On the use of NDVI data to calibrate a water balance model of the Sahel

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Vegetation indices derived from satellite images, such as the Normalized Difference Vegetation Index (NDVI), are frequently used to parameterize land surface models or simple water balance models. In the present study, we go a step further and investigate the question whether NDVI data contains enough information to calibrate a water balance model for semi-arid regions in absence of any other reference data on the system output (such as discharge).

We developed a simple water balance model for a reference region in the Sahel including two different reference vegetation types and having as input precipitation and potential evapotranspiration. Assuming a simple linear relationship between NDVI and the average simulated transpiration, we calibrated the water balance model for around 1000 grid cells (8 km x 8 km) by minimizing the sum of squared errors between the simulated and the observed monthly NDVI per grid cell.

The distributed calibration results show that the identifiability of the water balance parameters using exclusively NDVI data critically depends on the model formulation, i.e. on the assumptions about the dominant hydrologic processes and how to encode them in a water balance model. The obtained results are case-study specific. However, the developed framework to calibrate water balance models on NDVI data, to analyze parameter identifiability and to incorporate process knowledge into simple conceptual models are readily transferable to the development of more sophisticated hydrologic or land surface models for semi-arid regions.