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Estimating land evaporation at field scales using GLEAM

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Terrestrial evaporation is a key component of the hydrological cycle and accurate estimates of the flux are essential for adequate water management and irrigation scheduling. Traditional methods to estimate land evaporation from remotely-sensed date use changes in land-surface temperature (LST) to diagnose the flux. Nowadays, LST can be observed with both high temporal (several minutes using geostationary satellites) and spatial resolution (several metres using drones), allowing the estimation of land evaporation at regional scales with high spatio-temporal detail. However, dedicated thermal-based algorithms typically estimate land evaporation as the residual of the energy balance. In addition, retrievals of LST obtained from thermal infrared measurements are sensitive to clouds, which limits the estimation of land evaporation to optimal weather conditions. Here, we present the results of applying for the first time the Global Land Evaporation Amsterdam Model (GLEAM) at 100 m spatial resolution over The Netherlands (hereafter referred to as GLEAM-HR). GLEAM is a process-based algorithm dedicated to the estimation of land evaporation and root-zone soil moisture from satellite-based geophysical parameters. Most of the forcing data used in this regional study are obtained from satellite-based measurements in the microwave domain, which enables us to provide continuous daily estimates of land evaporation and root-zone soil moisture with limited gapfilling. Validation experiments show that the surface soil moisture estimates of GLEAM-HR compare well with in situ measurements from 29 soil moisture sensors, yielding an average correlation coefficient of 0.76 across the sites. The temporal dynamics of land evaporation are validated against measurements from five eddy-covariance towers, resulting in correlation coefficients ranging between 0.65 and 0.95. Comparison to alternative datasets do not reveal a significant improvement of the temporal dynamics upon existing products. However, GLEAM-HR shows substantially more spatial detail while providing estimates of land evaporation under all weather conditions (and of its separate components, such as transpiration). This pilot study provides promising results on the applicability of GLEAM at high spatial resolution and over large domains. Nevertheless, future efforts should aim at further validating the spatial patterns of GLEAM-HR and assessing its accuracy under different climatic conditions.