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Impact of GPS-Integrated Water Vapour assimilation on Regional Climate Model simulations of heavy precipitation events in the western Mediterranean

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An accurate representation of the devastating heavy precipitation events, that typically strike the western Mediterranean regions by autumn, is still a challenge for current weather prediction models. The misrepresentation of the atmospheric moisture distribution and the convective processes where it plays a role have been pointed out as sources of error in their prediction. Provided the fast variability of water vapour in the atmosphere, an improved representation of its distribution is expected from the Data Assimilation (DA) of very frequent measurements, such is the case of Global Positioning System derived Integrated Water Vapour (GPS-IWV). Moreover, an improved representation of the model physics is expected from the application of the DA on fine-scale model grids.

The presented research work aims at assessing the impact of the selective assimilation of GPS-IWV retrievals on the representation of the atmospheric moisture distribution in relation to heavy precipitation in seasonal simulations over the western Mediterranean.

COSMO simulations in CLimate Mode (CCLM) are run with two different horizontal resolutions (2.8 km and 7 km) to reproduce the period September 2012 to March 2013, encompassing the Special Observation Period 1 (SOP1) of the Hydrological Cycle in the Mediterranean Experiment (HyMeX). A state-of-art GPS-IWV data set, specially homogenized for the western Mediterranean countries spanning the aforementioned seven month period is selectively assimilated into the model runs with a high frequency (10 minutes). The impact of such assimilation combined with the grid refinement of the model is assessed in the representation of the atmospheric moisture distribution and its influence in the processes leading to deep moist convection and heavy rain. Observational data sets of precipitation obtained with the Climate Prediction Centre MORPHing technique (CMORPH), from the HyMeX rain gauge network as well as the GPS-IWV retrievals are employed to validate our model results and support the process studies.
Results show remarkable discrepancies in the representation of the temporal evolution of IWV by CCLM well corrected by the assimilation. This rectification of the amount of water vapour in the atmosphere influences the intensity and location of extreme precipitation, albeit the sign and extent of this influence was shown to be event-dependent.