Benefits of Sentinel-1 backscatter assimilation to improve land surface model irrigation estimates in Europe

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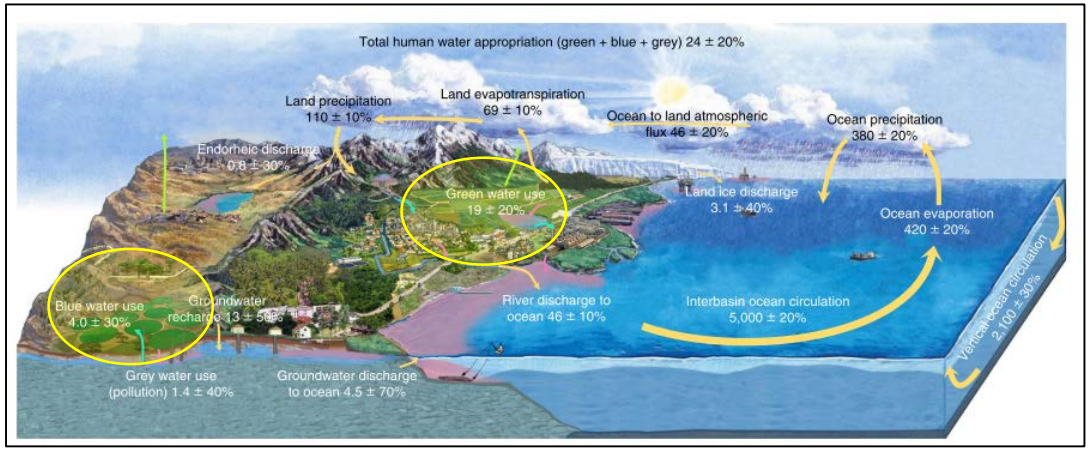
Session HS6.5

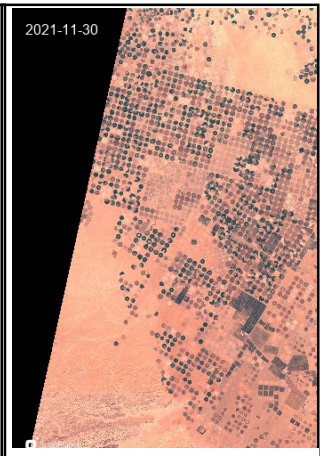
Irrigation Estimates and Management from Remote Sensing and Hydrological Modelling

Introduction: Impacts of irrigation on the water cycle

The water cycle in the Anthropocene following Abbot et al. (2019)
https://www.nature.com/articles/s41561-019-0374-y



Ravenna, Italy (Feb-May 2022)
Sentinel-2



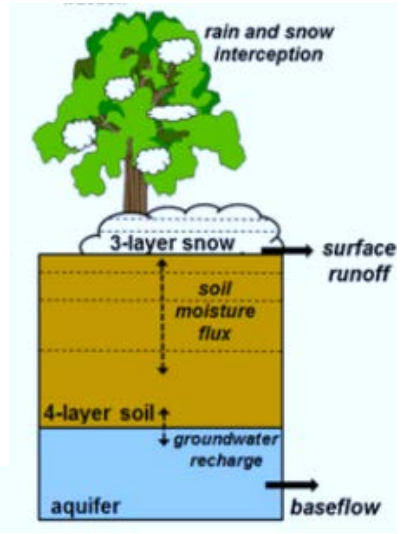
Al Jawf, Saudi Arabia
(Sep 2021 – April 2022)
Sentinel-2

Irrigation is one of the most impactful disturbances in the water cycle.

70% of the global freshwater withdrawn are used for irrigation (FAO,2006)

Key question: Can we quantify irrigation?

LAND SURFACE MODELS (LSM)

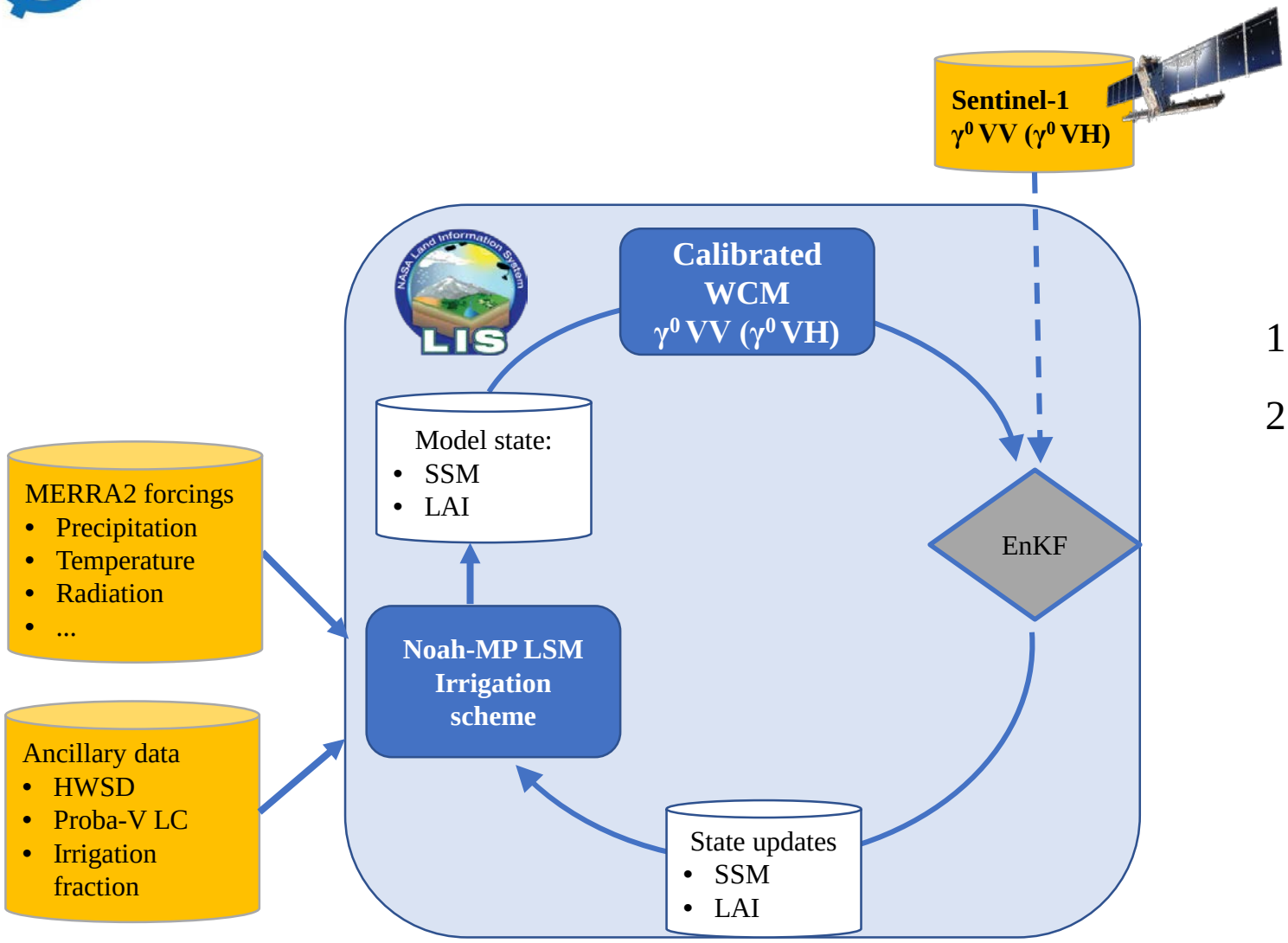


Simplified parameterization.

Irrigation scheme cannot deal with:

- water policies and availabilities;
- farmers' decision.

Sentinel-1 backscatter data assimilation: method



1 km spatial resolution

EXPERIMENTS

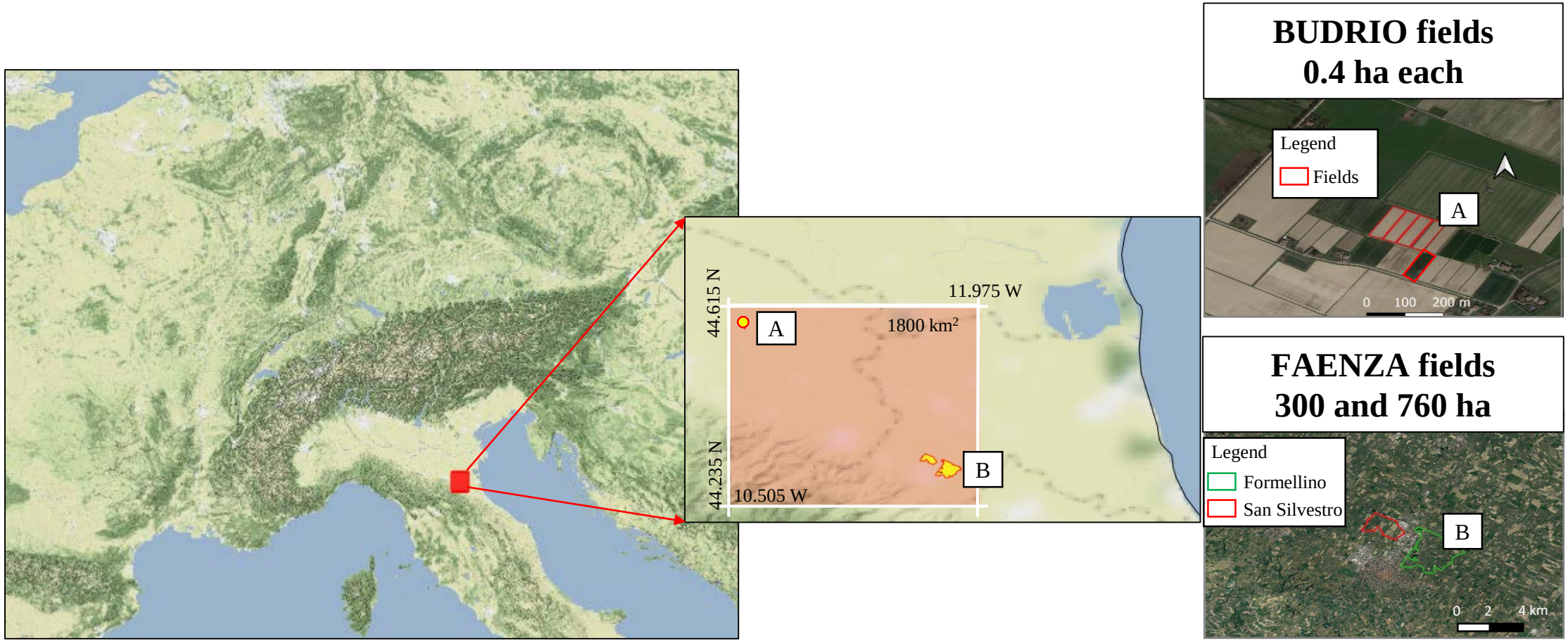
1. Sentinel-1 γ^0VV DA to update SM and LAI;
2. Sentinel-1 γ^0VH DA to update SM and LAI.

$$\widehat{x_i^+} = \widehat{x_i^-} + K_i\left[y_{obs,i} - h_i(\widehat{x_i^-})\right]$$

WCM CALIBRATION:
Modanesi et al. 2021
https://doi.org/10.5194/hess-25-6283-2021

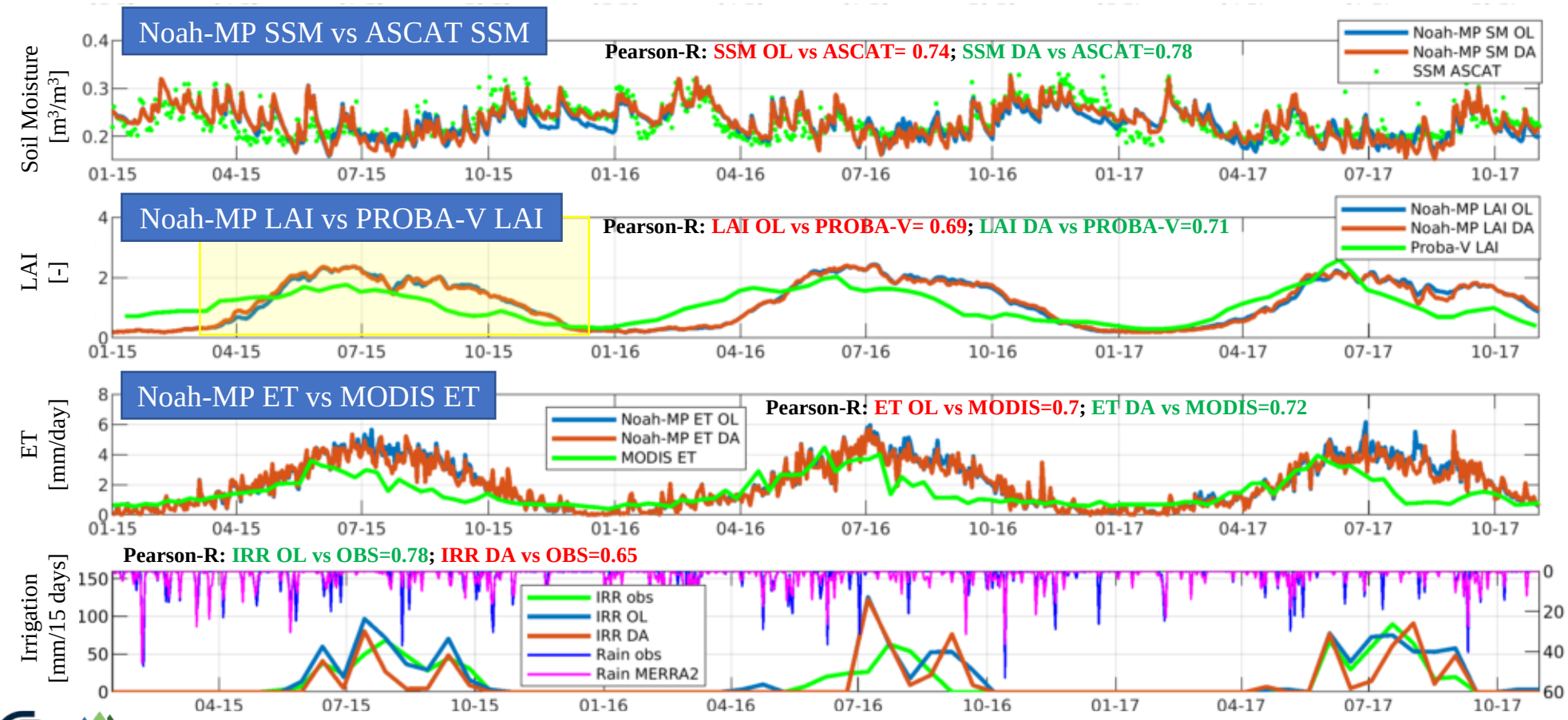
DATA ASSIMILATION:
Modanesi et al. 2022 ***(under review)***
https://doi.org/10.5194/hess-2022-61

Sentinel-1 backscatter data assimilation: study area

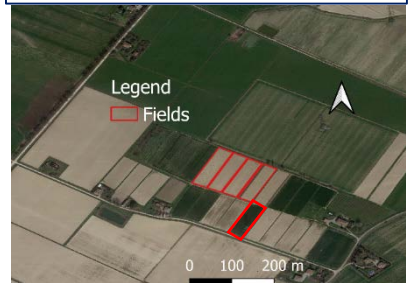


Sentinel-1 backscatter data assimilation: results

Italy: Sentinel-1 γ^0VV updates SSM and LAI



Budrio test site

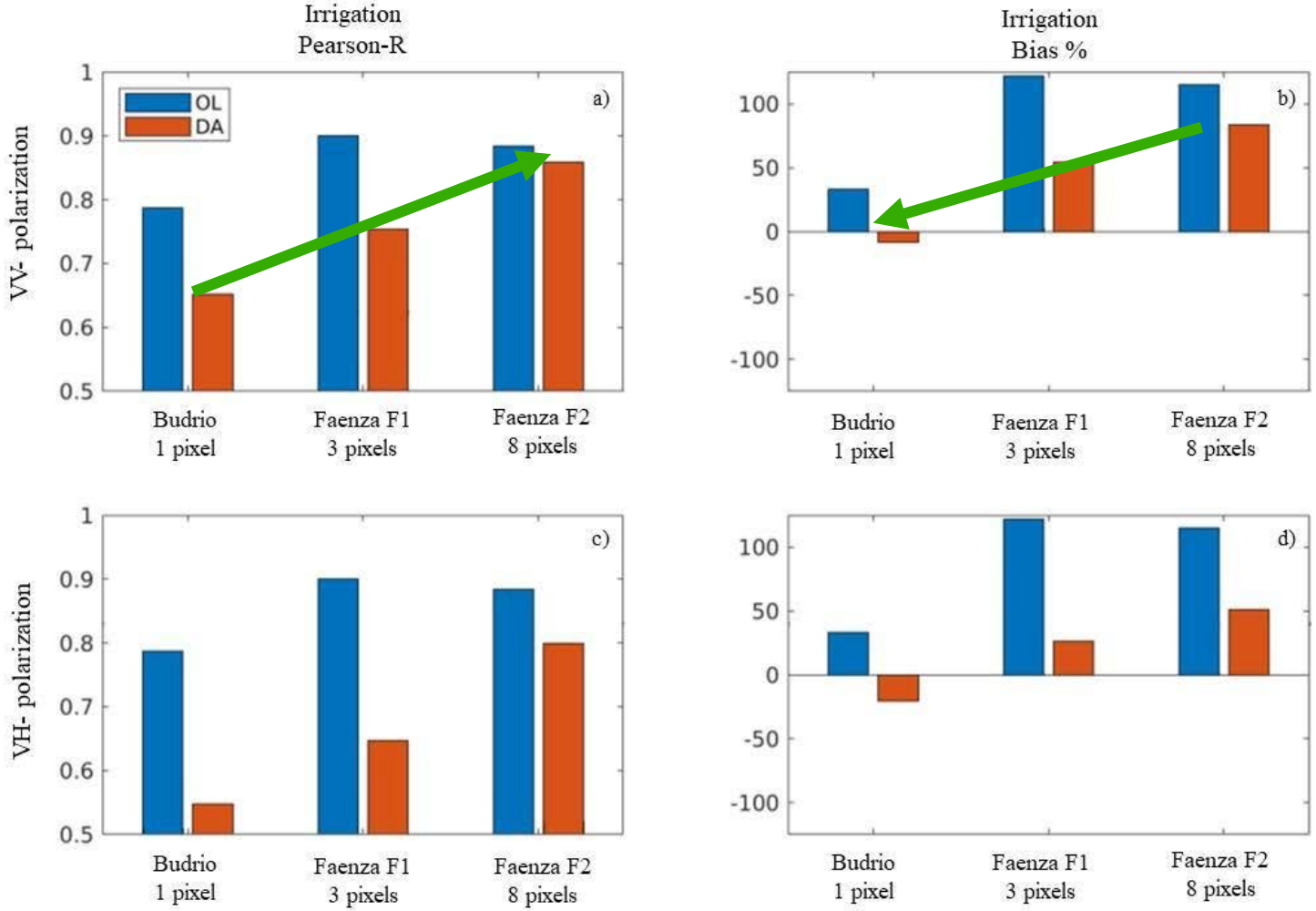


Irrigation data averaged over five fields (0.4 ha each)

AMOUNT OF IRRIGATION
Obs=917.2 mm
OL=1220.1 mm
DA=842.5 mm

Sentinel-1 backscatter data assimilation: results

Italy: Irrigation estimates results



STRENGHTS and LIMITATIONS

Data assimilation:

- Deteriorates Pearson-R;
- **Affected by scale effect** (R-values increase when moving from Budrio to Faenza);
- Reduces bias (especially Sentinel-1 γ^0 VH DA).

FUTURE IMPROVEMENTS

- Calibration of the irrigation scheme;
- Improvements of LSM inputs;
- More sophisticated backscatter operators.

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Thank you for your attention

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