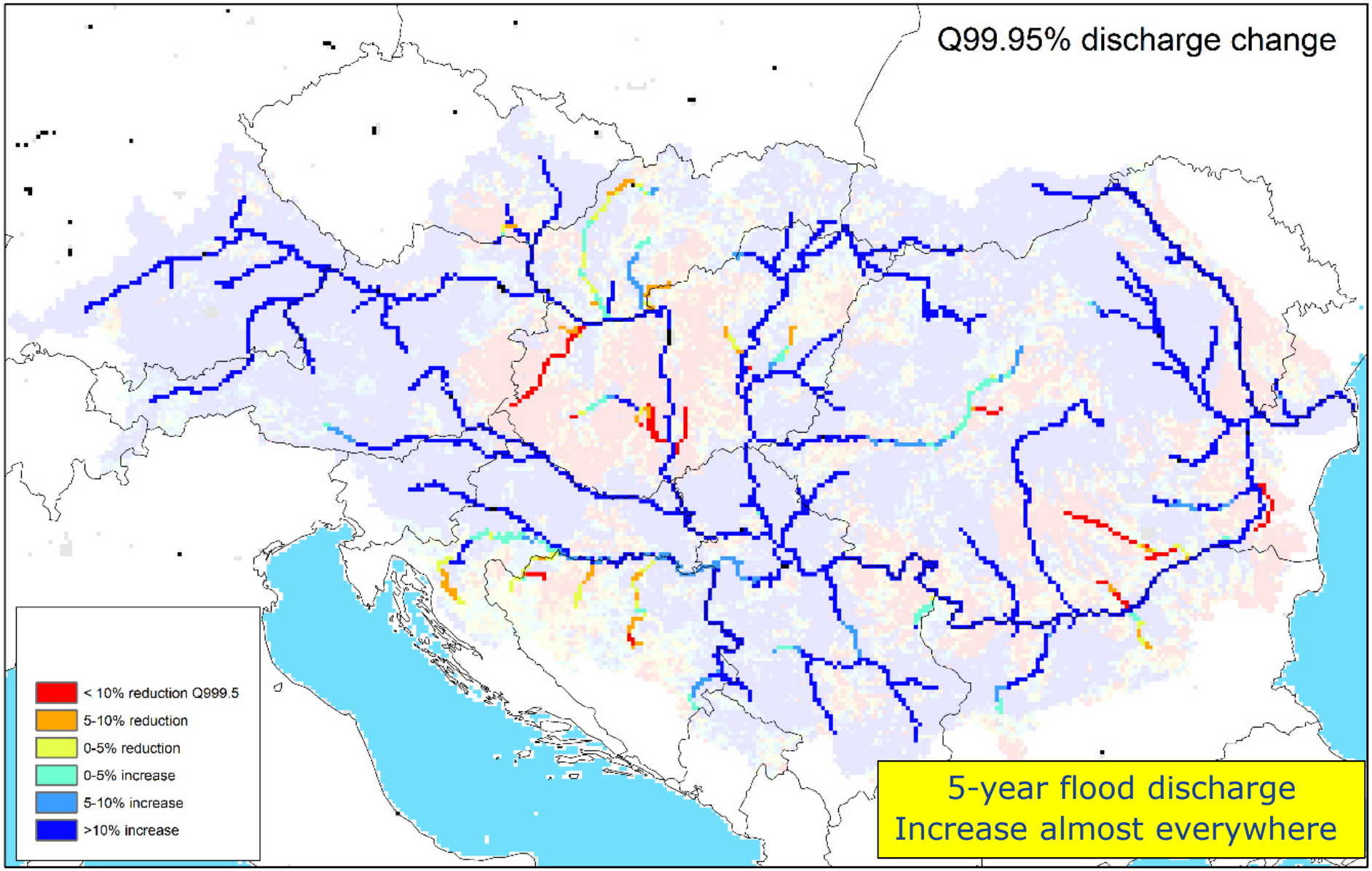
Occasional water shortage (1990-2014 climate)



Change in Water Exploitation Index under 2 degree global temperature increase

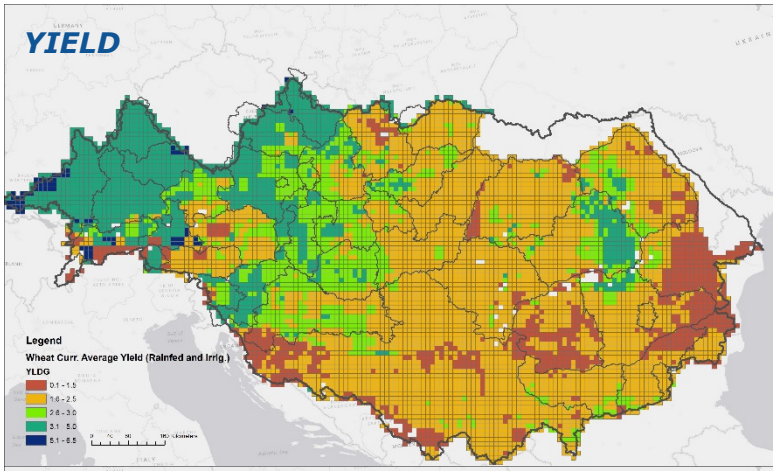


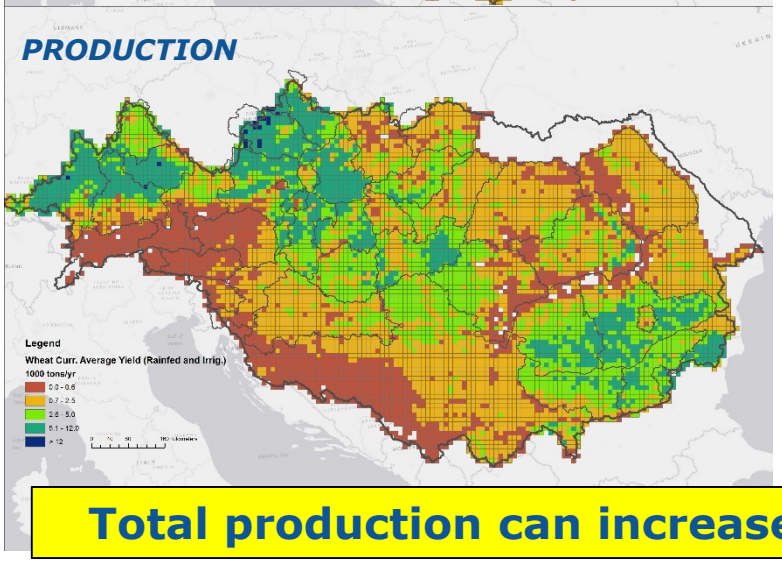
Flooding will be a increasing concern in Danube



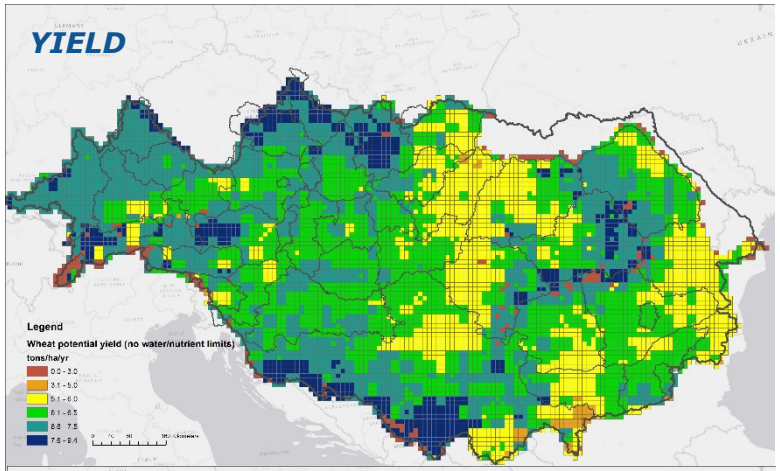
Simulated (EPIC) Wheat yield/production: baseline and optimal scenario

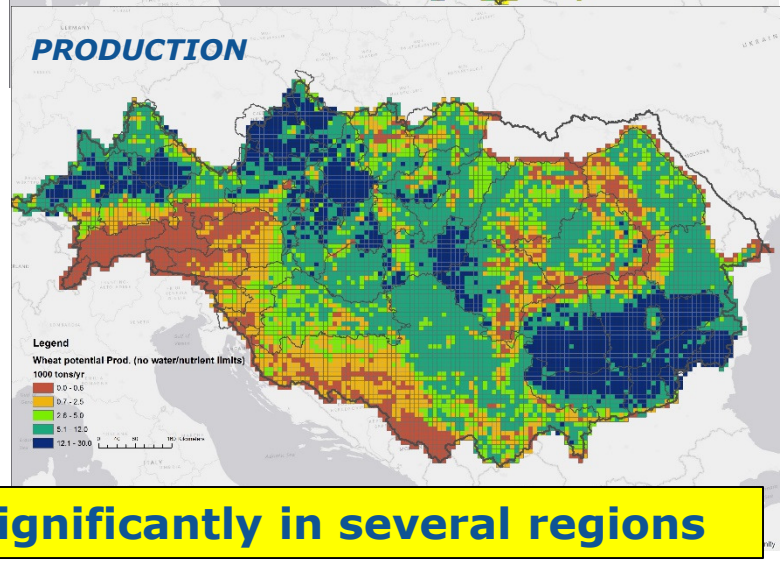
BASELINE





POTENTIAL





Total production can increase significantly in several regions

In the north-western region limited nitrogen/water stress allow high yields also under current management

Average simulated yield in the region is 2.2 tons ha^{-1}

Most of the basin allows to reach high yields (6-9 tons/ha)

Average simulated yield in the region is 6.2 tons ha^{-1}

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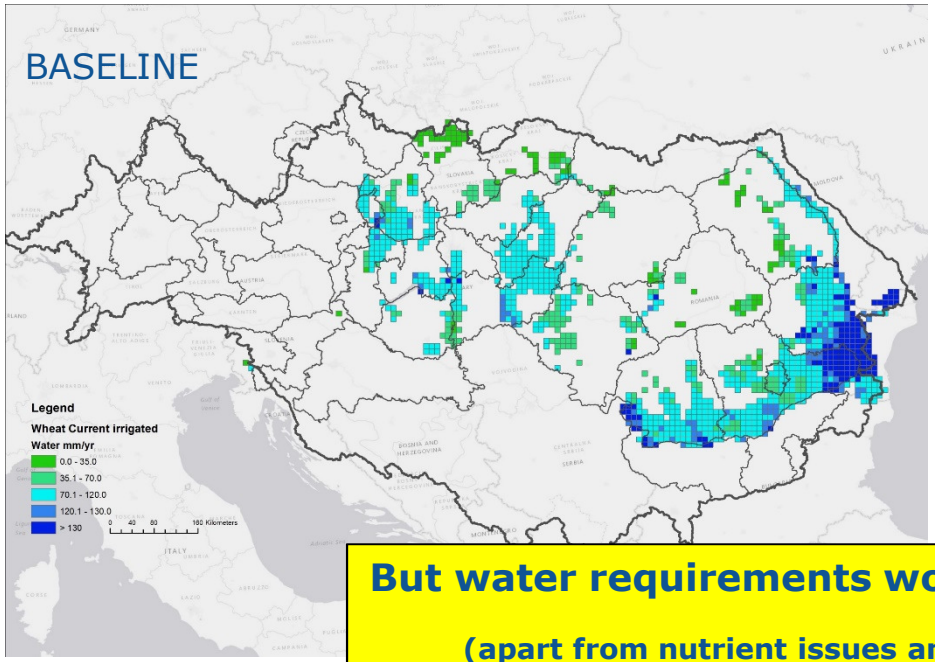
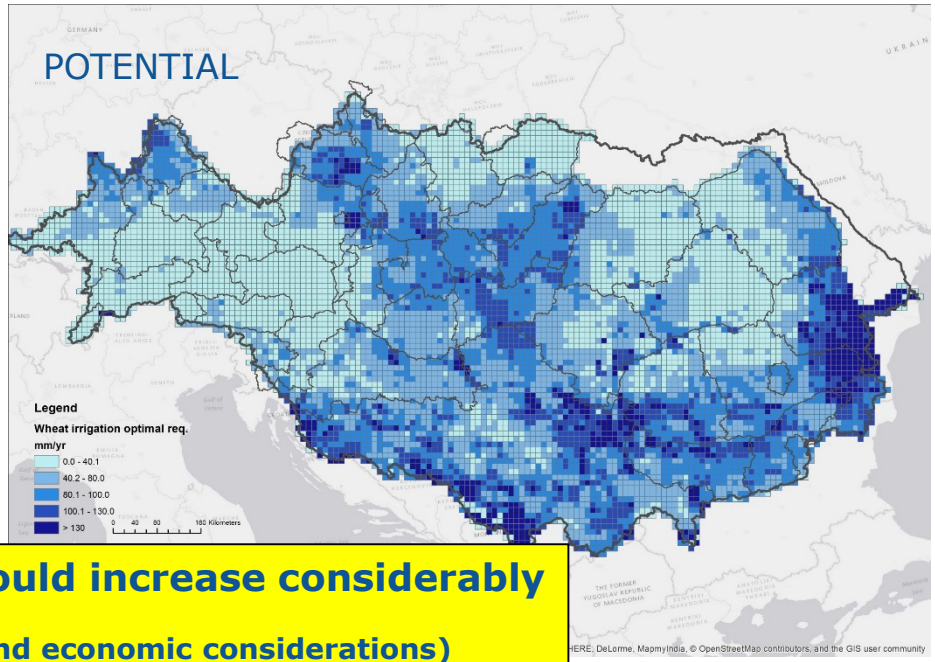
Simulated water requirements under baseline and potential scenario





But water requirements would increase considerably

(apart from nutrient issues and economic considerations)

Current irrigated crop area is very limited. For wheat, just 2-3 % is irrigated.

When irrigation is applied, 70-150 mm water is required

Around 9 Mm^3 water is currently used for wheat (baseline simulation)

In the potential scenario all wheat is irrigated.

Irrigation requirements are quite limited in several regions (light colors = less than 40 mm/yr; in other regions requirements are moderate and high (ranging between 100 - 200 mm/yr)

Around 180 Mm^3 would be required for all Danube wheat area

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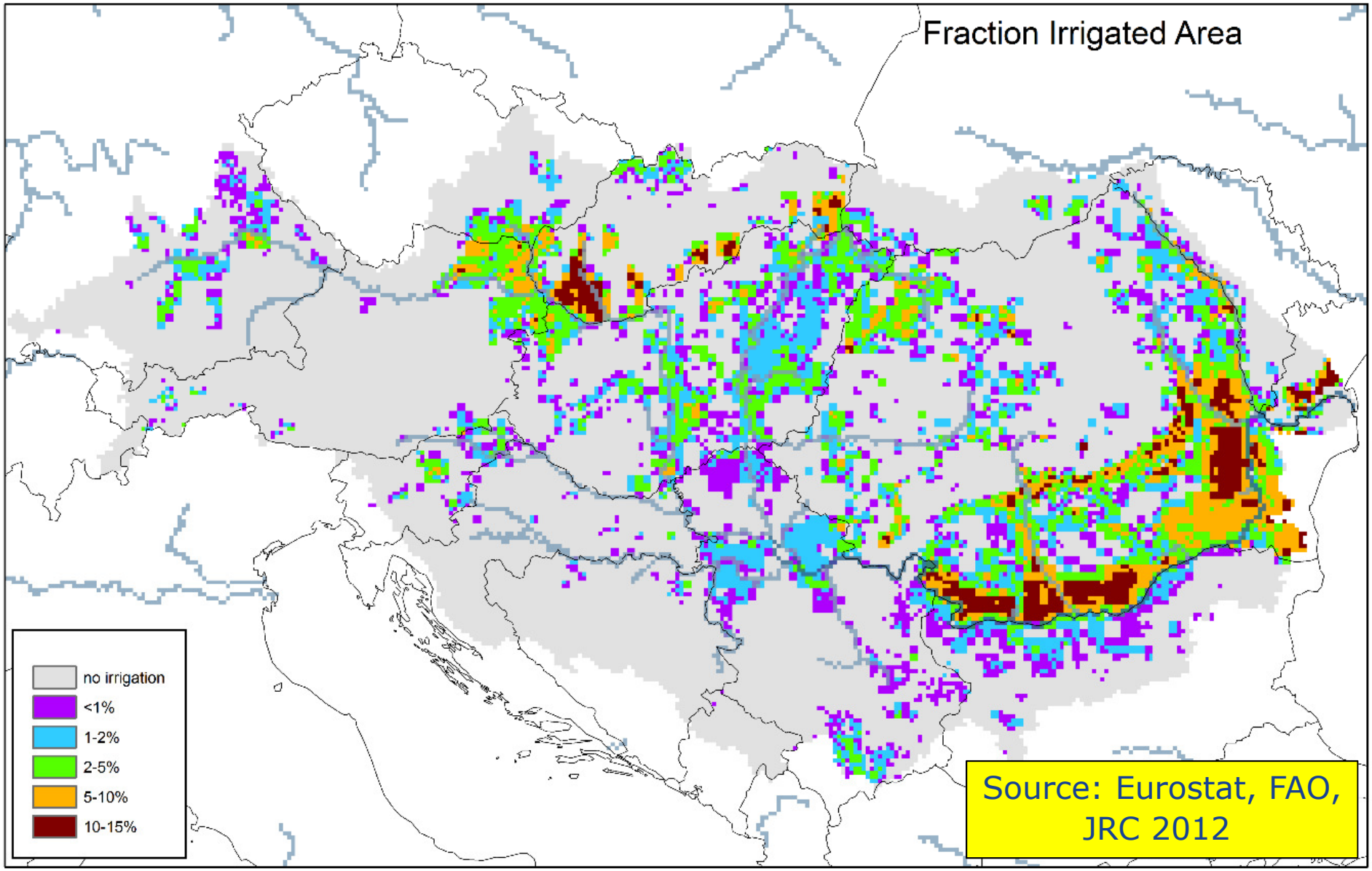
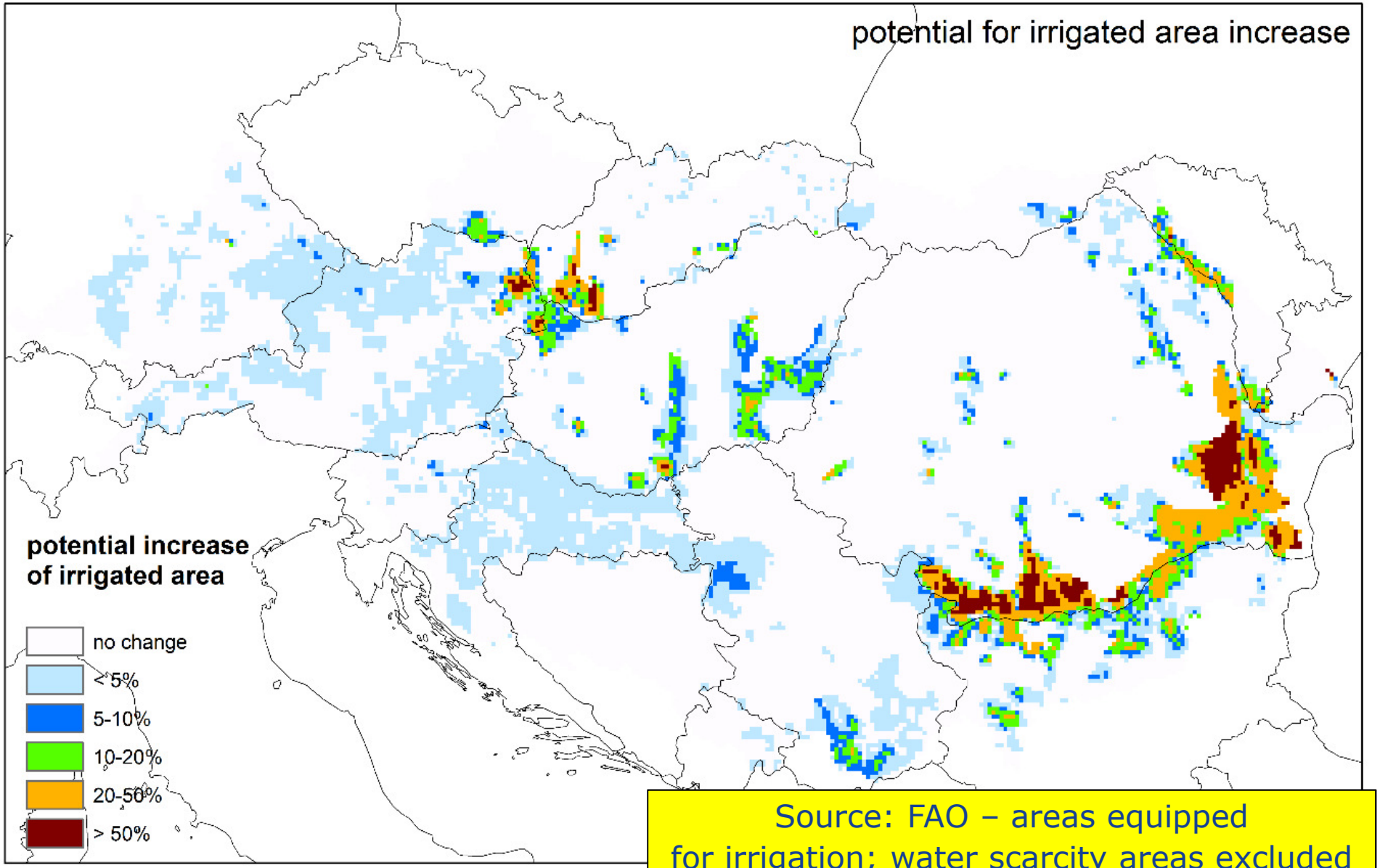
Current irrigated areas

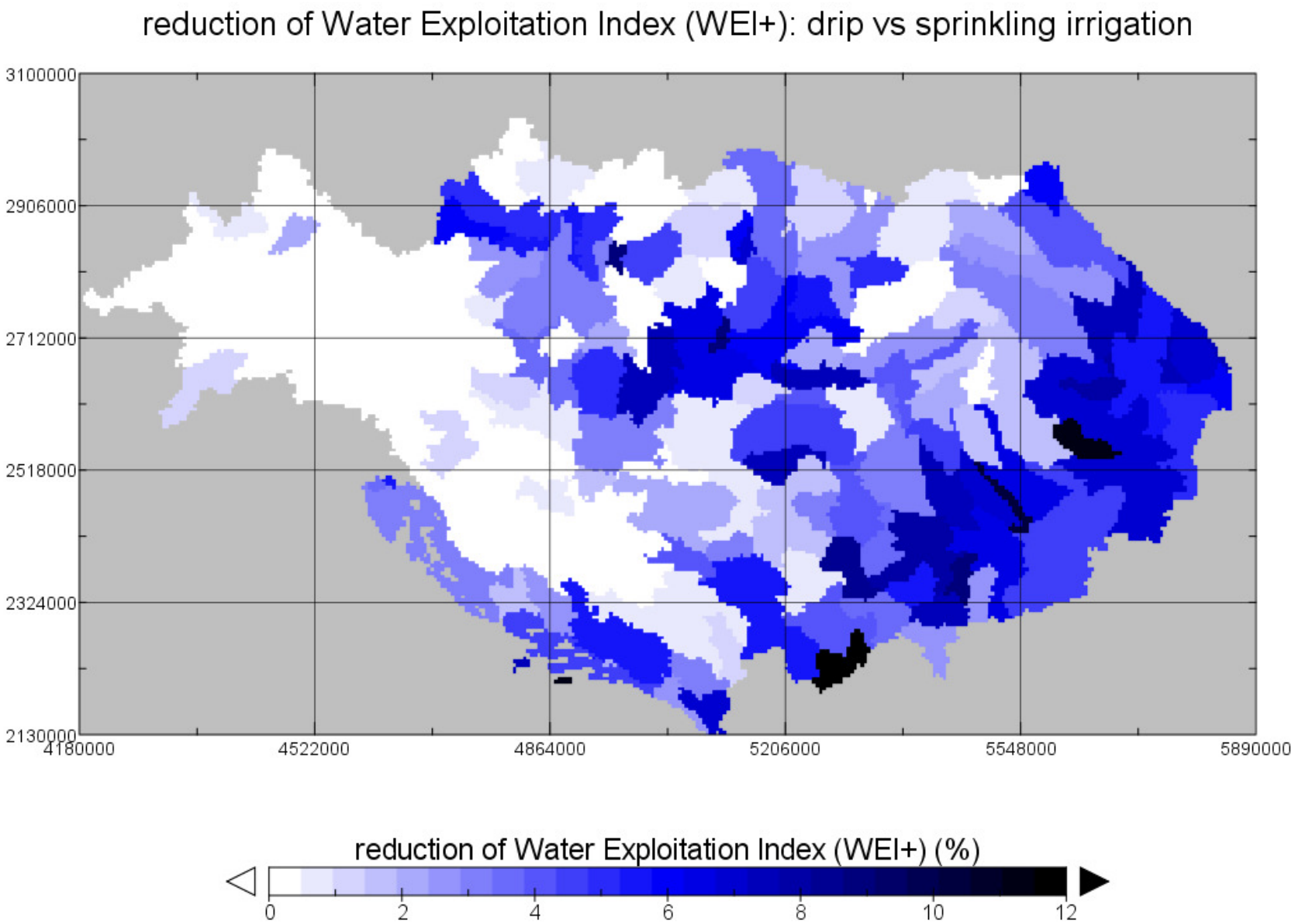


Potential for irrigation expansion



Source: FAO – areas equipped for irrigation; water scarcity areas excluded

Drip irrigation would decrease WeiC up to 12%



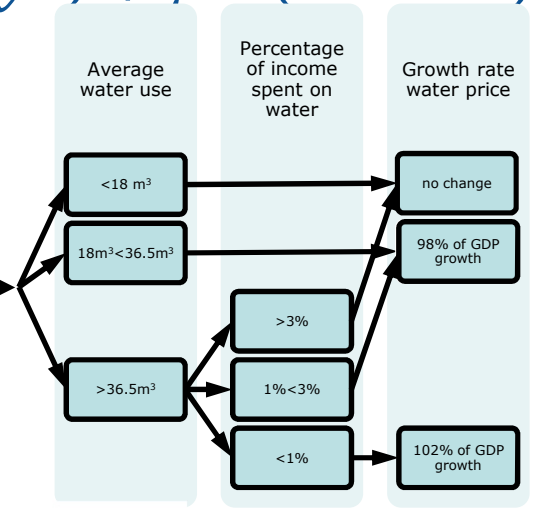
Improving irrigation efficiency through drip irrigation: water savings vs investment

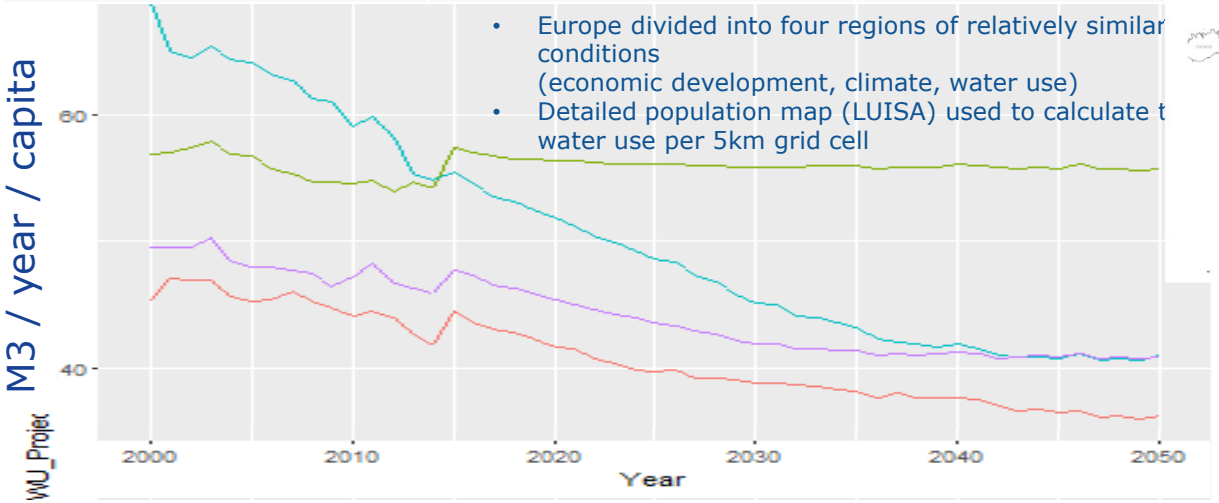
Changing the price of public water

Water demand function for Water use per capita:

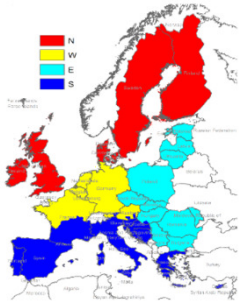
$$ln(WaterUse) = \alpha\, ln(\frac{Income}{Price}) + \beta\, ln(DryDays) + \gamma\, ln(Over65)$$

Variable	Driver for future projections	Source
Income	GDP projections	The 2015 Ageing Report
Water price	GDP projections; price scheme	
Nr. Dry Days	Climate projections	CORDEX
Population 65 or older	Demographic projections	The 2015 Ageing Report





- Europe divided into four regions of relatively similar conditions (economic development, climate, water use)
- Detailed population map (LUISA) used to calculate t water use per 5km grid cell



Price policy will influence water usage: different effects per country

Regions
E
N
S

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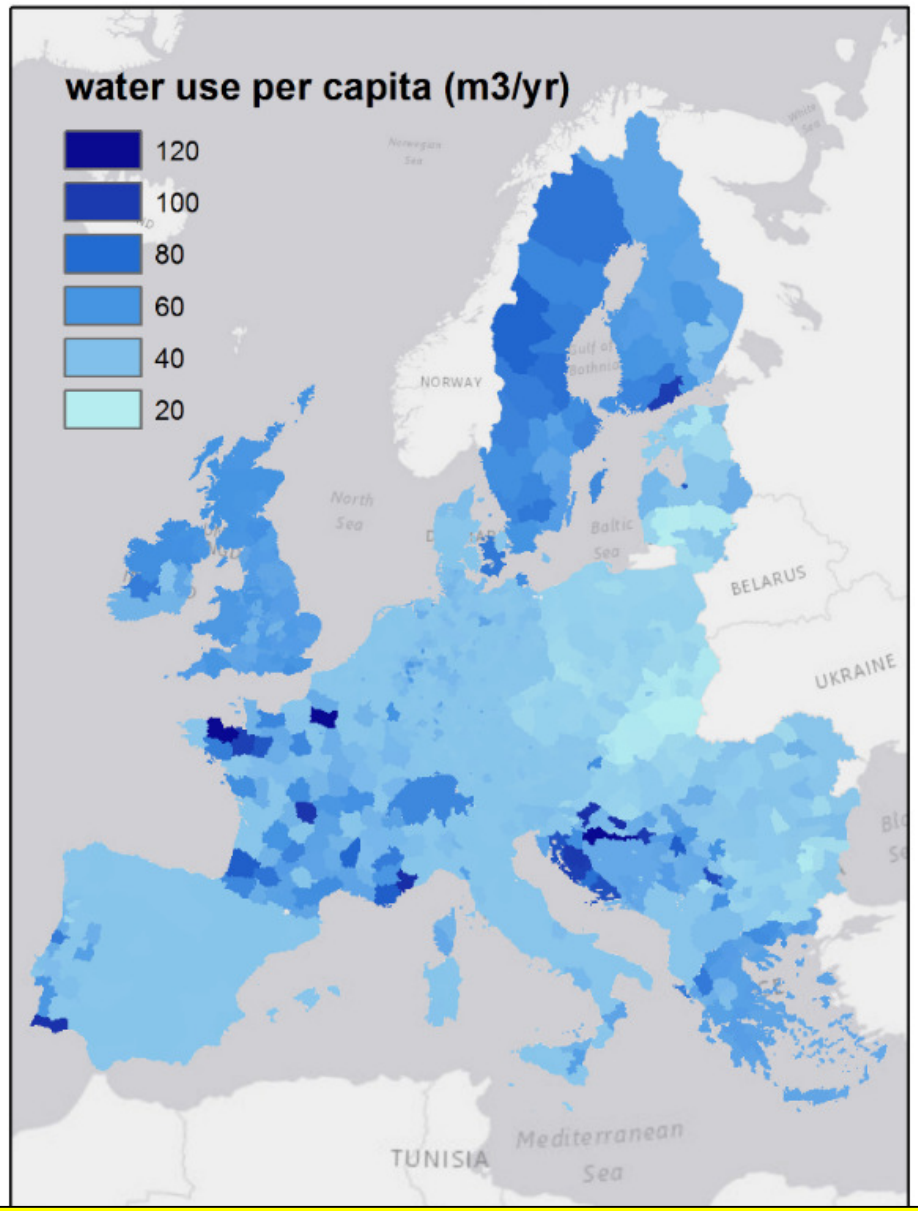
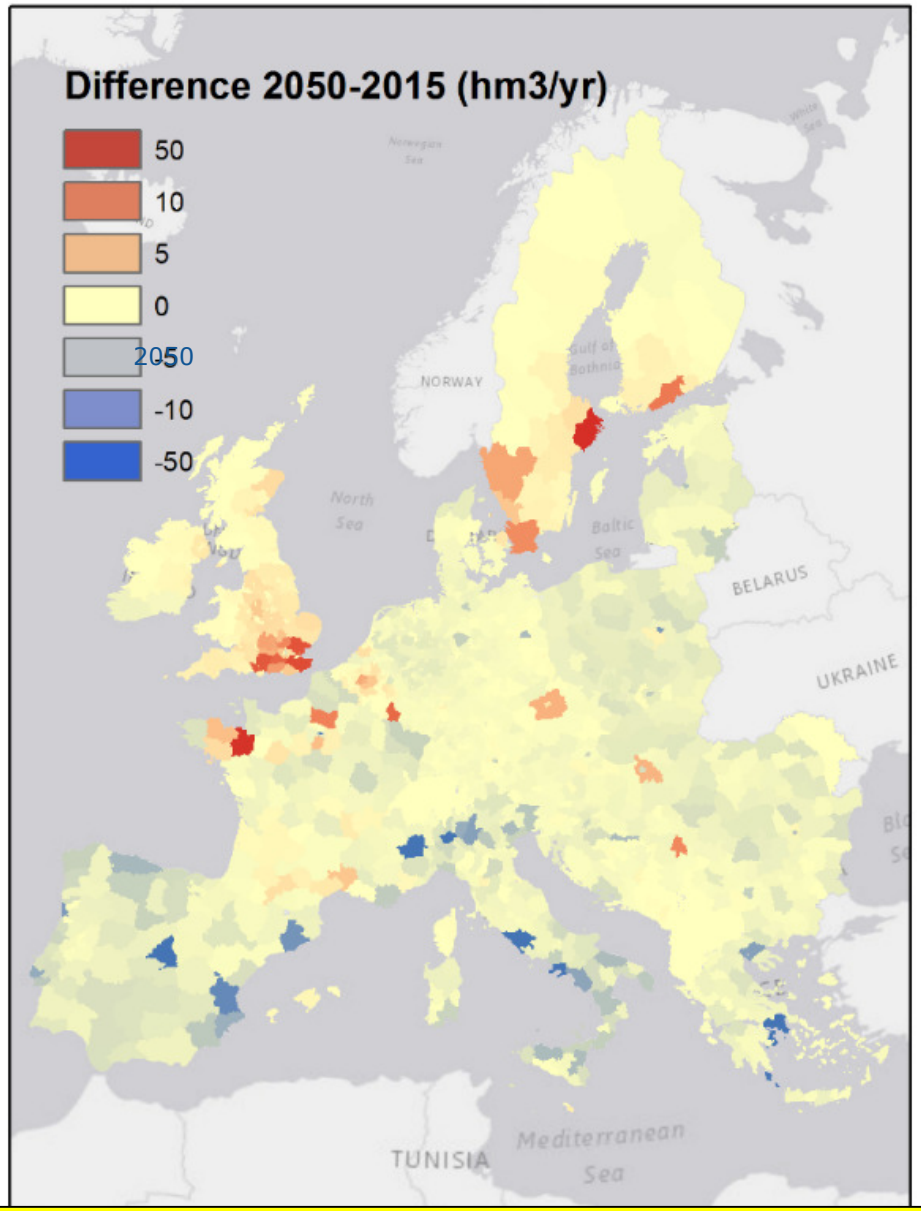
Scenario: extreme water price convergence





Price below 20 m3/capita stable; gradually more expensive for surplus use

Key Messages / Conclusions

- If the Paris Agreement is respected, climate change impacts will be less dramatic than previously estimated; the Danube, with exception of the southern edge will experience on the average **slightly wetter and warmer conditions**

- Water scarcity issues are in general projected to get slightly better in the Danube basin, but **regional seasonal scarcity** stays

- However, **flooding** magnitudes in the Danube are projected to **increase** as compared to present climate; increasing urban area requires even more attention for flood risk management

- From a water quantity perspective, there are areas in the Danube where **additional irrigation** might take place to increase crop yield; the issue is however if this is economically also feasible, giving the required investments and market prices; using **drip irrigation** beneficial to reduce water requirements

- **Water pricing** strategies (households, agriculture, industry) may lead to incentives for water saving/efficiency