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Hydrological response to warming climate in the Greater Horn of Africa

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Over the recent decades, frequent, long-duration and severe droughts have intensified in the Greater Horn of Africa (GHA), reducing streamflow and causing water and food shortages. Rapid population growth and rising urbanization will intensify future water use and can increase the risk of water scarcity. Estimates of future streamflow changes in the region have so far been highly uncertain and evaluations using ground-based measurements are limited. Here future streamflow changes are estimated using a distributed hydrological model forced with an ensemble of high-resolution climate simulations. The simulated streamflow is evaluated using observed data from 29 stations across different climate zones in the region. Evaluation results show large sub-regional variations in the performance of simulated streamflow with monthly correlation ranging from >0.9 in the Blue Nile to <0.4 in Rovuma basin, Tanzania. While the streamflow seasonality is well captured for the rivers with June-September high flows (e.g., Blue Nile), some ensemble members miss the long-rainy season (March-May) peak flow for rivers with bimodal seasons (e.g., Shabelle). The sign and magnitude of future streamflow changes also vary between the ensembles and across climate zones. Overall, the streamflow projections indicate large (seasonal, long-term mean, and extreme) streamflow decreases for all major rivers in Ethiopia and increases in the equatorial parts of the region at the end of the century. The results have far-reaching implications for future water, food and energy supply of the region, and hence they should be considered in climate adaptation policies and transboundary river basin management.