Geophysical Research Abstracts
Vol. 20, EGU2018-15638, 2018
EGU General Assembly 2018

First example of Sentinel-1 InSAR PWV maps assimilation into a high resolution NWP to improve the forecast of convective system in atmosphere

Giovanni Nico (1), Pedro Mateus (2), Joao Catalao (2), and Pedro Miranda (2)

(1) Consiglio Nazionale delle Ricerche, Istituto per le Applicazioni del Calcolo, Bari, Italy, (2) Instituto Dom Luiz (IDL), Faculdade de Ciências, Universidade de Lisboa, Lisboa, Portugal

We study the impact of assimilating very high-resolution Precipitable Water Vapor (PWV) maps into a non-hydrostatic Numerical Weather Prediction (NWP) model by the three-dimensional variational (3D-var) technique. PWV maps are obtained by processing the Sentinel-1 Synthetic Aperture Radar (SAR), using the SAR interferometry (InSAR) technique. Changes in the 3D distribution of water vapor, temperature and wind are studied to explain the onset of a deep convection phenomenon. Sentinel-1 images are used to build a time series of PWV maps having a spatial resolution up to 25 m and a time sampling of 6 days. We show that a sub-daily time sampling can be attained if data from different SAR platforms and/or orbits are used, or when future geosynchronous SAR satellites will become operational. The Weather Research Forecasting Data Assimilation (WRFDA) model is used to implement the 3D-Var technique. The finer 3-km domain is centered over the area of interest. A two-way nesting procedure was used. The initial and boundary conditions are set using ECMWF forecasting over Europe are available at very high resolution (0.1°). The InSAR PWV map are assimilated only on the fine domain (3-km). A model spin-up for 6h. For the assimilation the model is initiated at the time of SAR acquisitions and run for 12 hours. The background error covariance matrix B was computed by the National Meteorological Centre (NMC) method, for the finer-resolution domain, where the model perturbations were given by the differences between forecasts (e.g., T + 24 minus T + 12) valid at the same time over a period of one month. We discuss the improvement of the InSAR PWV assimilation in terms of model thermodynamics. Changes in the Convective Available Potential Energy (CAPE), Convective Inhibition (CIN) and Severe Weather Threat Index (SWEAT) are evaluated and used to improve the detection of deep convection onset. A thorough statistical analysis is performed comparing the WRF output with the results obtained by assimilating InSAR and GNSS-based PWV measurements. We show that the assimilation of InSAR data provides an improvement in terms of precipitation and forecast skill score. We analyze also the changes in the 3D distribution of hydrometeors that in the case of storms can significantly contribute to the measured PWV. A case study of deep convection which affected the city of Adra, Spain, on 6-7 September 2015 is presented. The advantage and limitations of assimilating InSAR data into the mesoscale model are discussed.

Reference:
P. Mateus, J. Catalão, and G. Nico, “Sentinel-1 Interferometric SAR Mapping of Precipitable Water Vapor Over a Country-Spanning Area”, IEEE Transactions on Geoscience and Remote Sensing, 55(5), 2993–2999, 2017.