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An inter-comparison of approaches and frameworks to quantify irrigation from satellite data

Søren Julsgaard Kragh et al.

Correspondence to: Søren Julsgaard Kragh (sjk@geus.dk)

Supplementary material

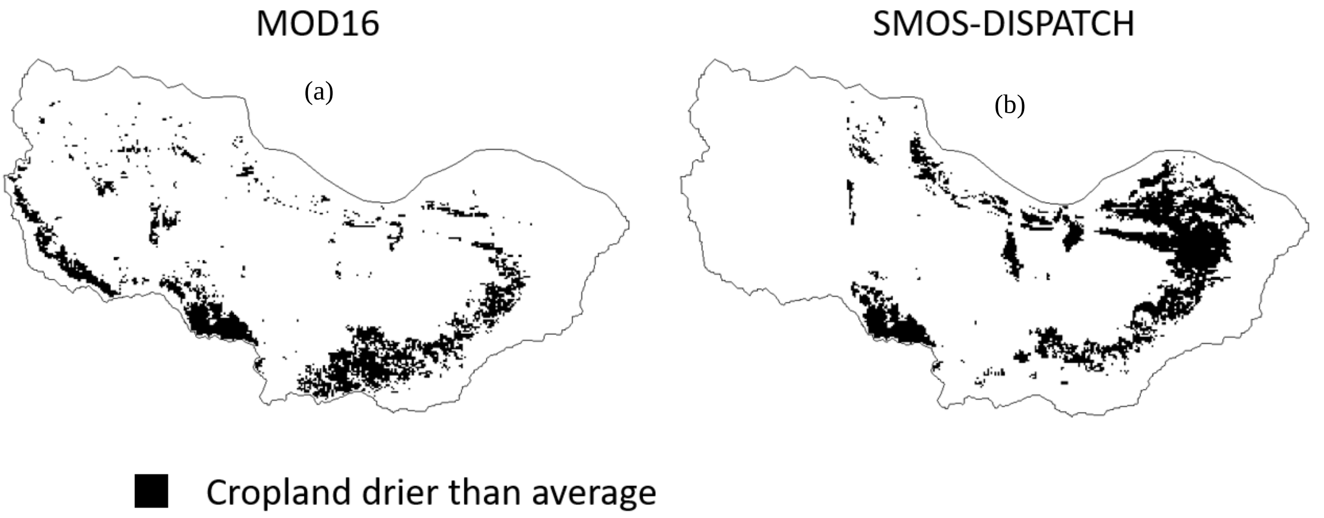

Figure S1: Rainfed maps as obtained from the temporal stability analysis using MOD16 ET (a) and SMOS-DISPATCH soil moisture (b). The black areas show a lower ET flux or soil water content on average compared to all croplands.

The two maps in Figure S1 depict cropland that has a lower ET flux or is drier than average, estimated by temporal stability analysis. This classification is used to indicate where rainfed cropland is located. The SMOS-DISPATCH dataset does not cover the western part of the catchment, which explains the missing data in the western part in Figure S1 b). Overall, the temporal stability analysis can capture the statistical differences between rainfed and irrigated cropland. Comparable results were found by Dari et al. (2021) who incorporated temporal stability measures of observed and modelled soil moisture in the K-means clustering algorithm to map irrigated cropland.

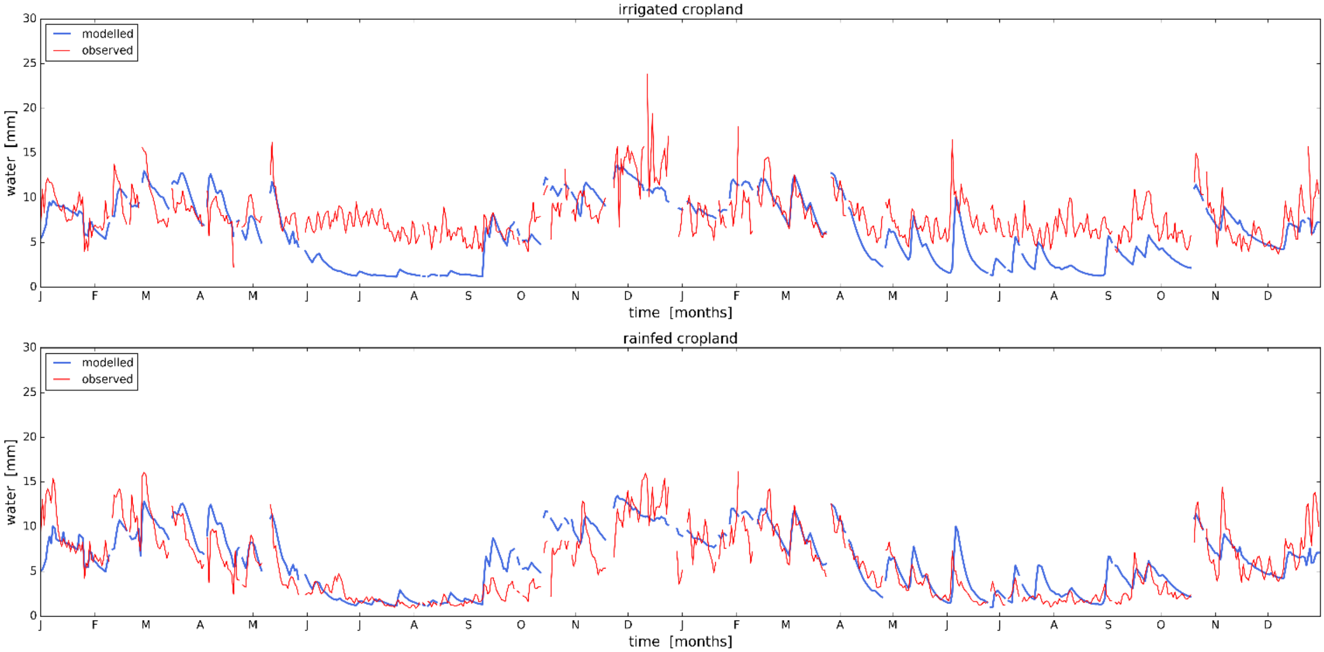

Figure S2: Timeseries of observed and modelled soil moisture for rainfed and irrigated cropland. The model (RZ-SM_bf) was calibrated against rainfed root zone soil moisture observations (lower panel). The time period covers the years 2016 and 2017.

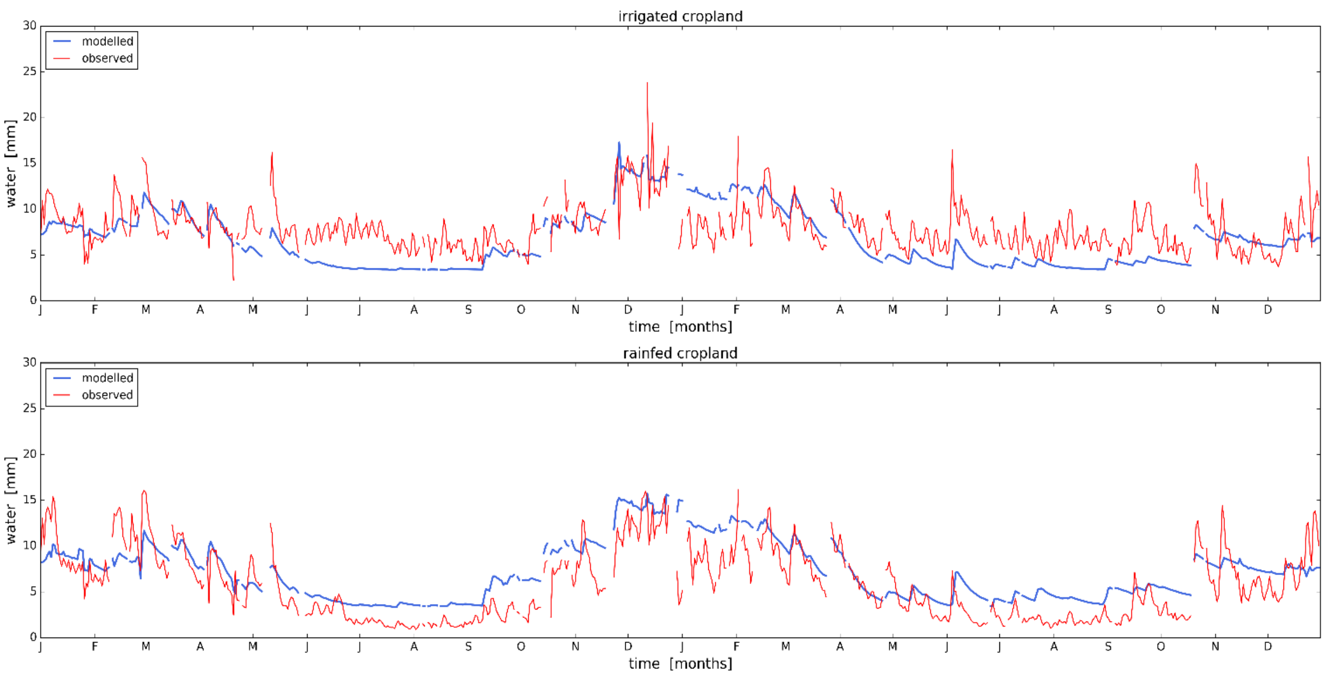

Figure S3: Timeseries of observed and modelled soil moisture for rainfed and irrigated cropland. The model (joint_bf) was calibrated against rainfed root zone soil moisture observations (lower panel) and rainfed ET observations (Figure S4). The time period covers the years 2016 and 2017.

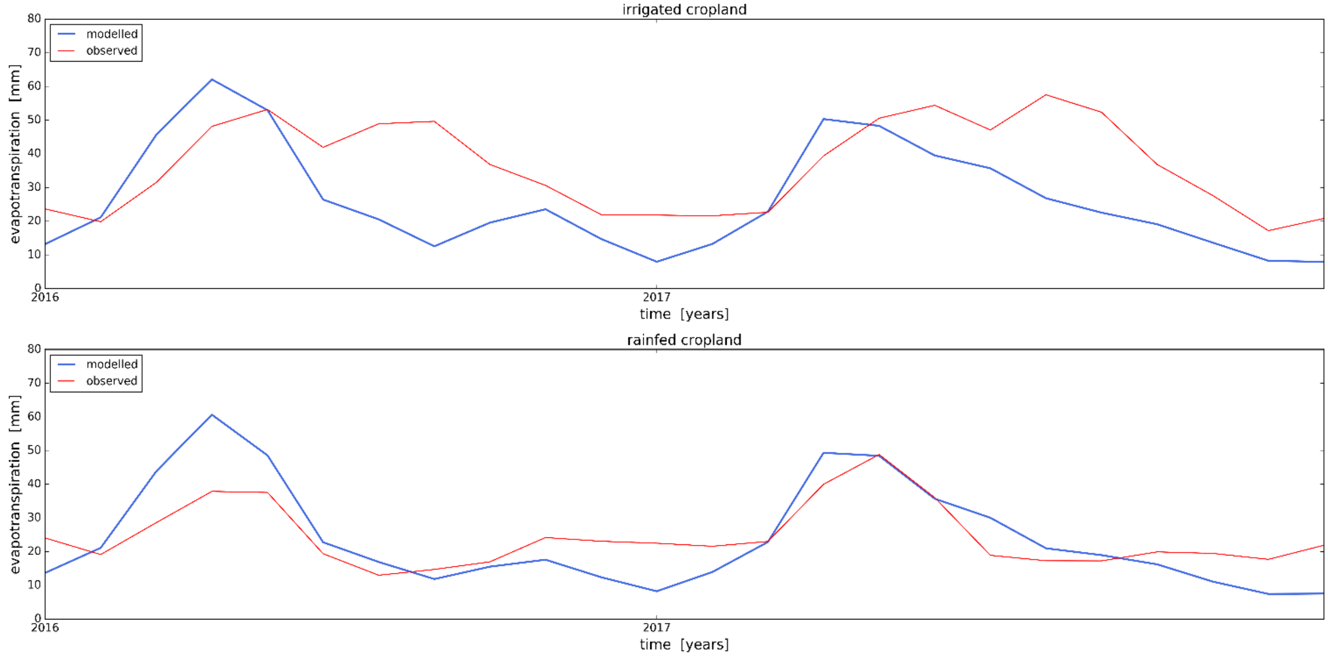

Figure S4: Timeseries of observed and modelled ET for rainfed and irrigated cropland. The model (joint_bf) was calibrated against rainfed ET observations (lower panel) and rainfed root zone soil moisture observations (Figure S3). The time period covers the years 2016 and 2017.

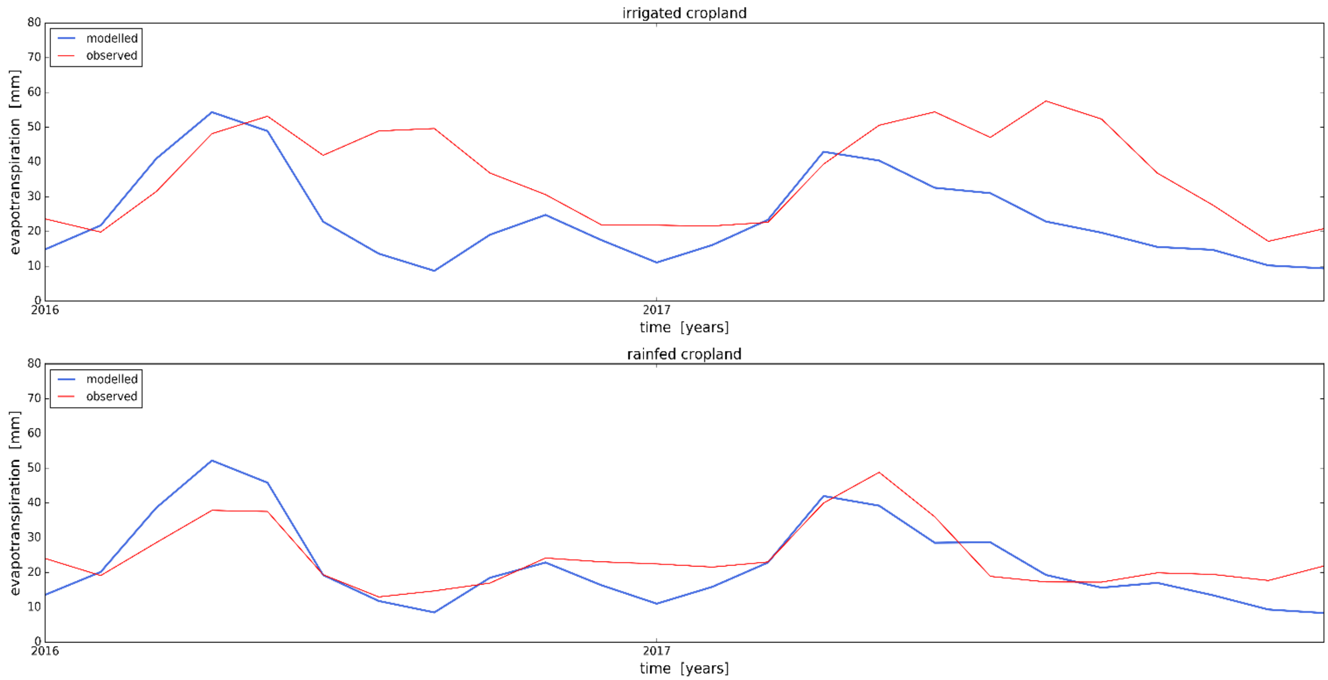

Figure S5: Timeseries of observed and modelled evapotranspiration for rainfed and irrigated cropland for the. The model (ET_bf) was calibrated against rainfed ET observations (lower panel). The time period covers the years 2016 and 2017.

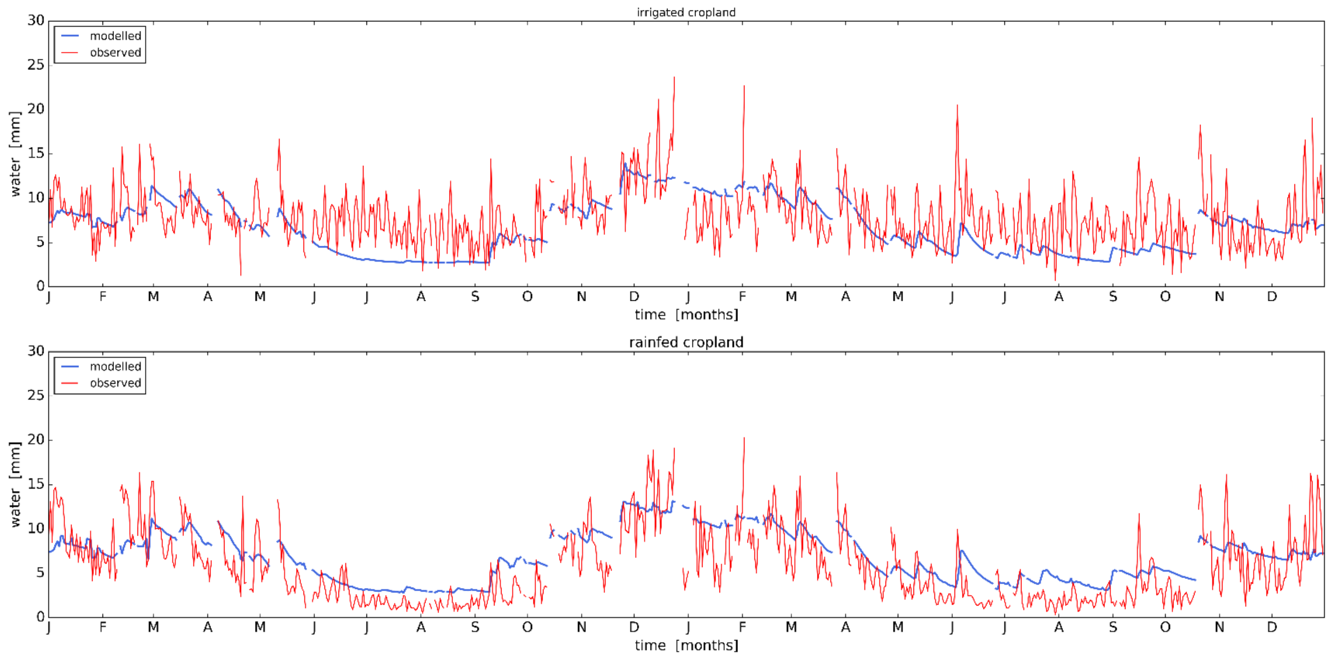

Figure S6: Timeseries of observed and modelled soil moisture for rainfed and irrigated cropland. The model (NS-SM_bf) was calibrated against rainfed near-surface soil moisture observations (lower panel). The time period covers the years 2016 and 2017.

Table S1: Bias measure for the four baseline frameworks. Statistics are calculated over rainfed cropland for the period 2016 – 2017. The mean error (ME) is calculated as the mean bias over all rainfed cells and the standard deviation of all bias is stated as std(ME).

bias measure	RZ-SM_bf	joint_bf	ET_bf	NS-SM_bf
ME	-3.3E-14 mm soil moisture/day	0.25E-14 mm soil moisture/day 0.3 mm ET/month	1.8 mm ET/month	-2.8E-14 mm soil moisture/day
std(ME)	3.2 mm soil moisture/day	3.3 mm soil moisture/day 10.7 mm ET/month	9.0 mm ET/month	3.8 mm soil moisture/day