Dangerous hydrological events in future climate as projected by an ensemble of high resolution RCM for northern Eurasia

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The evidence of modeling projections of climate change impacts on floodings is important for water resources management and flood assessment by decision-makers. Impact models usually use climate projections provided by global and regional climate models (RCM). However, challenges in representing dangerous hydrological events over the river catchments suggest that decisions should be made depending on the degree of realism of runoff simulation by an RCM at high resolution. Given an RCM simulated surface and groundwater inflow to rivers, the river routing model can compute flow and volume of water everywhere across watersheds taking into consideration the multitude of feeders.

Here to simulate future changes in flood frequency and intensity over the northern Eurasia the CaMa-Flood river routing model (Yamazaki et al., 2011) is used. The model is driven by runoff derived from an ensemble of ten decadal long RRCM (Shkolnik and Efimov, 2015) simulations spanning 1990-1999 and 2050-2059 (10×2=20 simulations in total). The horizontal grid size of RRCM is 381×183 with a mesh width of 25 km. All the simulations differ in the atmospheric initial and time dependent lateral boundary conditions, provided by an AGCM T42L25. The experiments include SST/IC evolution as projected by three most successful CMIP5 models using IPCC RCP8.5 scenario.

Given that modeling runoff, being a small difference of the two large values (precipitation and evaporation), is prone to significant biases due to biases in water balance components, it needs to be calibrated (corrected for bias) to be used for an input in the CaMa-Flood model. The quality of the simulated river discharge is evaluated through comparison of RCM-driven river routing model output with river discharge observations at 43 level gauges across watersheds of northern Eurasia. Simulated changes in the mean and extreme water discharge over the river network in northern Eurasia at resolution 0.25°×0.25° are considered. Possible changes in flood area (Fig.1), flood depths and flood water volume are analyzed in the context of projection uncertainties.

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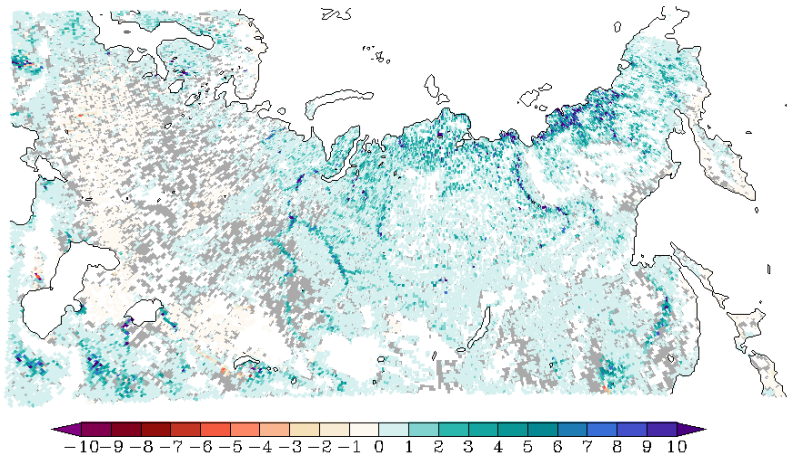

Fig. 1 Changes (%) in the annual maximum flood area by 2050-2059 relative to 1990-1999 as simulated by 10-member ensemble of RRCM at 25 km resolution under IPCC RCP8.5 scenario.

References

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