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A Daily High-resolution Surface Evapotranspiration Dataset for the MENA Region

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Evapotranspiration (ET) from natural and agricultural vegetation is an important hydrologic process for establishing the water balance in basins, estimating water demand of irrigation systems, as well as crop biomass production and yield at field scales. Several satellite based ET models are now available with enough robustness to retrieve ET using multispectral and thermal imagery from Landsat TM and other sensors. Most of their use has been limited to local and regional studies; but few have been applied to continental or global scales.

In this paper, we will describe a new satellite-based daily ET product developed for the Middle East and North Africa (MENA) region, based on the Atmosphere-Land-Exchange Inverse (ALEXI) model. ALEXI contains the Two-Source Energy Balance (TSEB) land surface representation, which partitions fluxes and surface temperature between nominal soil and canopy components within the modeling scene. The MENA region ET product consists of a higher spatial resolution (375 m pixel resolution) estimation based on the Visible Infrared Imaging Radiometer Suite (VIIRS) satellite instrument. The dataset is generated with a recently developed technique, which exploits day-night observations of Land Surface Temperature (LST) from polar orbiting sensors such as MODIS, and VIIRS to estimate the morning rise in LST, needed as a crucial forcing to the ALEXI system. The ET product estimation makes use of other VIIRS products such as lands surface albedo, leaf area and fraction of vegetation cover, land cover/vegetation type classification and cloud masks as well as incoming solar radiation from geostationary platforms and meteorological surface fields from the Climate Forecast System Reanalysis dataset.

The MENA region ET product has been generated going back to the first full year of available VIIRS data in 2014, and will extend into the future for the life of this instrument program (15 years). In order to estimate ET at field scales, a Python version of the DisALEXI disaggregation scheme has been developed (PyDisALEXI) to downscale the 375 m ET pixels to higher spatial resolutions using Landsat Thematic Mapper data.

The VIIRS calibrated imagery and the derived ET product is used in the elaboration of the MENA Composite Drought Index (MCDI) and the downscaled product, to estimate field level ET, crop biomass and yield along with spatial crop water productivity. Several examples of the product at different scales will be presented, along with preliminary testing of the product against eddy covariance flux towers and weather stations in the region.