Climate change impacts on hydro-climatic extremes in the Danube basin - How robust are projections?

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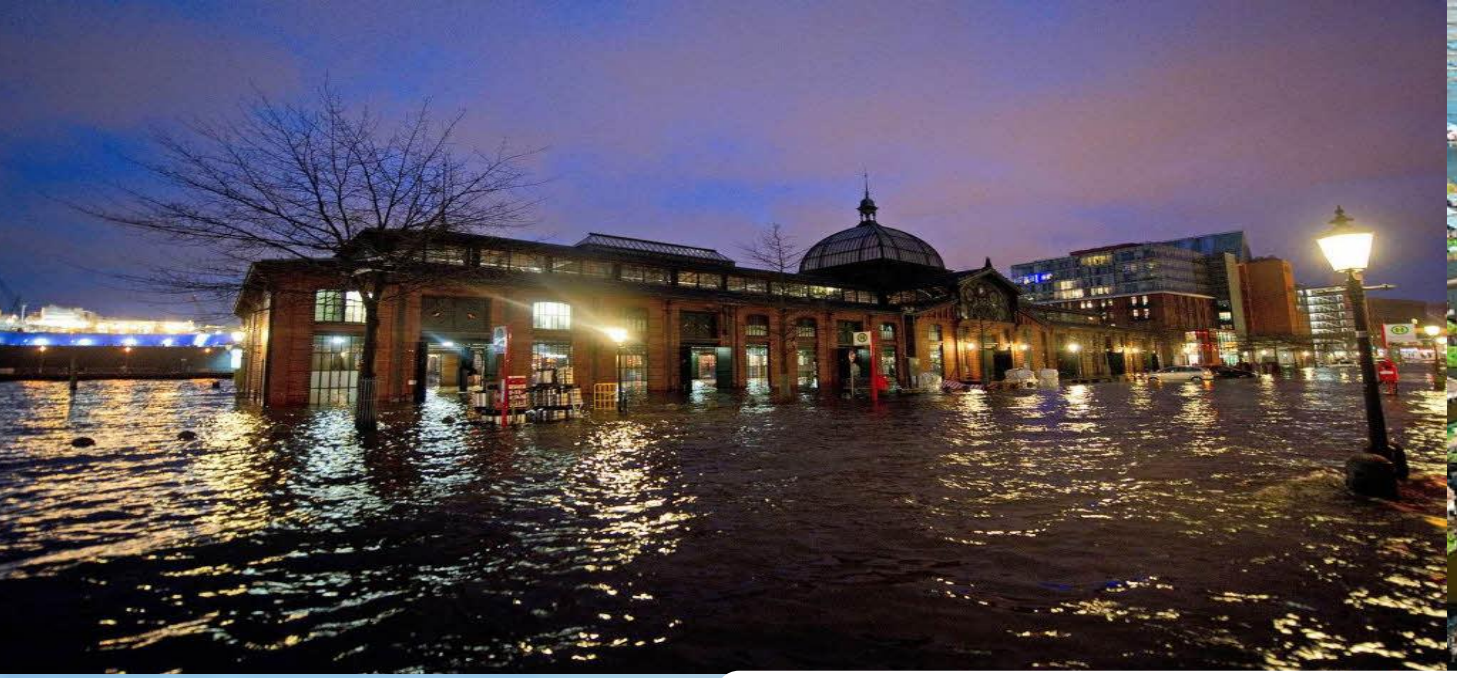
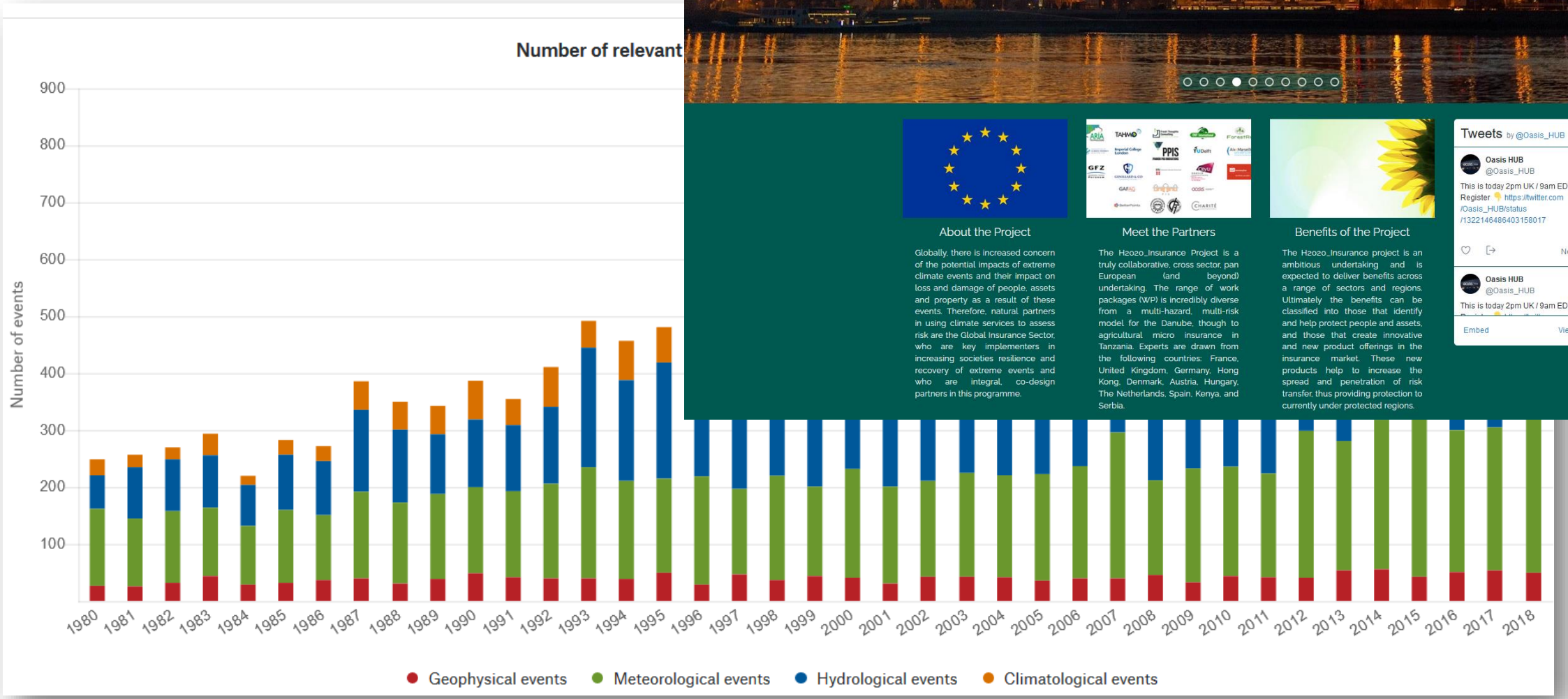


Is this climate change?

Number of natural desaster

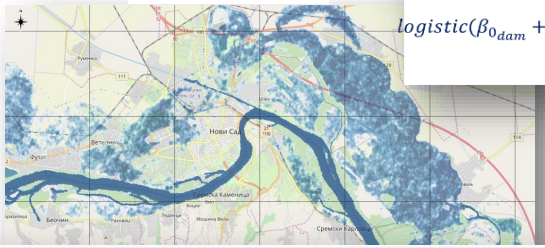


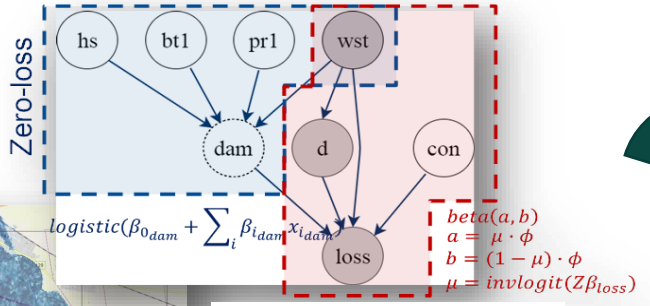
Source: Munich Re NatCat Service

The workflow in a nutshell

Expert workshops

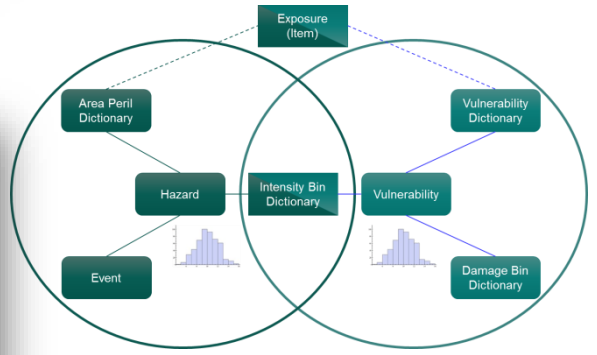
Results



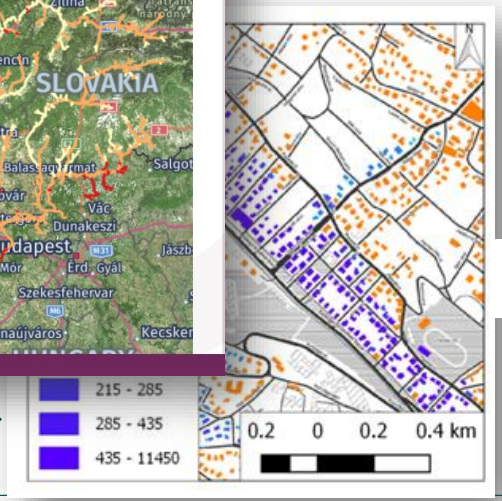


Methodologies

OASISL LMF

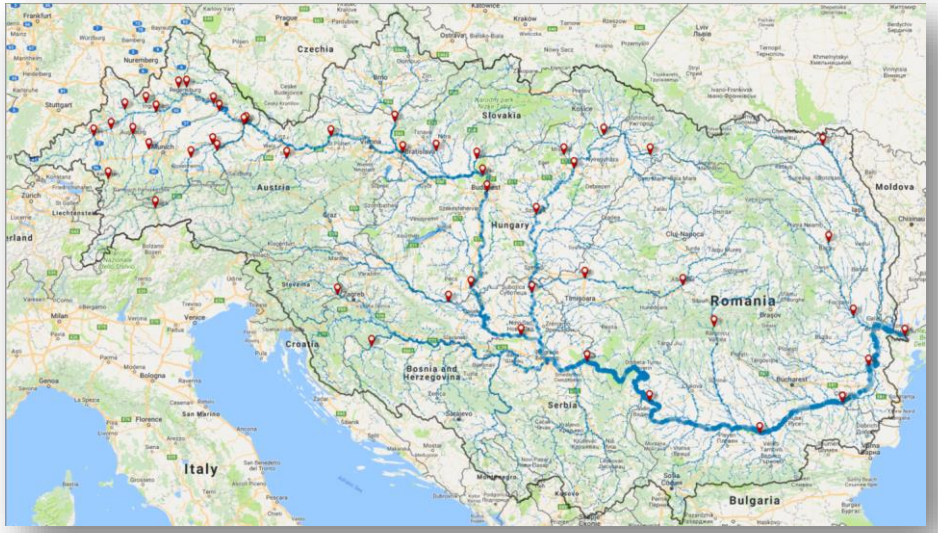


E-market



Exposure

Future Danube Model



CORDEX-EU
- GCM-RCM climate model simulations

IMAGE
- Multisite, multivariate stochastic weather generator
- Imperial College London

SWIM
- Hydrological model
- PIK Potsdam

CaMa Flood
- Hydraulic model
- PIK Potsdam

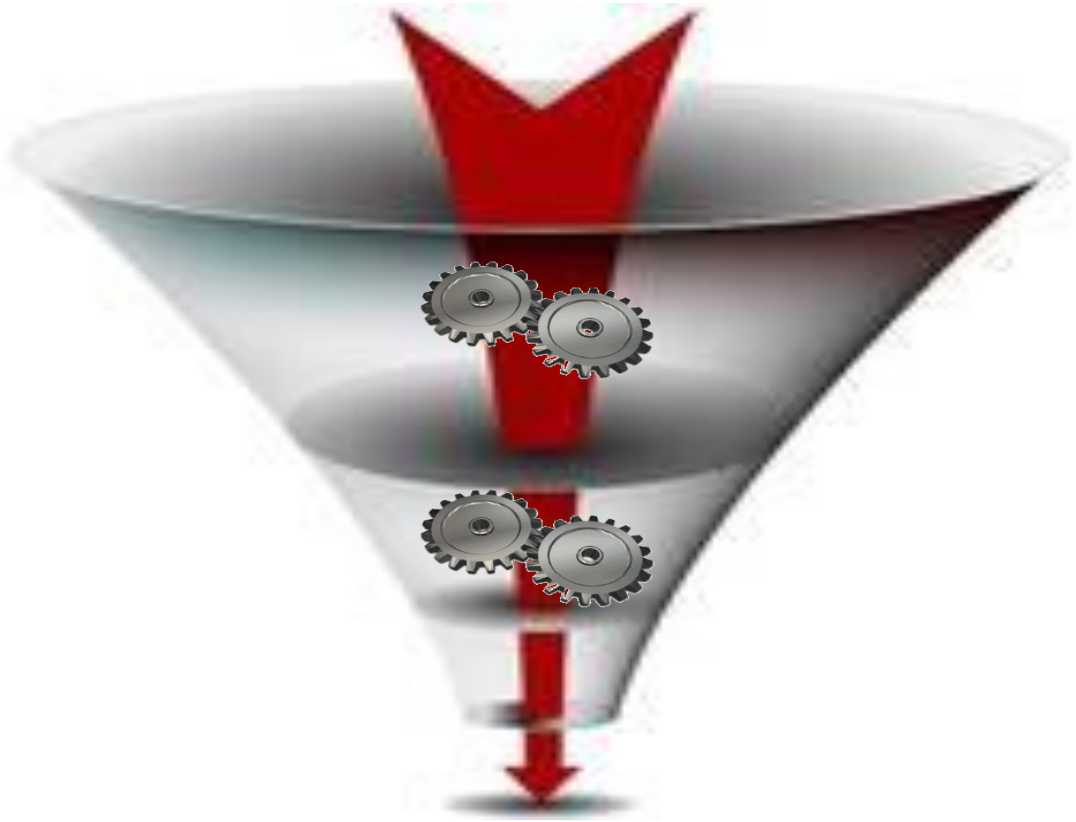
MIKE flood
- Pluvial flood model for selected cities
- DTU Copenhagen

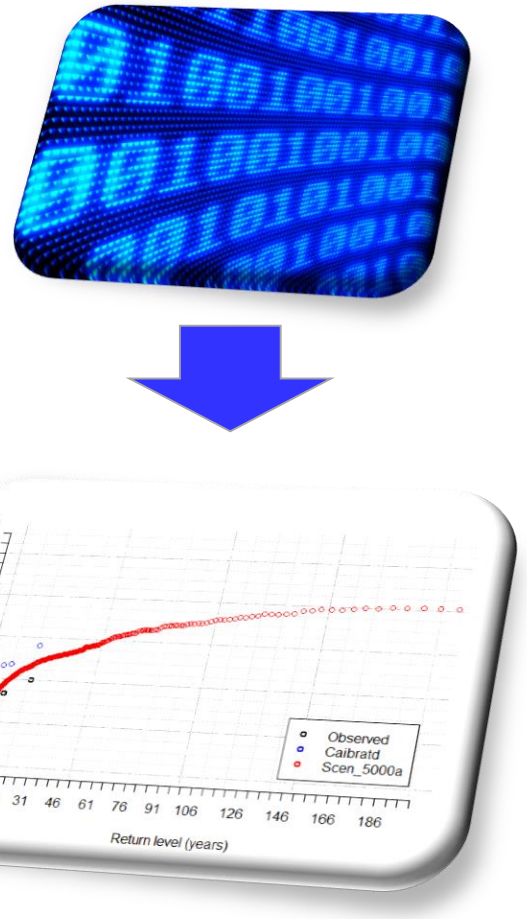
BN-FLEMOps
- Probabilistic flood loss model
- GFZ Potsdam

- Genillard & Co
- Pannon Pro
- Uni. Novi Sad
- Insurance sector

Big data -> condensed information

280,000 years of daily climate and hydrological data
~13,0000 river sections ~200,000 spatial units

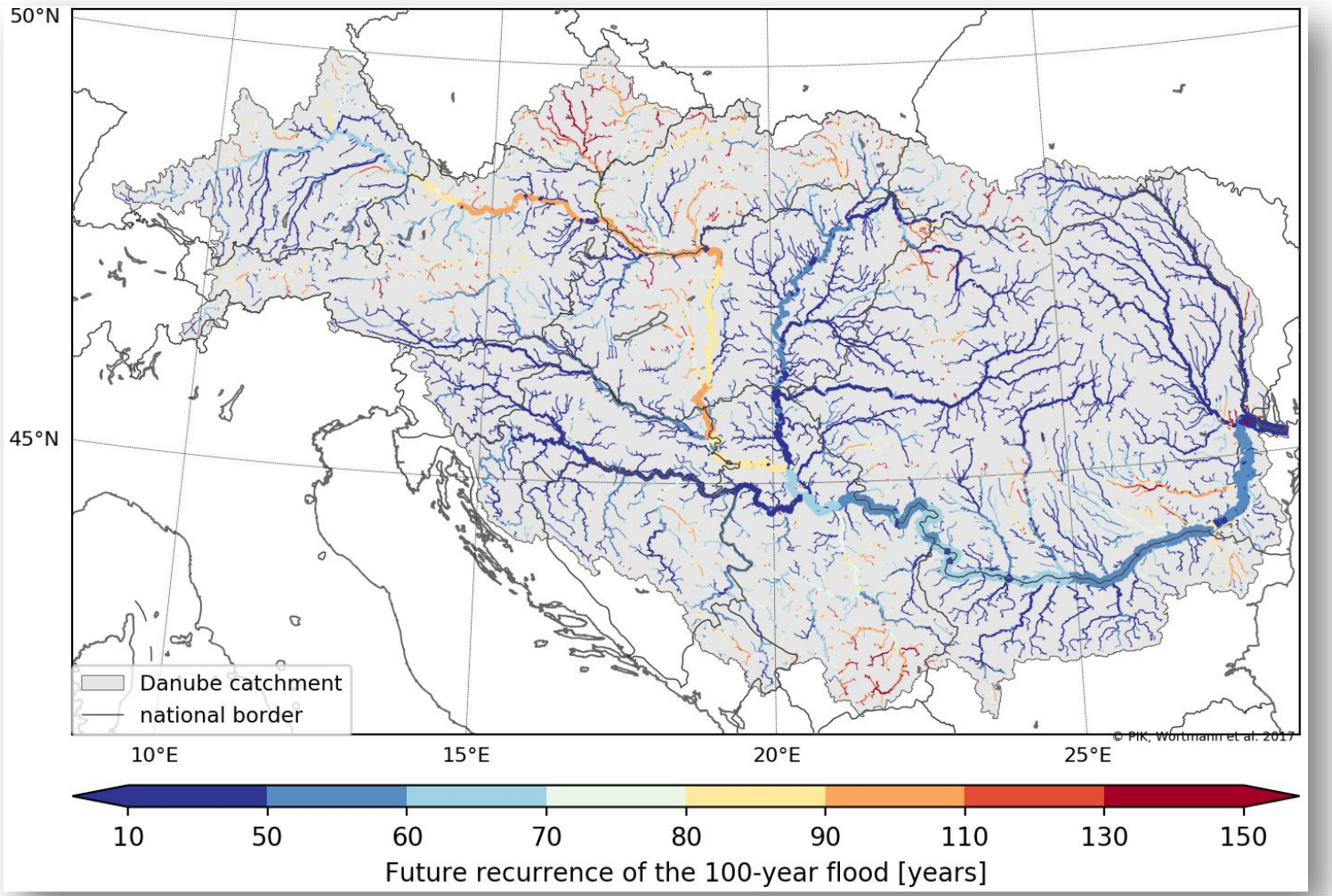




Robust risk information

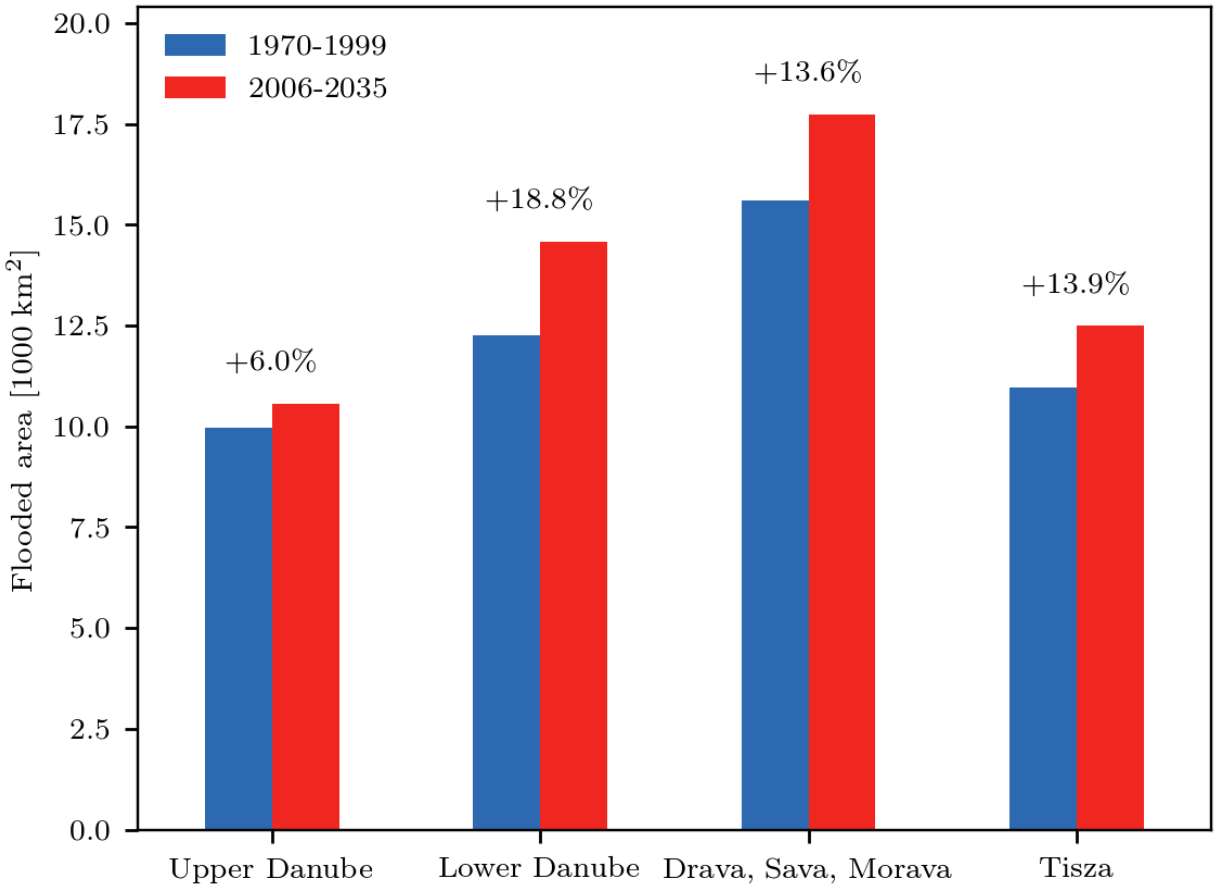
Changes from reference period until “now” 2006-2035

Future reoccurrence of the 100-year flood

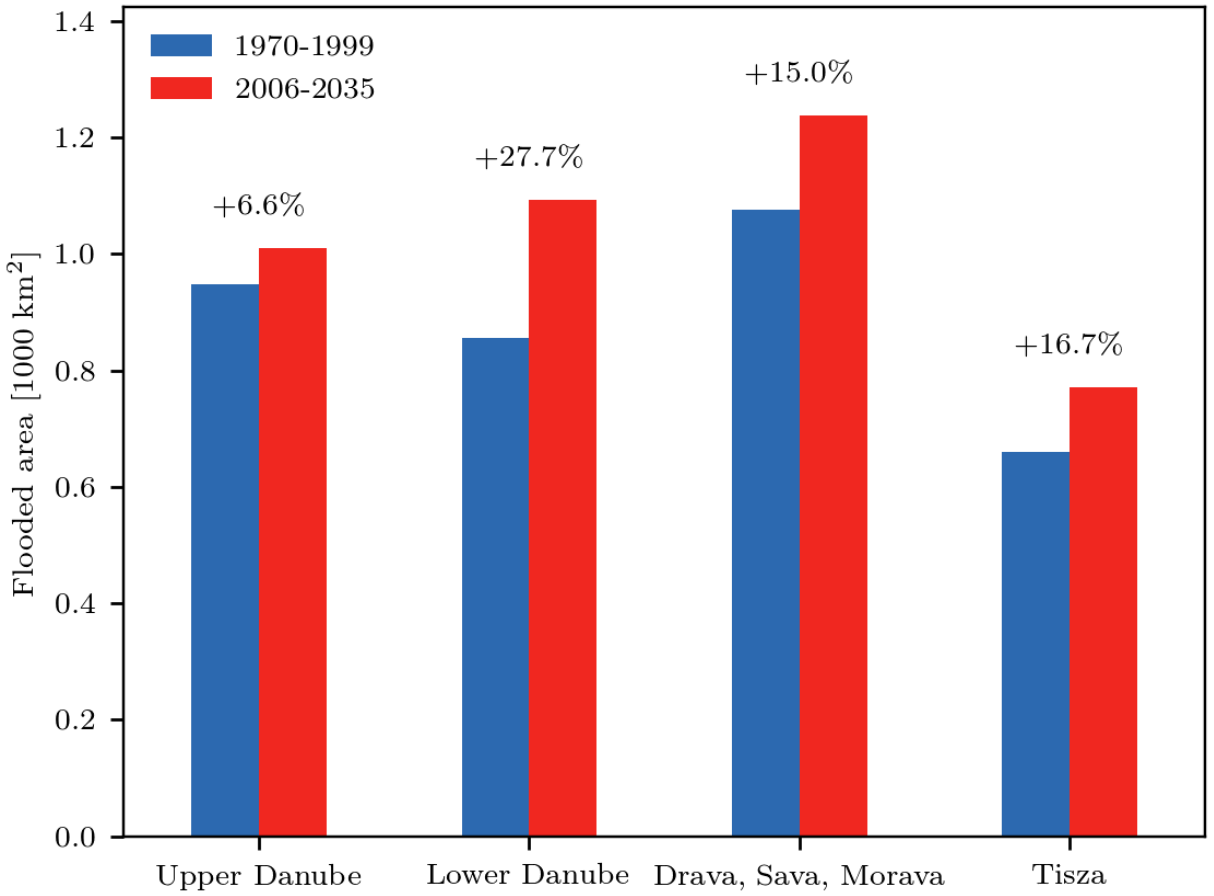


Changes from reference period until “now” 2006-2035

Entire catchment

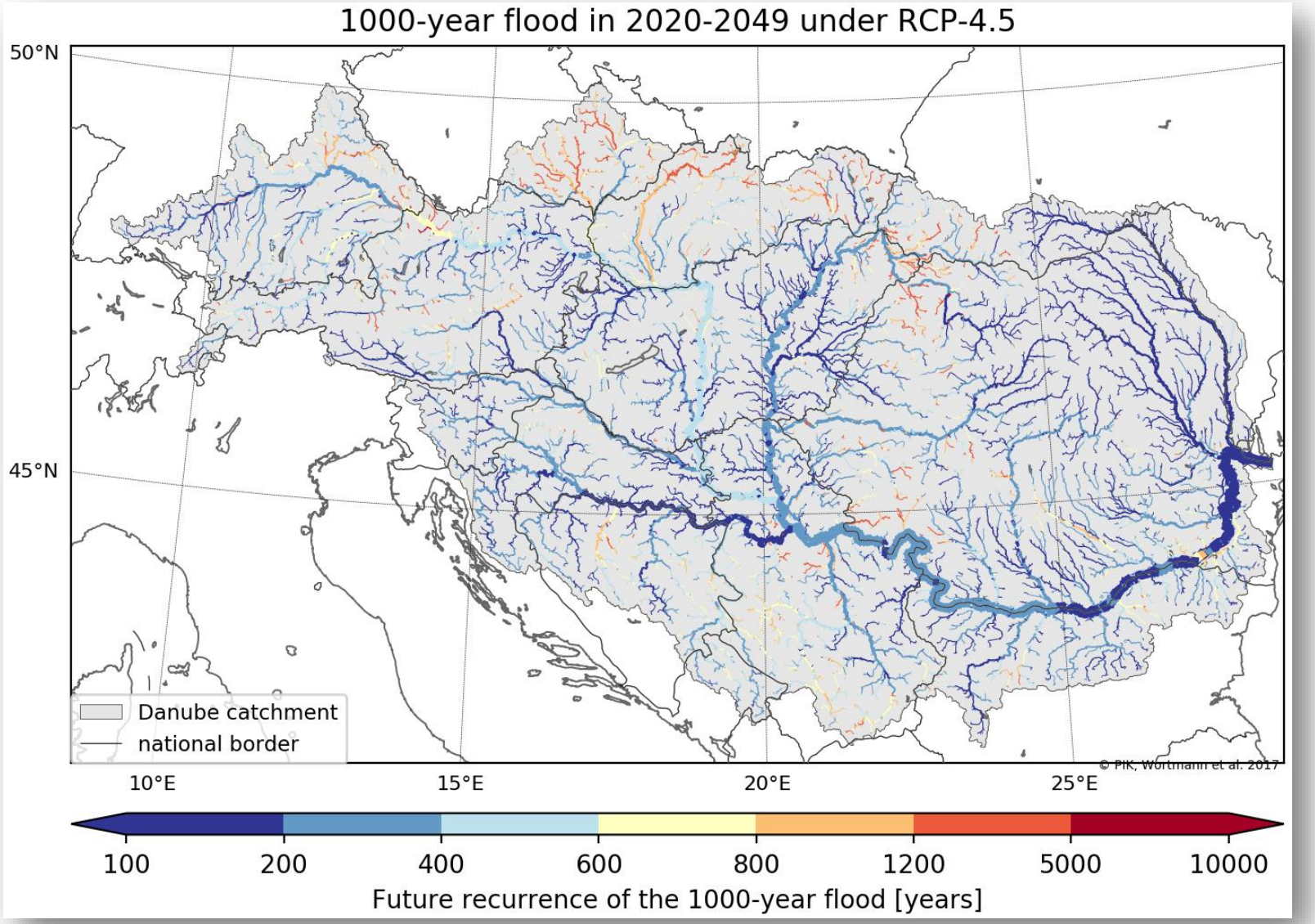


Area populated/industrial



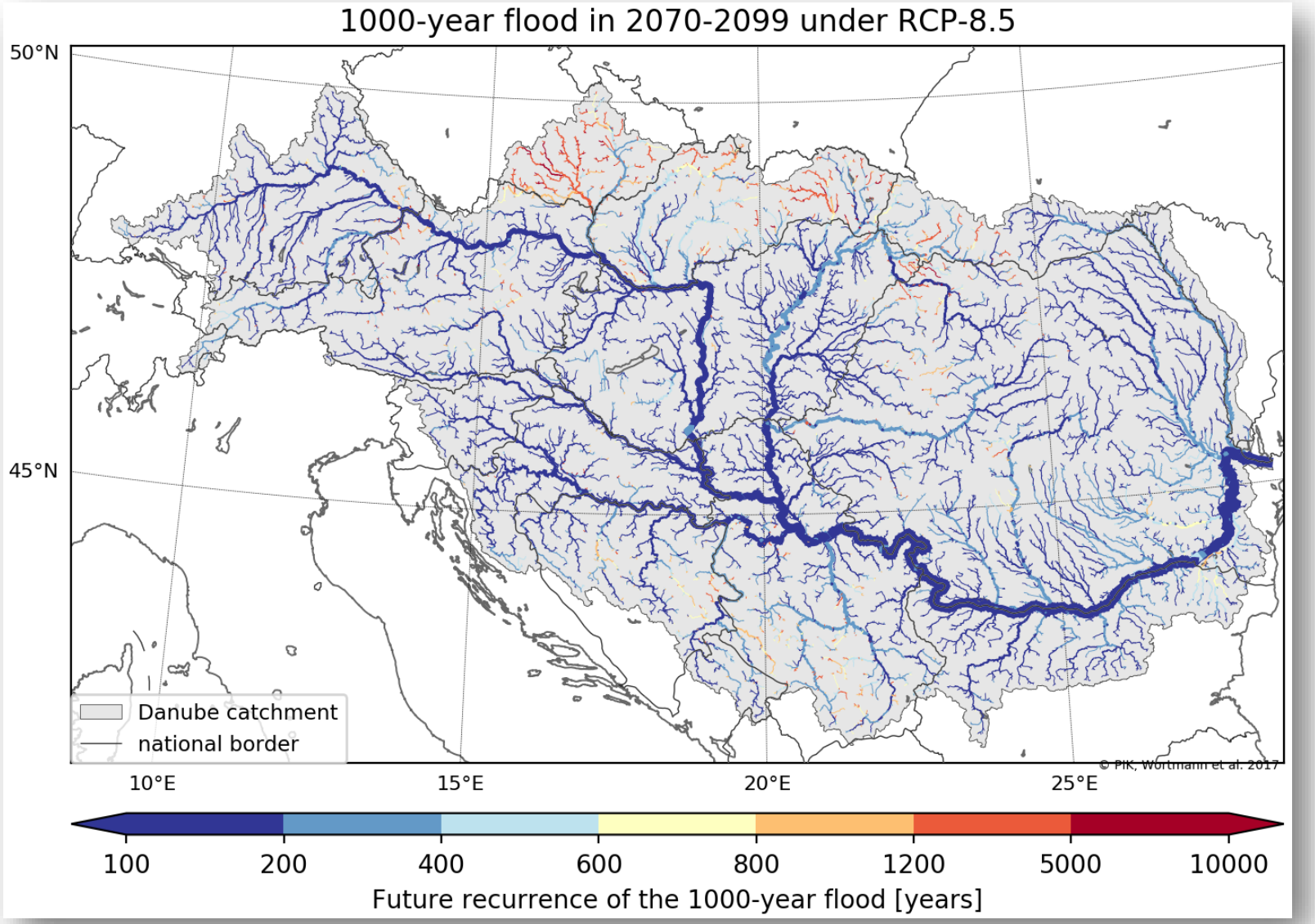
The future reoccurrence of the current 1000-year flood

RCP4.5, 2020-2049



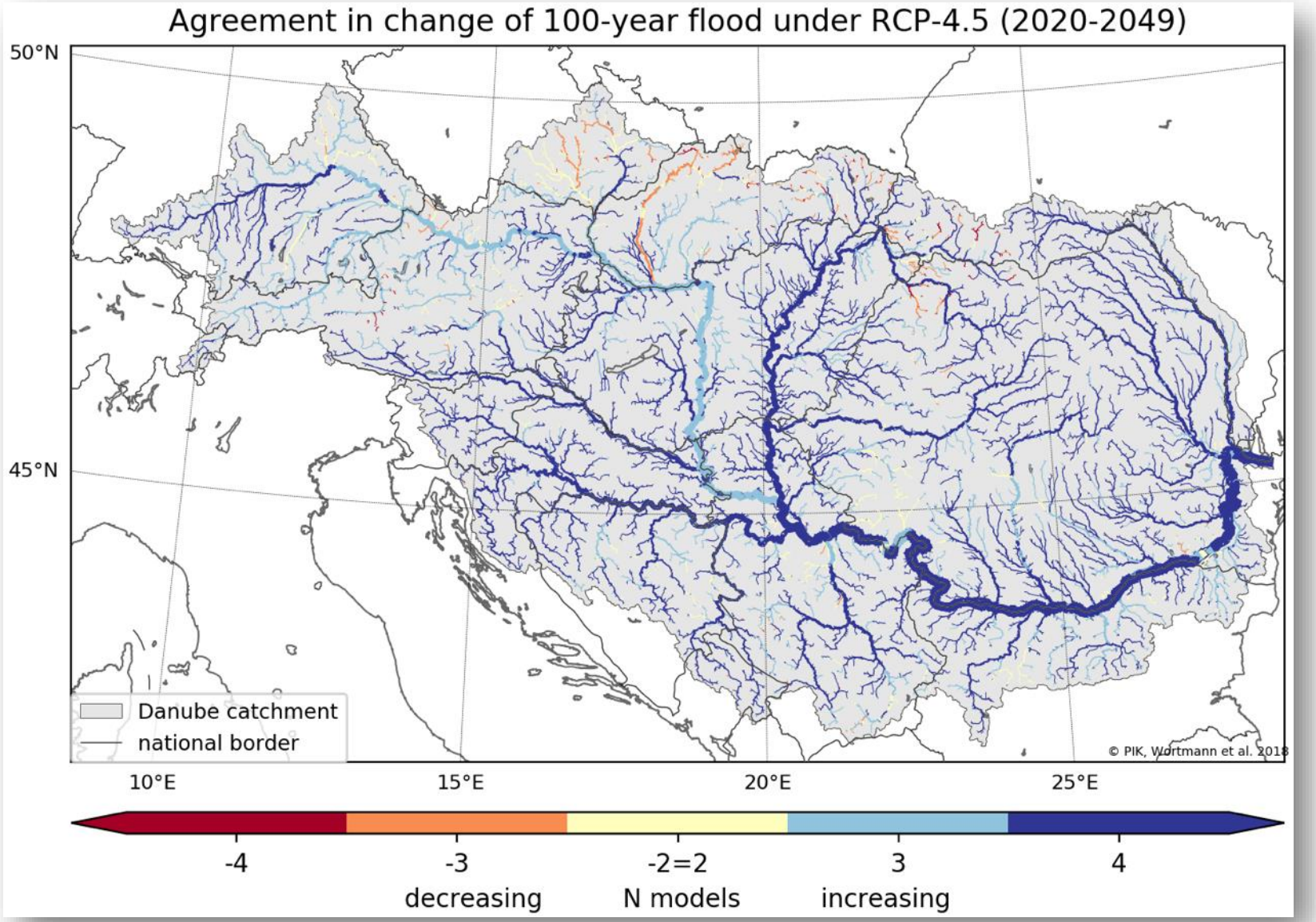
The future reoccurrence of the current 1000-year flood

RCP8.5, 2070-2099



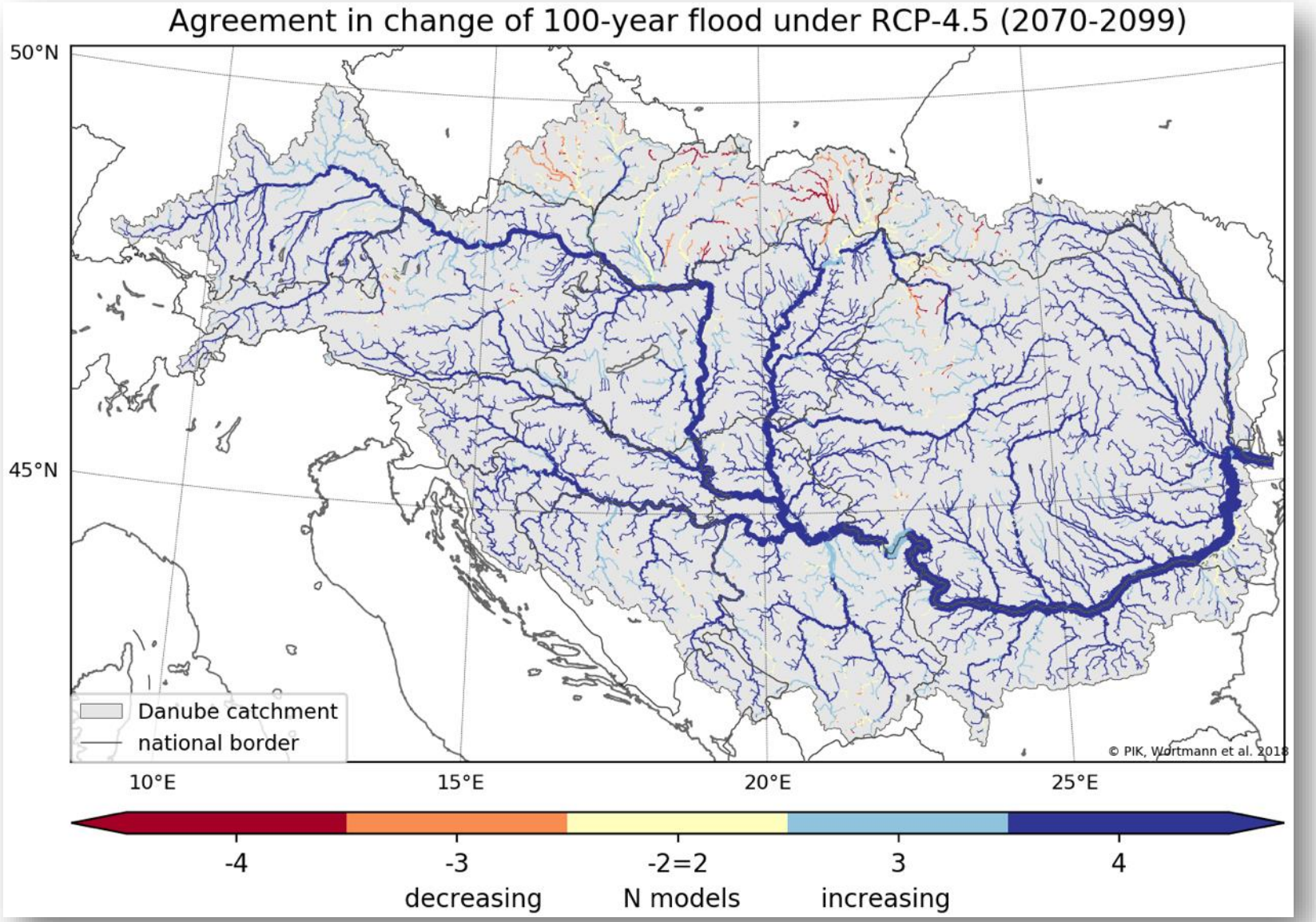
Ensemble agreement of change in the 100-year flood

2020-2049



Ensemble agreement of change in the 100-year flood

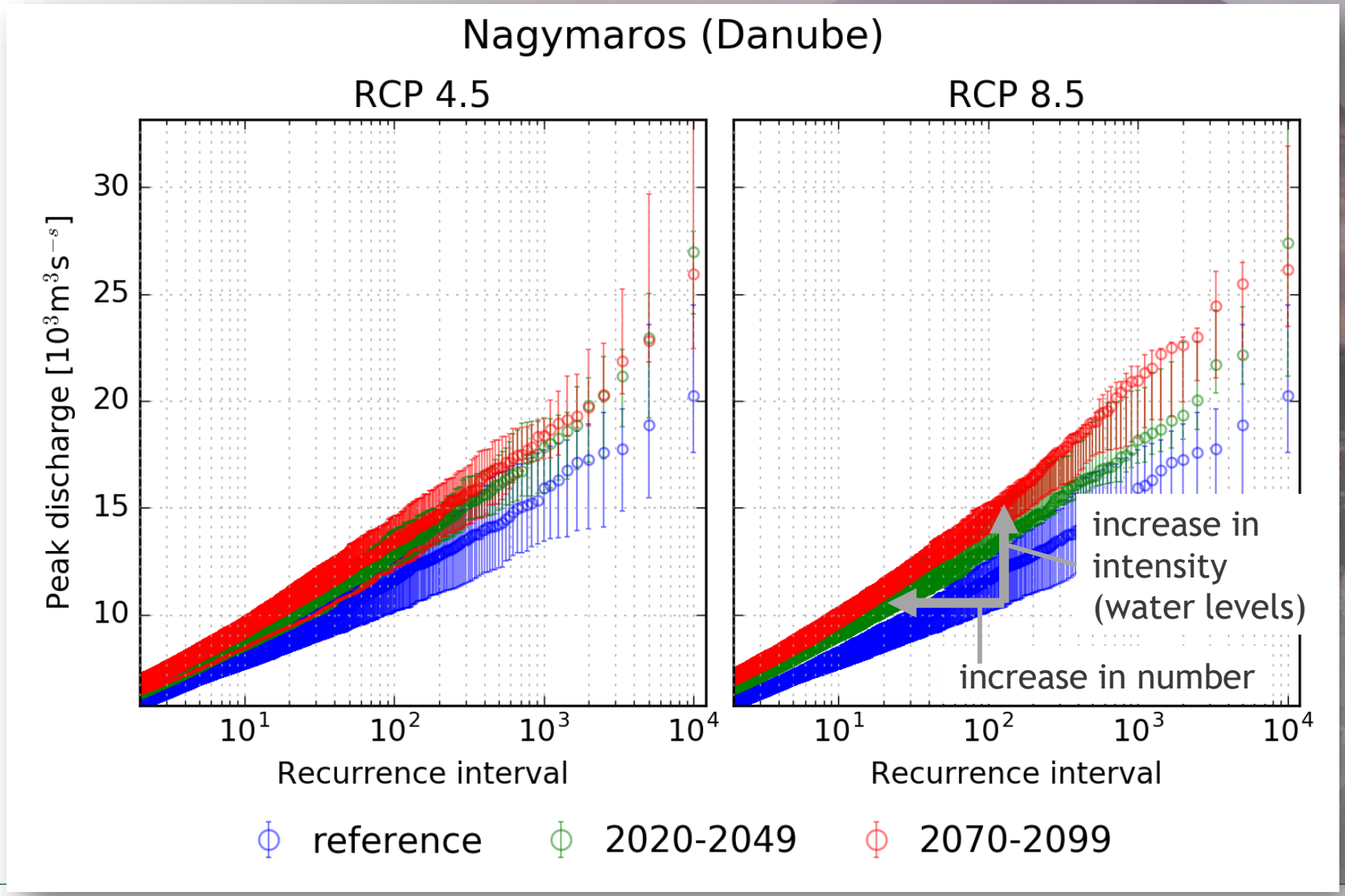
2070-2099



Current and future flood reoccurrence

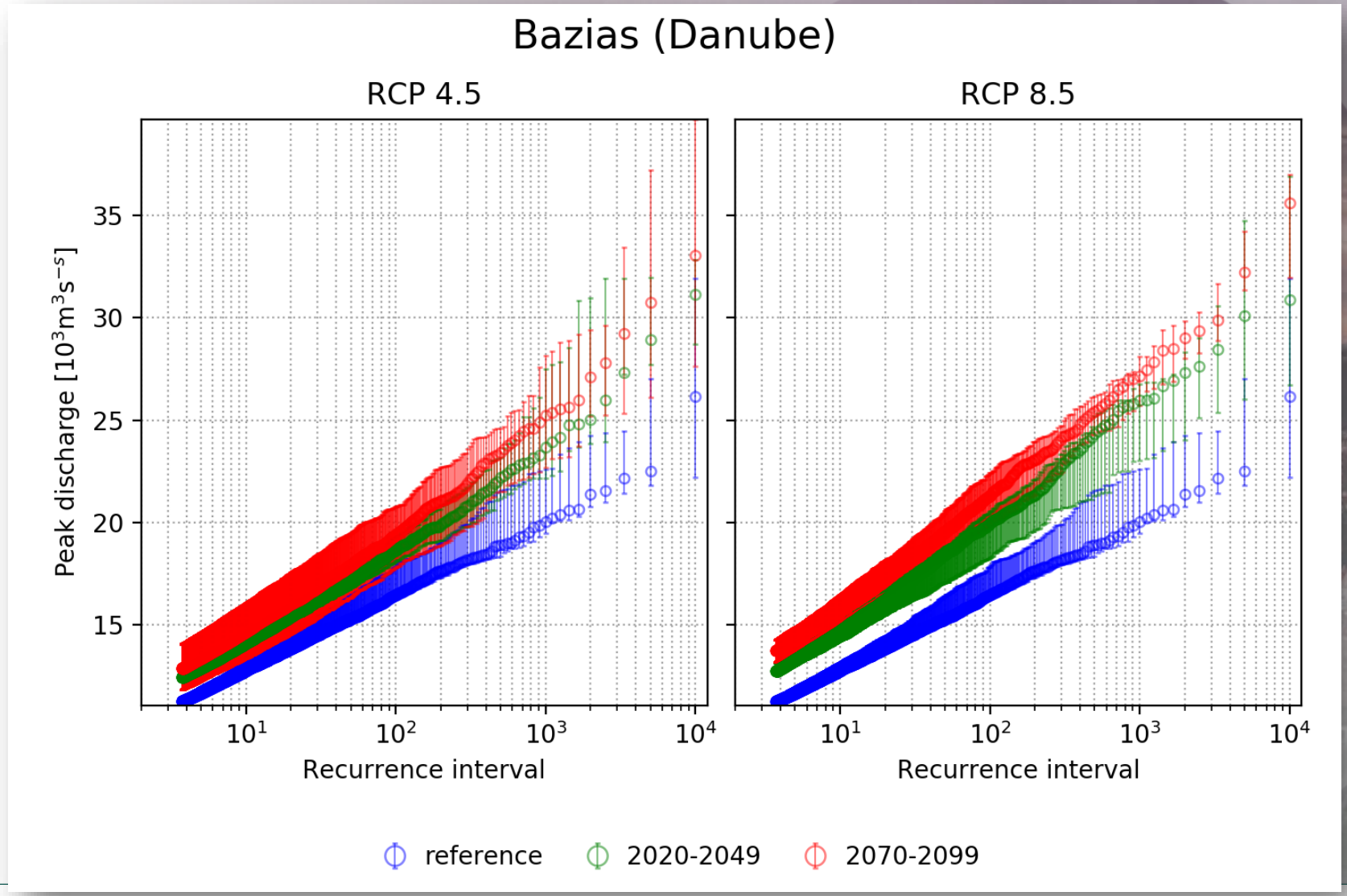
Hungary

These statistics are there for each of the ~13,0000 river sections



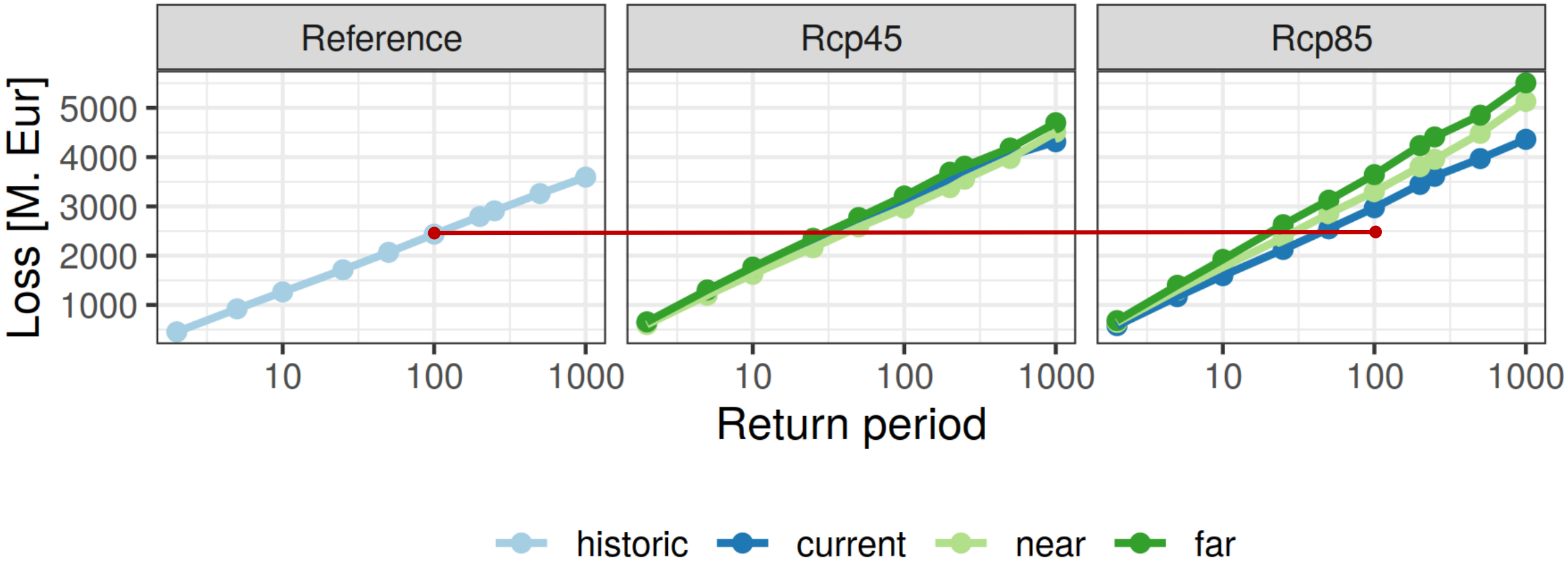
Current and future flood reoccurrence

Romania

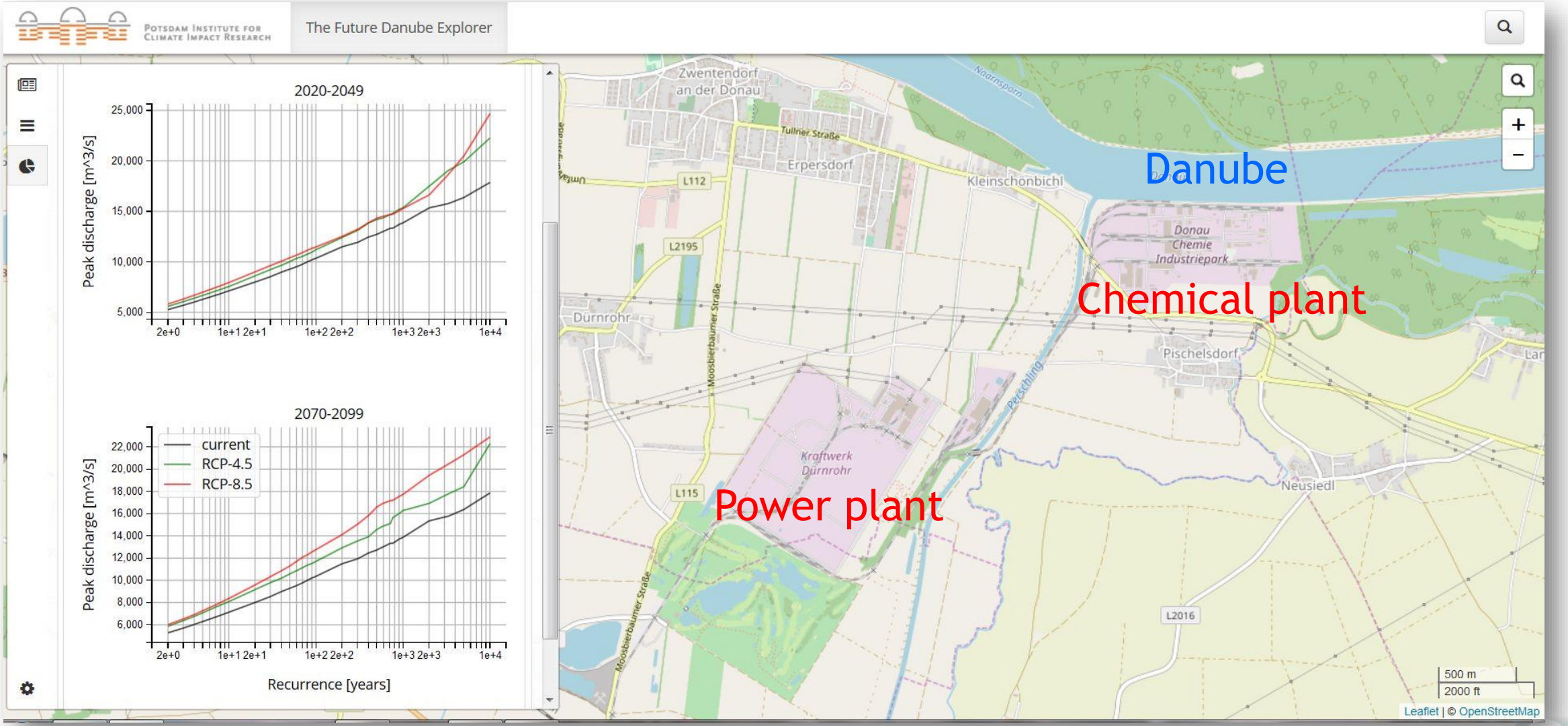


AEP curves for fluvial flood risk of commercial buildings

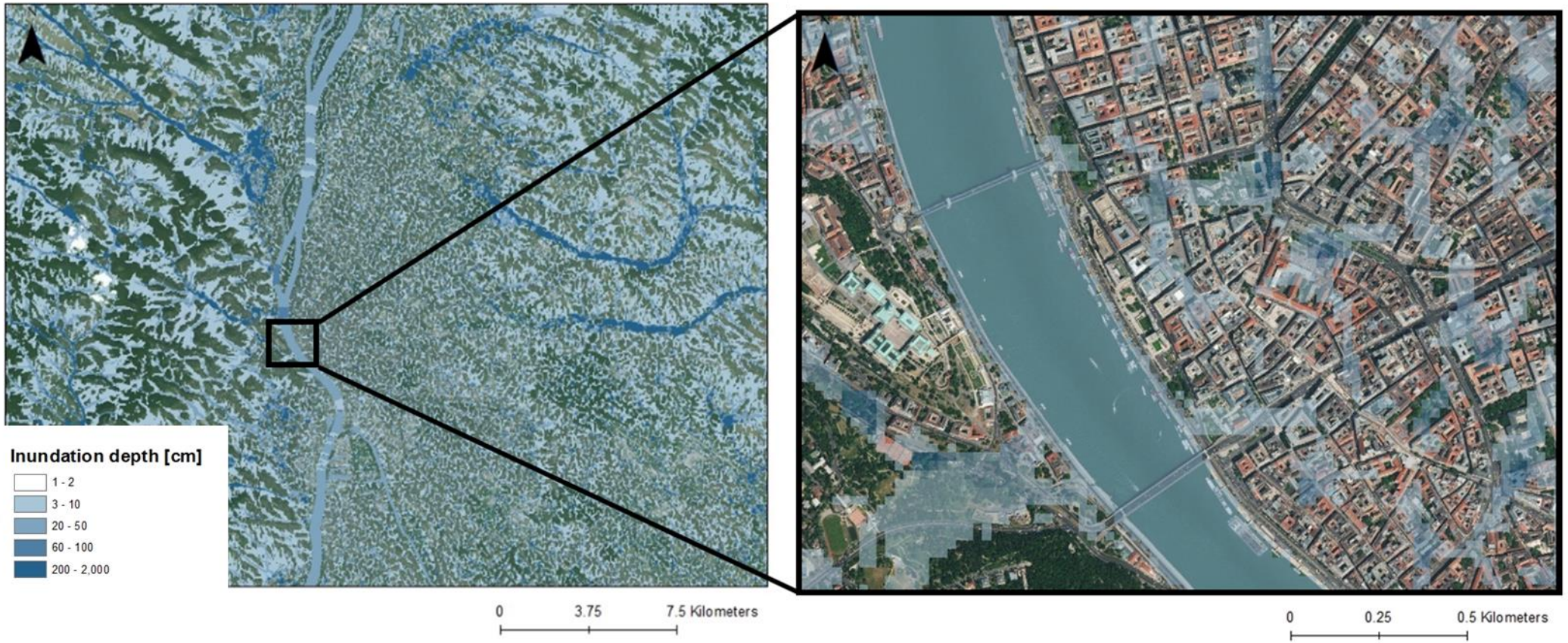
Entire Danube catchment for historic, current and future climate periods and two RCPs



Critical infrastruture



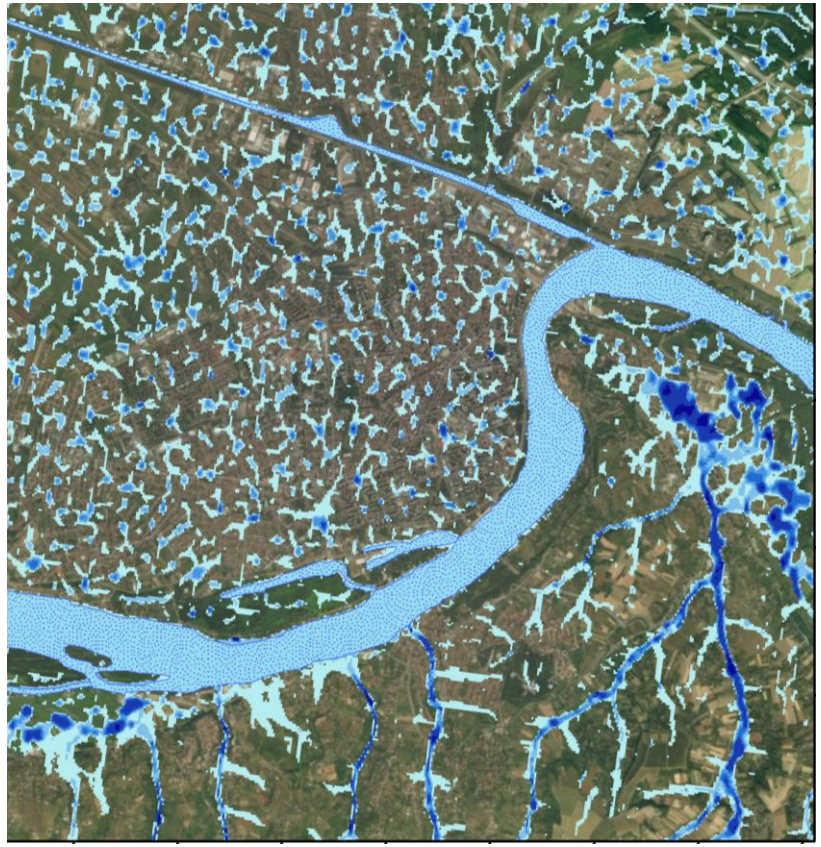
Pluvial flood risk in Budapest (100 year event current conditions)



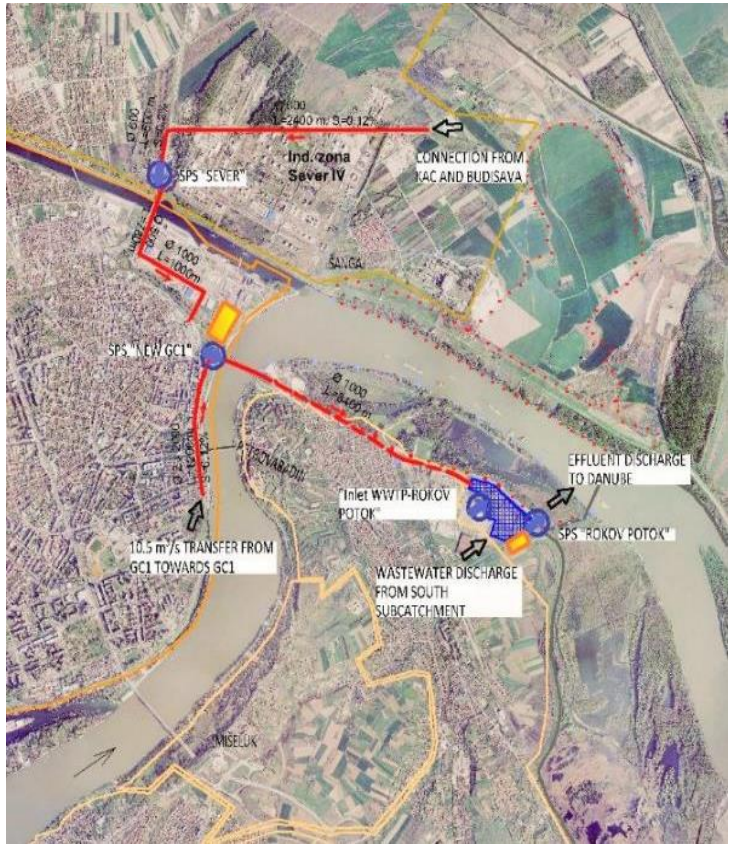
Flood risk for new wastewater treatment plant (Novi Sad, Serbia)

Stakeholder engagement and pluvial flood simulations

- 3 stakeholder workshops in Novi Sad with
- Completed Climate Change Impact Assessment for the wastewater treatment plant
- Detailed flash-flood simulations incl. high-resolution weather simulations

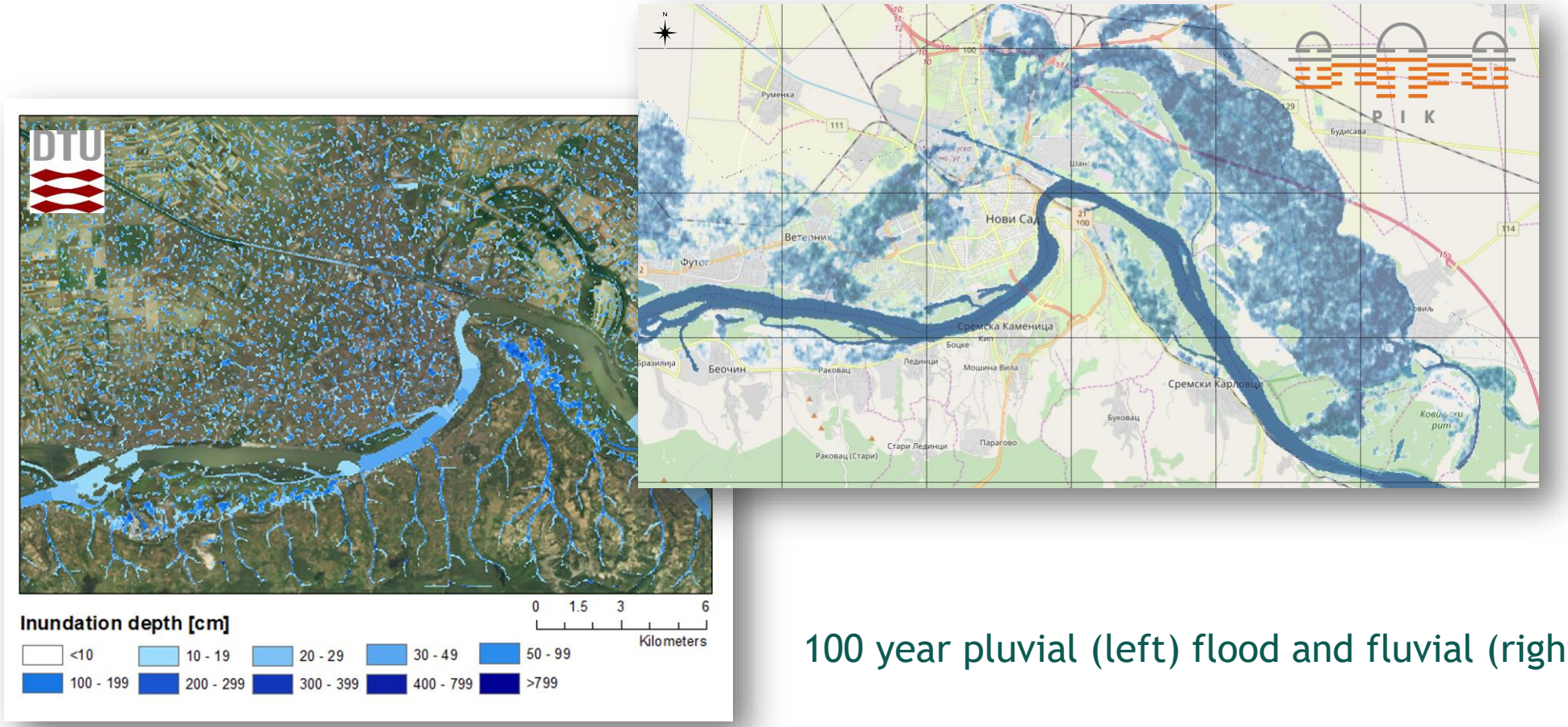


Model simulations (100-year event)



Selected site

Compound events – pluvial and fluvial floods



100 year pluvial (left) flood and fluvial (right) foods

Thinking out of the box

Or thinking the unthinkable?

There are strong indications that hydro-climatic extremes will increase in number and intensity

What is possible?

- Highest historical event?
  (In Germany Magdalenen-Flood in 1342 with an recurrence >> 1000)
- How good are climate models in reproducing extremes?
  (For example concerning compound events, large scale circulation pattern)
- “Constructed events”
  (Example of the Rhine basin with to flood generation processes – how does a combined event look like?)

Thank you

Hattermann, F.F., Wortmann, M., Liersch, S., Toumi, R., Sparks, N., Genillard, C., Schröter, K., Steinhausen, M., Gyalai-Korpos, M., Máté, K., Hayes, B., Drews, M., Maria del Rocio Rivas Lopez, Rácz, T. (2018) **Simulation of flood hazard and risk in the Danube basin with the Future Danube Model**. *Climate Services*.

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Martin Drews, Morten Andreas Dahl Larsen, Michel Wortmann, Gwendoline Lacressonnière, Mads Lykke Dømgaard, Céline Déandreis, Fanny Velay Lasry and Fred Hattermann (2020) Compound effects of atmospheric and soil conditions on flash flood severity in prep. for a special issue of Hydrological Processes.

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