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Estimating high-resolution evapotranspiration in East Africa using Earth observation data

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East Africa has experienced a number of droughts in recent decades with devastating impacts for human and natural systems. Drought is not only a product of declining precipitation, but also increased evapotranspiration. A simple water balance equation can tell us that the inputs of water are important, but so are the outputs. Since 1998, only 2010 and 2013 have exhibited positive rainfall anomalies. Global temperatures have also been rising. This pressure on water systems from both sides requires high-resolution evapotranspiration to better monitor water resources over complex topographic terrain, as in East Africa.

Owing to the lack of ground measurements, Earth observation data is the only source of evapotranspiration data that can cover a wide area. Currently, major evapotranspiration products include MODIS (MOD16) and GLEAM (v3). MOD16 is limited by the short time scale (2000-2010) and data gaps. GLEAM utilises Earth observation data to drive a land surface model. However, the evapotranspiration data product is currently produced at 25 km scale. Over the spatially heterogeneous region in East Africa there exists the potential for this data to smooth over key spatial variability.

In order to meet the demand for long term, high resolution data, we use HOLAPS (High resOlution Land Atmosphere Parameter estimation from Space). HOLAPS is a novel model framework for estimating surface water and energy fluxes. Driven by earth observation data, we are able to get evapotranspiration estimates in basins and areas without in-situ measurements.

HOLAPS makes use of meteorological data from globally available Earth observation and reanalysis datasets. It describes the interfaces between a planetary boundary layer module, a soil module, a radiation module and a surface fluxes module. It has been validated against FLUXNET data at individual station sites. However, this doesn't demonstrate the key spatial gradients in evapotranspiration which are required to monitor water fluxes over space. These gradients are essential to better understand historical droughts and to consider the impact of future changes in temperature and precipitation on drought characteristics.

The generated dataset is produced for the time period from 1981 to 2017, at daily temporal, and 5km spatial resolution. The input data includes surface radiation from CMSAF EUMETSAT, precipitation estimates from TMPA and top-of-atmosphere radiation from GRIDSAT. ERA-Interim is used for other surface variables such as temperature and pressure, and MODIS for surface albedo and leaf area index. We find that increasing the resolution of the evapotranspiration dataset has an impact on drought statistics (frequency, duration, spatial extent), particularly in topographically complex regions. While there is broad agreement with already existing evapotranspiration products, there are also interesting differences which reflect the increase in resolution.

References:
Loew, A., Peng, J., & Borsche, M. (2016). High-resolution land surface fluxes from satellite and reanalysis data (HOLAPS v1. 0): evaluation and uncertainty assessment. Geoscientific Model Development, 9, 2499-2532

Peng, J., Loew, A., Chen, X., Ma, Y., & Su, Z. (2016). Comparison of satellite-based evapotranspiration estimates over the Tibetan Plateau. Hydrology and Earth System Sciences, 20, 3167-3182