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A comparison of ASCAT and modelled soil moisture over South Africa, using TOPKAPI in land surface mode

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Two independent soil moisture estimates are compared over South Africa. The first estimate is provided by operational runs of the TOPKAPI hydrological model. The model has been adapted to run as a collection of independent 1 km cells located on a grid with a spatial resolution of 0.125°, using 3 hourly rainfall estimates and evapotranspiration forcing calculated at 1 h intervals.

The rainfall forcing used is the TRMM 3B42RT product, while the evapotranspiration forcing is based on a modification of the FAO56 reference crop evapotranspiration (ET_0), which accounts for vegetation health and the availability of surface and soil water, as limiting factors on the potential rate of evapotranspiration.

We compare the ET_0 estimates, computed using observed meteorological data at a network of weather stations, to those computed using 24 h forecast fields from the South African Weather Service's Unified Model runs. The results show that the ET_0 computed using the forecast fields is strongly correlated with and unbiased relative to, the independent values computed (from observed data) at the weather station locations. We therefore conclude that the Unified Model forecasts are suitable for producing an estimate of ET_0 instead of observed station data, especially considering the sparse coverage of weather stations in the region.

Using the rainfall and evapotranspiration forcing data, the percentage saturation of the TOPKAPI soil store is computed, for each of 6984 uncalibrated TOPKAPI cells at 3 h time-steps, and compared with estimates of surface soil moisture from the ASCAT instrument onboard the METOP polar orbiter. The comparisons indicate a good correspondence in the dynamic behaviour of an exponentially filtered time series of the ASCAT surface soil moisture and the TOPKAPI estimates for several climatic regions in South Africa. The linear agreement in dynamic behaviour for these independent soil moisture estimates suggests that both are correctly capturing the soil moisture dynamics for a significant proportion this region, and could be combined to produce a "best estimate" soil moisture field.