POTSDAM INSTITUTE FOR CLIMATE IMPACT RESEARCH

Quantification of risks and costs of climate change impacts on floods and droughts in the Danube basin

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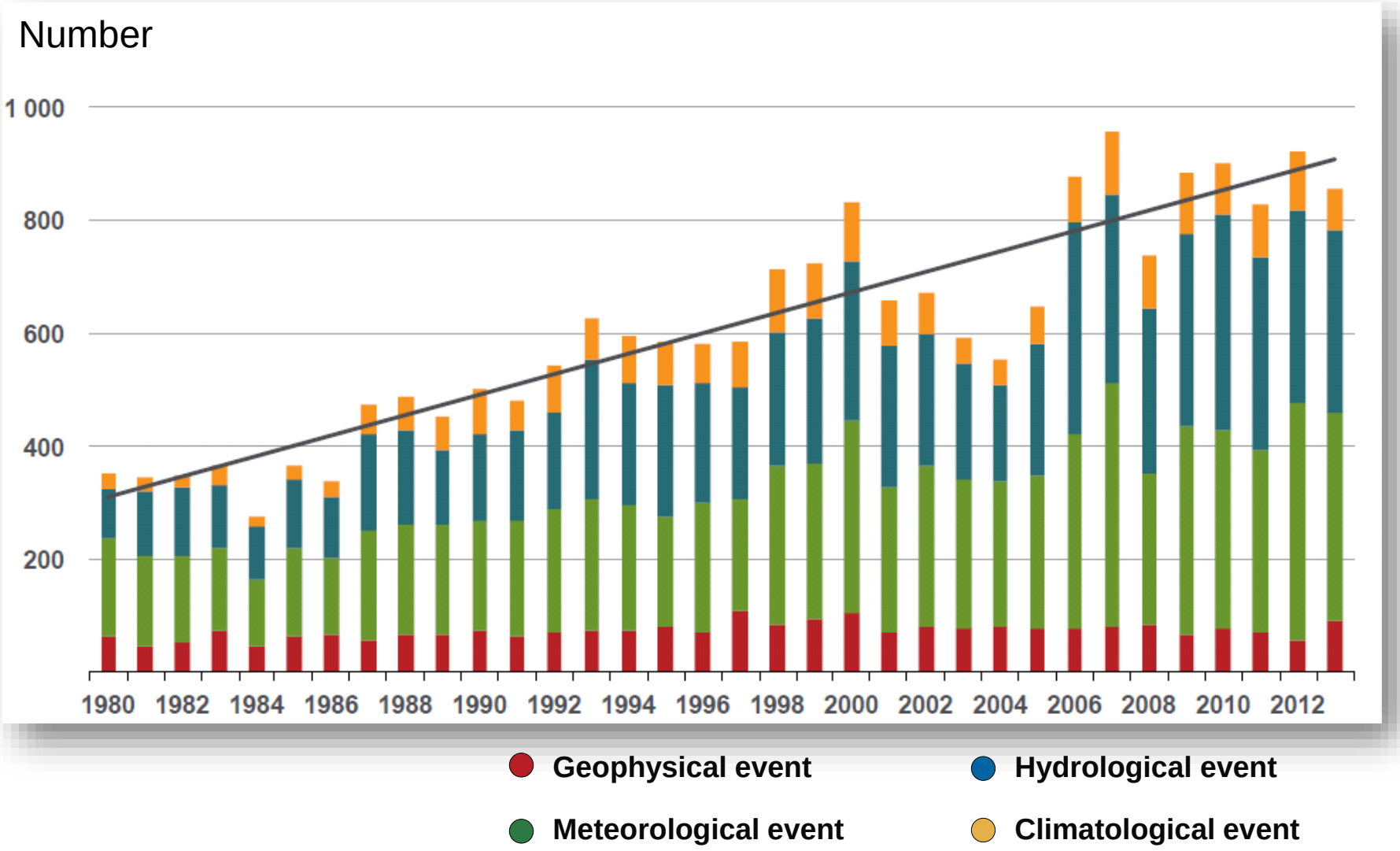
Leibniz Gemeinschaft

Potsdam Institute for Climate Impact Research
RD2 Climate Impacts & Vulnerability

Number of major events 1980 – 2013 worldwide



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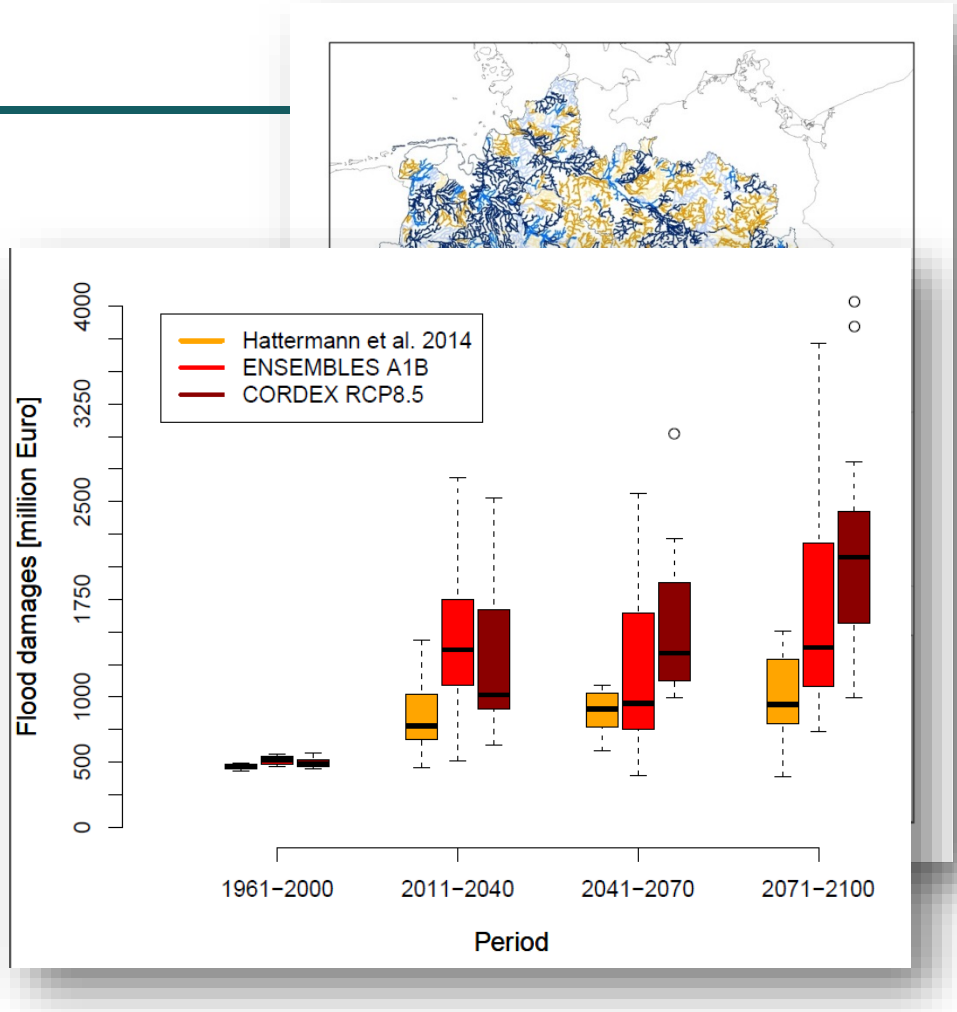
Previous co-operations with insurance sector

GDV DIE DEUTSCHEN VERSICHERER

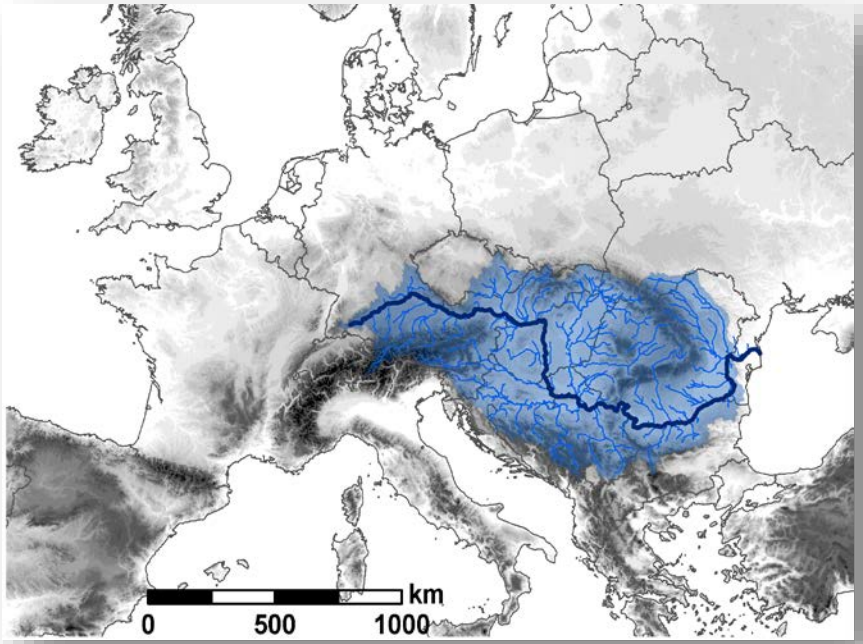
- Climate change impacts on the insurance sector in Germany
- 2008-2011
- Modelling of flood and storm damages under different scenario conditions
- Strong increase in projcted losses



Hattermann, F.F., Huang, S., Burghoff, O., Hoffmann, P., and Kundzewicz, Z. W. (2016) Brief Communication: An update of the article "Modelling flood damages under climate change conditions – a case study for Germany", Nat. Hazards Earth Syst. Sci., 16, 1617-1622, doi:10.5194/nhess-16-1617-2016.

Hattermann, F. F., Huang, S., Burghoff, O., Willems, W., Österle, H., Büchner, M., Kundzewicz, Z. W. (2014): Modelling flood damages under climate change conditions - a case study for Germany. - Natural Hazards and Earth System Sciences, 14, 12, 3151-3168 (http://www.nat-hazards-earth-syst-sci.net/14/3151/2014/nhess-14-3151-2014.html)

Why the Danube?



- 19 Countries and 83 million people, 4 capitals
- 2002 floods in Germany, Austria, Czech Republic, Hungary, Moldova, Switzerland, and Slovakia, causing total damages of 16,5 billion Euro (3,400 billion insured losses) and 39 fatalities
- 2013 floods in Austria, Czech Republic, Germany, Hungary, Poland, Switzerland, causing damages of 12,600 billion Euro (3,100 billion insured losses), and 25 fatalities (NatCatSERVICE, Munich RE)

Future Danube: Project background

EU Climate-KIC funded

- Open access cat-modelling driving adaptation to enable resilience in an uncertain future
- Set-up of the flood risk model for the Danube started in 2016
- Funding for the Danube until end of 2017

EU Horizon 2020 funded

- Project duration Mai 2017 – April 2020
- Multi-hazard and multi-risk
- Strong cooperation with the OASIS consortium
- OASIS LMF and Genillard & Co are partners
- Several insurers committed their interest
- Climate service call

H2020 Insurance – project background

WP1: Providing **standards and methodologies** through the OASIS Loss Model Framework

http://www.oasislmf.org/the-framework/

WP2: **Demonstrating** the added value of climate services in the insurance sector and beyond

2.1.1: Flood and storm hazard

2.1.2: Damage and risk

2.1.3: Infrastructure

2.2.1: Tropical typhoon

2.2.2: Micro-insurance

2.3.1: Health insurance

2.3.2: Forest fire insurance

WP3: Scaling Climate Service Data & Model Accessibility – **Oasis eMarket**

http://www.oasishub.co.uk/

WP4: **Maximizing the impact** – Oasis Innovation and Communication Hub

http://www.oasishub.co.uk/

Future Danube: Model suite

Weather and climate module:
Stochastic generation of weather extremes under current and future conditions (precipitation, heat waves)

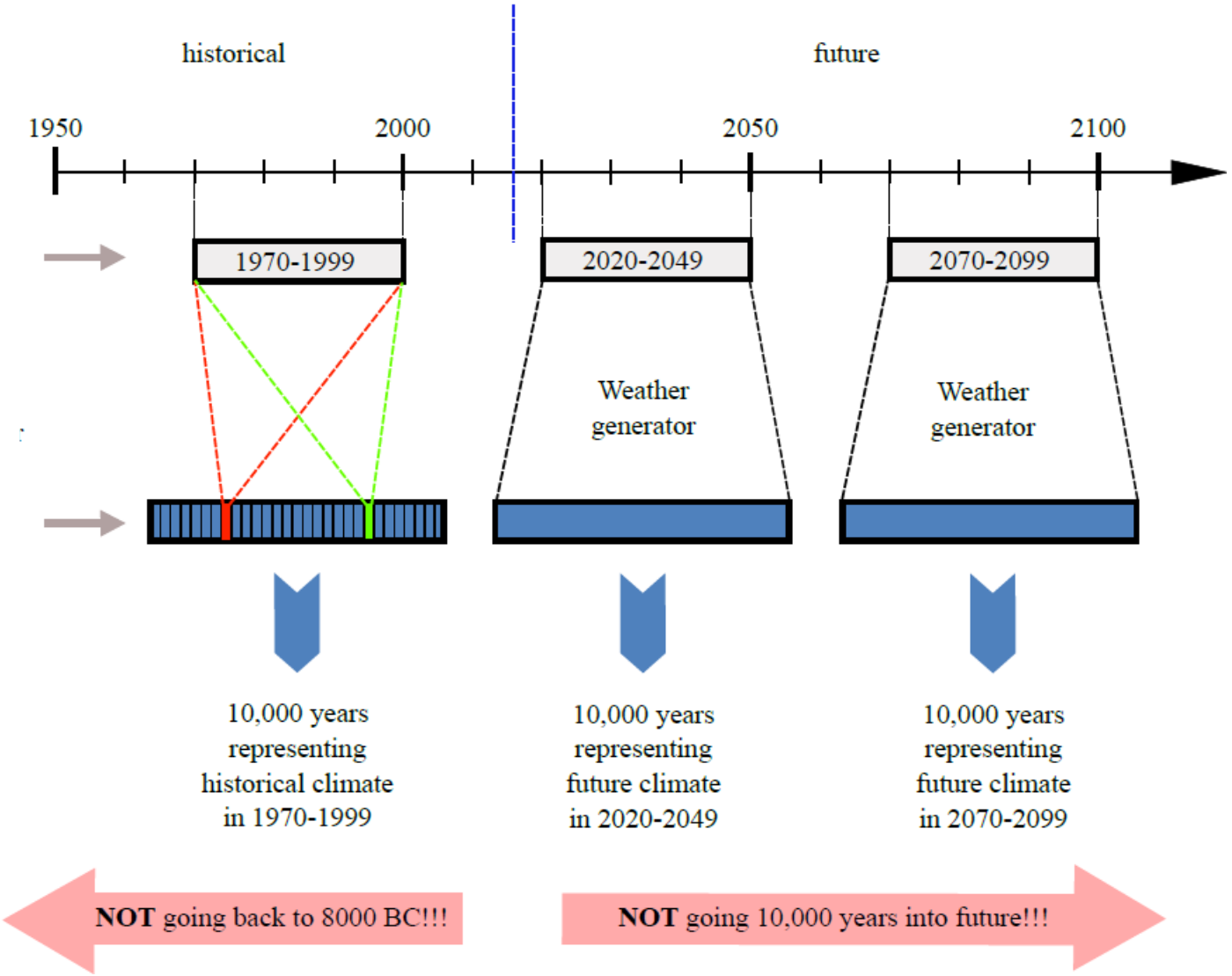
Hydrological module:

& Additional partners:

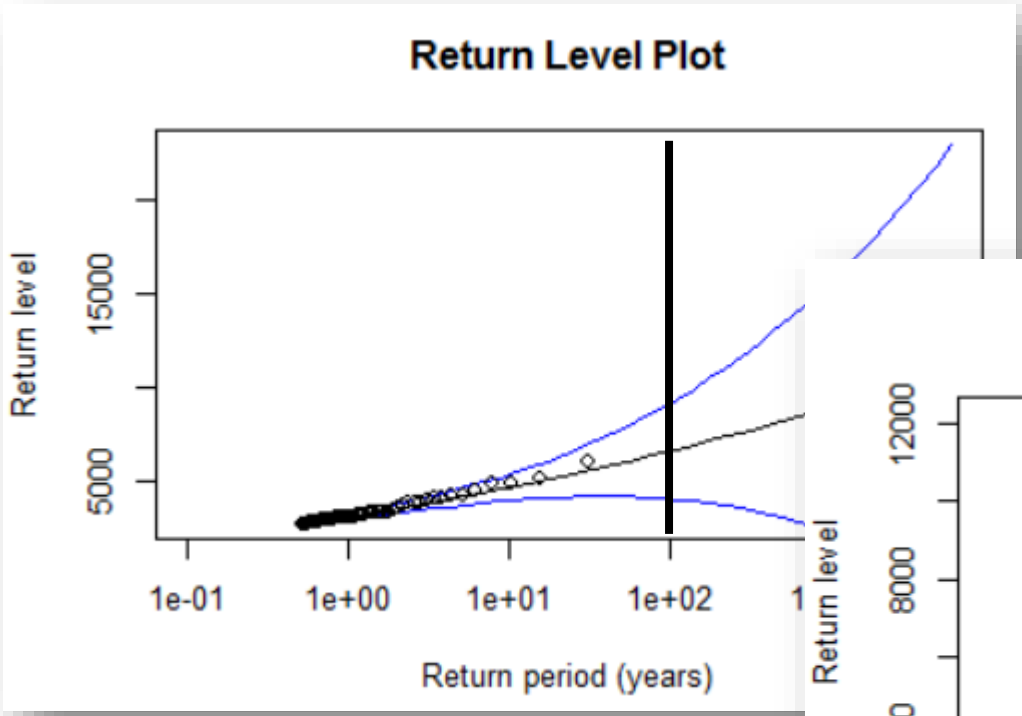
- **OASIS LMF**
- **Genillard & Co**
- **Pannon Pro**
- **Budapest Water Works**
- **Budapest Sewage Works**
- **Insurance sector**

Visualization module:
Graphical interface for visualization of hazards and risk and analysis of outputs

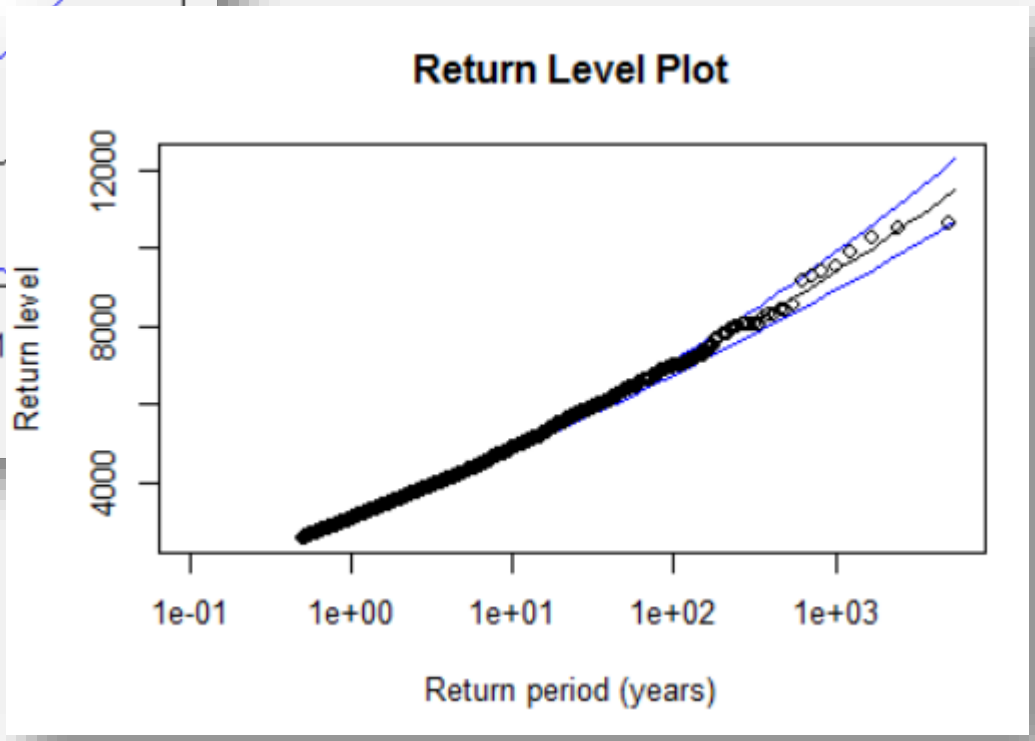
Modelling concept



Increasing robustness of risk information

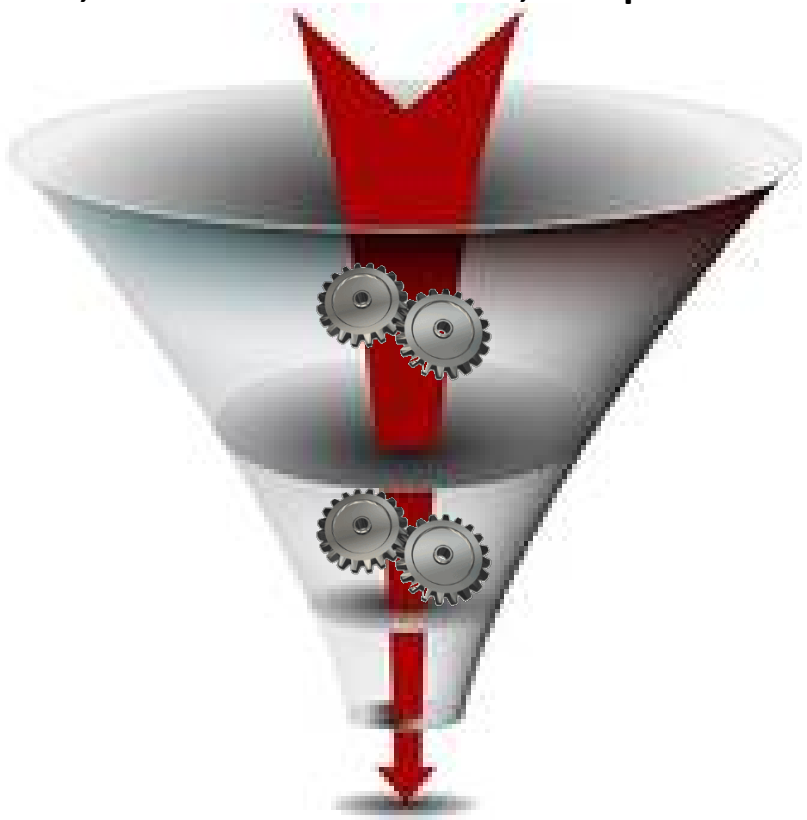


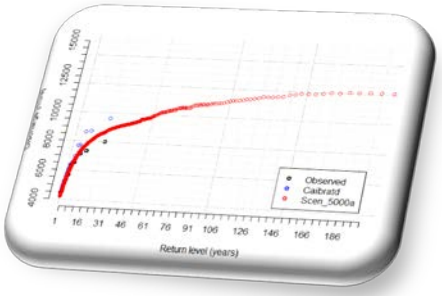
Uncertainty bounds (in blue) before and after -> decreasing uncertainty



Big data -> condensed information

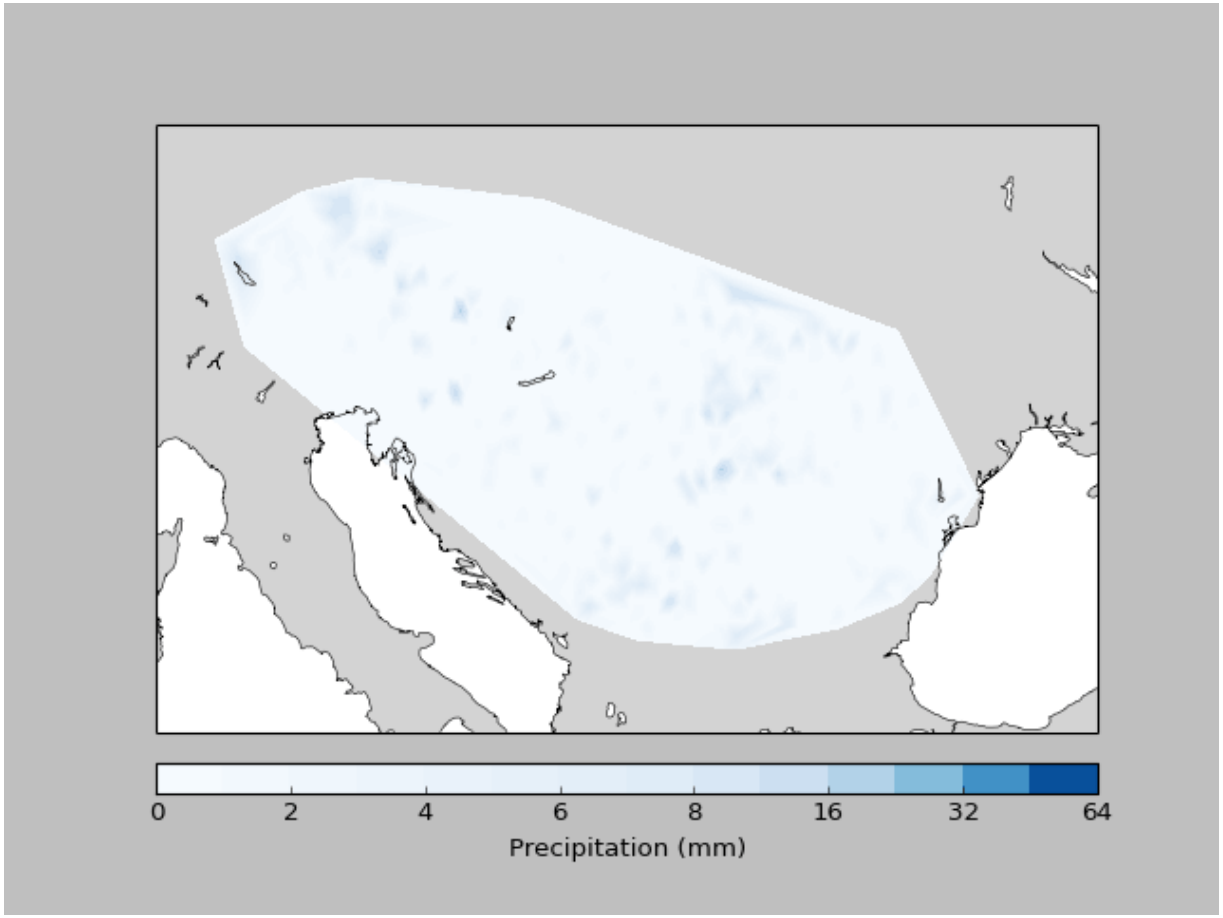
200,000 years of daily climate and hydrological data
~13,0000 river sections ~200,000 spatial units





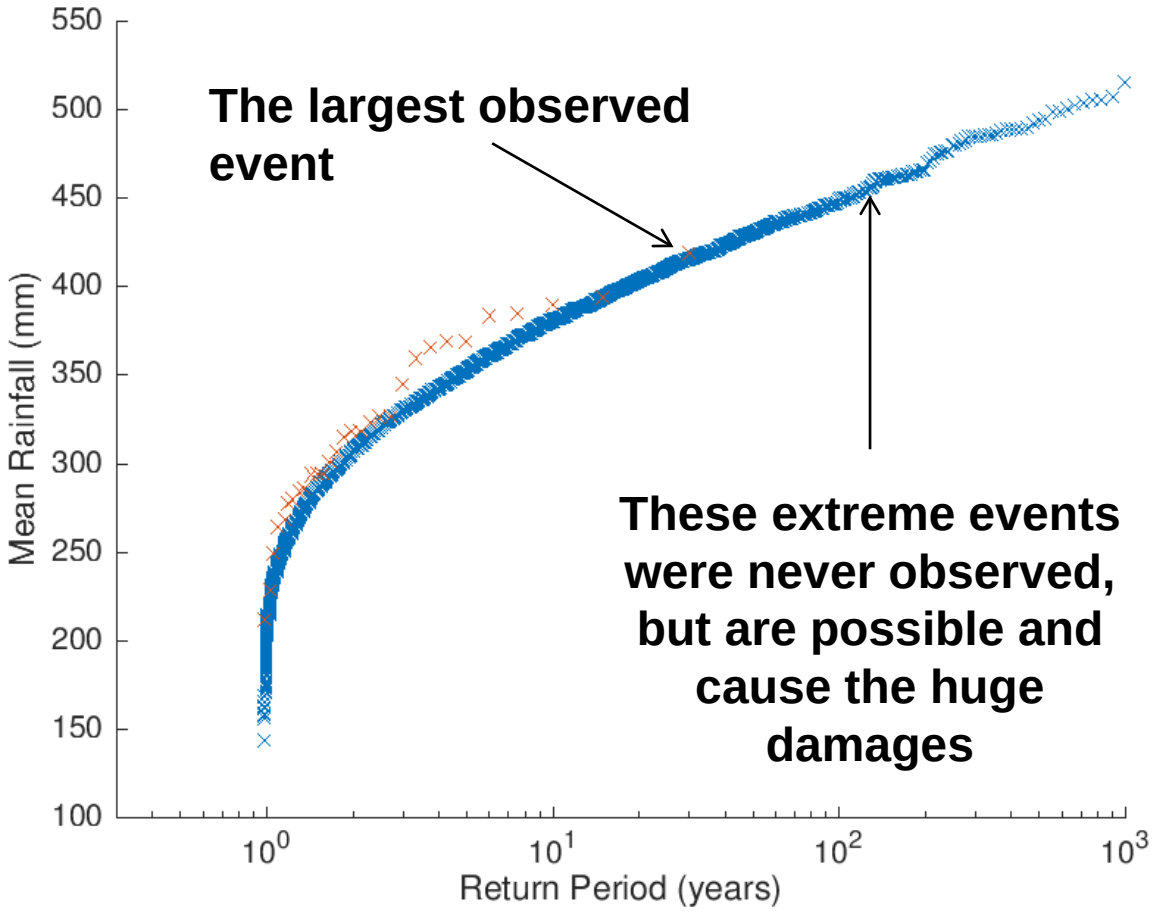
Robust risk information

Results weather module



Input: Realistic daily precipitation generated by weather module (many more events than observed -> rare (extreme) events)

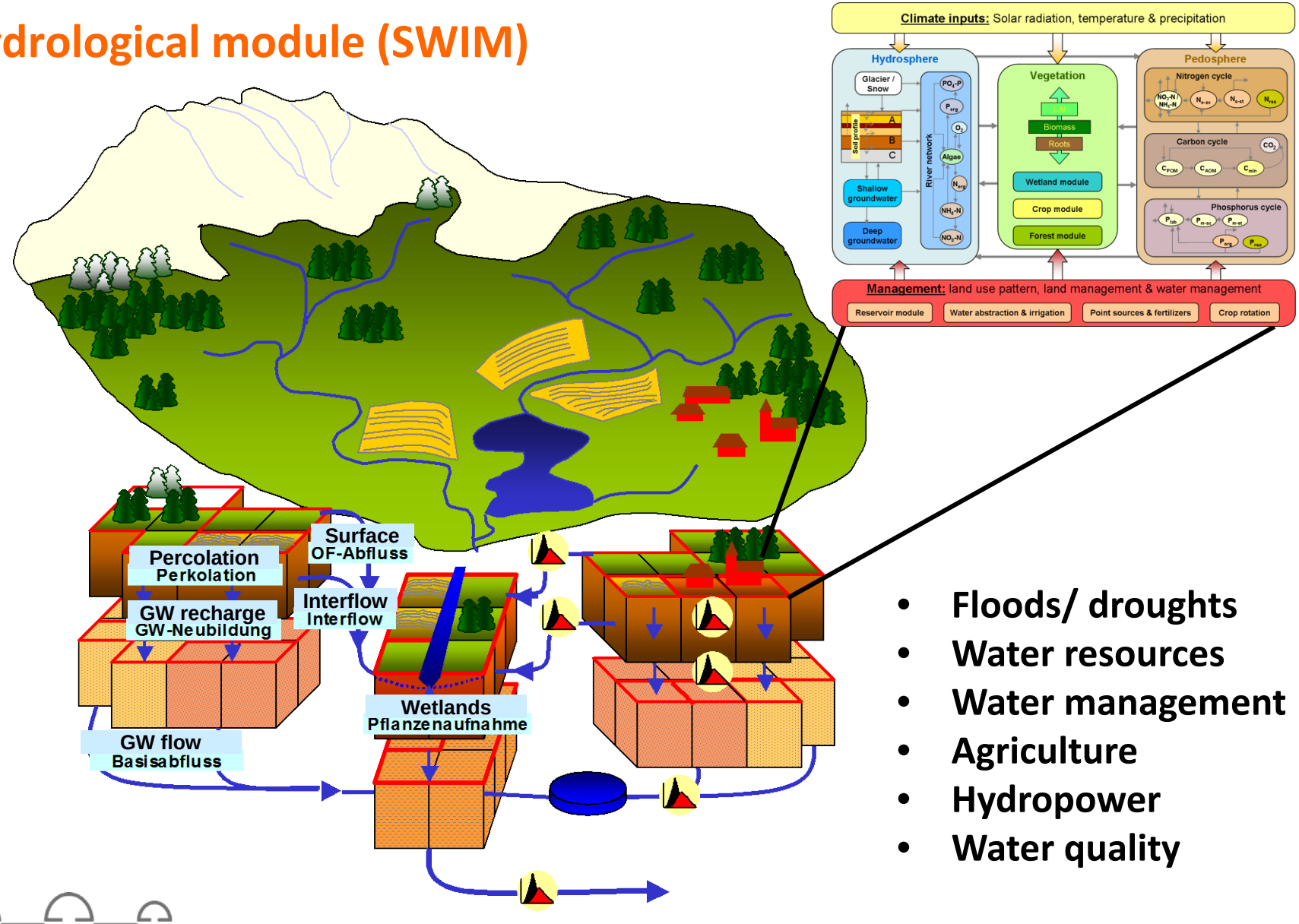
JJA precipitation for Upper Danube basin



X – 30 years of CORDEX data

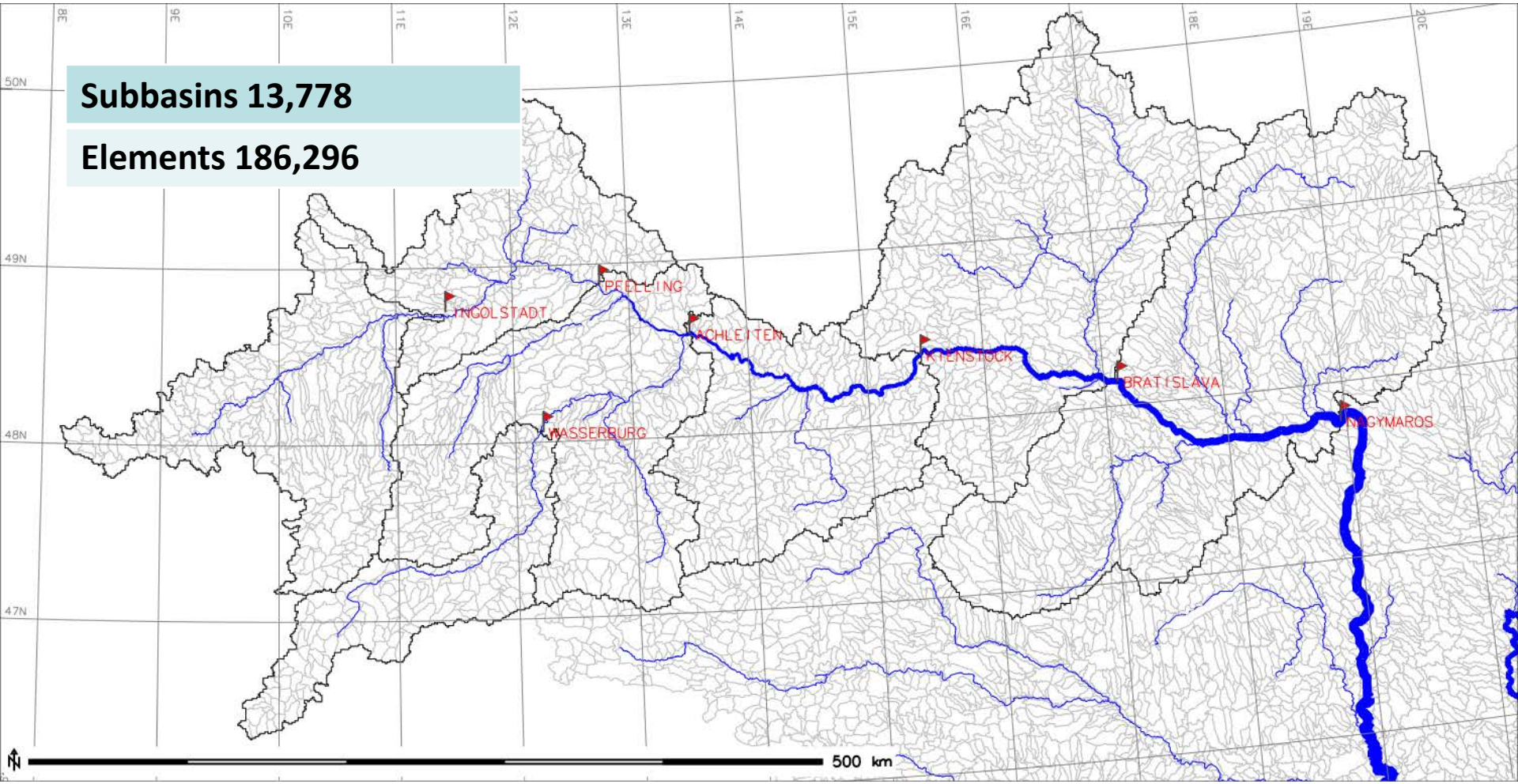
X – 10,000 years of IMAGE data

The weather information is fed into the hydrological module (SWIM)

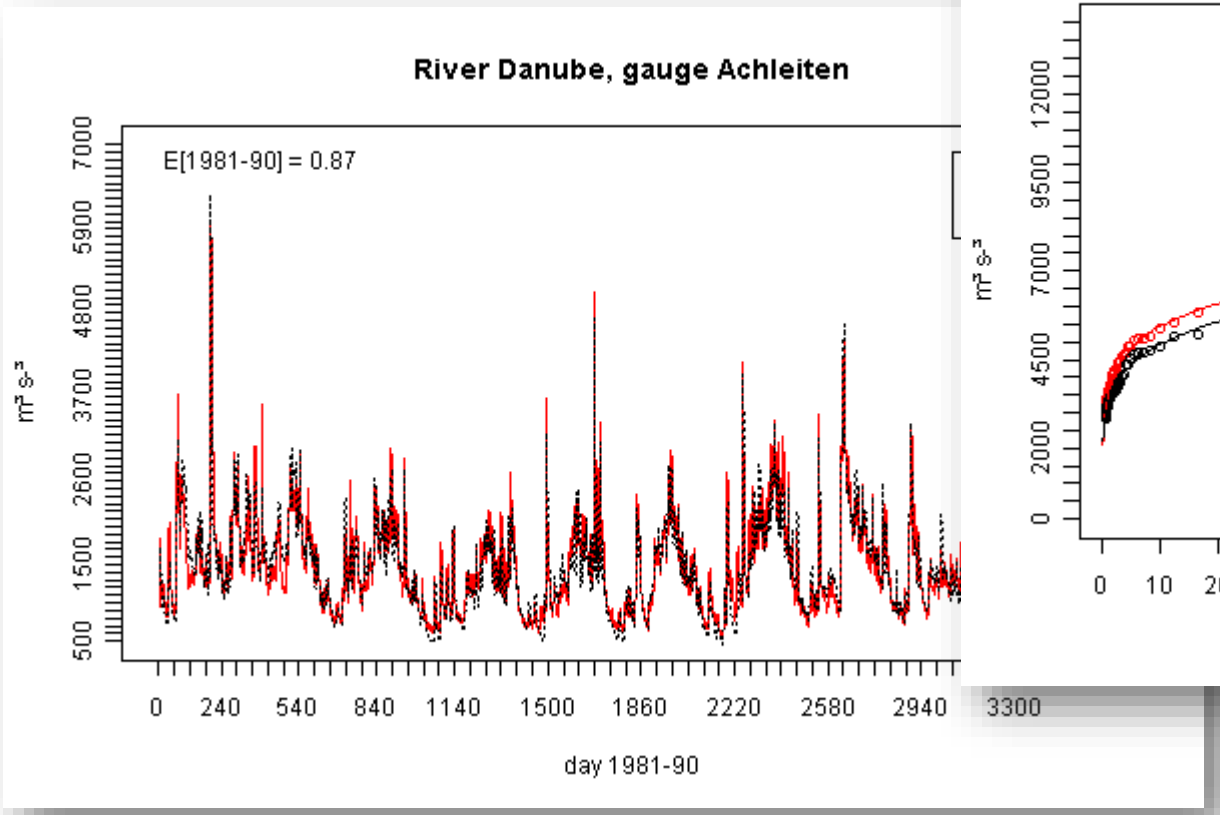


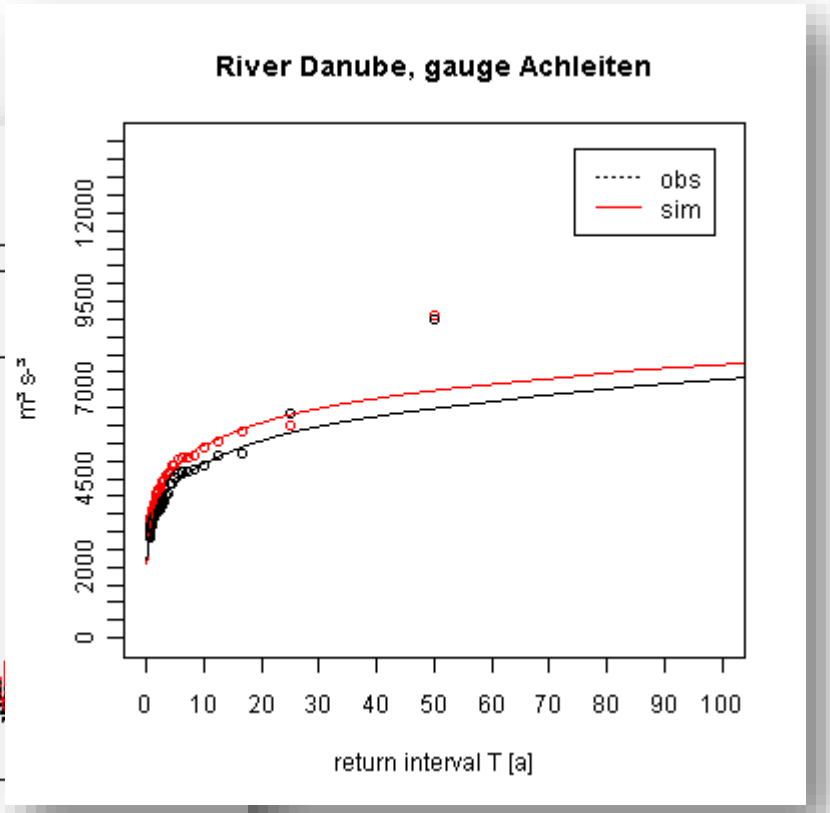
- Floods/ droughts
- Water resources
- Water management
- Agriculture
- Hydropower
- Water quality

River sections and subbasins upper part of the Danube until Budapest

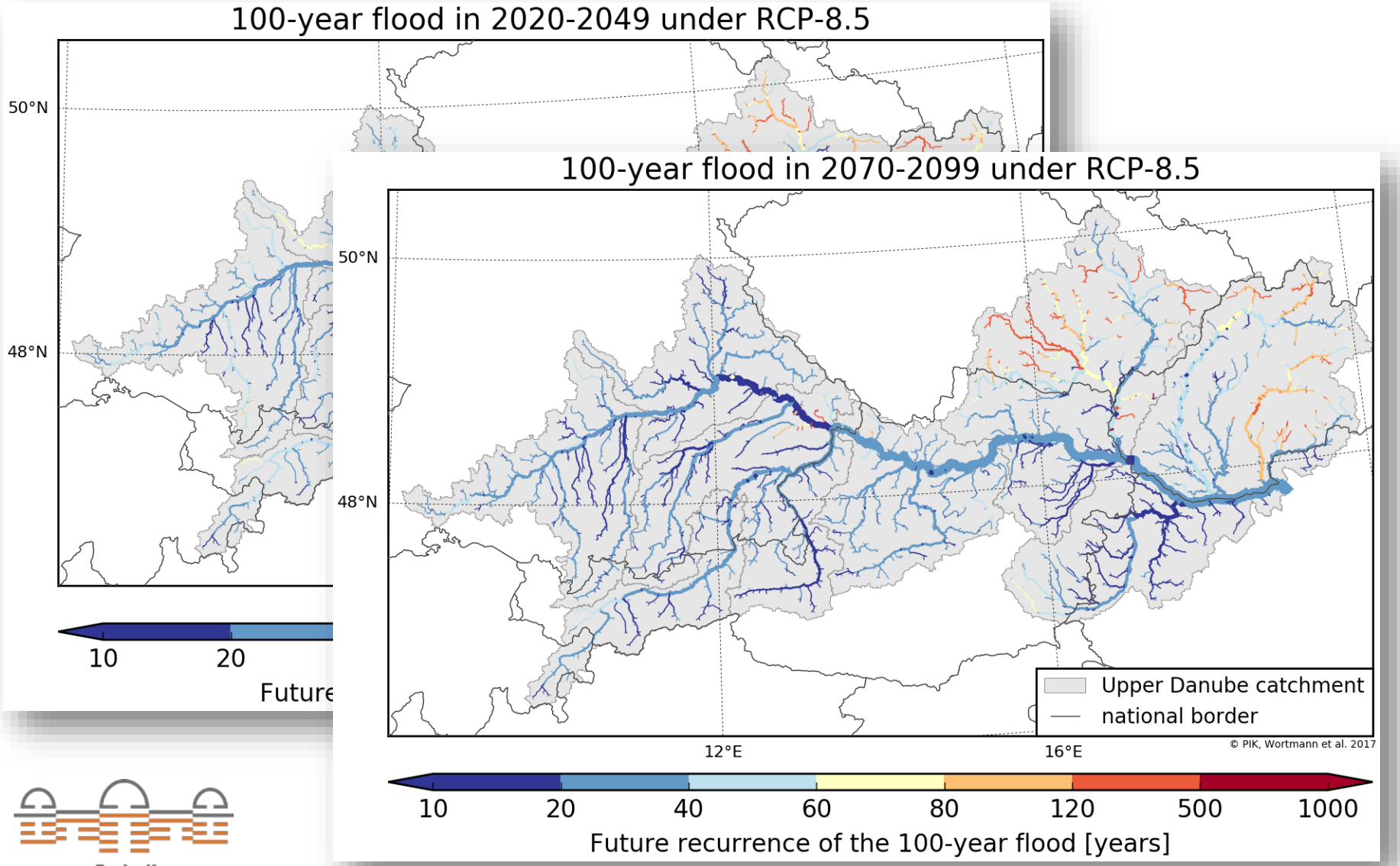


Calibration and validation of SWIM using observed climate data





Results SWIM: Change in recurrence of 100 year flood



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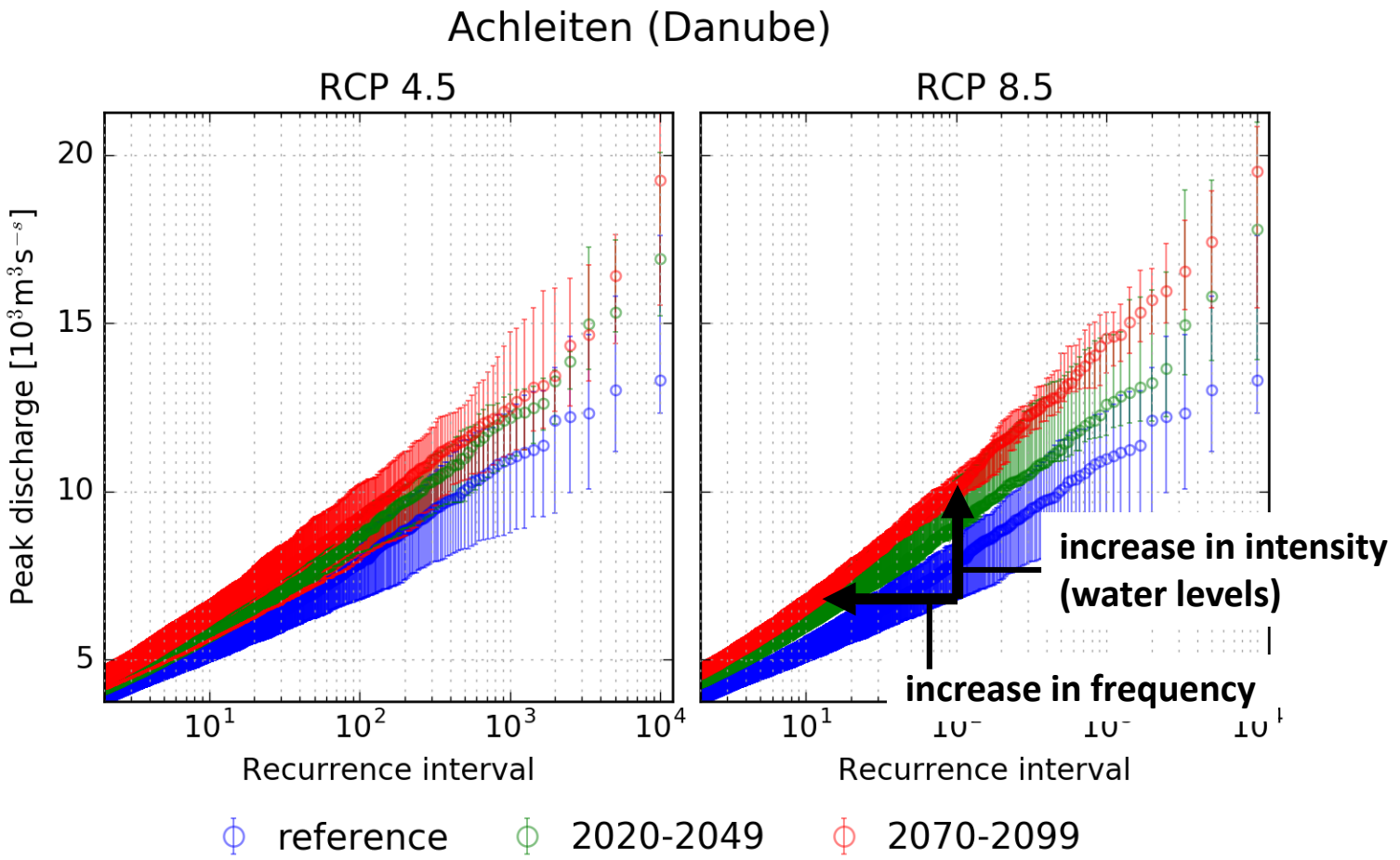
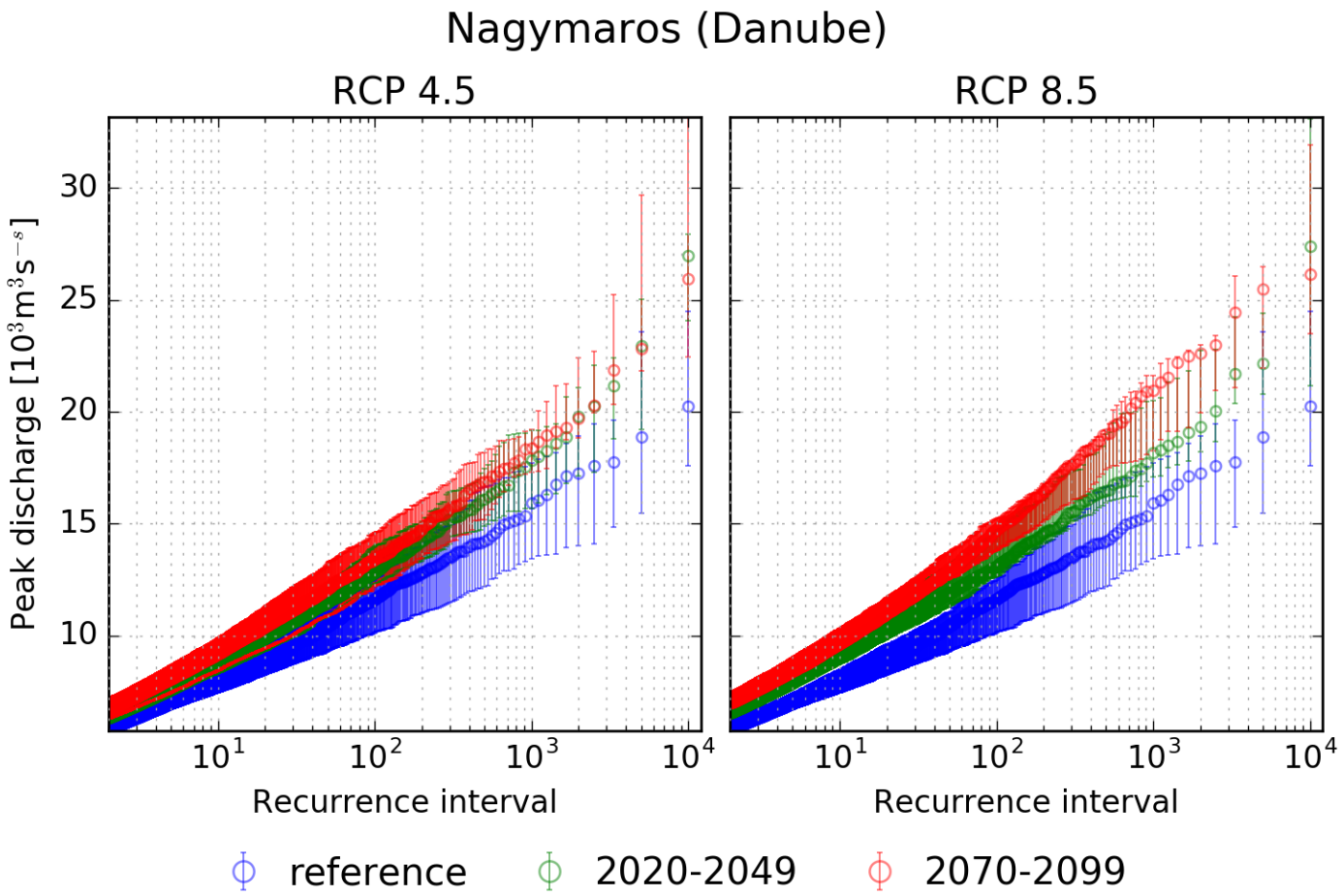
Change in flood frequency under CC

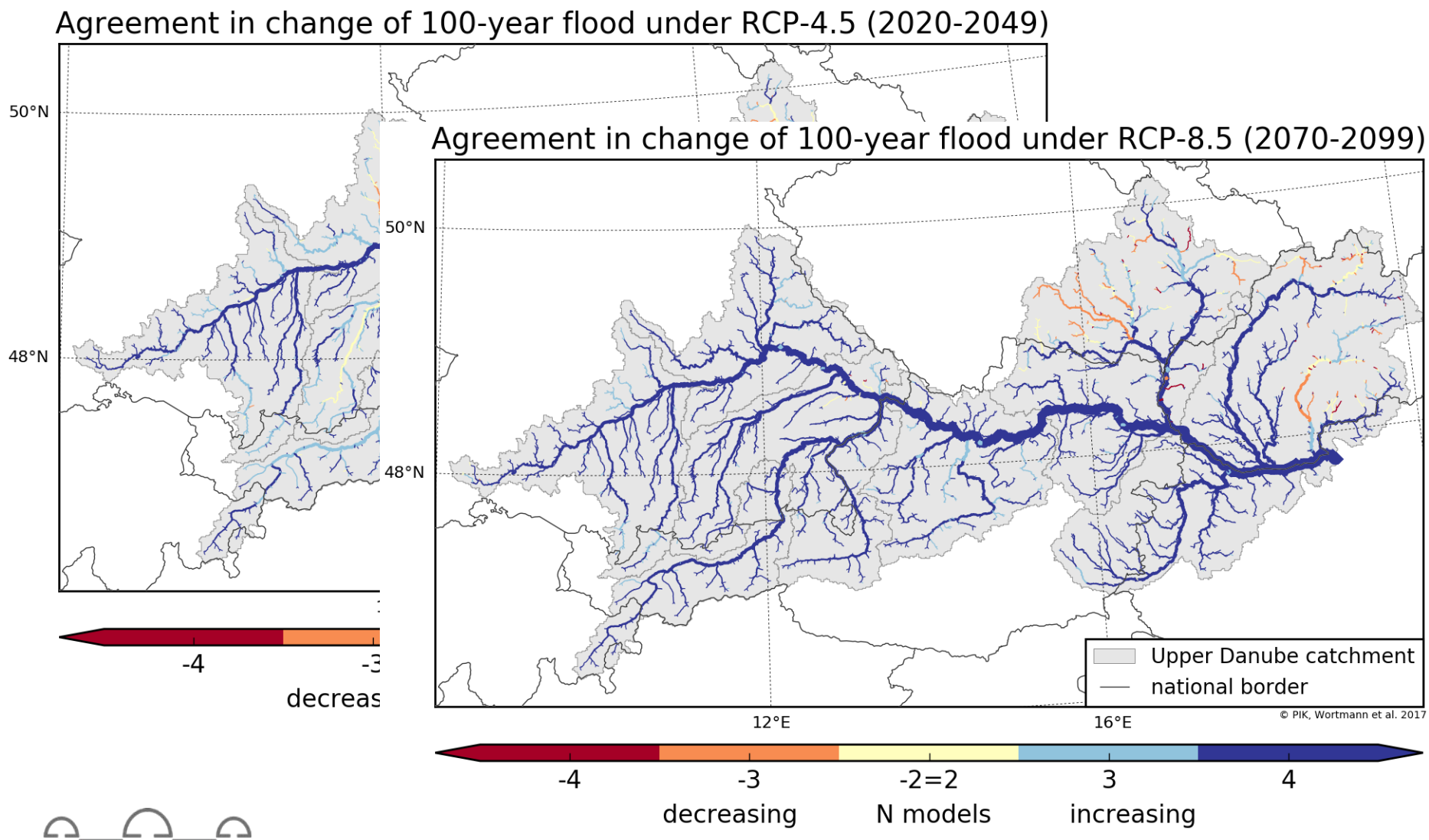


These statistics are there for each of the ~13,0000 river sections

Change in flood frequency under CC



Agreement in projections



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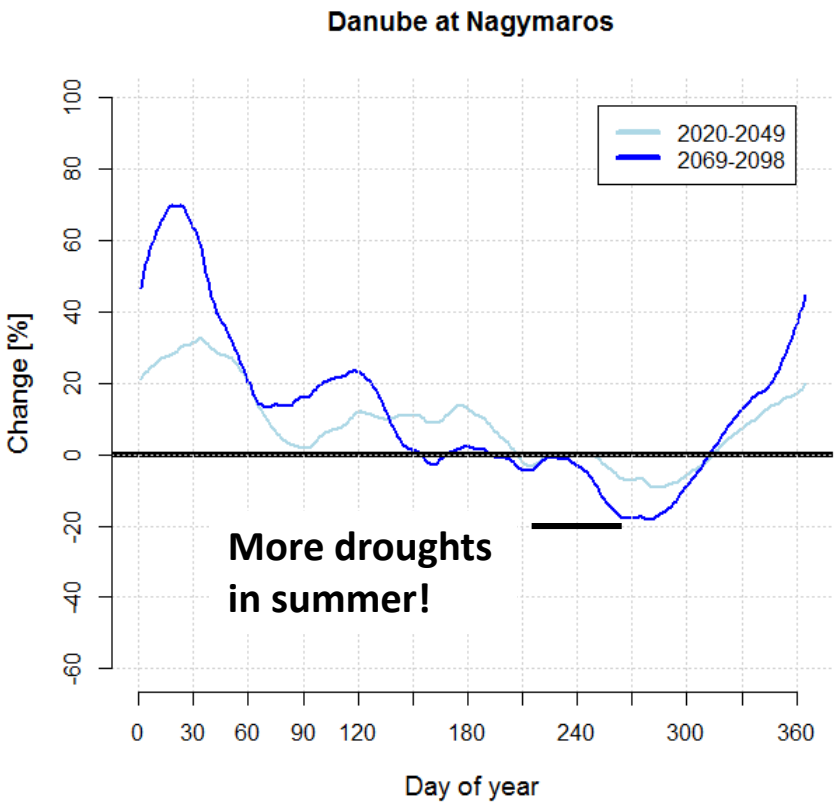
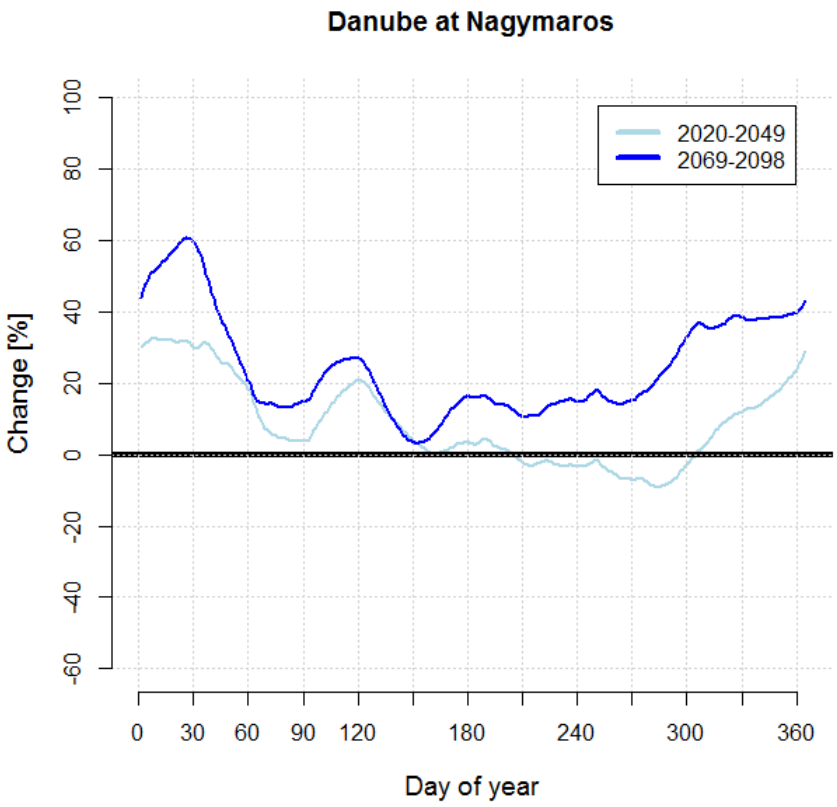
Average change in water availability

High end scenario (RCP8.5)

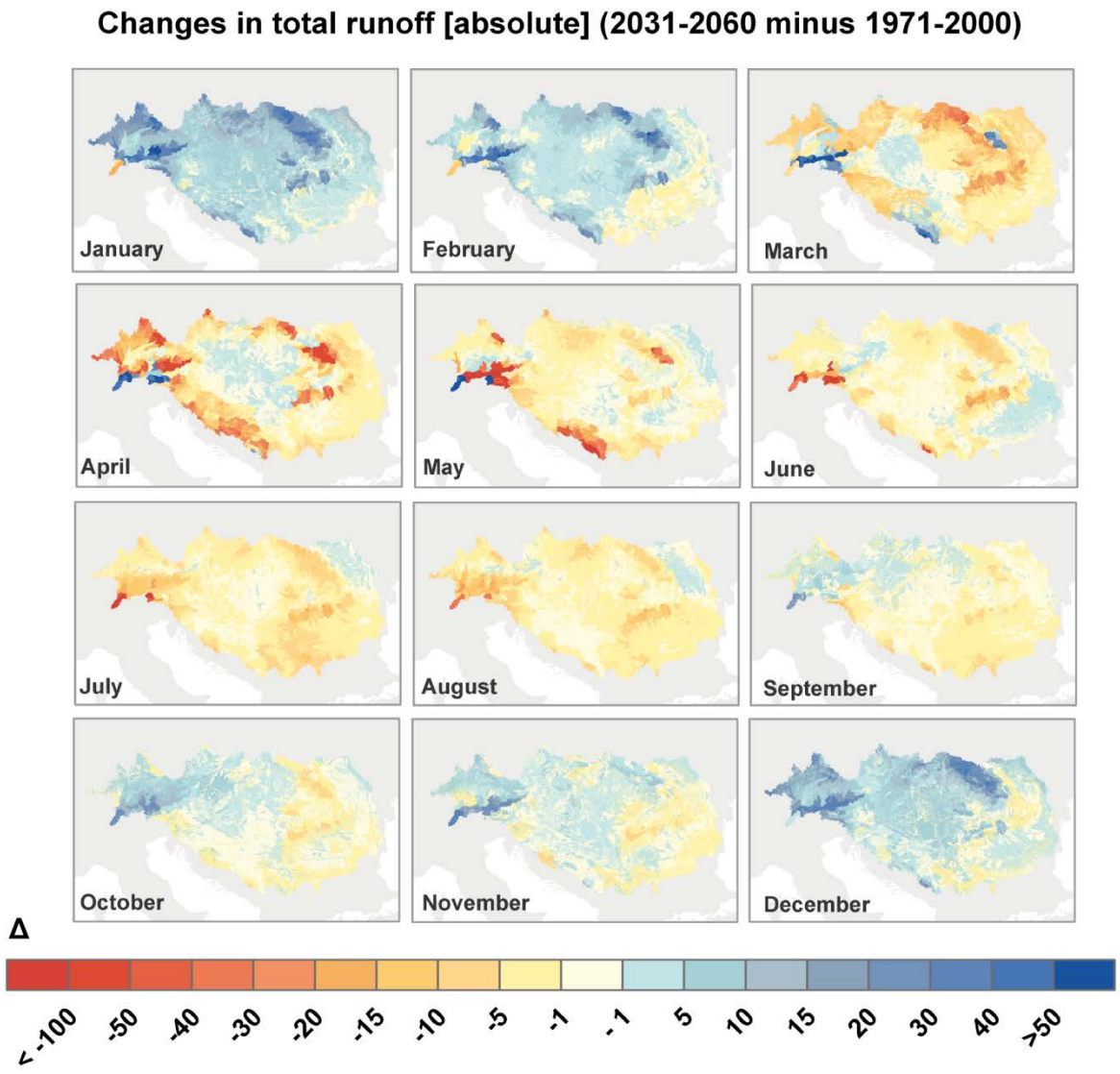


Moderate scenario (RCP4.5)



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

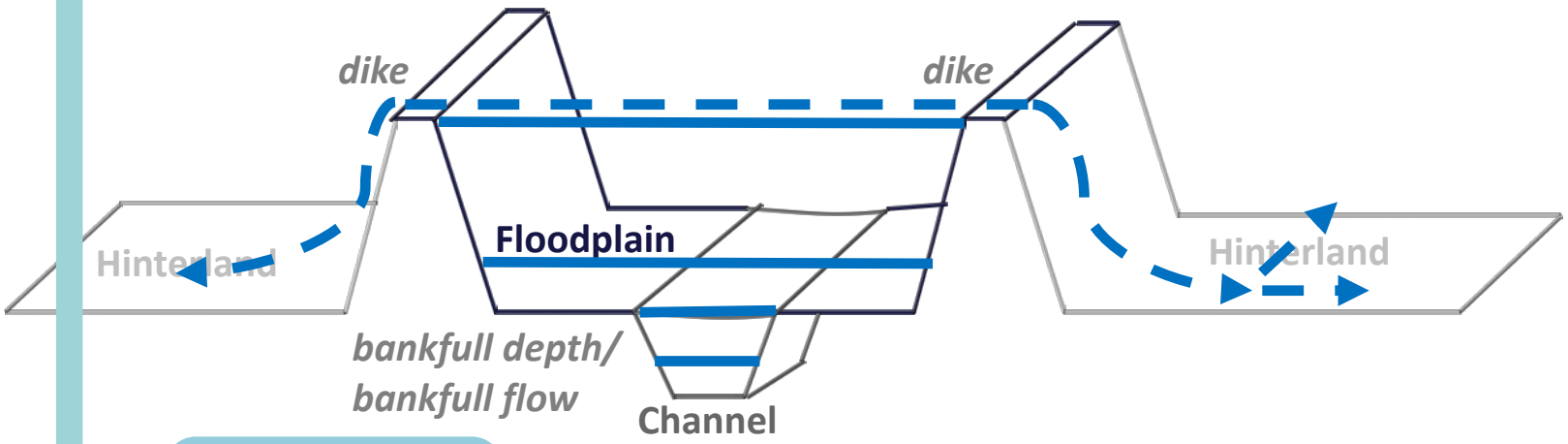
Spatial change in water resources



1D Channel / 2D Hinterland inundation model

River Network Routing: 1D Channel Network Model

1D (diffusive wave: continuity, pressure, friction, slope)



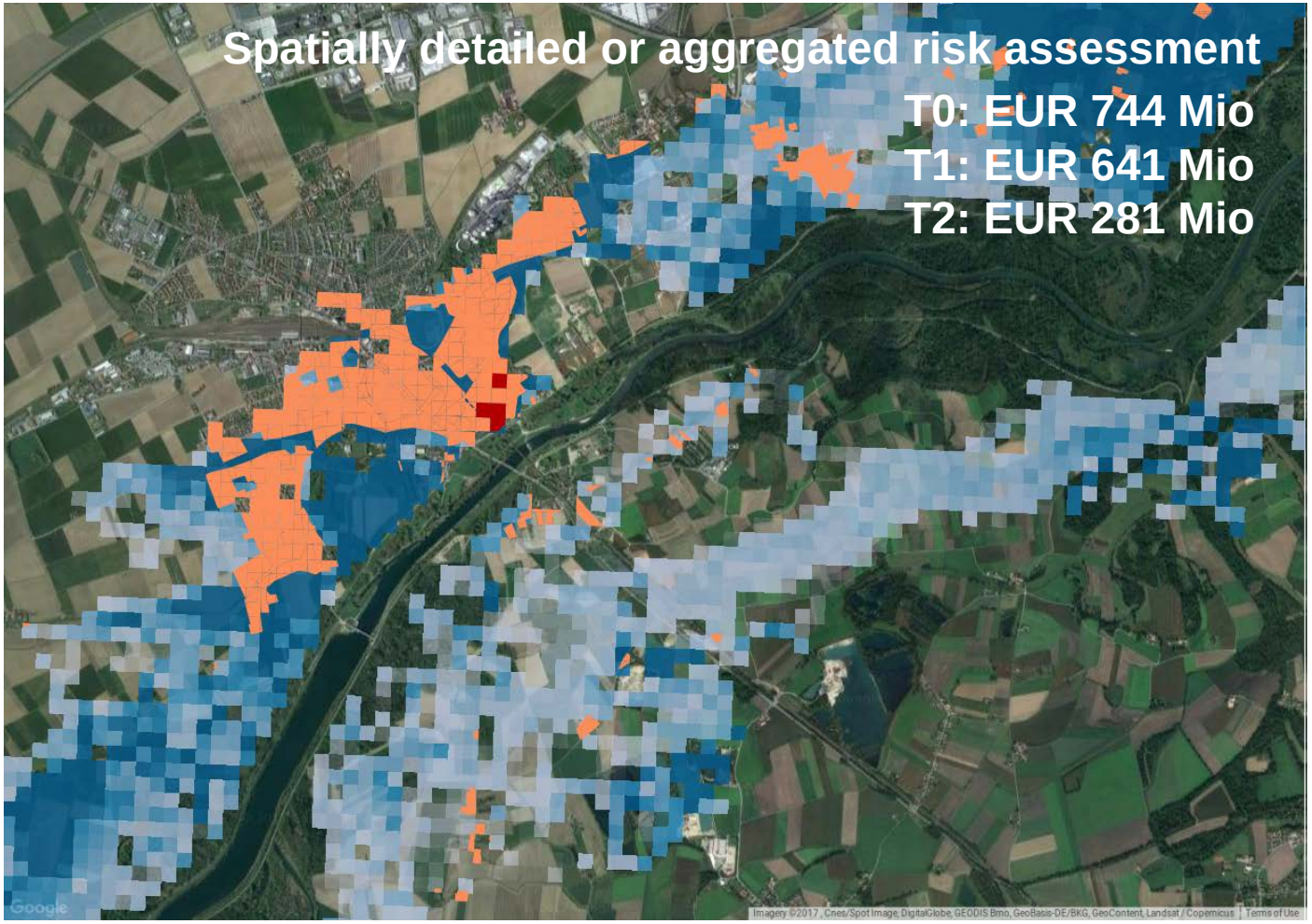
dike over-topping discharge

Hinterland Inundation: 2D Raster-Based Inertia Model

2D shallow water equations (continuity, pressure, friction, slope, local acceleration, no advection)
Explicit scheme, structured mesh 100m, GPU parallelisation

flood maps of max. water levels, duration, velocities

Loss estimation



Many thanks!