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Implementing PCR-GLOBWB on a 1 km resolution for Africa

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PCR-GLOBWB (Van Beek et al., 2012; Sutanudjaja et al., 2018) is a global hydrology and water resources model that has been developed over the past two decades at the Department of Physical Geography, Utrecht University, The Netherlands. The latest version of the model has a spatial resolution of 5 arc minutes (approx. 10 km at the equator) and runs on a daily resolution covering several decades. Different initiatives have expressed the need for hyper-resolution global hydrological modelling (see e.g. Bierkens et al., 2015), and in compliance we aim to further refine the spatial resolution of the model to 30 arc seconds (approx. 1 km at the equator). As a starting point, we are currently developing a version for the African continent. In doing so, two major challenges need to be overcome. First, computation time constitutes a hurdle, in particular to model river water routing/flow using a time-explicit scheme. To reduce run time, we apply a river basin partitioning strategy decomposing the model domain into several groups of river basins such that each river basin, connecting from their most upstream to downstream cells, could be run as an independent process. We aim to further advance this with a Pfafstetter domain decomposition (de Jager and Vogt, 2010,) that capitalizes on the hierarchical structure of a drainage network in combination with massive parallel computing to make this possible.

Second, the parameterization of the model at 30 arc seconds poses a major challenge as this resolution approaches that of available global datasets. Preliminary, we have therefore derived the first version of the model parameters at 30 arcsec resolution for Africa using globally-available datasets and following our past experiences (see e.g. Sutanudjaja et al., 2011; van Beek and Bierkens, 2009). We have tested this version of the model with our own meteorological forcing (derived based on the CRU TS 3.21 and ERA-Interim). Results are promising (e.g., NSE = 0.63; KGE = 0.29 at Nawuni, a station on the White Volta in Ghana) and will be discussed in the presentation.

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