A Case Study of Weather Radar Data Assimilation into the Harmonie Numerical Weather Prediction System

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Quantitative Precipitation Forecasting (QPF) is among the most central challenges of atmospheric prediction systems. The primary aim of such a task is the generation of accurate estimates of heavy precipitation events associated with severe weather, atmospheric fronts and heavy convective rainfalls. QPF is still among the most intricate challenges of Numerical Weather Prediction. The efforts in this direction are mainly concentrated on improving model formulations for microphysics and convective process and remote sensing data assimilation.

This paper describes the first results with the regional radar signal processing chain that provides the radar data assimilation (RDA) in the Harmonie convection permitting numerical model. This task is performed for a case study focusing on a wintertime frontal cyclone over the island of Cyprus. Reflectivity measurements from two weather radars, at Larnaka and Paphos, are exploited for simulations of severe weather conditions associated with this synoptic-scale system. Through the variational assimilation procedure, the model takes into account the atmospheric processes occurring in the upstream flow which can be outside the area of radar measurements. The focus is on the precipitable water vapor content and its changes during the cyclone evolution, as well as on the impact of the radar data assimilation on precipitation estimates.

The results show that the numerical experiments exhibit, in general, a suitable simulation of precipitable water at different stages of the cyclone. In particular, the bulk of the rainfall volume exhibits three stages: intensive rain on the cyclone’s frontal zone, weaker precipitation immediately behind the front, and the secondary enhancement of rainfall. The largest corrections due to RDA are of up to 5 mm and occur during the approach of the cyclone frontal zone in a form of enhanced rainfall over the whole area, but more prominently in weak precipitation locations.
