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Current and future flood risk assessment in the Danube region

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Severe hydro-meteorological hazards have been increasing during recent decades and, as a consequence of global change, more frequent and intense events are expected in the future. Climate informed planning of adaptation actions needs both consistent and reliable information about future risks and associated uncertainties, and appropriate tools to support comprehensive risk assessment and management.
The Future Danube Model (FDM) is a multi-hazard and risk model suite for the Danube region which provides climate information related to perils such as heavy precipitation, heatwaves, floods and droughts under recent and future climate conditions. FDM has a modular structure with exchangeable components for climate input, hydrology, inundation, risk, adaptation and visualisation. FDM is implemented within the open-source OASIS Loss Modelling Framework, which defines a standard for estimating ground-up loss and financial damage of disaster events or event scenarios.
The OASIS lmf implementation of the FDM is showcased for the current and future fluvial flood risk assessment in the Danube catchment. We generate stochastic inundation event sets for current and future climate in the Danube region using the output of several EURO-CORDEX models as climate input. One event set represents 10,000 years of daily climate data for a given climate model, period and representative concentration pathway. With this input, we conduct long term continuous simulations of flood processes using a coupled semi-distributed hydrological and a 1.5D hydraulic model for fluvial floods. Flood losses to residential building are estimated using a probabilistic multi-variable vulnerability model. Effects of adaptation actions are exemplified by scenarios of private precaution. Changes in risk are illustrated with exceedance probability curves for different event sets representing current and future climate on different spatial aggregation levels which are of interest for adaptation planning.

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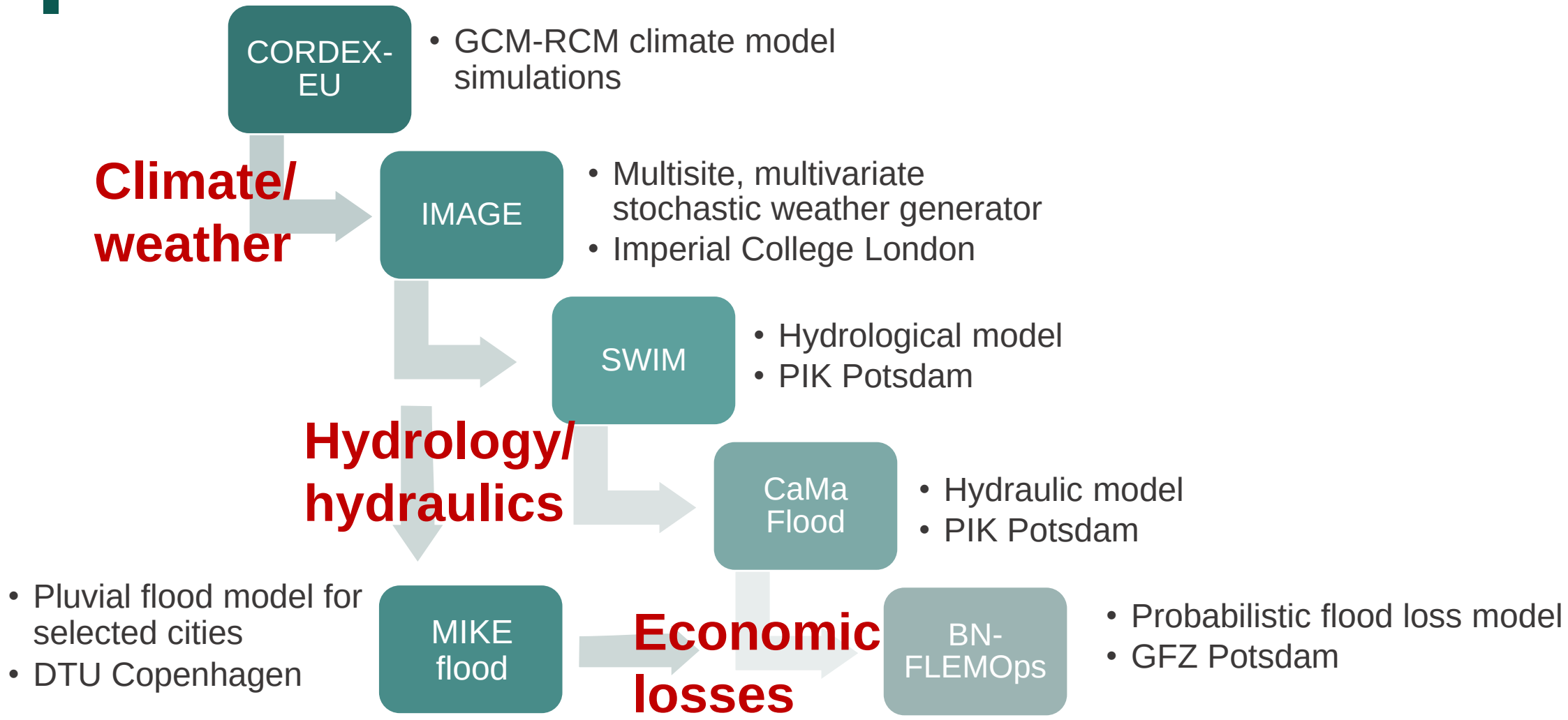
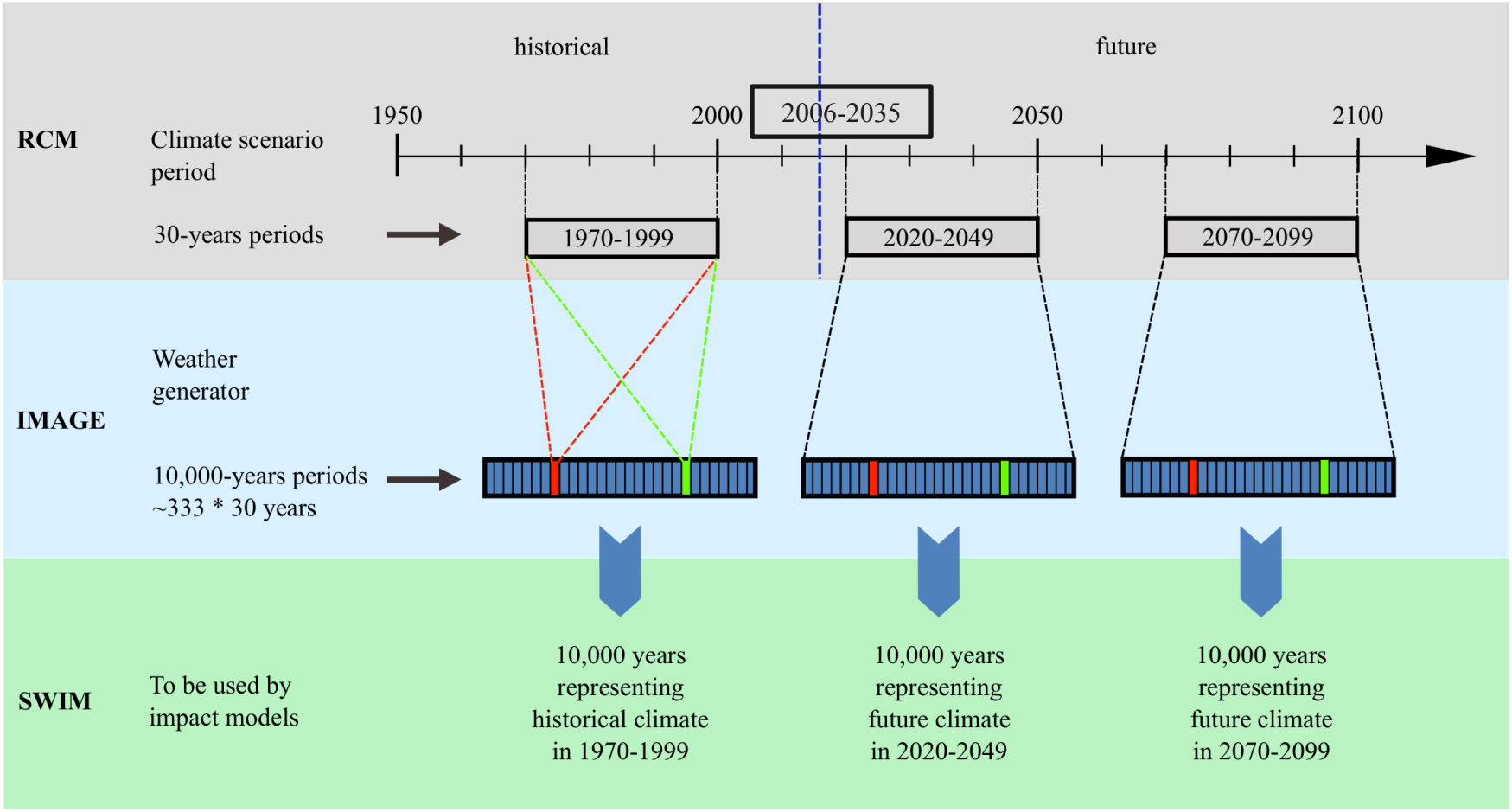
Future Danube Cat-Model Overview



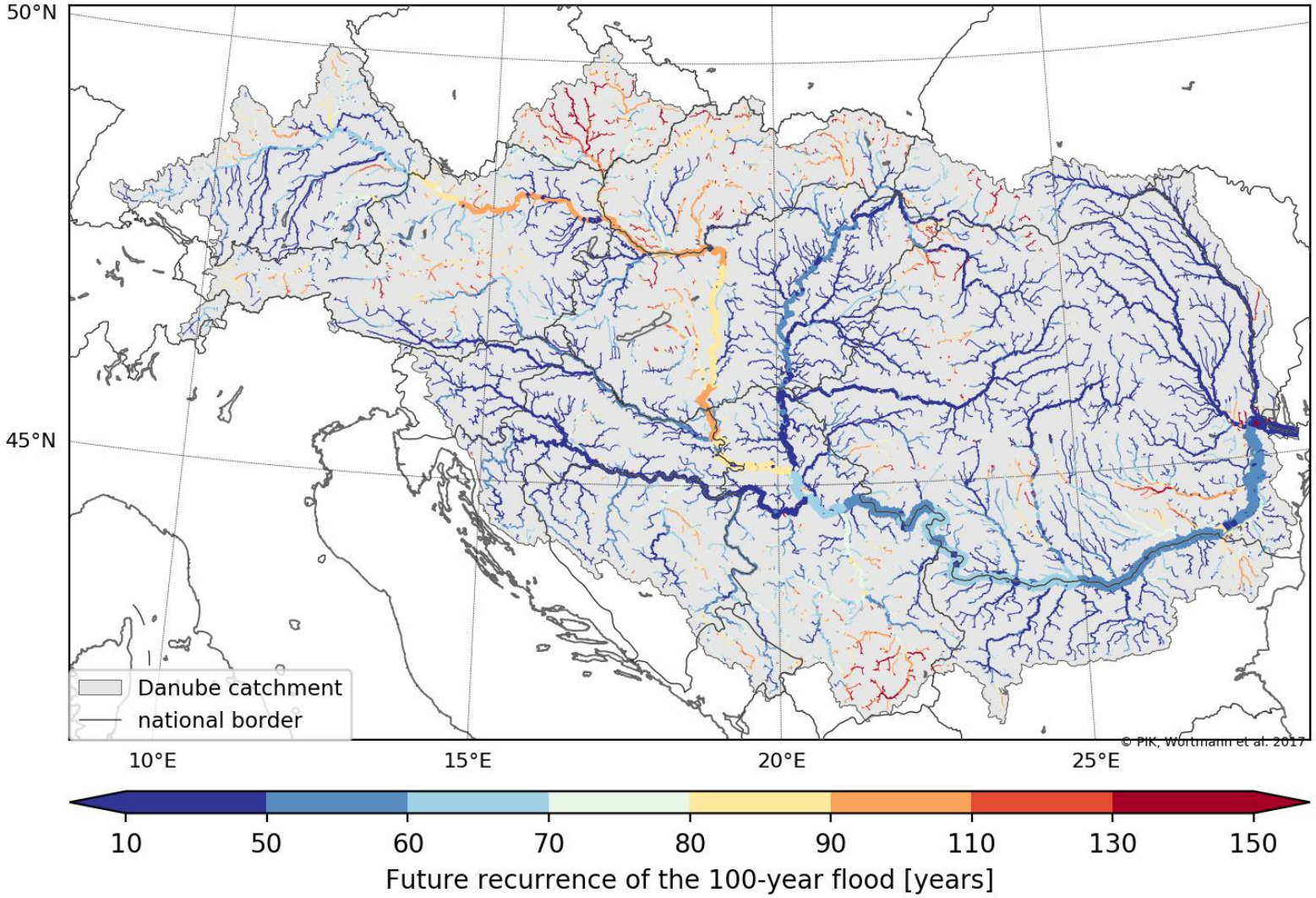
Future Danube: climate risk information

- 4 regional climate models (CORDEX-EU)
- 2 climate scenarios (RCP-4.5 & 8.5)
- Historical reference climate (1971-2000), current climate (2006-35) and two future periods (2020-49, 2070-99)



Changes of fluvial flood frequencies (1970-1999 vs 2006-2035)

Future reoccurrence of the 100-year flood



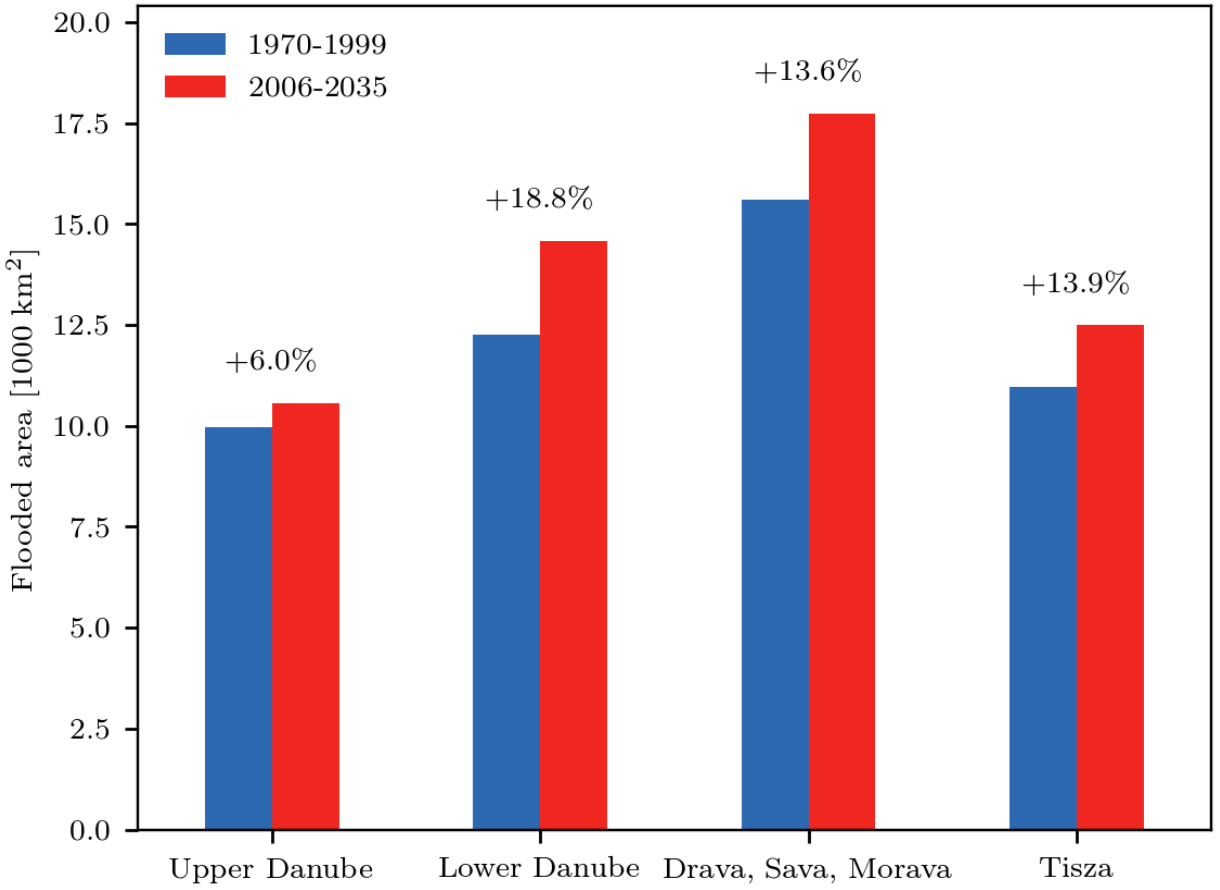
Greater probability of risk of flooding

Little/no change

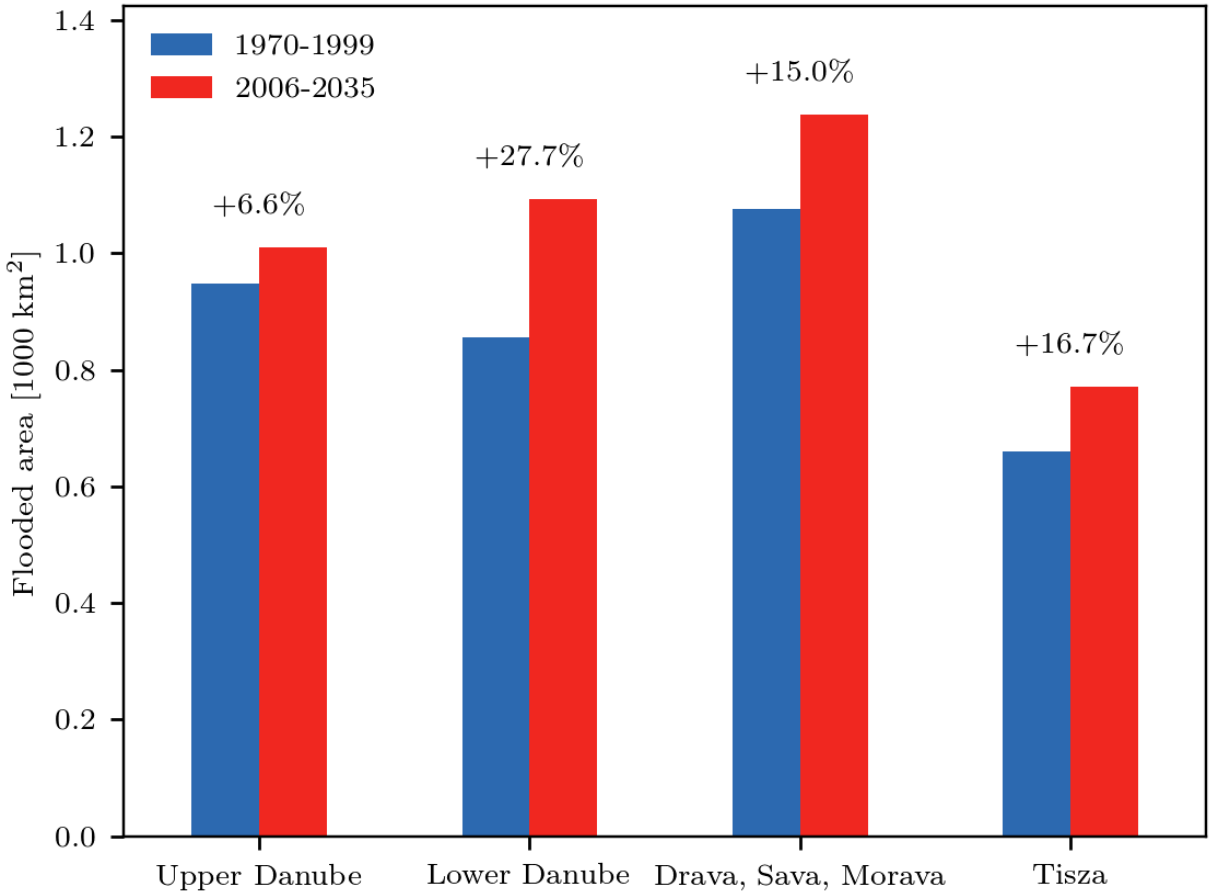
Lower probability of risk of flooding

100-year flooded area, reference vs current climate period

Entire catchment

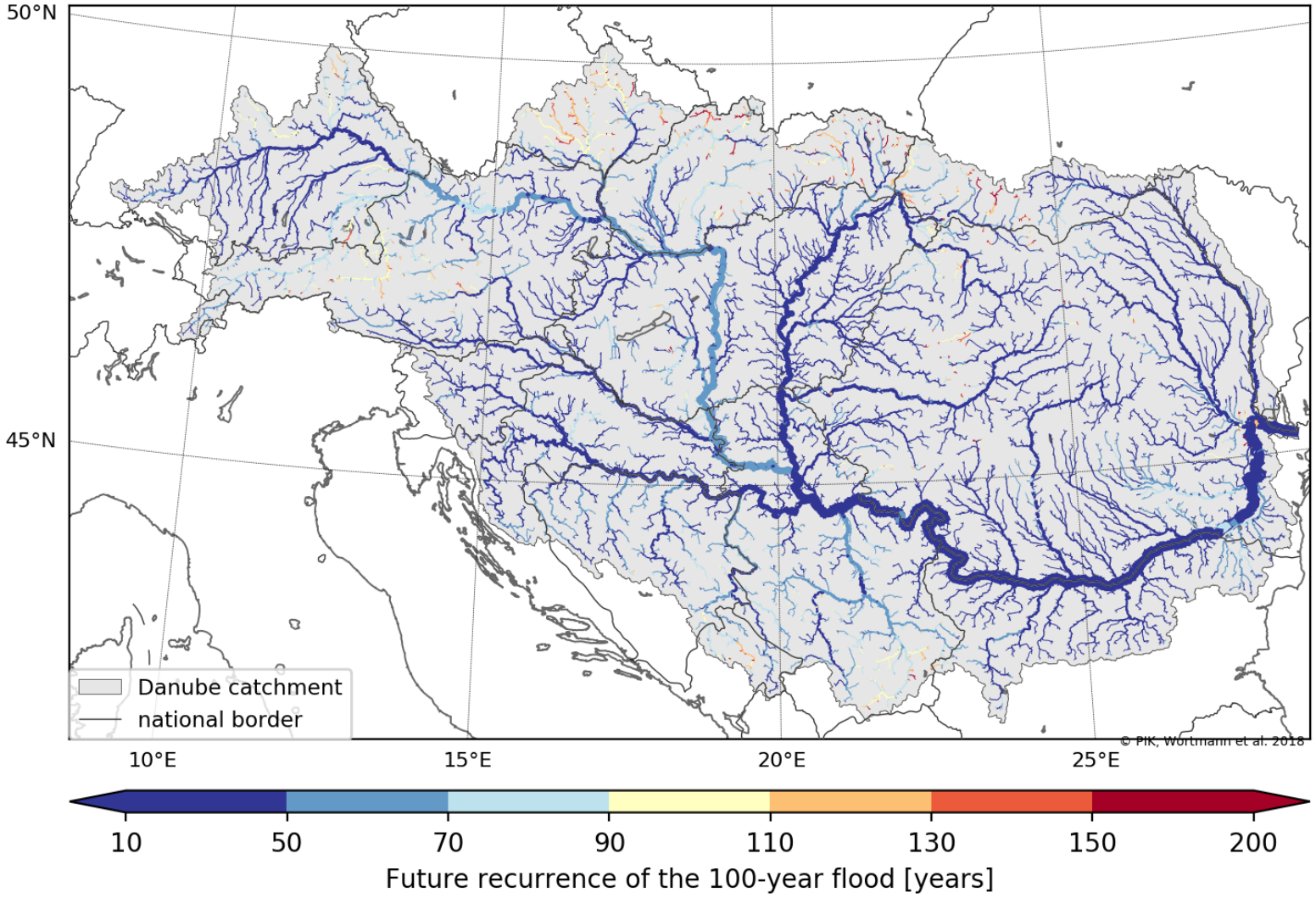


Area populated/industrial



Changes of fluvial flood frequencies (2020-2049)

Future reoccurrence of the 100-year flood



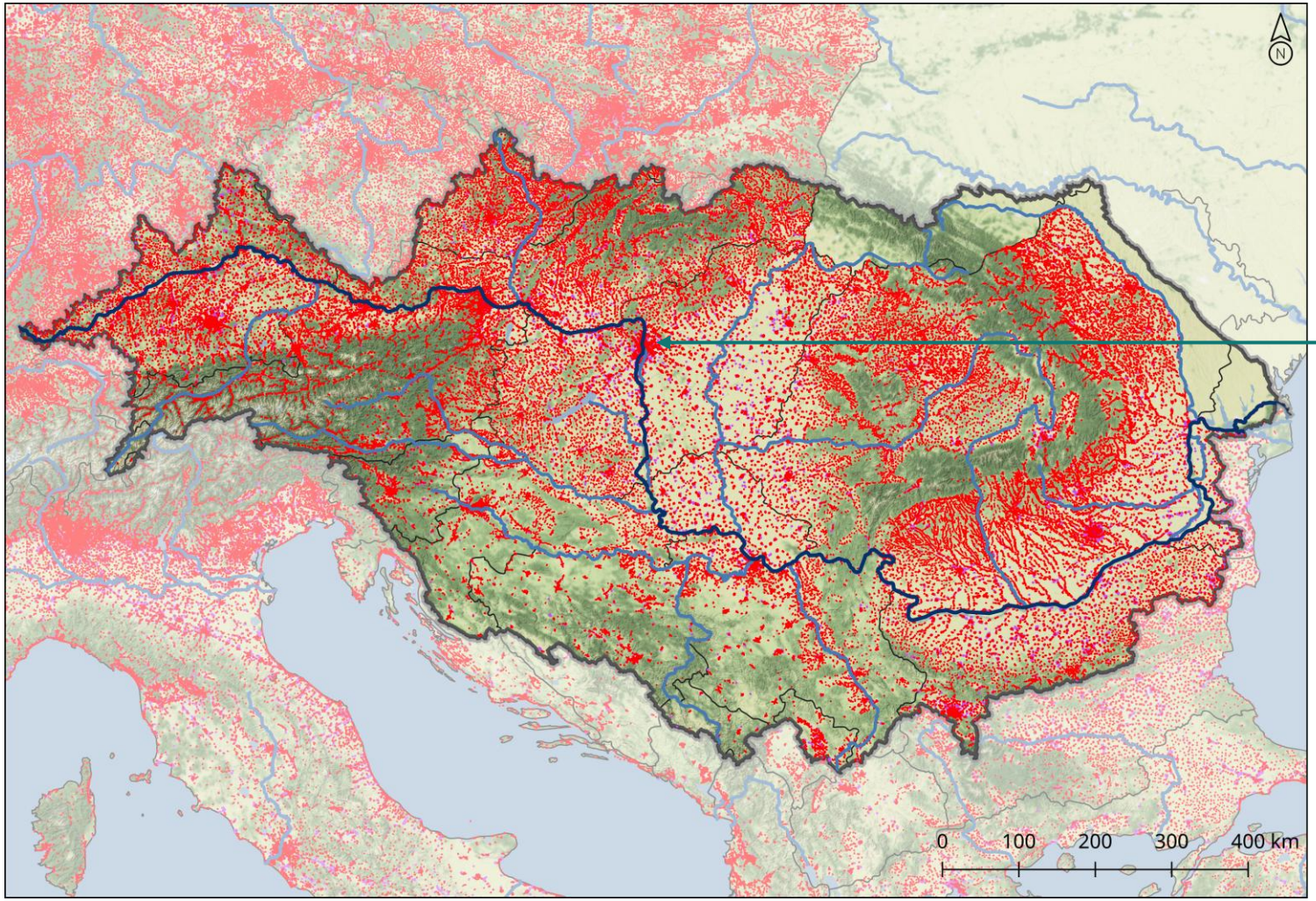
Greater probability of risk of flooding

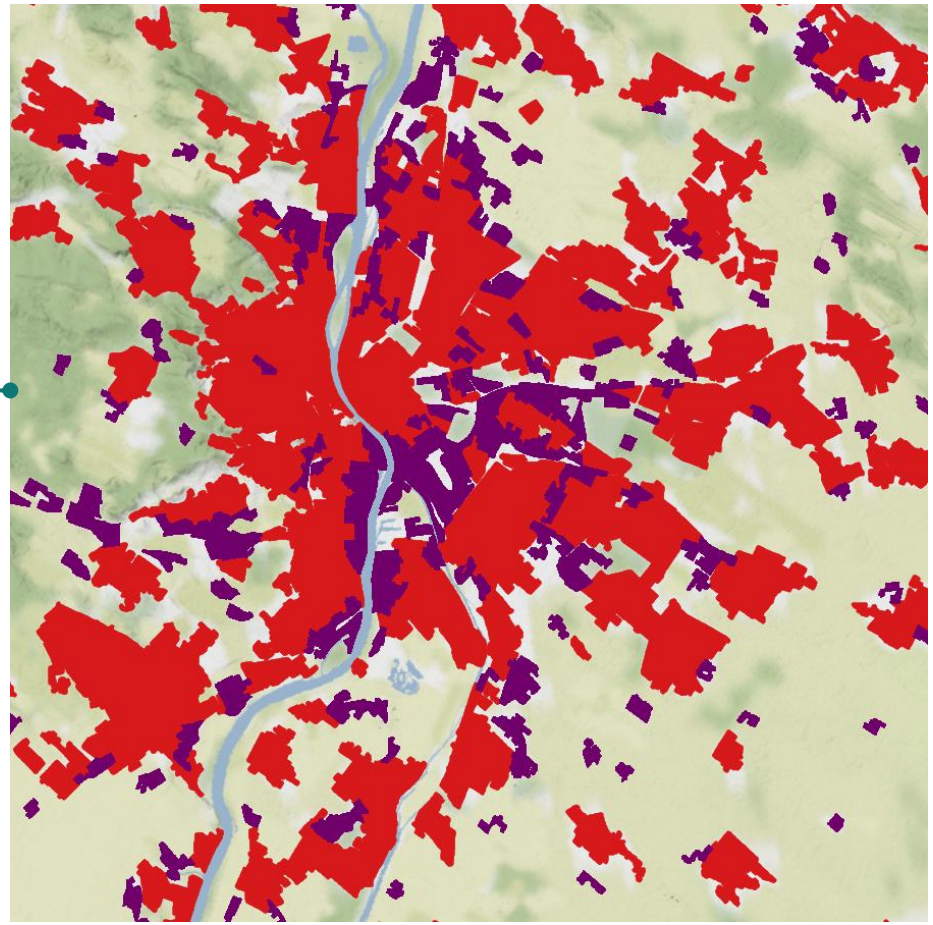
Little/no change

Lower probability of risk of flooding

Current and future flood risk assessment in the Danube basin

Distribution of residential and commercial assets (CORINE LULC 2012)

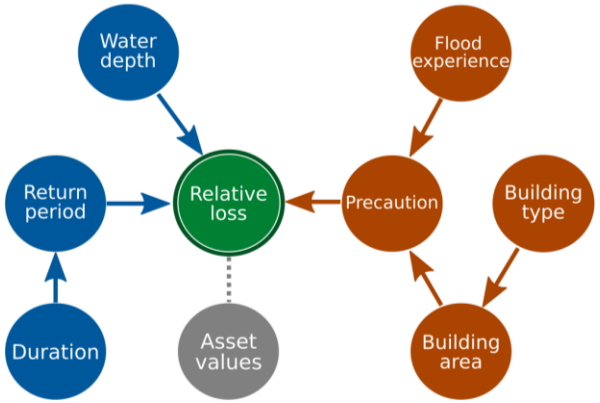




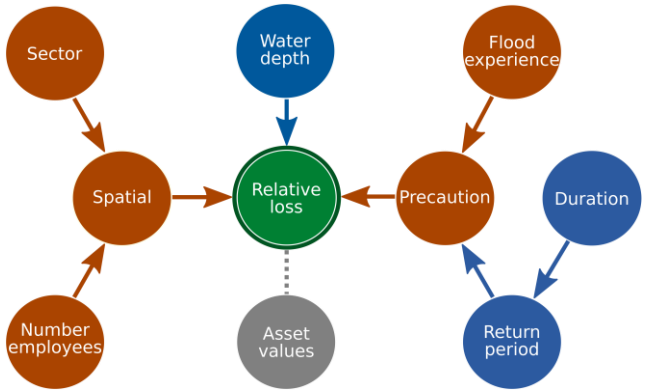
Zoom to Budapest region

OASIS LMF implementation of Flood vulnerability models

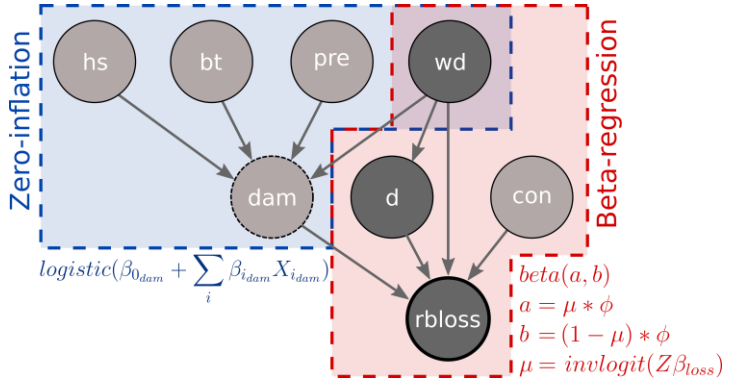
Residential fluvial flood loss



Commercial fluvial flood loss



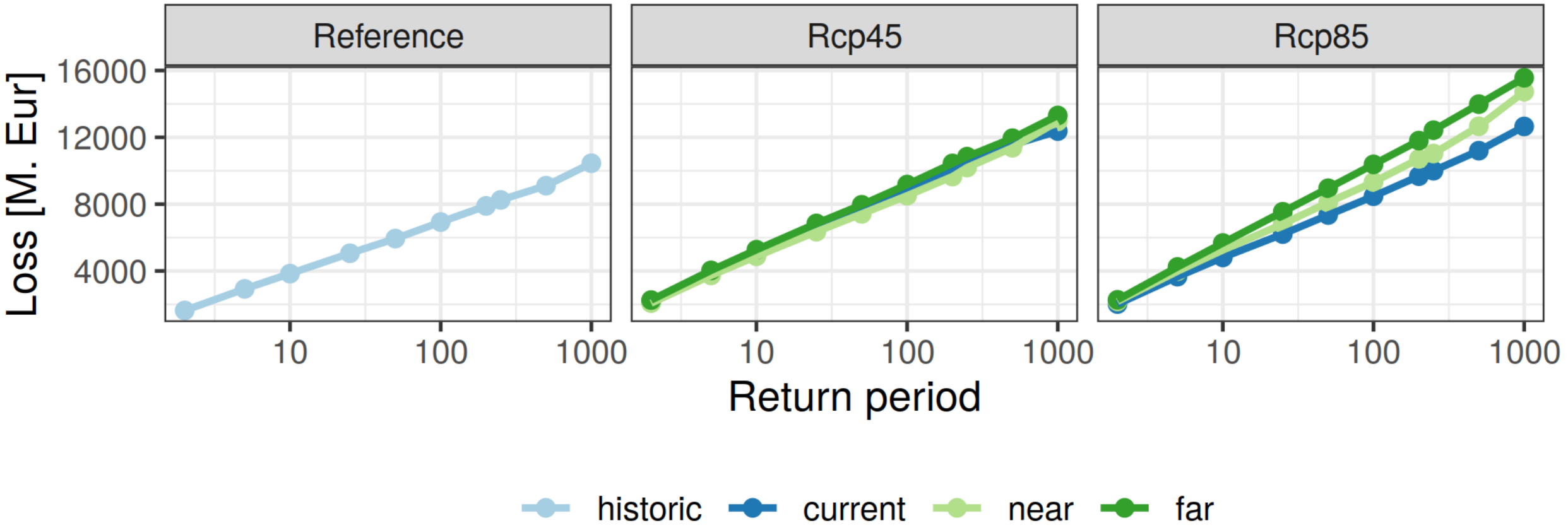
Residential pluvial flood loss



OASIS LOSS MODELLING FRAMEWORK

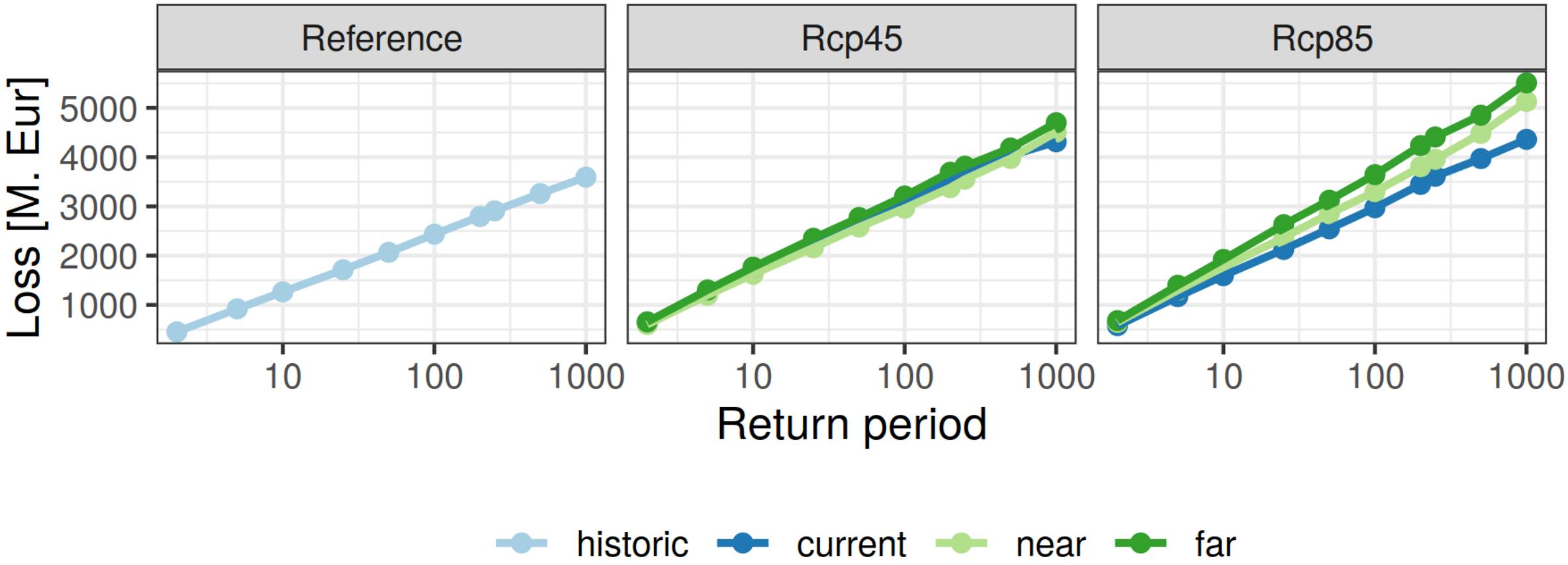
AEP curves for fluvial flood risk of residential buildings

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



AEP curves for fluvial flood risk of commercial buildings

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



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www.oasislmf.org, www.oasishub.co

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