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Estimating irrigated areas from satellite and model soil moisture data over the contiguous US

Felix Zaussinger, Wouter Dorigo, and Alexander Gruber

Department of Geodesy and Geoinformation, Vienna University of Technology, Vienna, Austria
(felix.zaussinger@geo.tuwien.ac.at)

Information about irrigation is crucial for a number of applications such as drought- and yield management and contributes to a better understanding of the water-cycle, land-atmosphere interactions as well as climate projections. Currently, irrigation is mainly quantified by national agricultural statistics, which do not include spatial information. The digital Global Map of Irrigated Areas (GMIA) has been the first effort to quantify irrigation at the global scale by merging these statistics with remote sensing data. Also, the MODIS-Irrigated Agriculture Dataset (MirAD-US) was created by merging annual peak MODIS-NDVI with US county level irrigation statistics.

In this study we aim to map irrigated areas by confronting time series of various satellite soil moisture products with soil moisture from the ERA-Interim/Land reanalysis product. We follow the assumption that irrigation signals are not modelled in the reanalysis product, nor contributing to its forcing data, but affecting the spatially continuous remote sensing observations. Based on this assumption, spatial patterns of irrigation are derived from differences between the temporal slopes of the modelled and remotely sensed time series during the irrigation season.

Results show that a combination of ASCAT and ERA-Interim/Land show spatial patterns which are in good agreement with the MIrAD-US, particularly within the Mississippi Delta, Texas and eastern Nebraska. In contrast, AMSRE shows weak agreements, plausibly due to a higher vegetation dependency of the soil moisture signal. There is no significant agreement to the MIrAD-US in California, which is possibly related to higher crop-diversity and lower field sizes. Also, a strong signal in the region of the Great Corn Belt is observed, which is generally not outlined as an irrigated area. It is not yet clear to what extent the signal obtained in the Mississippi Delta is related to re-reflection effects caused by standing water due to flood or furrow irrigation practices. Consequently, future research should focus on the specific effects of different irrigation practices and crop types.

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