SPECIAL PROJECT PROGRESS REPORT

All the following mandatory information needs to be provided. The length should *reflect the complexity and duration* of the project.

Reporting year

2019

Project Title:

Investigating the impact of radar data assimilation using 3D-Var, 4D-Var and ensemble Kalman Filter into the high resolution weather forecast

Computer Project Account:

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Principal Investigator(s):

Prof. Rossella Ferretti

Affiliation:

CETEMPS – Department of Physical and Chemical sciences, University of L'Aquila

Name of ECMWF scientist(s) collaborating to the project
(if applicable)

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Start date of the project:

March 19, 2019

Expected end date:

December 31, 2019

Computer resources allocated/used for the current year and the previous one
(if applicable)
Please answer for all project resources

		Previous year		Current year	
		Allocated	Used	Allocated	Used
High Performance Computing Facility	(units)			5000000	341589.53
Data storage capacity	(Gbytes)			20000	101Gbytes

Summary of project objectives (10 lines max)

The impact of assimilation methods (3D-Var, 4D-Var, ENKF) will be evaluated in terms of Short-term Quantitative Precipitation Forecasts (SQPF). In this respect three different approaches will be used: traditional, grid to grid and spatial. The traditional approach compares the observed and forecasted rain at the exact location through several statistical indexes, derived from a contingency table. The other approach compares the rainfall fields using a neighbourhood technique. And lastly, the spatial approach, identifies the spatial patterns (or objects) in observed/predicted precipitation fields and compare them through a number of attributes, e.g. distance between centroid, area of intersection, orientation, that are calculated on the basis of fuzzy logic. The aforementioned statistical analyses will be performed with the Model Evaluation Tools (MET) verification package (Brown et al. 2009), developed by the National Center for Atmospheric Research (NCAR) Developmental Testbed Center (DTC).

Summary of problems encountered (10 lines max)

This was our first time working with ECMWF – HPC, we had problems in compiling WRFV4 model. At the end we succeed in compiling WRFV4 in Cray environment but the model simulation was very slow. We could simulate 10min forecast in 10min wall clock. We were using a heavy configuration: 3 domains from 4.5km to 300m using 476x376 grid points. Hence, we contacted the help desk, Mr Bojan Kasic helped us. He found out that task decomposition does not work properly the WRFV4 ie. cpus are not decomposed through nested domains as with versions 3.9*. Therefore, we switched to Version 3.9.1.1 which indeed worked properly: 1h forecast in 5min wall clock. At this point we proceed to compile WRFDA (3-4DVAR) but we did not yet succeed because of problems with the version of da_radiance.f (WRFDA3.9.1) that is not compatible with the default HDF5 library on CCA[B]. There is a problem with Cray version of cray-hdf5/1.10.2.0 and Bojan is still investigating what it is.

Summary of plans for the continuation of the project (10 lines max)

After compiling the WRFDA we will proceed to the radar data assimilation on the high-resolution domain (1km). The results will be compared against the Data Assimilation Research Testbed (DART) toolkit to assimilate conventional observations for several days prior to the event to better represent the mesoscale background environment. Comparisons will be made between the initial conditions generated using a continuously cycled DART analysis versus those drawn from ECMWF data analysis. Thereafter, tests with and without Doppler radar assimilation over a short window (~1 hour) will determine the impact of radar observations in a DART assimilation framework for two cases of a heavy rainfall event in Italy. Comparisons between forecasts with 3D-Var, 4D-Var and DART generated initial conditions, and with and without radar observations, will be made to better understand the predictability of extreme rainfall events with varying observations and assimilation methods.

List of publications/reports from the project with complete references

There are not yet publications but an oral presentation:

▪ Capozzi, V., Mazzarella, V., Maiello, I., Cotroneo, Y., Ferretti, R., Miglietta, M.M., Budillon, G.: Observation and simulation of a tornadic supercell over the plain of Caserta (Southern Italy) using X-band weather radar and WRF model in LES mode, EMS Annual Meeting, 2019.

Summary of results

- WRFV3.9.1.1 compilation, after discovering that the task decomposition does not work properly for WRFV4
- 2 model simulations using a very high-resolution configuration (3oom) for testing the model performance. The results of the simulations are under evaluation to verify the ability to correctly reproduce a tornadic event occurred on March 11-13, 2018 in south Italy
- Attempt to compile WRFDA not yet done because of a problem with Cray version of cray-hdf5/1.10.2.0