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Satellite-based drought monitoring in the Sahel: Evaluation of two global physically-based evapotranspiration algorithms

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Regional estimates of daily evapotranspiration and surface fluxes in water-scarce and climatic vulnerable regions are critical for improving agricultural and hydrological information as well as our understanding of land surface-atmosphere interactions. The final aim of this study is to evaluate two global operational evapotranspiration algorithms in the Sahelian grasslands of Africa, where in-situ data are scarce, relying on satellite products at 1 km spatial resolution with no field calibration or in-situ variables.
Two process-based models were applied to estimate surface fluxes including evapotranspiration (ET): the global MODIS evapotranspiration algorithm (MOD16), based on a three source Penman–Monteith approach; and a version of the PT-JPL model, based on a three source Priestley–Taylor model with an apparent thermal inertia module to estimate soil moisture.
Both models were forced using climatic reanalyses data from two sources: MERRA GMAO (NASA re-analysis GEOS-5) and NCEP/NCAR (National Centers for Environmental Prediction/National Center for Atmospheric Research). Additionally, to assess if errors were due to algorithm assumptions or with the quality of input data in-situ climatic tower data were used to compare with results from reanalyses. All model results were compared with eddy covariance data from two field sites in Mali and Sudan spanning a total period of 5 years.

Preliminary results showed a better performance of both algorithms using in-situ climatic data, with a superior performance of the PT-JPL model despite a low bias relative to the measured ET. Climatic forcing with MERRA provided better results than using NCEP data. Aggregation of results from daily to 8-day time scale decreased errors significantly. The PT-JPL model version with a thermal inertia approach to estimate soil moisture offers great potential for regionalization in regions where the main limitation to evapotranspiration is soil moisture, such as the Sahel as no field-calibrations are required the only input variables required are air temperature and incoming solar radiation, apart from routinely available satellite products.