Synergic use of Sentinel-1, Sentinel-2 and PRISMA images to estimate soil moisture: a case study in the Capitanata area, southern Italy

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Motivation

• Why do we use SAR to estimate the SM?

  *Can provide an estimate of SM in any weather and sun-illumination conditions*

• Why do we use the InSAR phase to estimate the SM instead of the RCS?

  *No need to separate the contributions of terrain roughness and SM*
SM has been measured at a depth of 20, 40 and 60 cm with a sampling time of 15 min. In 2022, measurements were collected from May, 19 till Aug, 26.
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Satellite data

All S1-A images acquired in 2022 have been interferometrically processed.

130 interferograms have been generated with temporal baselines of 12, 24, 36, 48 and 60 days.

All interferograms have been corrected for topography and geolocated.
Satellite data

\[ \varphi_{12} = \varphi_{\text{disp}12} + \varphi_{\text{atm}12} - \varphi_{\text{d}12} + \varphi_{n} \]

\[ \varphi_{23} = \varphi_{\text{disp}23} + \varphi_{\text{atm}23} - \varphi_{\text{d}23} + \varphi_{n} \]

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**Methodology**

Closure phases

$$\zeta_{123} = \phi^d_{12} + \phi^d_{23} - \phi^d_{13} + \phi_n$$

- \( N \) = \# SAR images;
- \( M \) = \# interferograms \( \varphi \);
- \( K \) = \# phase triplets \( \zeta \);

\[
\begin{align*}
\frac{N}{2} & \leq M \leq \frac{N \cdot (N - 1)}{2} \\
\frac{N}{3} & \leq K \leq \frac{N \cdot (N - 1) \cdot (N - 2)}{6}
\end{align*}
\]

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Results

Graph 1: Correlation between ΔSM and Decoherence Phase. R = 0.74215

Graph 2: Comparison of InSAR-DecoPhase and Model-Obs. Time from 01/06/2022 to 01/09/2022

Graph 3: Coherence over time. R = 0.73187

Graph 4: Coherence vs. SM.
Take-away message and future work

- The (InSAR) decorrelation phase can provide a further means to estimated the SM

- Need to better understand if the decorrelation phase depends only on the temporal changes of SM or also on the plant evapotranspiration

- How do we compare the InSAR estimates of SM to the in-situ measurements collected at depths of 40 and 60 cm?

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