EGU24-12903, updated on 12 Feb 2025
https://doi.org/10.5194/egusphere-egu24-12903
EGU General Assembly 2024
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Global 30 arcsecond PCR-GLOBWB: Challenges and Opportunities.

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Land surface characteristics play an important role in shaping hydrological response and groundwater-surface water interactions. It is therefore paramount to model the terrestrial hydrological at cycle spatial resolutions which incorporate appropriate land surface heterogeneities.

Our objective is to enable modelling of the global terrestrial hydrological cycle at very high spatial resolution. As a first step towards this goal, we present the first global application of PCR-GLOBWB at 30 arcseconds (~1 km) resolution. In this global 30 arcseconds PCR-GLOBWB model we implement a new statistical downscaling routine for meteorological forcing that relies on CHELSA high resolution climatologies to provide an improved spatial distributions of precipitation, temperature and reference evapotranspiration. To better capture snow and ice dynamics, we have embedded an improved snow and ice distribution scheme, which is critital for high mountain regions. Finally, we improve on the method of parralisation used when running the model at a global scale to overcome computational limitations.

We simulated the global terrestrial hydrological cycle from 1985 – 2019 at the daily timestep and validate simulated river discharge, evaporation, total water storage anomalies and snow cover against observed data. The model outputs are also compared to previous more coarse scale global PCR-GLOBWB model at 5 arcminute and 30 arcminute resolutions as well as simulations with the lower resolution meteorological forcing to separately quantify the impact of increasing the spatial resolution in the land surface and meteorological forcing. Furthermore, we discuss the computational challenges encountered along the way and outline future directions and opportunities in high-resolution global hydrological modelling.