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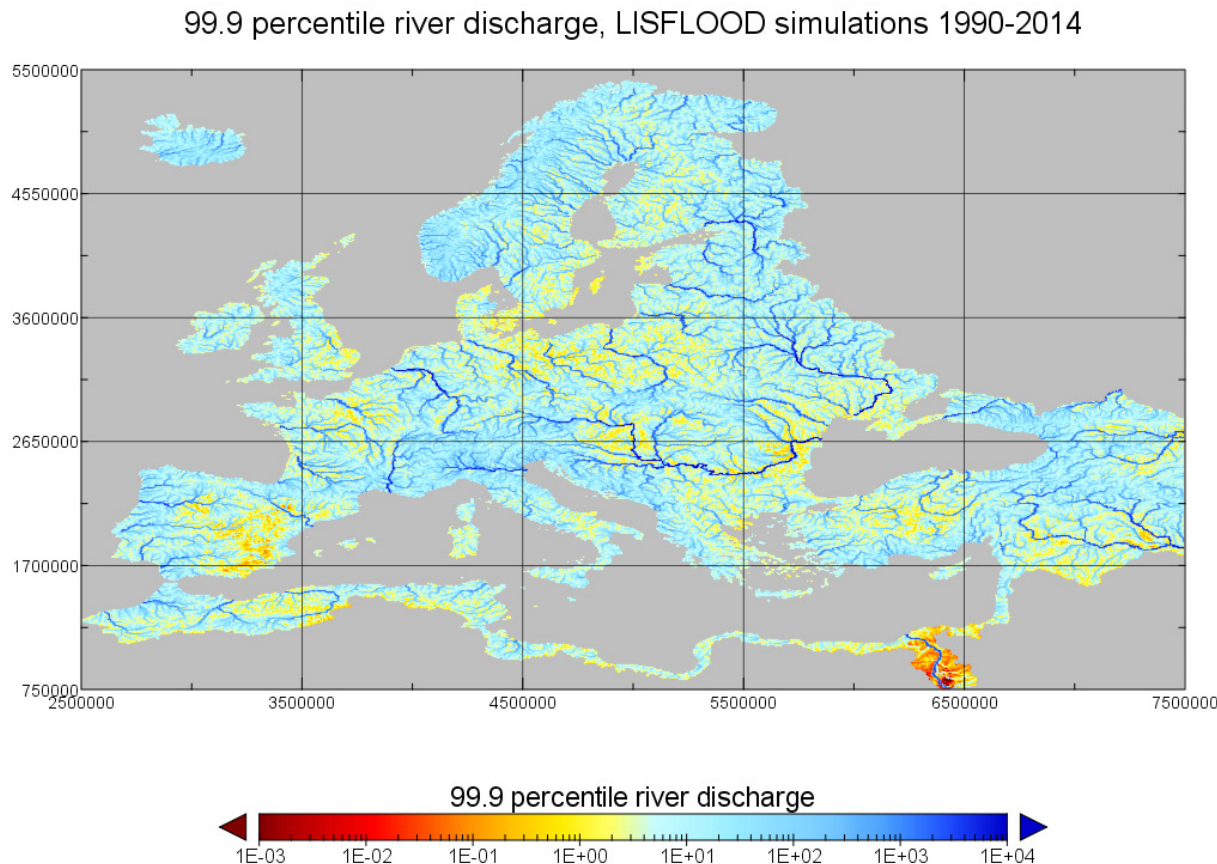
Impact of land use and climate change on Europe's water resources

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Lavalle*



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LISFLOOD: water resources, floods, droughts and nexus simulation model



5km Europe

- **EFAS - floods**
- **EDO - droughts**
- **EU nexus studies**
- **BLUE2**

0.1° Global

- **GloFAS – floods**
- **E2O Tier1&2**
- **Africa Nexus studies**

0.5° Global

- **HELIX**

LISFLOOD model

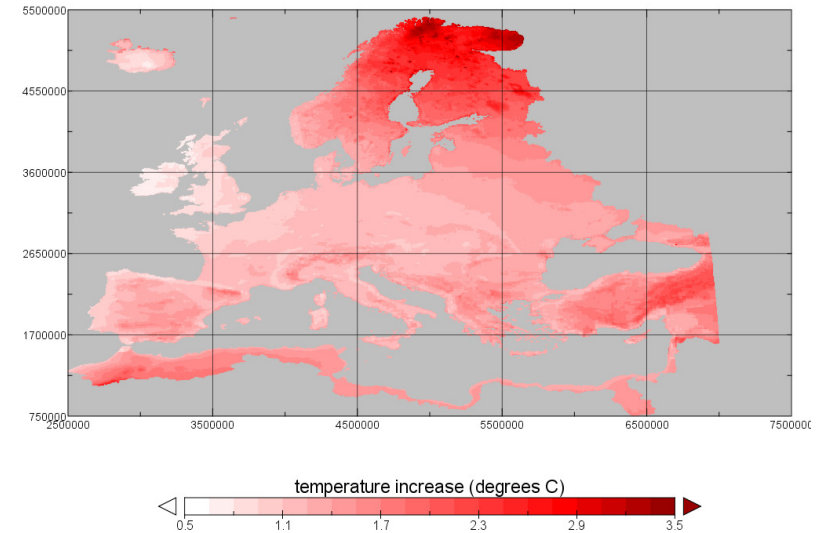
- LISFLOOD is an **hydrological rainfall-runoff** model including the simulation of **water abstraction and consumption** (irrigation, rainfed agriculture, cooling for energy production, manufacturing industry, livestock, public water usage, environmental flow)
- LISFLOOD simulates the detailed hydrological cycle, including human water consumption, **irrigation, lakes and reservoirs**, and **riverflow routing**
- LISFLOOD is used for **operational** flood (**EFAS, GloFAS**) and drought (EDO) forecasting, as well as river basin (Meuse, Oder, Elbe, Danube, Toce), European, African and Global water resource studies
- Runs with daily timestep, 6 hourly in progress; various spatial resolutions from 250m-50km; Europe at 5km; Global at 10&50km
- Not to be confused with LISFLOOD-FP (2D model developed in collaboration with Prof. Paul Bates – Bristol university)

Climate Change

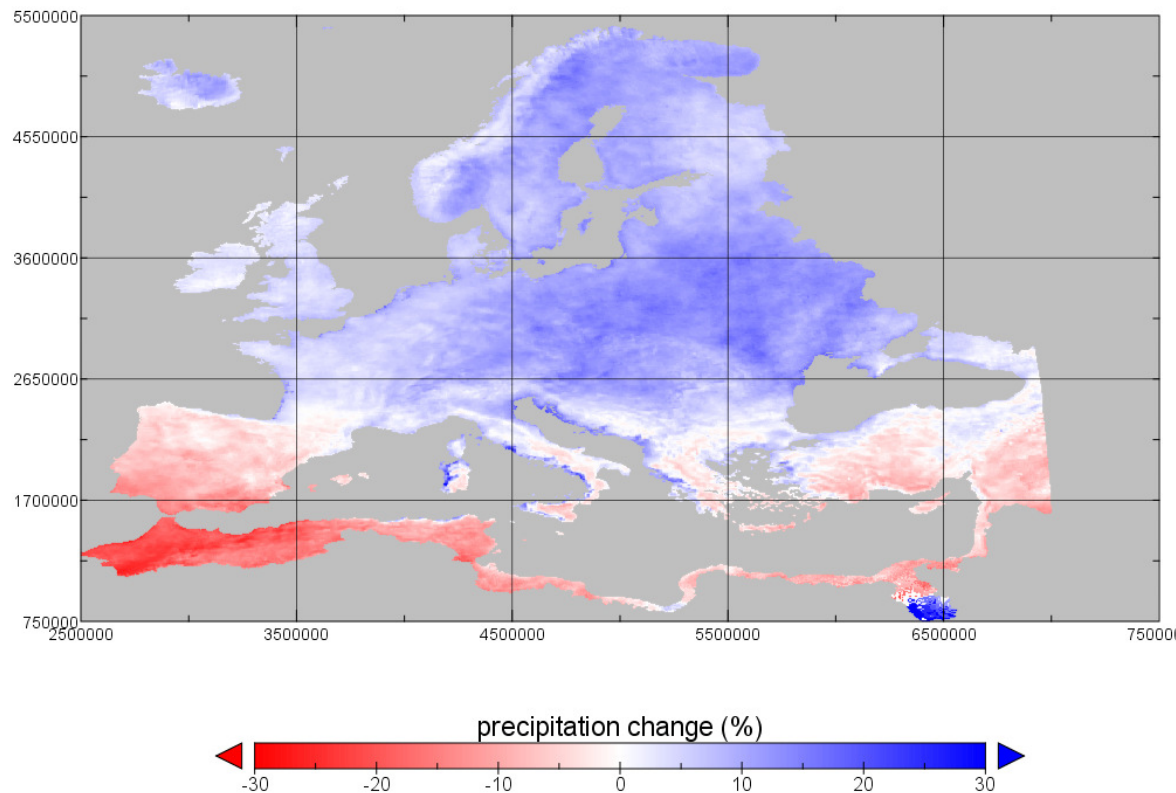
Projected climate change

average of 11 Euro-Cordex models

Temperature increase under 2 degree global temperature increase



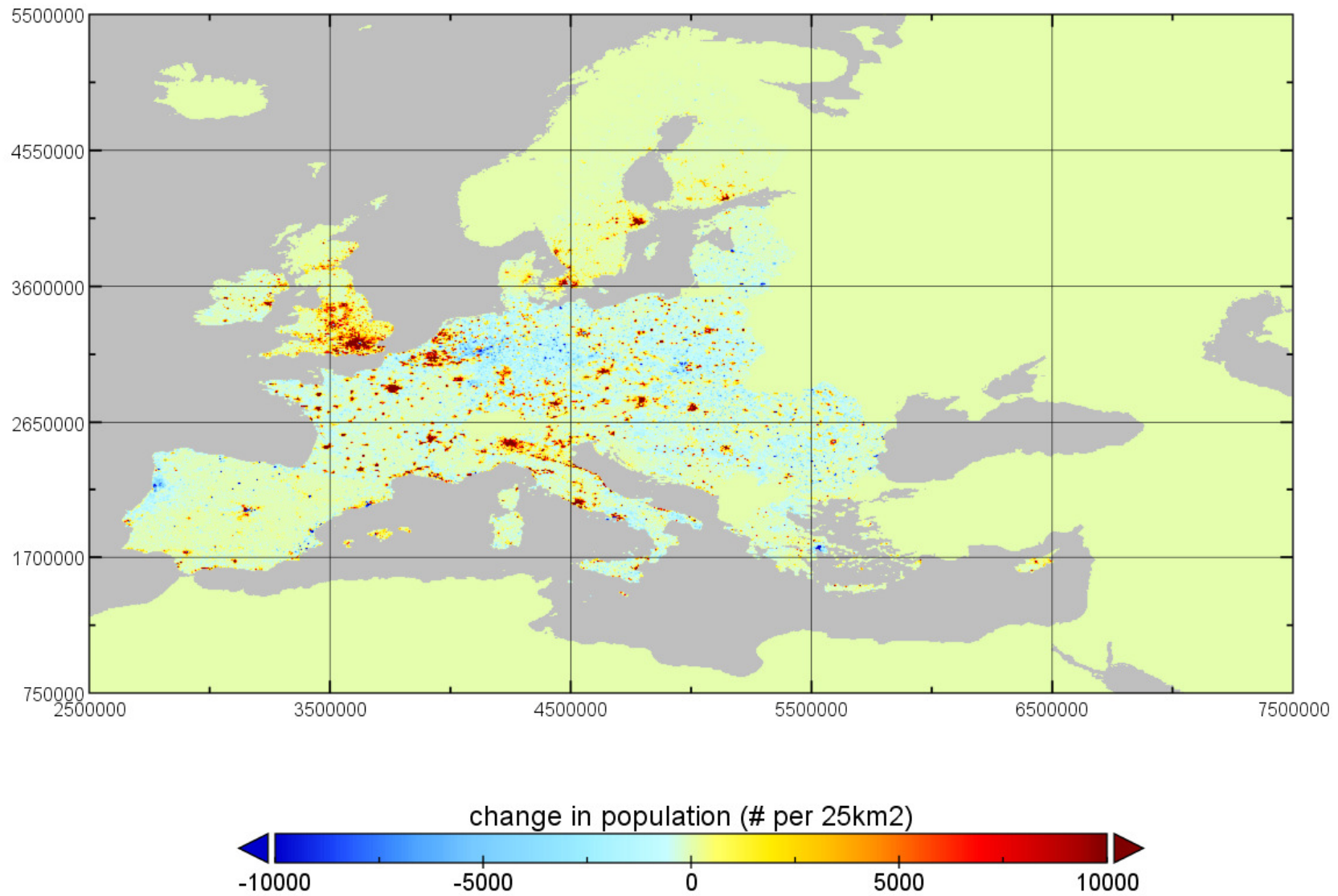
Precipitation change under 2 degree global temperature increase



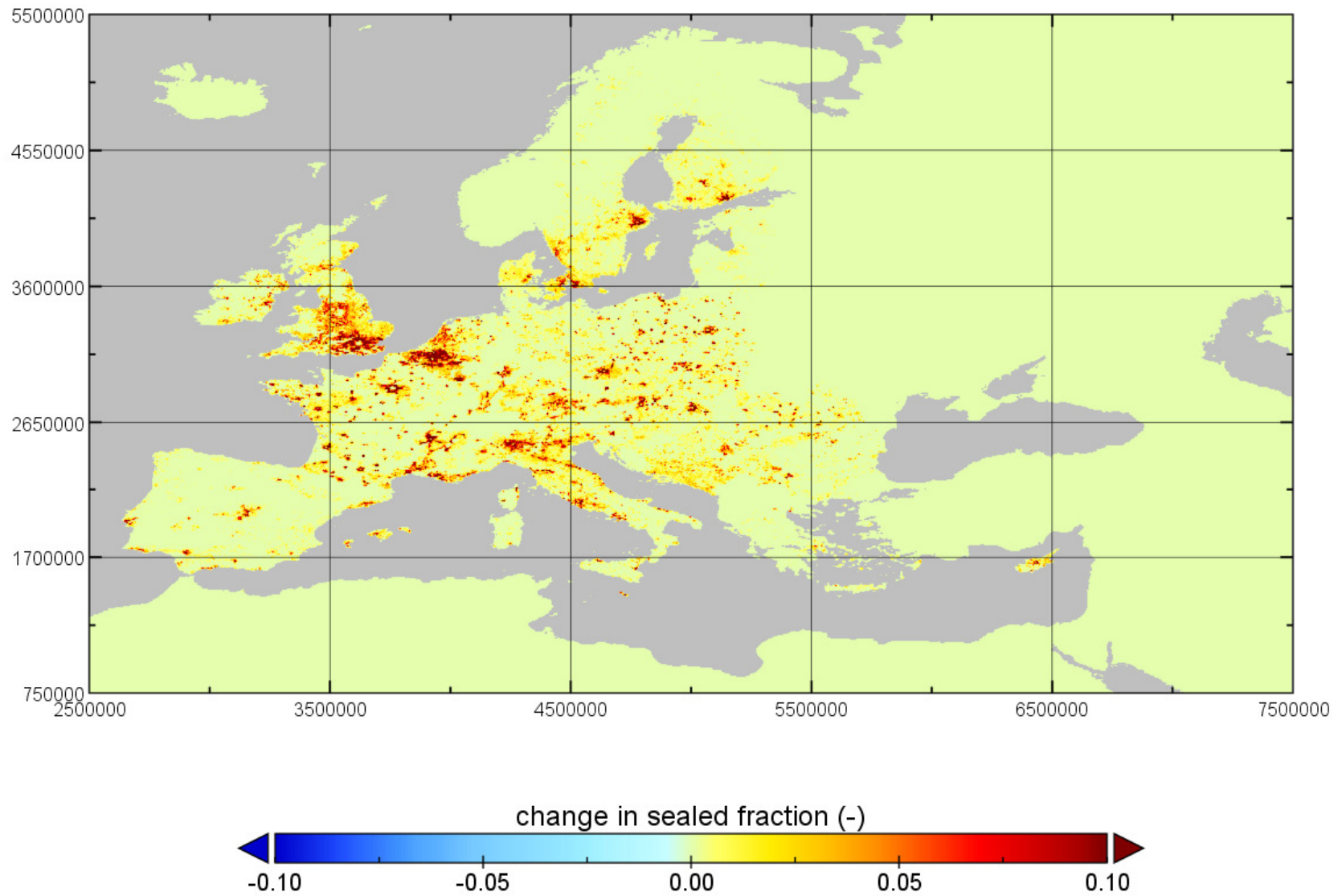
11 models:
Hist 1981-2010
RCP4.5 2011-2099
RCP8.5 2011-2099

Land Use Change

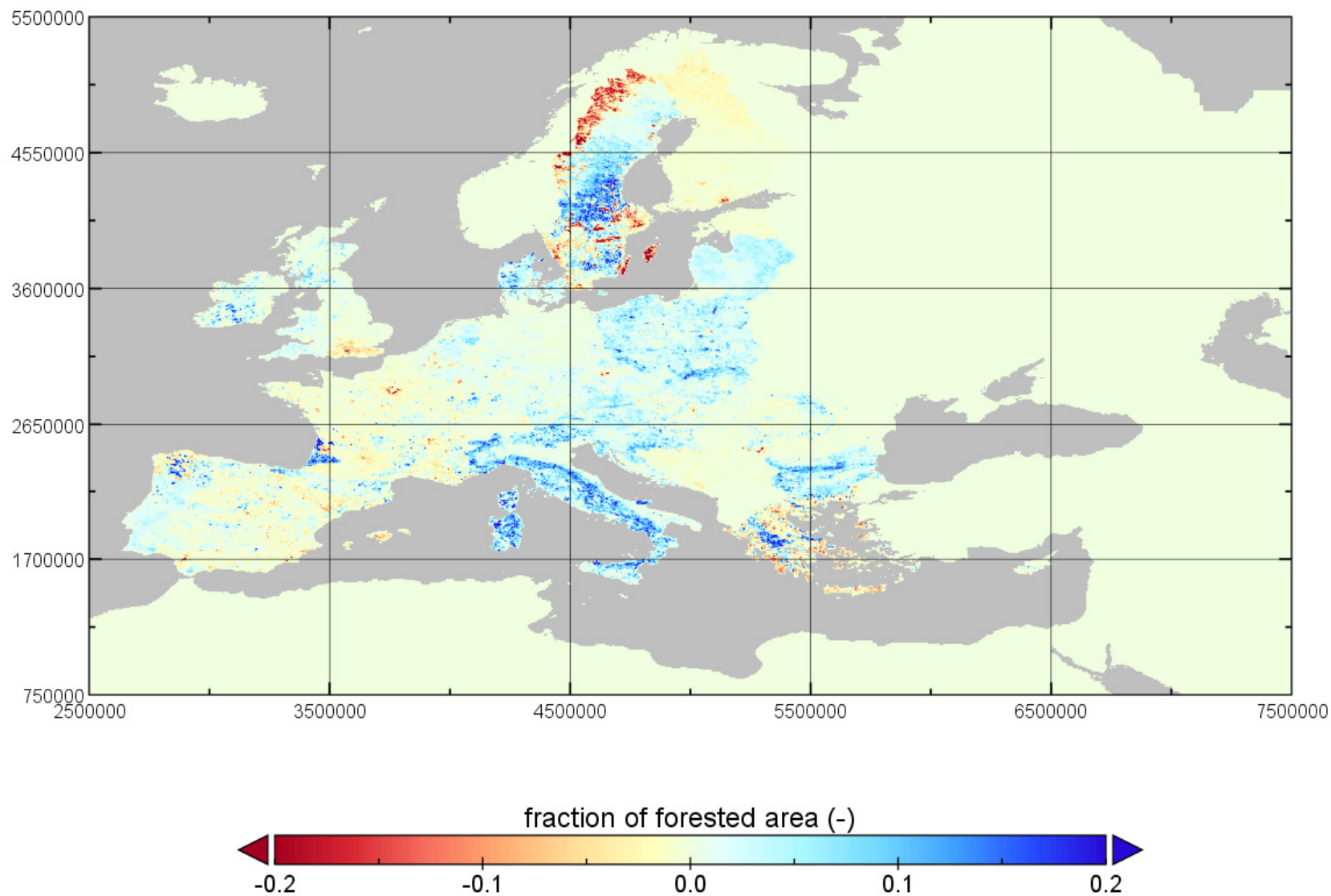
Projected change in population from 2010 to 2050 (LUISA reference)



Projected change in fraction of sealed area from 2010 to 2050 (LUISA reference)



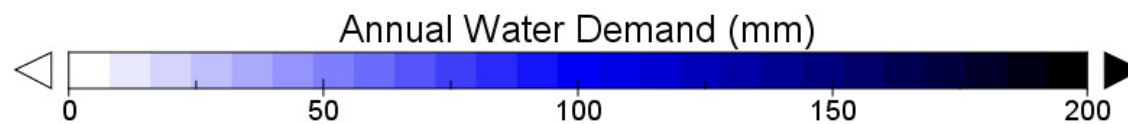
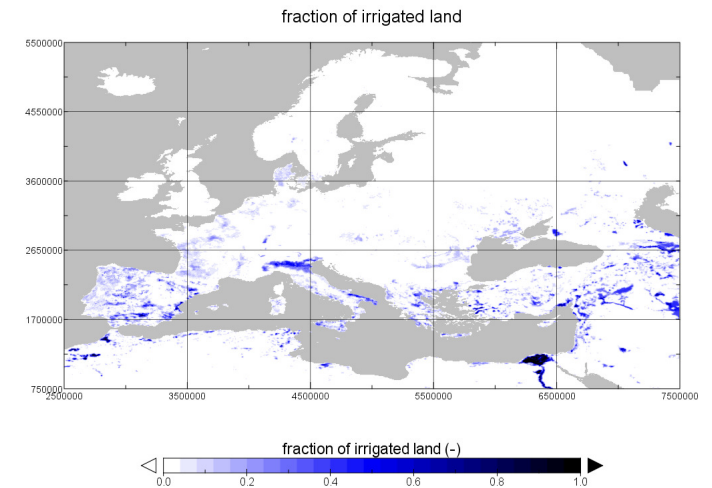
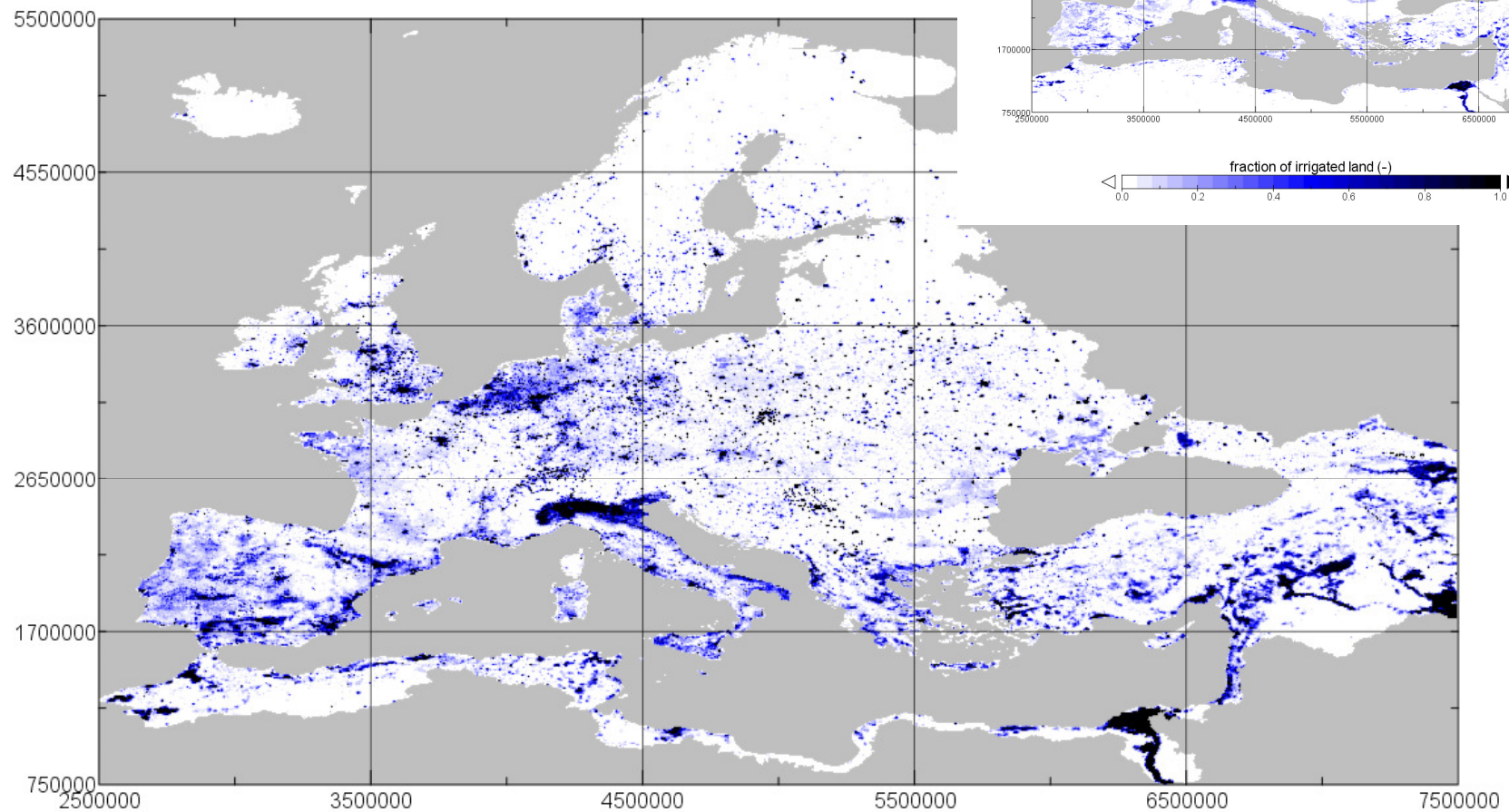
Projected change in fraction of forested area from 2010 to 2050 (LUISA reference)



Water Demand Change

Water demand 1990-2016

Average Annual Water Demand



Water Resources Change

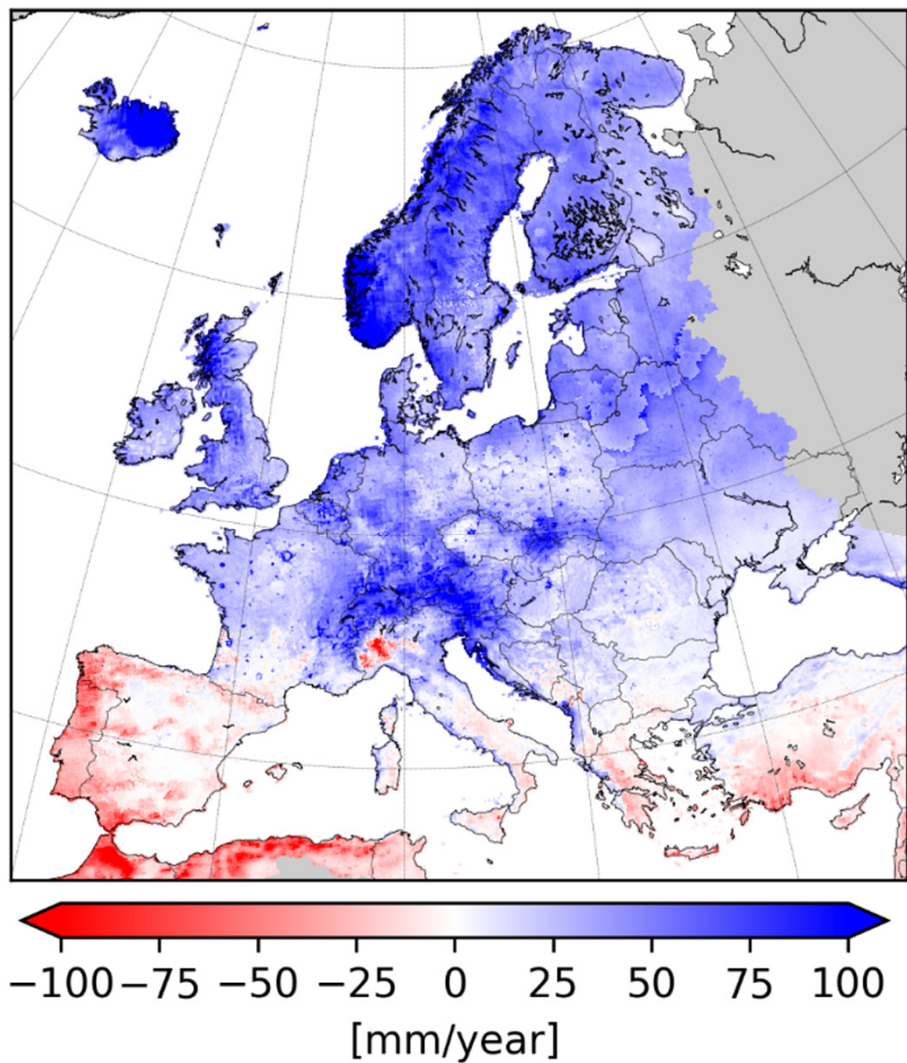
processing 120 Tb data...

11 climate models

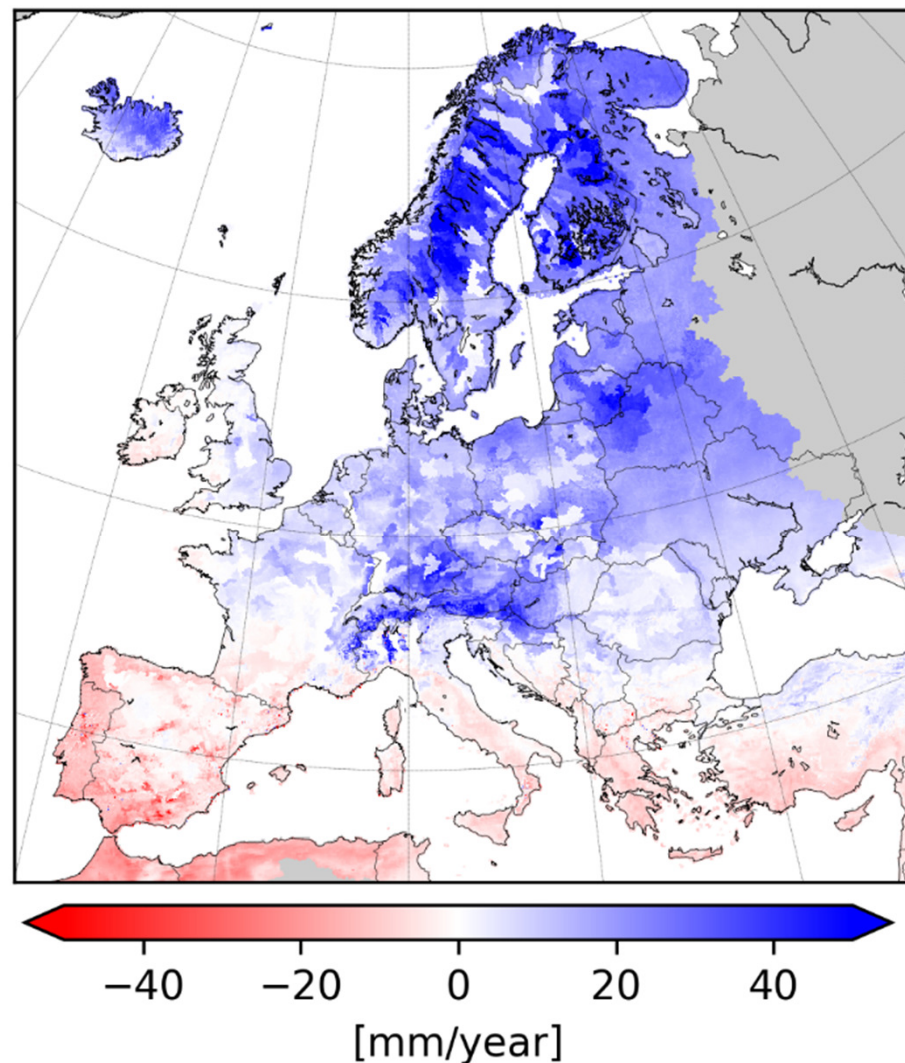
55 LISFLOOD runs

(control, RCP4.5, RCP8.5, CC, CC+LU, CC+LU+WD)

Change in annual runoff



Change in groundwater recharge

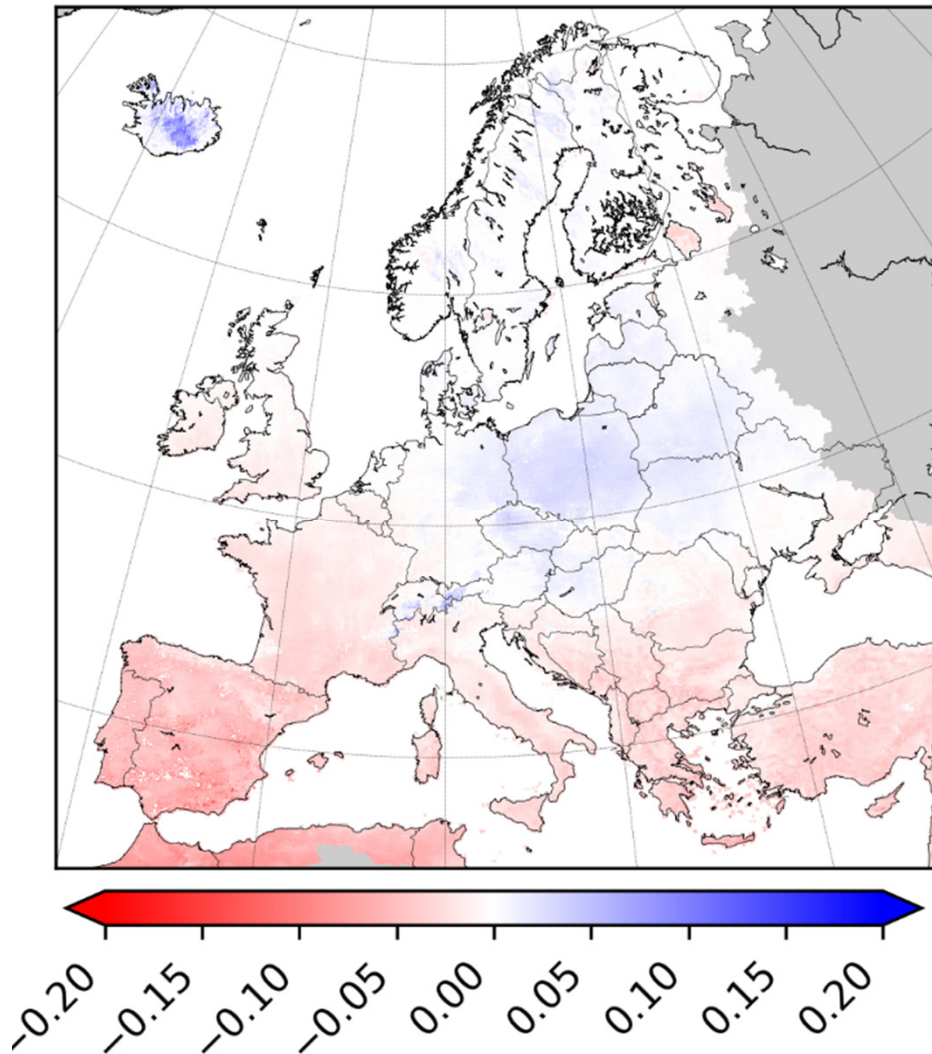


LISFLOOD forced with 11 Euro-Cordex model outputs

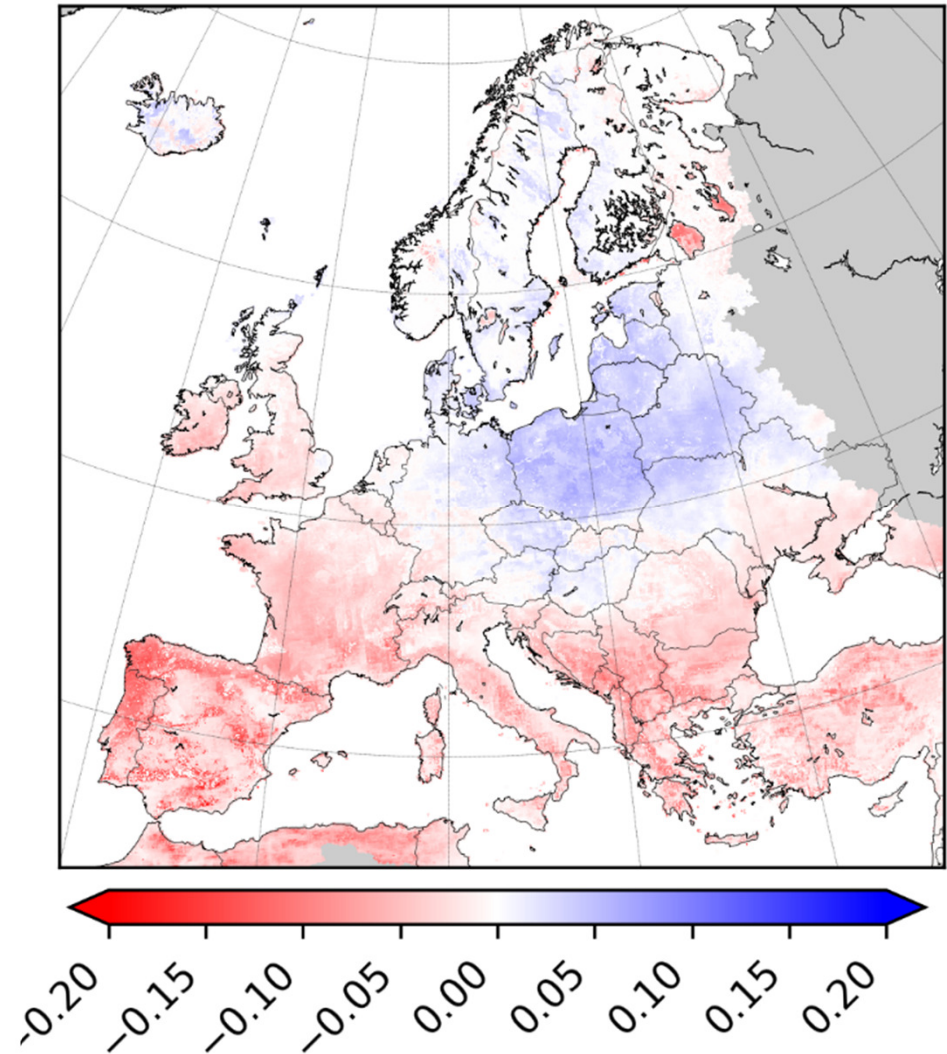


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Change in annual soil water stress



Change in JJA soil water stress

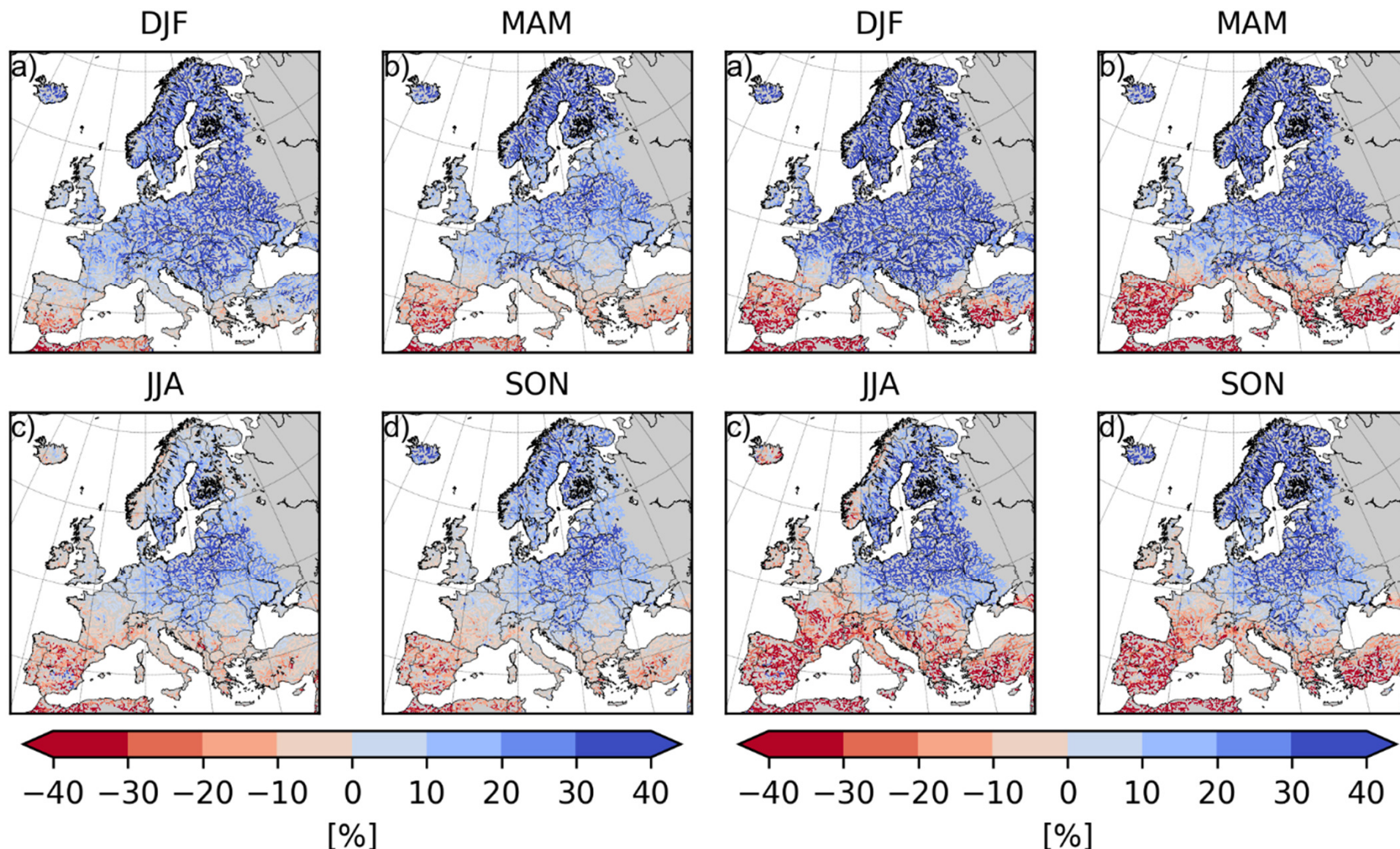


LISFLOOD forced with 11 Euro-Cordex model outputs

Change in mean water availability (Q50)

2 degree temperature change

2070-2099 RCP8.5



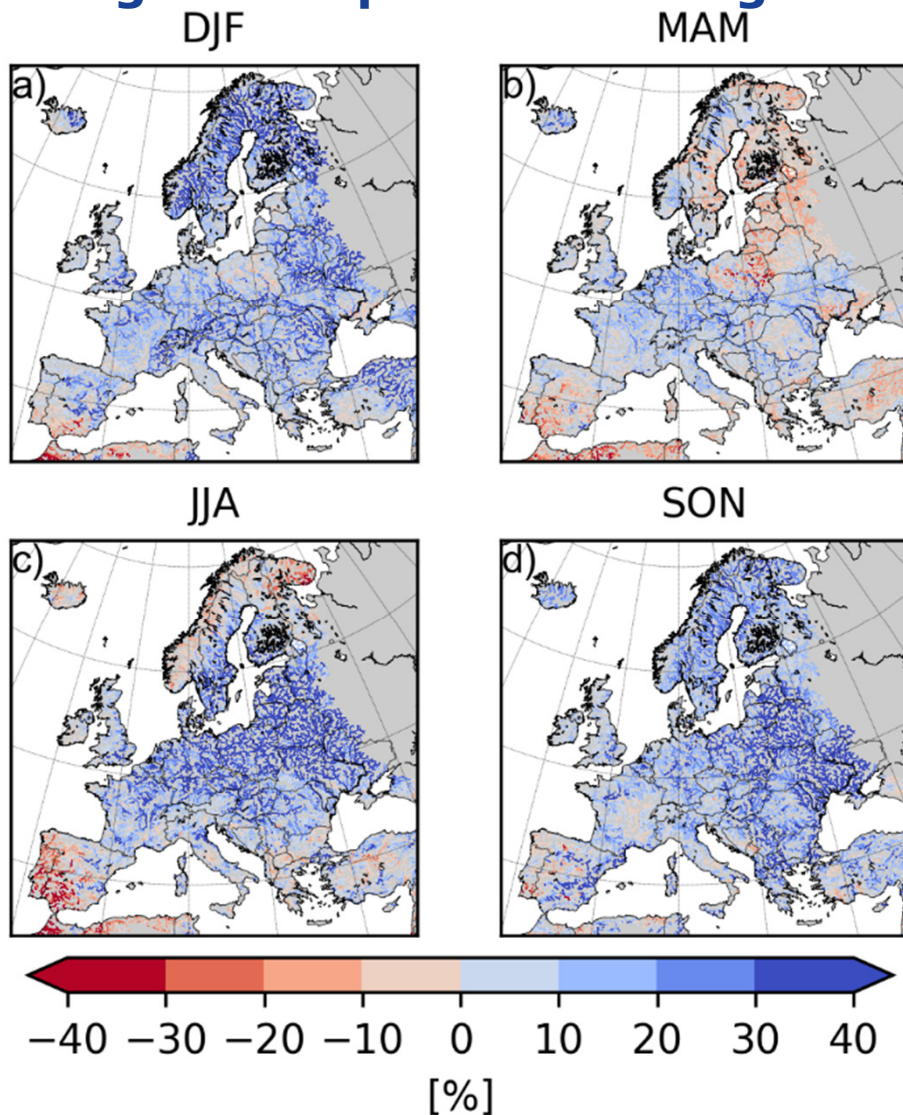
LISFLOOD forced with 11 Euro-Cordex model outputs



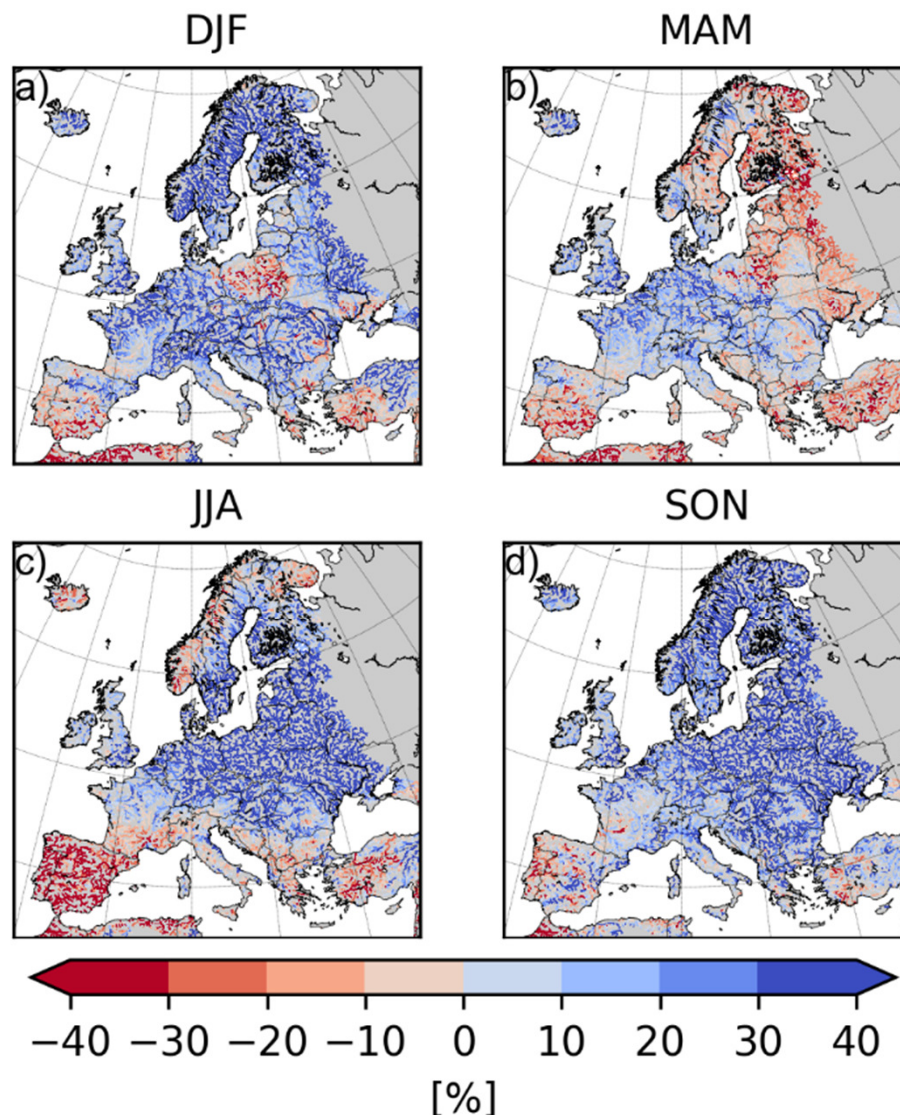
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Change in flood hazard (Q99.5)

2 degree temperature change



2070-2099 RCP8.5

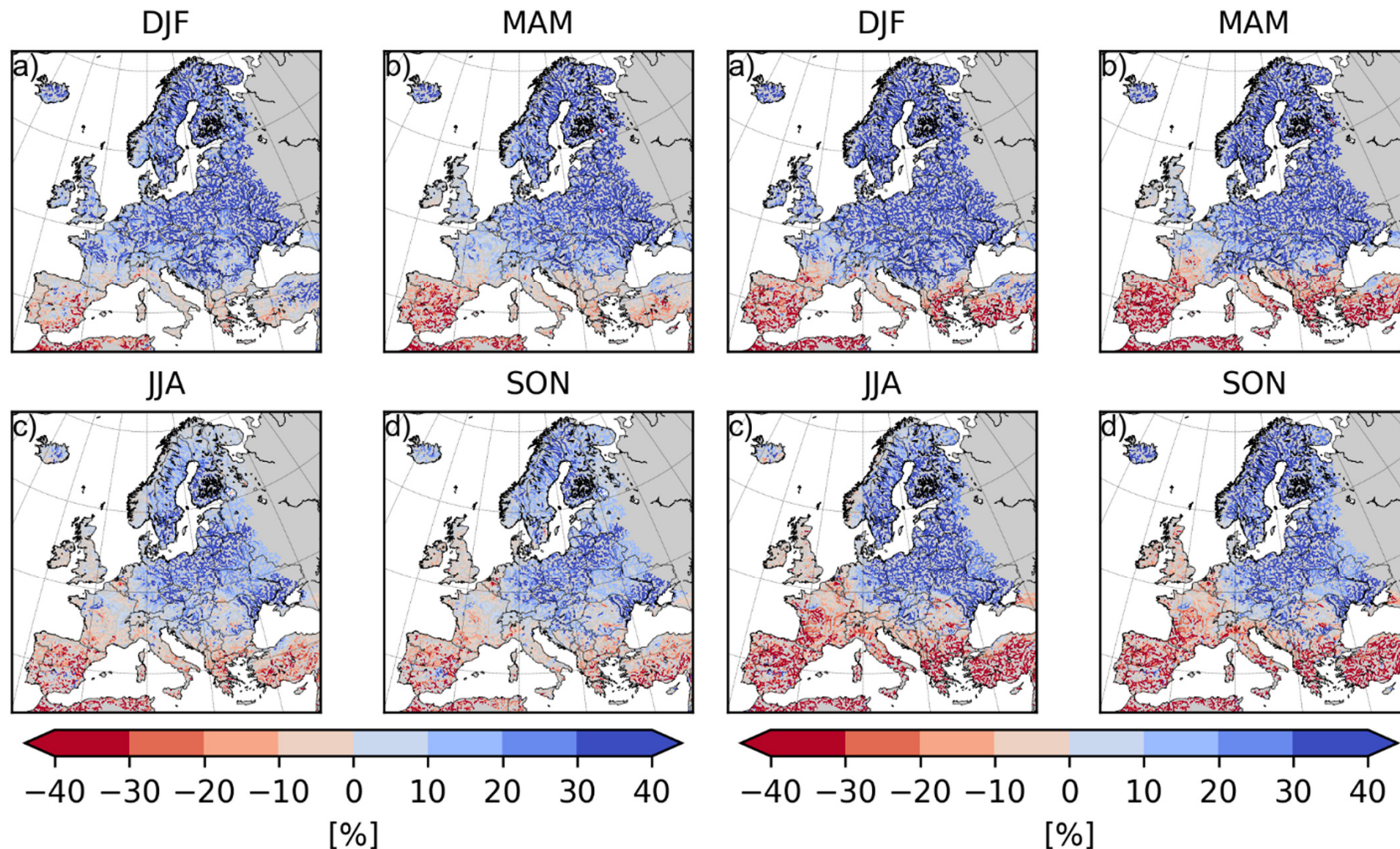


LISFLOOD forced with 11 Euro-Cordex model outputs

Change in low flow magnitude (Q05)

2 degree temperature change

2070-2099 RCP8.5



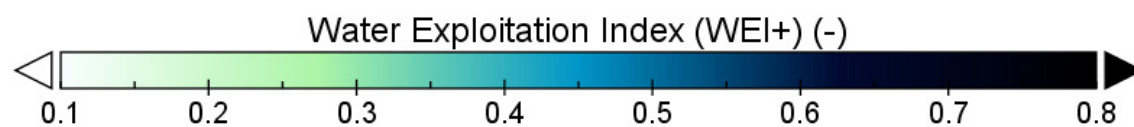
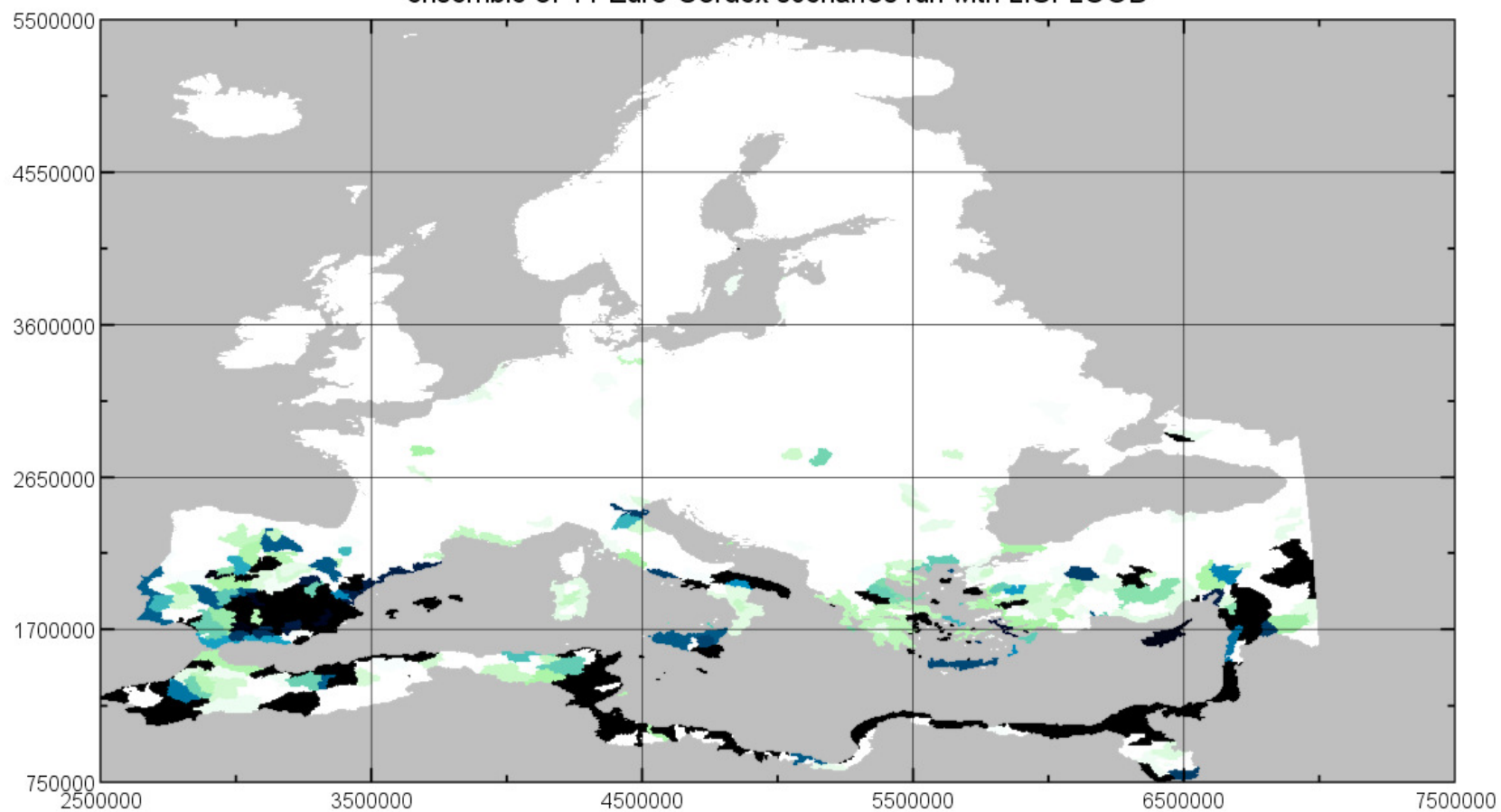
LISFLOOD forced with 11 Euro-Cordex model outputs



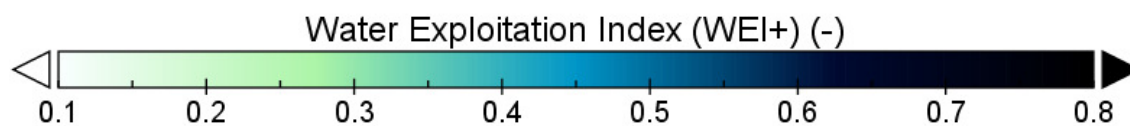
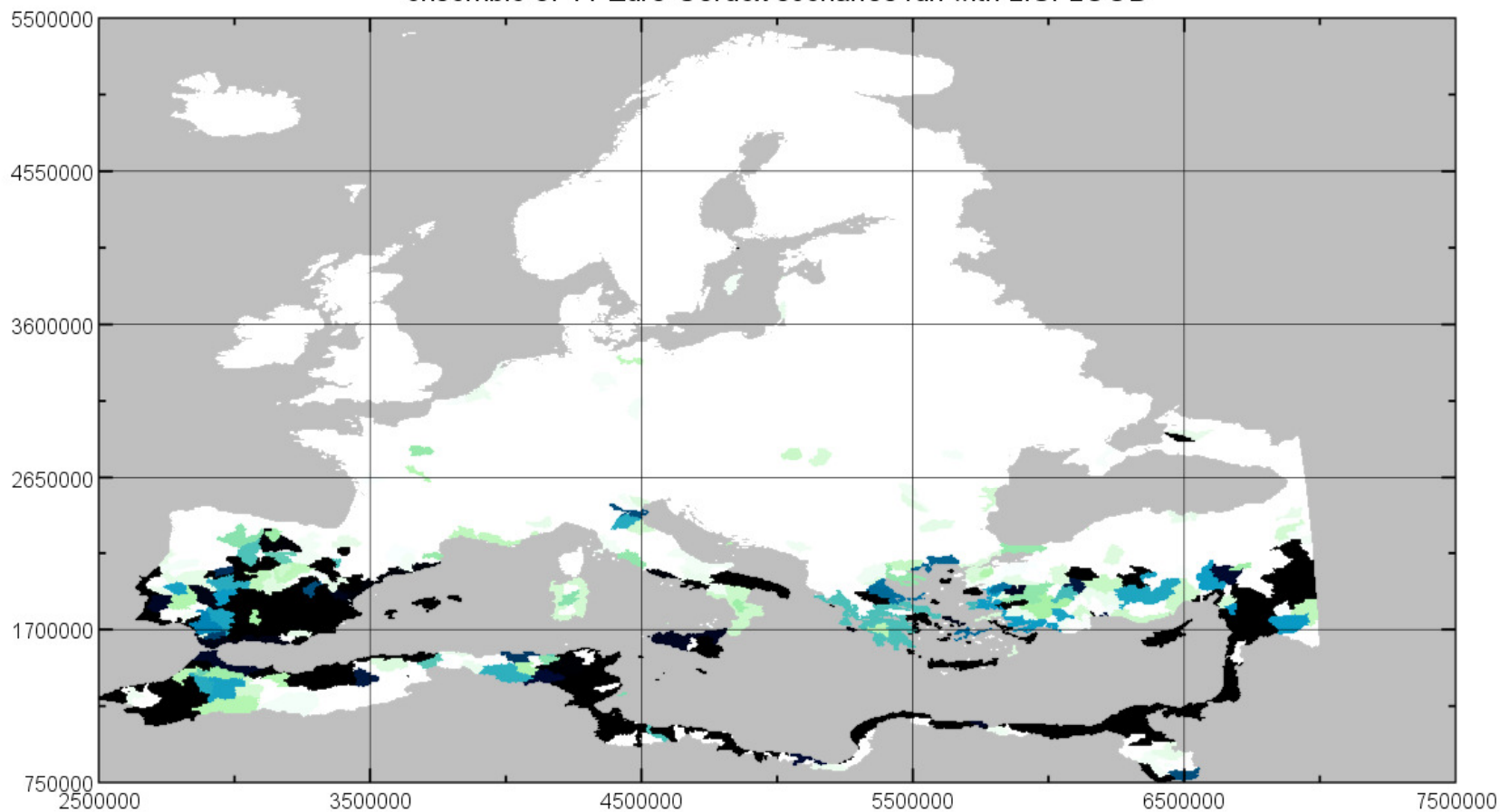
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Water Exploitation Index (WEI+) (consumption): control climate 1981-2010

ensemble of 11 Euro-Cordex scenarios run with LISFLOOD

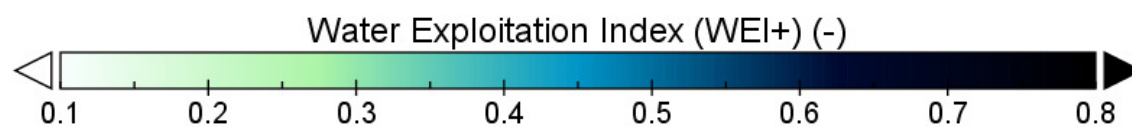
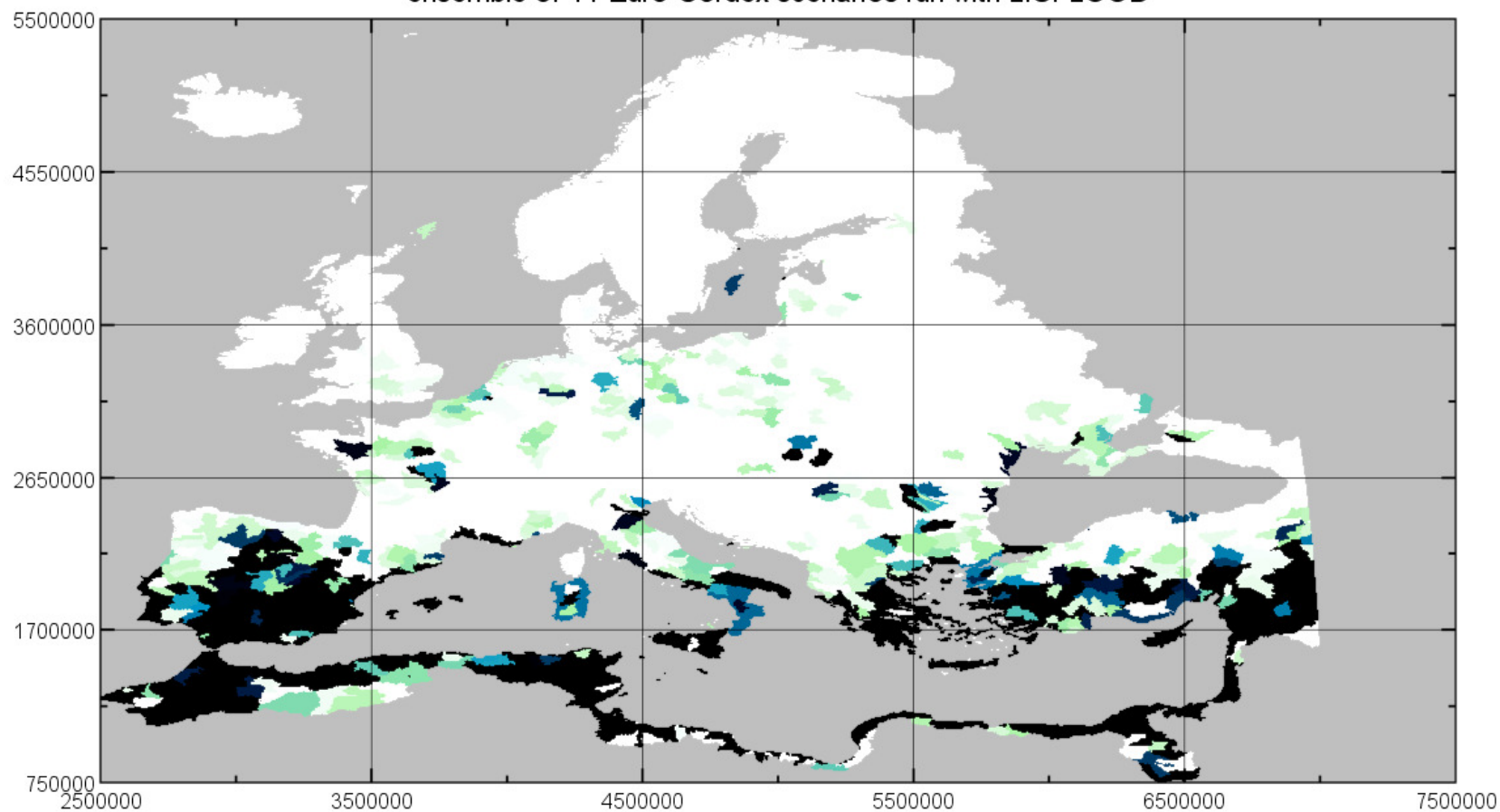


Water Exploitation Index (WEI+) (consumption): 2degree climate ensemble of 11 Euro-Cordex scenarios run with LISFLOOD



Water Exploitation Index (WEI+) (consumption): rcp85 climate 2070-2099

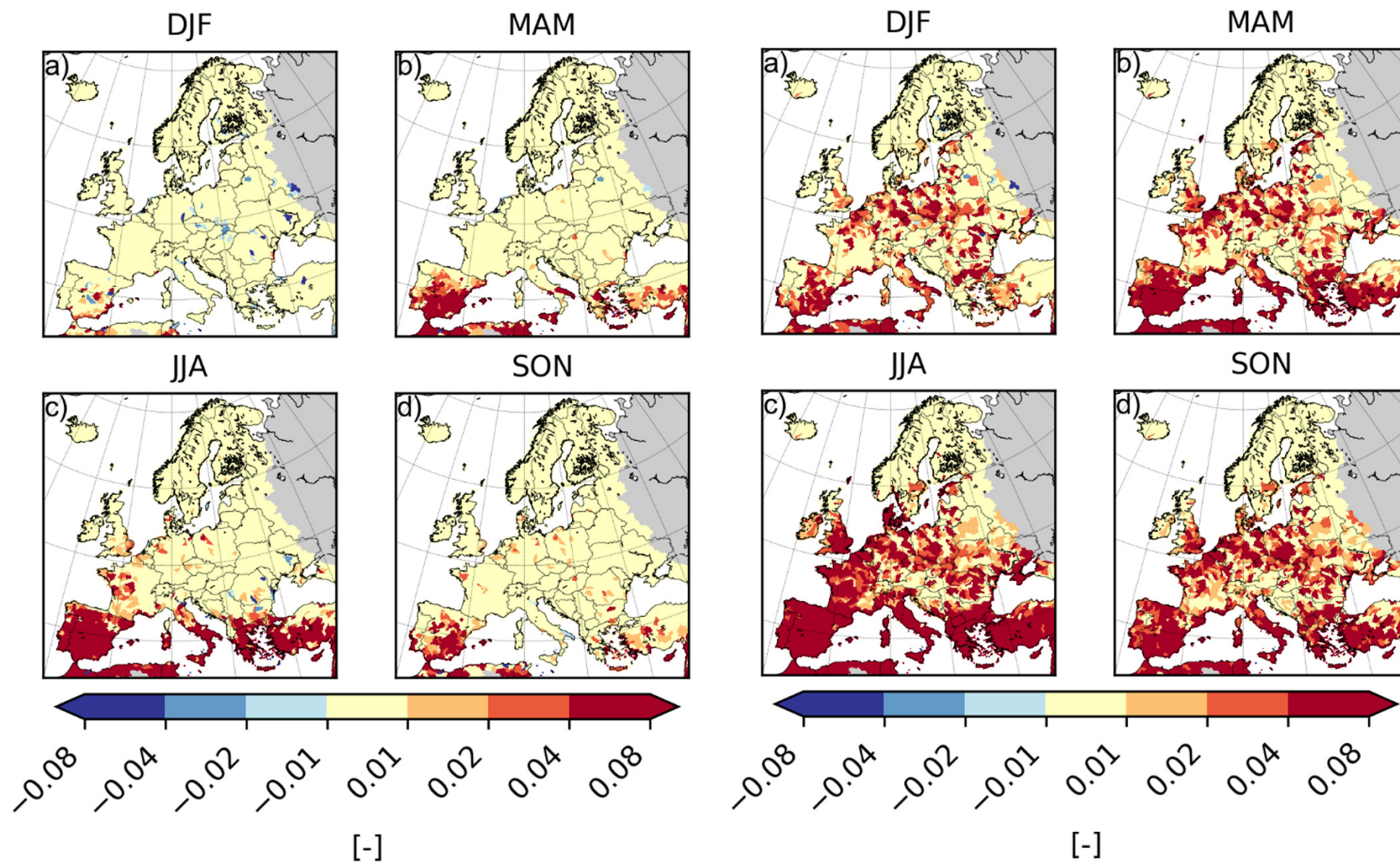
ensemble of 11 Euro-Cordex scenarios run with LISFLOOD



Change in Water Exploitation Index (WEI+)

2 degree temperature change

2070-2099 RCP8.5



LISFLOOD forced with 11 Euro-Cordex model outputs

Conclusions on Europe's water resources until 2050

- Climate change causes **wetter** conditions in north and central Europe, and **drier** conditions in the Mediterranean
- **Mediterranean gets 3 increasing issues**: less water for rainfed agriculture; less surface and groundwater for irrigation and other activities
- Water scarcity is **exacerbated** in areas where it is already an issue
- An extreme warming scenario (RCP8.5 end of 21st century) projects increased water scarcity problems in central Europe and England, especially during summer
- Land use change and water demand changes play a role, but the **climate change effect is dominating** for water resources
- **River floods** are an increasing problem, even in autumn months in the Mediterranean;
- **Urban excess water** is a growing issue in central European countries incl UK

Thanks for your attention

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