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Proceedings

Predicting medium scale soil moisture patterns by integrating remote sensing based energy balance modelling with soil water balance modelling in Morocco

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It has been reported that in the last decades of the past century precipitation has decreased throughout the southern Mediterranean region, while the demands of fresh water are rising due to expansion of irrigated areas and urban development. Climate models predict even a further reduction in precipitation and an increase of annual temperature. A key variable both in sustainable agriculture and land degradation processes such as erosion and desertification is the spatial and temporal distribution of soil moisture. This study focuses on a coupling of energy balance modelling with soil moisture modelling to predict soil moisture patterns changes in time. The study area has a size of 55 km^2, and is located in the community of Sehoul in the province of Sala al Jadida about 20 km south-east of Rabat (Morocco). Land use consists of rainfed and irrigated agriculture and oak forest. Satellite images were combined with field measurements to derive land surface physical parameters (albedo, emissivity, temperature, vegetation coverage, etc.). Also soil moisture is monitored with a portable TDR (top 10 cm) in several key areas, meteo data is obtained with a local meteostation and a DEM is made from SRTM data.
Soil moisture prediction is done in several steps by coupling two models:

a. The Surface Energy Balance System (SEBS) is a model that can estimate the evapotranspiration flux using Earth Observation data in the visible, near infrared, and thermal frequency range. The model is validated with data from the ESA funded SPARC/EAGLE field campaign in Barrax (Spain). For the Morocco research area SEBS is applied using Moderate Resolution Imaging Spectroradiometer (MODIS) images, scaled to a resolution of 250 m.
b. A 3 layer spatial soil water balance model is constructed based on gravitational flow to predict the soil moisture for the top 10 cm of the soil with hourly timesteps. This model can be run on any spatial resolution and is calibrated for 5 field sites where TDR measurements have been done.
c. The soil water balance model and SEBS are linked through the evapotranspiration flux that is predicted by both models independently. Using a “constant gain Kalman filter” data assimilation technique the predicted soil moisture is corrected by comparison of the ET flux of the soil water model and of SEBS. These corrections are done for moments of satellite overpass resulting in an improvement of the soil moisture predictions.

At this stage the soil moisture model has been calibrated for the 2004 data acquisition campaign and 3 MODIS images have been selected as input for SEBS (more are available and will be incorporated in the future). The system predicts daily soil moisture maps with a resolution of 50m. Results will be shown of a first attempt at data assimilation but a detailed validation and discussion on the uncertainties involved is not yet available.