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Assimilation of WIVERN Doppler data in WRF model for the case study of Medicane Ianos

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Accurate weather forecasts are important to our daily lives. Wind, cloud and precipitation belong to the fundamental variables in NWP models. The WIVERN (Wind Velocity Radar Nephoscope) mission (Illingworth et al., 2018), for observing global winds, clouds and precipitation, has the opportunity to be the first space-based mission to provide in-cloud winds. It is currently in the phase A of the European Space Agency (ESA) Earth explorer 11 program and, if demonstrated successful, WIVERN data could be beneficial to enhance NWP performance, to improve our knowledge of weather phenomena, and to validate climate statistics.

In this work, we present an assimilation experiment of the WIVERN Doppler (HLoS; Horizontal winds along the Line of Sight) data for the outstanding case of the Medicane Ianos, occurred in mid September 2020.

To this end, we use the following approach: we run the Medicane Ianos with WRF at 4km horizontal resolution using the ECMWF-EPS (European Centre for Medium range Weather Forecast – Ensemble Prediction System) analysis/forecast cycle issued at 12 UTC on 16 September 2020 as initial and boundary conditions. Fifty-one occurrences of the Medicane Ianos (members) are forecast, taking into account for the atmospheric predictability of that day. For all members the trajectory of the Medicane is determined by the minimum surface pressure.

The trajectories are then compared with the reference trajectory determined by the method of Flaounas et al. (2023) that makes use of ERA5 reanalysis and the best member among the 51 WRF simulations is determined. The best member is that minimizing the spatial error compared to the reference trajectory. WIVERN pseudo-observations are then generated for the best member using the Wivern simulator (Battaglia et al., 2022). Pseudo-observations are then assimilated into the WRF model every 3h using the 3DVar scheme of Federico (2013). Results show a positive impact of the data assimilation on the simulation of the Ianos trajectory. The distance between the simulations assimilating HLoS and the best trajectory are more than halved compared to the control forecasts.

Sensitivity tests to the observation error and to the WIVERN revisiting time show that the latter has a much larger impact on the quality of the forecast.

References

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