



*Supplement of*

## **Challenges and benefits of quantifying irrigation through the assimilation of Sentinel-1 backscatter observations into Noah-MP**

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## Supplementary Material

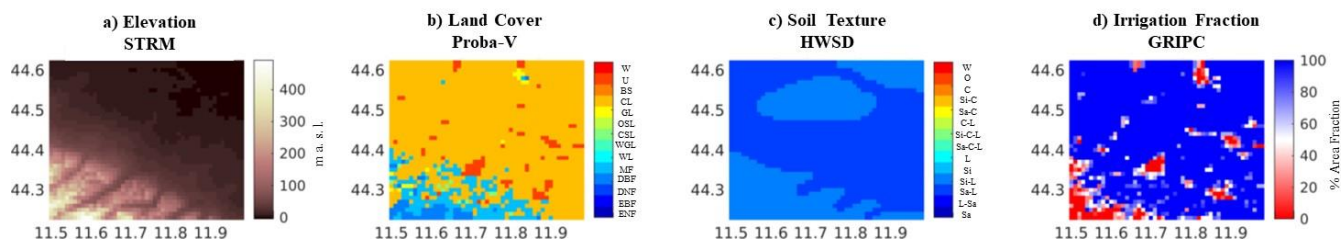


Figure S1: LIS input data over the Italian pilot site: a) elevation from the Shuttle Radar Topography Mission (SRTM); b) Proba-V LC; c) soil texture from the HWSD; and d) irrigation fraction map obtained from the GRIPC map.

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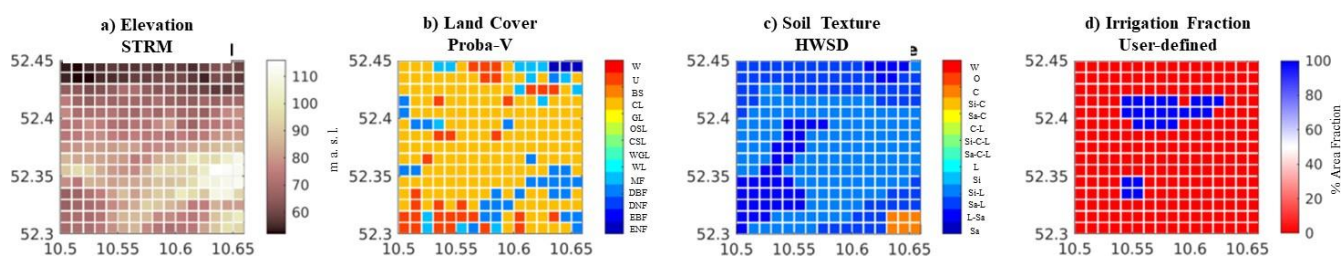
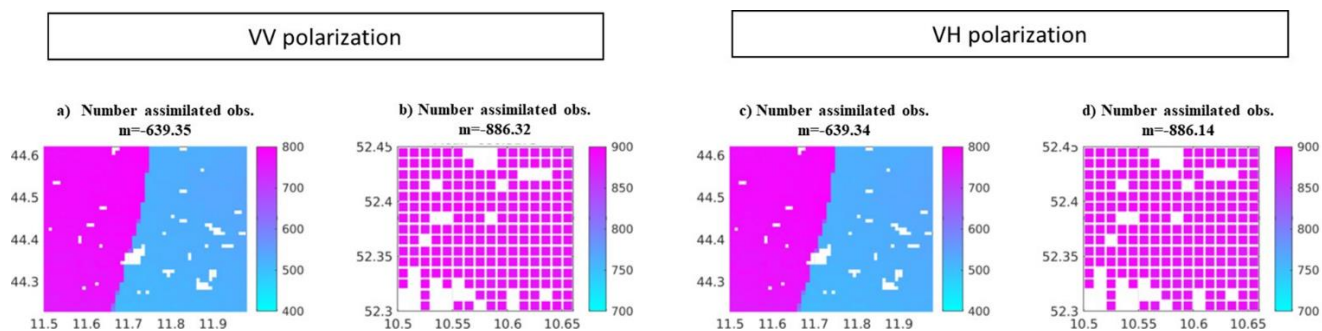
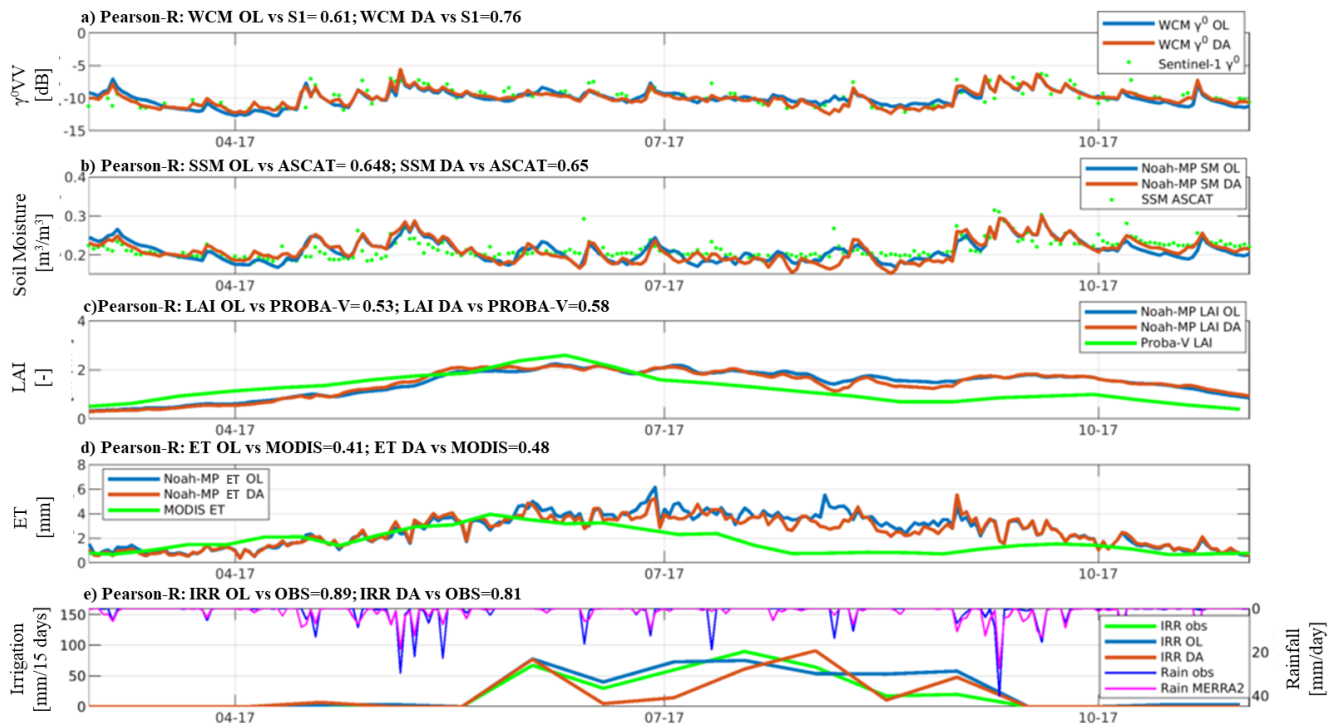


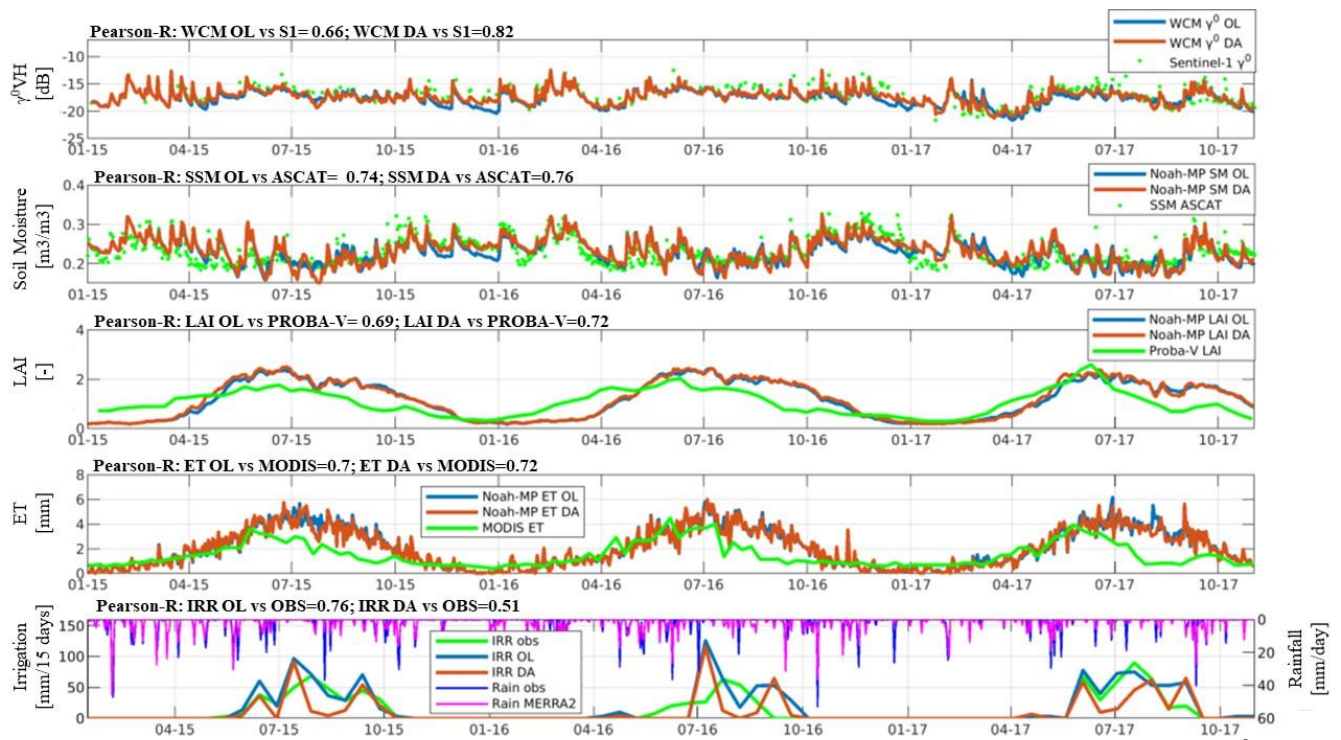
Figure S2: Same as S1, but for the Germany pilot site. In this case d) irrigation fraction map is user-defined.



10 Figure S3: Maps of the number of assimilated Sentinel-1 observations for: Sentinel-1  $\gamma^0$  VV DA a) in Italy and b) in Germany; Sentinel-1  $\gamma^0$  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  $\gamma^0$  VV DA experiment only for the year 2017: a) Sentinel-1  $\gamma^0$  VV against WCM  $\gamma^0$  VV; 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.**



**Figure S5: Evaluation of the OL (blue lines) and DA (orange lines) runs at the Budrio test site for the Sentinel-1  $\gamma^0$  VH DA experiment: a) Sentinel-1  $\gamma^0$  VH against WCM  $\gamma^0$  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.**

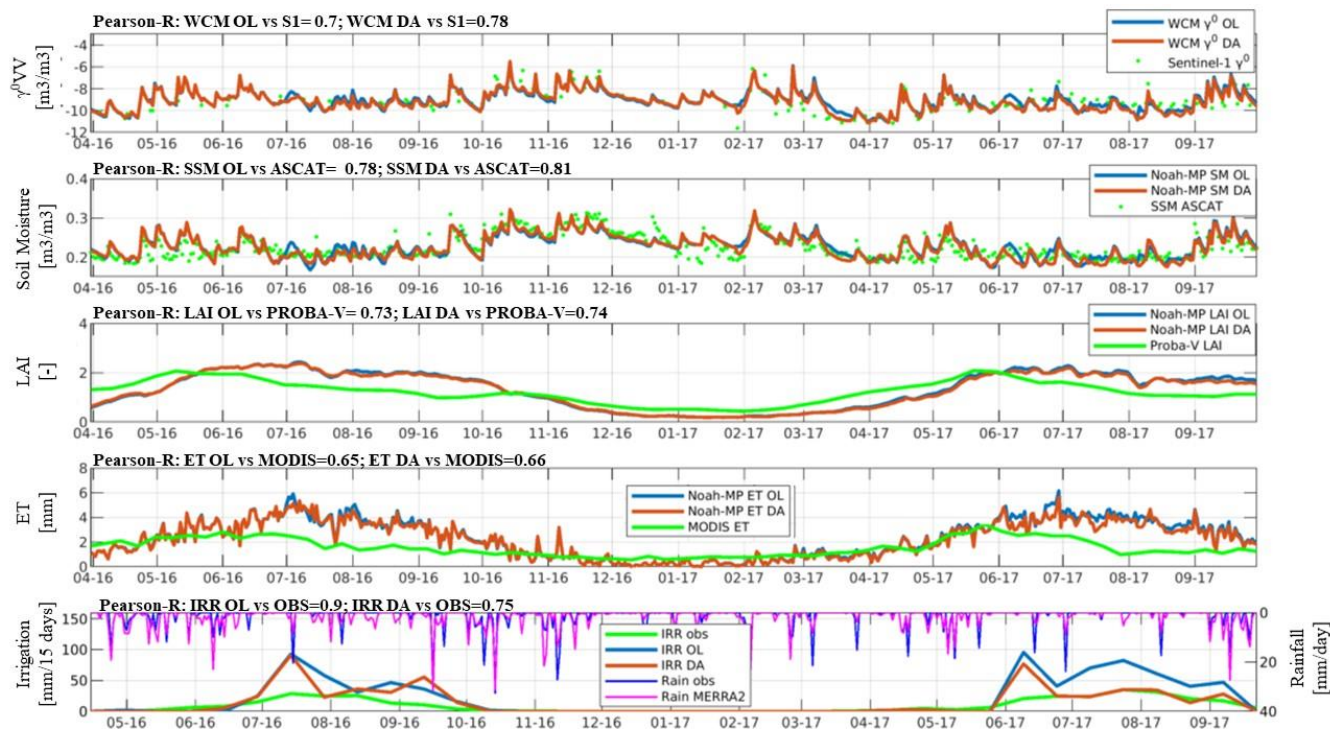


Figure S6: Same as Figure S5, but at the Faenza F1 test site for the Sentinel-1  $\gamma^0$  VV DA experiment.

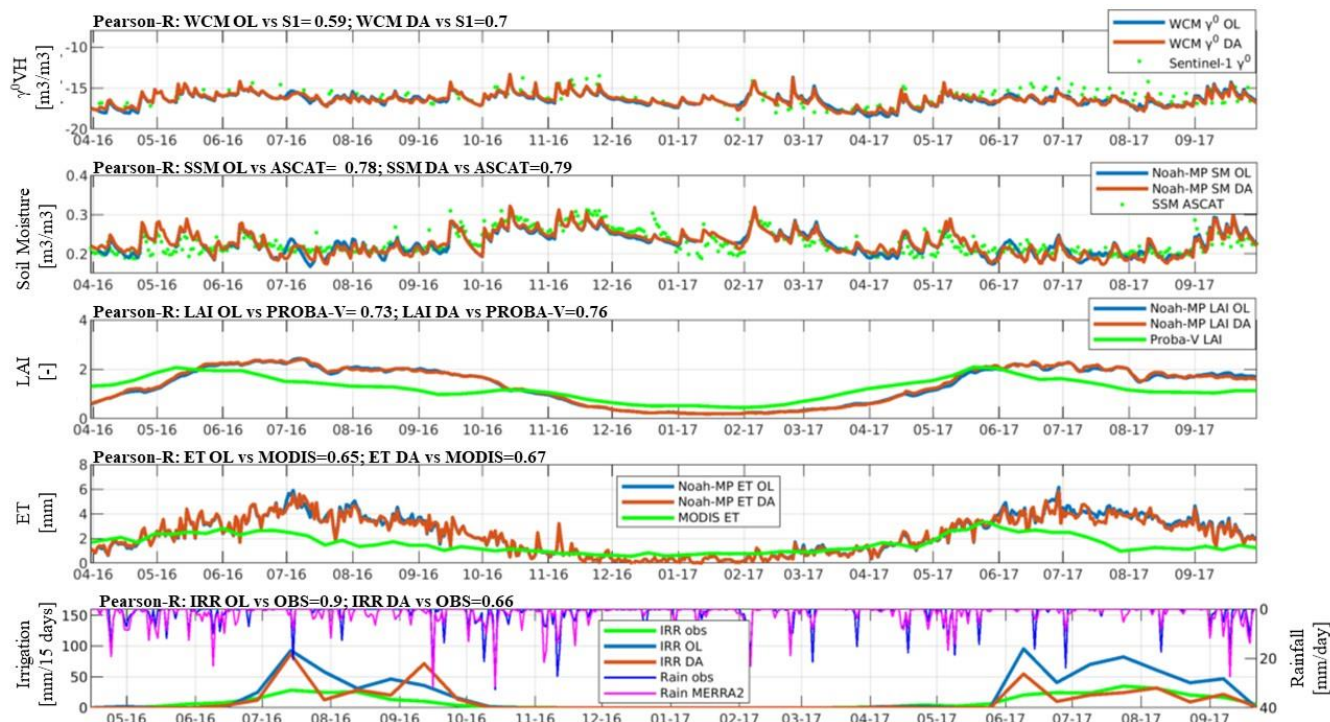


Figure S7: Same as Figure S5, but at the Faenza F1 test site for the Sentinel-1  $\gamma^0$  VH DA experiment