POTSDAM INSTITUTE FOR CLIMATE IMPACT RESEARCH

PIK

ISIMIP
Inter-Sectoral Impact Model Intercomparison Project

# Regional impacts of climate change on hydrology: a model intercomparison


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Coordinated at **PIK RD II**
Climate Impacts & Vulnerabilities


## ISIMIP (The Inter-Sectoral Impact Model Intercomparison Project)

**ISIMIP offers a framework for consistently projecting the impacts of climate change across affected sectors and spatial scales. An international network of climate-impact modelers contributes to a comprehensive and consistent picture of the world under different climate-change scenarios.**

## Regional Water Sector team in ISIMIP

- Nine hydrological models suitable for regional-scale applications
- Eleven modelling groups
- Twelve large-scale river basins modelled

## Goals

- To analyze and compare performance of regional hydrological models under current climate conditions;
- To analyze and better understand sensitivity of simulated river discharge to climate variability under current climate conditions;
- To compare simulated climate change impacts on water resources, flow regime including high and low flows, for the long-term average seasonal dynamics driven by 5 bias-corrected GCMs (data prepared by ISIMIP); and
- To quantify sources of uncertainty in a multi-model study: from RCP scenarios, driving GCMs and applied HMs.

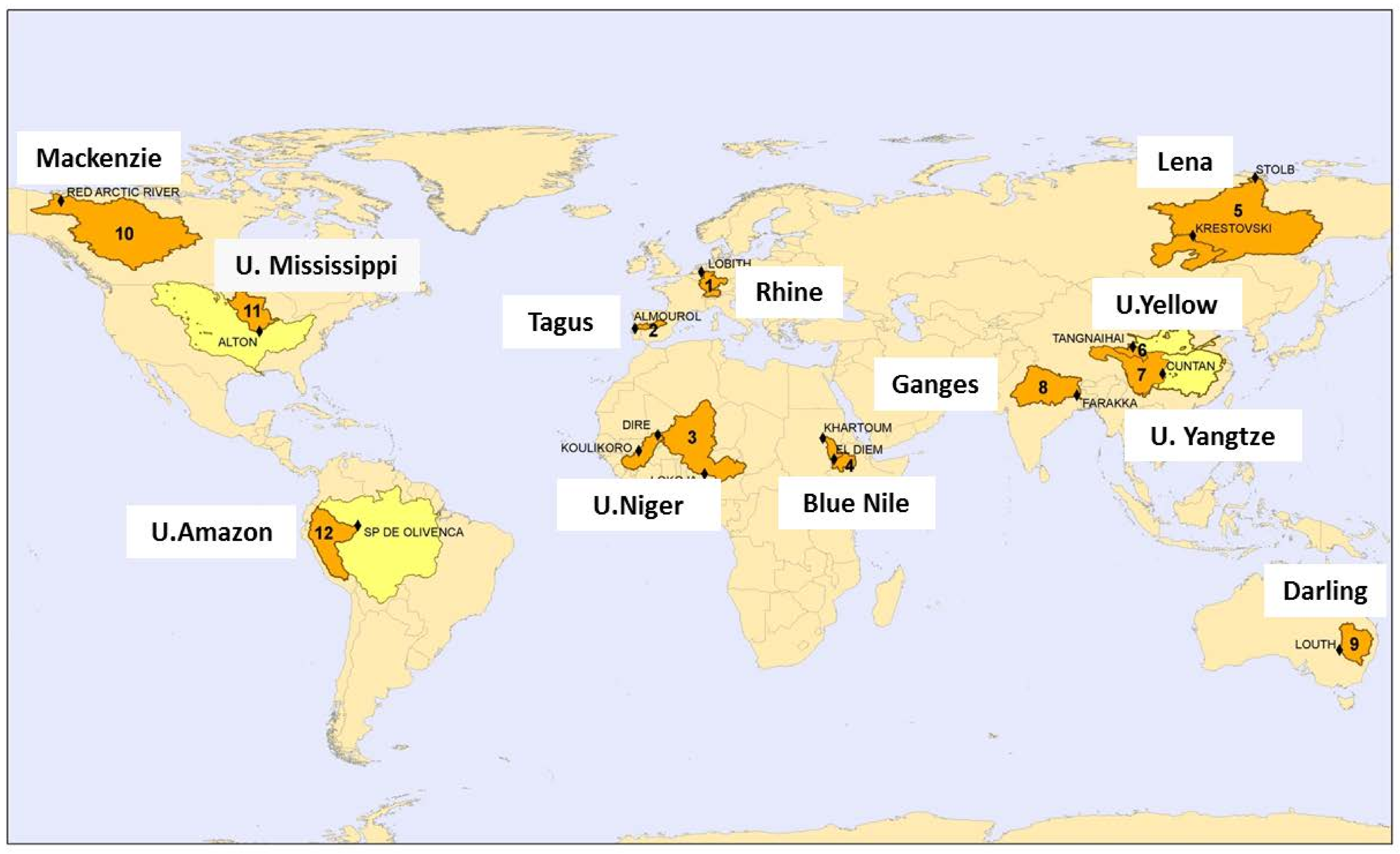


*Figure 1 The twelve river basins investigated in the regional hydrological model inter-comparison have been selected in such a way that they cover important climate zones.*

| Basins | Rhine | Tagus | Niger | | Blue Nile | | Ganges | Yellow | Yangtze | Lena | Darling | MacKenzie | Mississippi | Amazon |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| VIC | X | X | X | X | X | X | X | X | X | X | X | | X | X |
| SWIM | X | X | X | X | X | X | X | X | X | X | | | X | X |
| WaterGAP3 | X | X | X | X | X | X | X | X | | X | | | X | X |
| mHM | X | | | X | X | X | X | X | | | X | | X | X |
| HYMOD | X+X | | | X | X | | X+X | X | | | X | | X+X | X |
| HBV | X+X | X | | X | | X | X | X | X | | | | X | X |
| SWAT | | | | X | | X | | | X | | X | | X | X |
| HYPE | X | X | X | | | | X | | | X | | X | | |
| ECOMAG | | | | | | | | | | X | | X | | |
| Applications | 9 | 5 | 4 | 7 | 5 | 6 | 8 | 6 | 4 | 5 | 4 | 2 | 8 | 7 |

*Table 1 The regional hydrological models applied in the respective river basins. Two x indicate where different modeling groups applied the same model but with different parametrization.*

## Selected results 1: Changes in long-term daily discharge

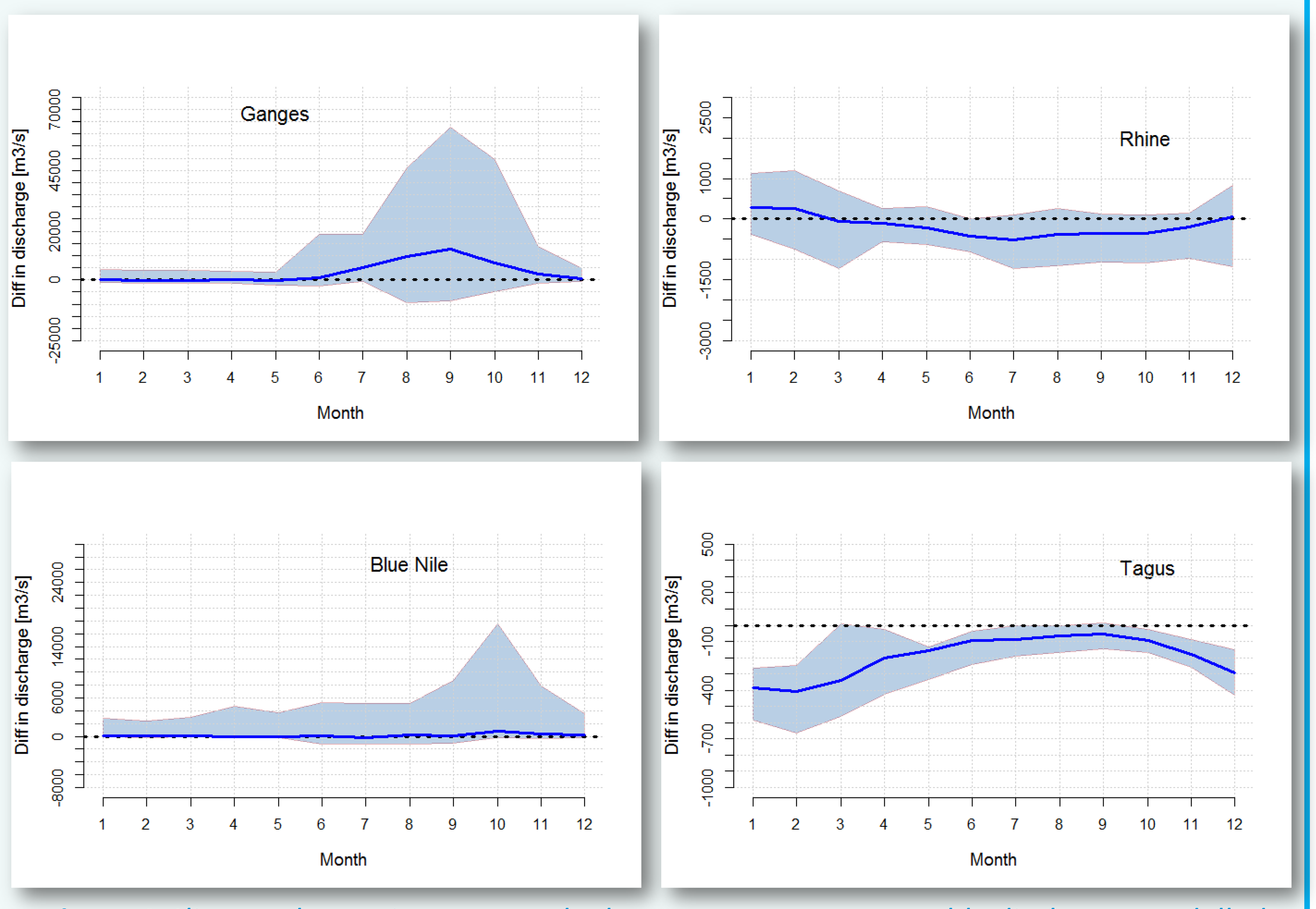


*Figure 2 Climate change impacts on the long-term average monthly discharge modelled by the regional HMs (scenario RCP8.5) for the period 2071-2099 compared to the reference period 1971-2000).*

## Selected results 2: Sources of uncertainty in regional hydrological impacts using Analysis of Variances (ANOVA)

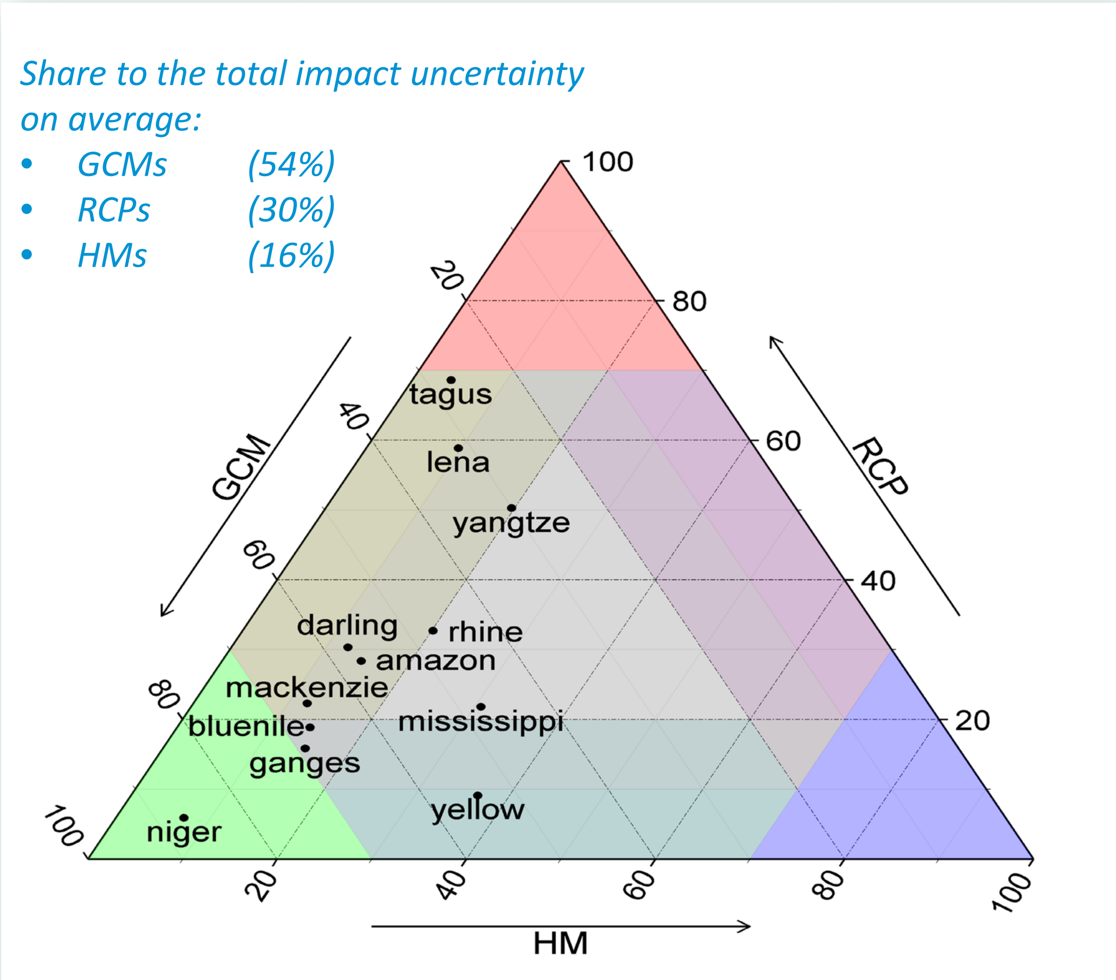


*Figure 3 The total impact uncertainty decomposed into the main sources (5 Global Climate Models GCM, 4 Representative Concentration Pathways RCPs and 9 hydrological models HMs). In the Niger, for example, almost all of the uncertainty is because of differences in GCM input (Vetter et al. 2016).*

### Articles related to the regional hydrological model intercomparison


Eisner S et al. (2016) An ensemble analysis of climate change impacts on streamflow seasonality across 11 large river basins. Clim Change. doi:10.1007/s10584-016-1844-5

Gelfan A et al (2016) Climate change impact on the water regime of two great arctic rivers: modeling and uncertainty issues. Clim Change. doi:10.1007/s10584-016-1710-5

Gosling S et al (2016) A comparison of changes in river runoff from multiple global and catchment-scale hydrological models under global warming scenarios of 1° C, 2° C and 3° C. Clim Change. doi:10.1007/s10584-016-1773-3

Hattermann F. et al. (2016) Cross-scale intercomparison of climate change impacts simulated by regional and global hydrological models in eleven large river basins. Clim Change. doi:10.1007/s10584-016-1829-4

Huang S et al (2016) Evaluation of an ensemble of regional hydrological models in 12 large-scale river basins worldwide. Clim Change. doi:10.1007/s10584-016-1841-8

Mishra V et al (2016) Multimodel assessment of sensitivity and uncertainty of evapotranspiration and a proxy for available water resources under climate change. Clim Chang (in press)

Pechlivanidis I et al (2016) Analysis of hydrological extremes at different hydro-climatic regimes under present and future conditions. Clim Change. doi:10.1007/s10584-016-1723-0

Samaniego L et al (2016) Propagation of forcing and model uncertainties on to hydrological drought characteristics in a multi-model century-long experiment in large river basins. Clim Change. doi:10.1007/s10584-016-1778-y

Strauch M et al (2016) Adjustment of global precipitation data for enhanced hydrologic modelling of tropical Andean watersheds. Clim Change. doi:10.1007/s10584-016-1706-1

Su B et al (2016) Impacts of climate change on streamflow in the upper Yangtze River basin. Clim Change. doi:10.1007/s10584-016-1852-5

Teklesadik AD et al (2016) Intercomparison of hydrological impacts of climate change on the Upper Blue Nile basin using ensemble of hydrological models and global climate models. Clim Chang (in press)

Vetter T et al (2016) Evaluation of sources of uncertainty in projected hydrological changes under climate change in 12 large-scale river basins. Clim Change. doi:10.1007/s10584-016-1794-y

Wang X et al (2016) Analysis of multi-dimensional hydrological alterations under climate change for four major river basins in different climate zones. Clim Change. doi:10.1007/s10584-016-1843-6



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