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# Representation of East African Rainfall in CMIP5 Models

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East Africa is an area of particular vulnerability to climate change, especially in terms of rainfall. The livelihoods of many people in the region are dependent on rain-fed agriculture, and consequently the climate can be regarded as a constraint on development. East Africa has recently experienced a series of severe droughts, for example in 1983-85, 2010-11, and 2015-2017. It has been estimated that around 17.5 million people are at risk from food shortages in Ethiopia, Somalia, and Kenya. The recent decline in the ‘long rains’ (March-April-May) is the most significant drying signal in the region’s observational record, but its causes are still not certain. Furthermore, current general circulation models (GCMs) tend to project a wetting signal for the region in the near future, in direct opposition to recent trends; this has been termed the ‘East African Climate Paradox’.

Understanding the discrepancy between models and observations requires assessment of models that goes beyond their ability to reproduce mean rainfall statistics. For instance, it has been shown that in West Africa, models can produce seemingly accurate rainfall via unrealistic mechanisms, which in turn casts doubt on the reliability of their future projections. Recent literature on African climate has called for a process-based assessment approach, which considers the dynamics of models. This can enable better usage of model data for future climate projections and adaptation planning in regions of high model uncertainty, such as East Africa; informed decisions can be made of which models to use for specific regional applications based on their dynamical performance, rather than an ensemble mean approach which may conceal biases caused by the inclusion of less plausible models.

Using CHIRPS rainfall and ERA-Interim reanalysis data as a baseline, we here consider the model representation of moisture flux and vertical velocity into and across East Africa, as well as rainfall, for individual months within the two main rainy seasons. Atmosphere-only models have been used initially, to control for the known CMIP5 SST biases in the Indian Ocean. In this preliminary work, model variability in the Turkana Jet and localised interactions with the Asian Monsoon flux are suggested as controlling factors on model East African rainfall, which in turn implies an impact of model resolution upon such topographically-controlled structures. Compared to ERA-Interim, many models have unrealistic monthly changes in the magnitude and direction of the Turkana Jet moisture flux, which is often more closely embedded in the large-scale Asian Monsoon flux in models than the reanalysis would suggest. Some models have large scale wind biases over the equatorial Indian Ocean which casts further doubt on their representation of moisture advection in the Indian Ocean basin, notwithstanding the known sea-surface temperature biases in coupled versions. Further work will consider resolution more explicitly by assessing models in varying grid configurations, as well as model responses during ENSO events, sensitivity to aerosol schemes, and moisture flux in coupled models.