Supplementary Material
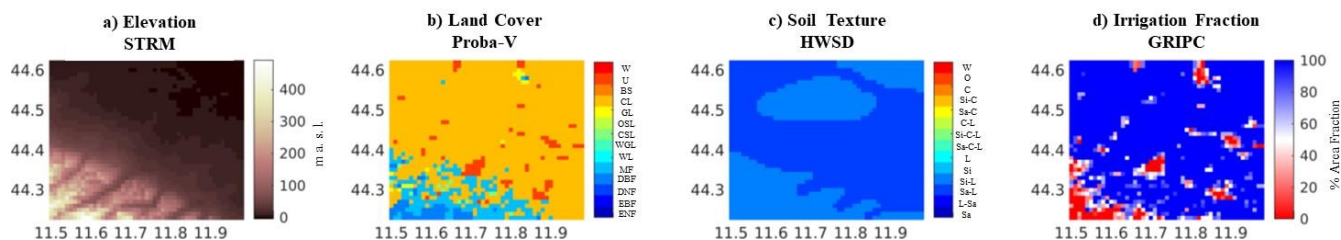
Figure S1: LIS input data over the Italian pilot site: a) elevation from the Shuttle Radar Topography Mission (SRTM); b) Proba-V LC; c) soil texture from the HWSD; and d) irrigation fraction map obtained from the GRIPC map.

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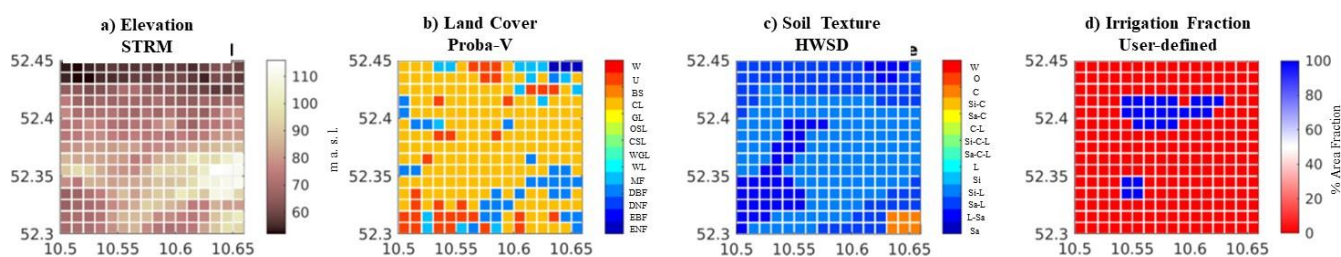
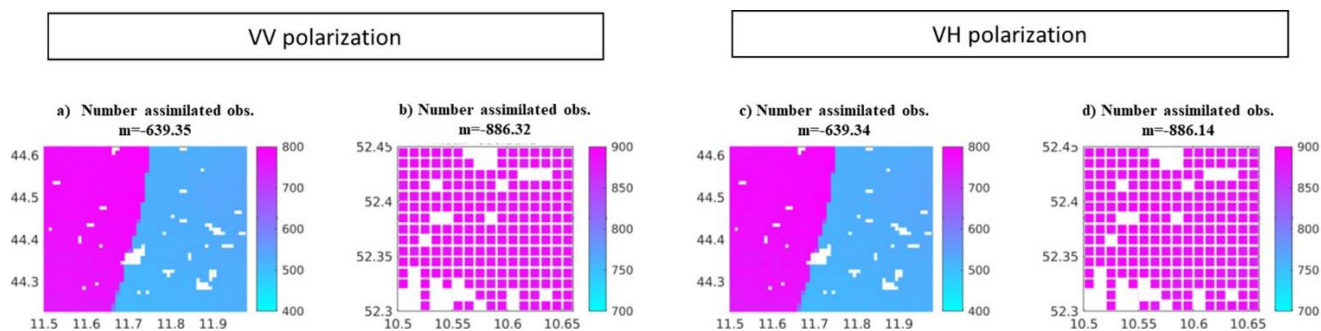
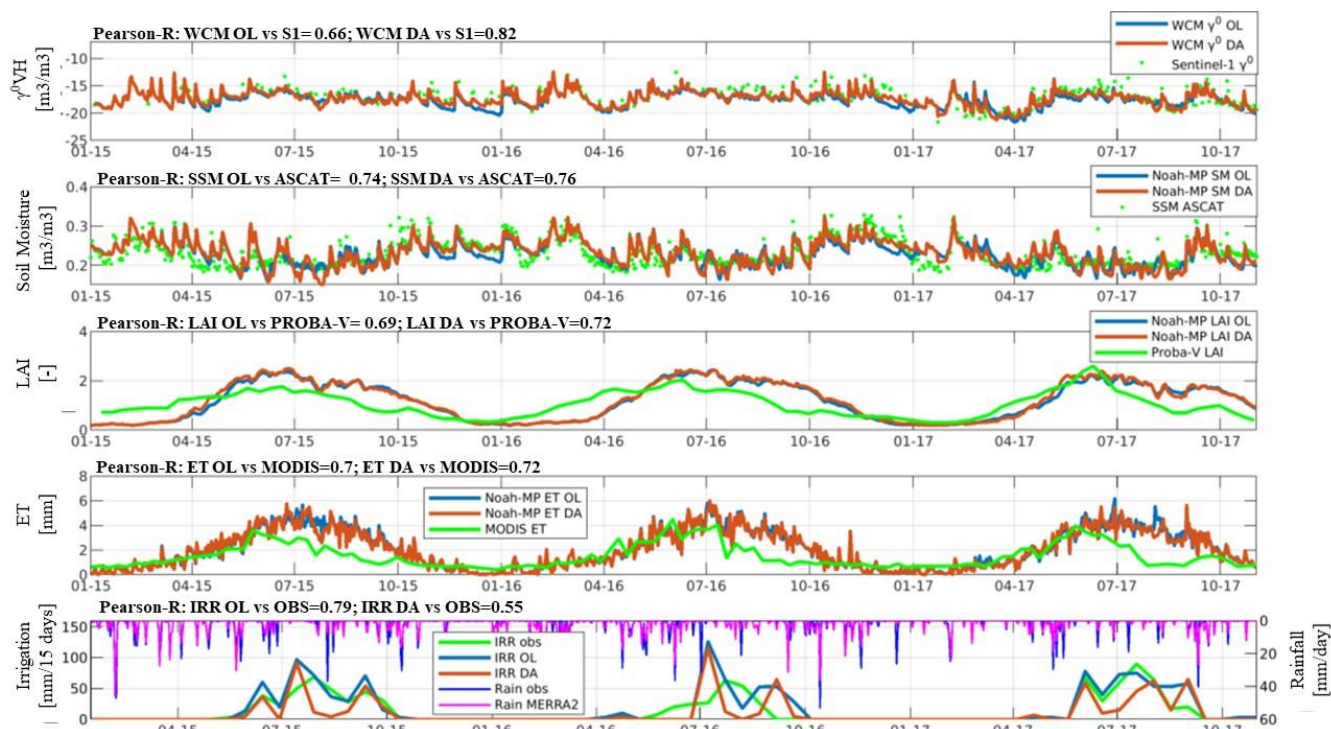


Figure S2: Same as S1, but for the Germany pilot site. In this case d) irrigation fraction map is user-defined.

10 Figure S3: Maps of the number of assimilated Sentinel-1 observations for: Sentinel-1 γ^0 VV DA a) in Italy and b) in Germany; Sentinel-1 γ^0 VH DA c) in Italy and d) in Germany. m is the mean over the entire study area. The reference period is January 2015-December 2020.

15 **Figure S4: Evaluation of the OL (blue lines) and DA (orange lines) runs at the Budrio test site for the Sentinel-1 γ⁰ VH DA experiment: a) Sentinel-1 γ⁰ VH against WCM γ⁰ VH; b) ASCAT SSM against simulated SSM; c) Proba-V LAI against simulated LAI; d) MODIS ET against simulated ET; e) irrigation benchmark against simulated irrigation.**

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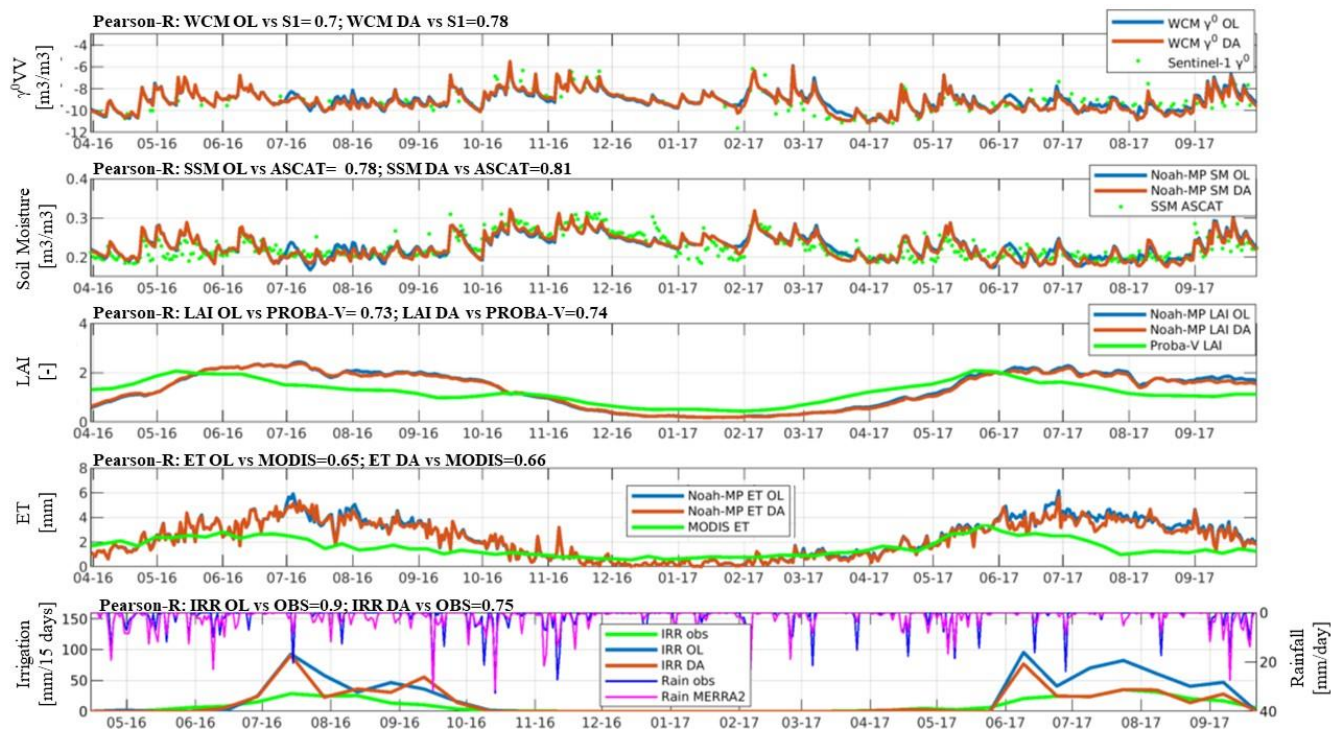
Figure S5: Same as Figure S4, but at the Faenza F1 test site for the Sentinel-1 γ^0 VV DA experiment.

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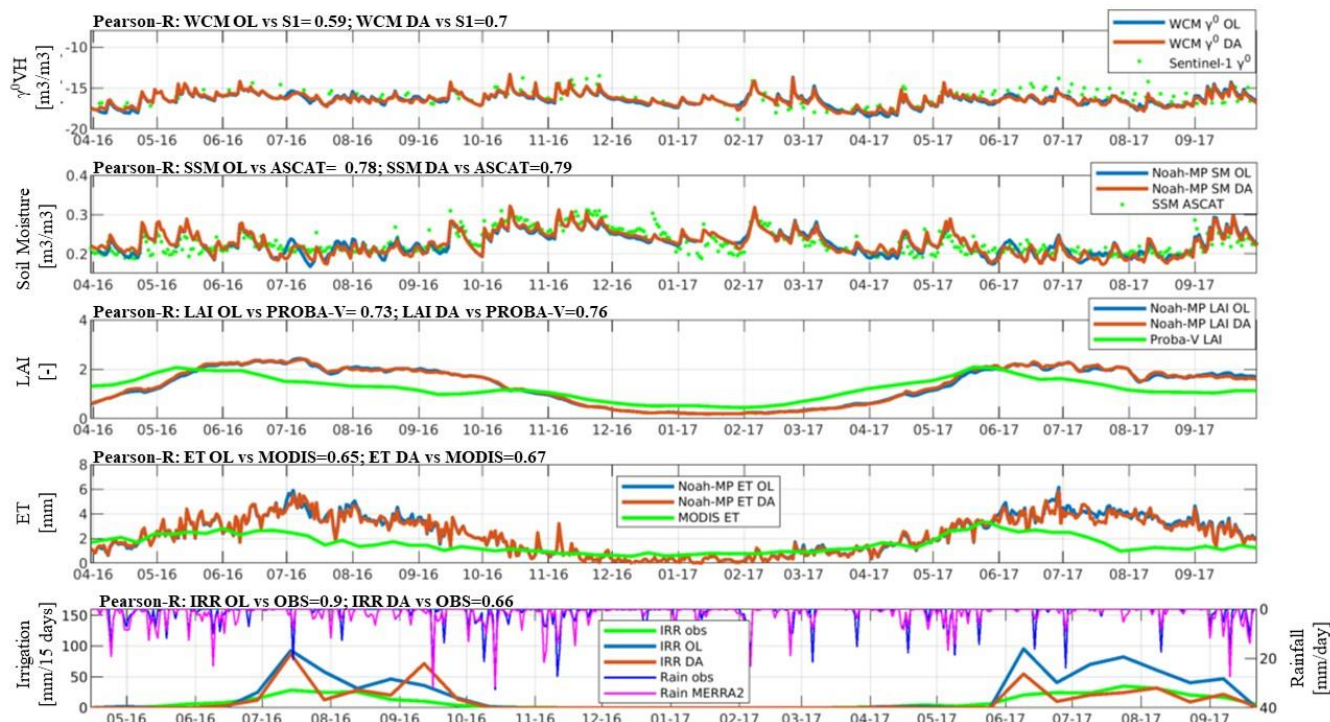
Figure S6: Same as Figure S4, but at the Faenza F1 test site for the Sentinel-1 γ⁰ VH DA experiment