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High resolution projections of shifts in freshwater biodiversity habitats under global climate change

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Changes in streamflow regimes and water temperature impact water quality and freshwater biodiversity. Yet the impact of these changes on aquatic biodiversity, especially at fine spatial scale, may vary regionally and often remains unknown. Climate-change impact assessments on freshwater biodiversity are typically done at coarse spatial resolution (>5km), due to a lack of fine scale hydrological information. In this work, we link a hyper resolution global hydrological model (PCR-GLOBWB, 1km) with a species distribution model (SDM). We use this to assess the suitability of current and potential future freshwater habitats for fish species, in the Rhine Basin as a case study. In addition to the high resolution streamflow simulations, we also provide 1km water temperature estimates derived from the DynQual water temperature model.

The results demonstrate that increases in anthropogenic water demands under SSP3 decrease habitat suitability across the entire Rhine basin. We also find that low flows are a higher predictor of freshwater fish suitability compared to water temperatures which is potentially due to the smaller temperature changes in the Rhine basin. Additionally, migratory fish and fish with a larger range of suitable habitats do not see large decreases in their suitabilities due to the larger range of acceptable locations. This work provides the first framework for hyper resolution climate change impact assessments that could be implemented globally and bridges hydrological and biodiversity modelling.