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InSAR Meteorology: examples and method to quantify the impact of assimilating InSAR maps of PWV in a Numerical Weather Prediction Model

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Abstract:
The processing of SAR images to generate maps of Precipitable Water Vapor (PWV) is becoming a useful tool in the community of atmosphere scientist to study atmospheric physical processes. Of particular interest is the assimilation of PWV maps in high resolution Numerical Weather Prediction (NWP) models. SAR meteorology, based on InSAR PWV maps and their assimilation in NWP models can help to better model phenomena such as deep convection with an impact on the correct forecast of extreme weather events as intense rainfalls. This has a crucial importance also on Civil Protection practices as it is tightly related to the flood and other hydrogeological risks. Sentinel-1 data are particularly suitable for SAR meteorology as its images cover large areas and have a short revisiting time of a few days.
We show the results obtained by assimilating PWV maps generated by Sentinel-1 data in the Weather Research and Forecasting (WRF) model. The enhancements in WRF forecasts is assessed in different ways, e.g. by comparing the PWV estimated numerically by the NWP model with GNSS measurements or the cumulated rainfall provided by the model with in-situ gauge measurements. The assessment is conducted both at the time of assimilation, and in a time window after the assimilation, to study the persistency of information on water vapor introduced by the assimilation of SAR maps. It is shown how the the impact of InSAR PWV maps on the output of NWP models changes depending on the specific atmospheric phenomenon and the NWP initial state. Also, the "memory effect" of the assimilated PWV maps changes from a few hours up to more than six hours. Methods to predict the impact that the assimilation of InSAR PWV maps would have on the output of an NWP are discussed.

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