

REQUEST FOR A SPECIAL PROJECT 2012–2014

MEMBER STATE: Italy

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Project Title: Experimentation of different strategies to generate a limited-area ensemble system over the Mediterranean region

If this is a continuation of an existing project, please state the computer project account assigned previously.	SP _____
Starting year: <small>(Each project will have a well defined duration, up to a maximum of 3 years, agreed at the beginning of the project.)</small>	2012
Would you accept support for 1 year only, if necessary?	YES <input type="checkbox"/> NO <input checked="" type="checkbox"/>

Computer resources required for 2012-2014: <small>(The maximum project duration is 3 years, therefore a continuation project cannot request resources for 2014.)</small>	2012	2013	2014
High Performance Computing Facility (units)	1.000.000	1.200.000	1.200.000
Data storage capacity (total archive volume) (gigabytes)	90	110	120

An electronic copy of this form **must be sent** via e-mail to: *special_projects@ecmwf.int*

Electronic copy of the form sent on (please specify date): 11 May 2011

Continue overleaf

¹ The Principal Investigator will act as contact person for this Special Project and, in particular, will be asked to register the project, provide an annual progress report of the project's activities, etc.

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Extended abstract

It is expected that Special Projects requesting large amounts of computing resources (500,000 SBU or more) should provide a more detailed abstract/project description (3-5 pages) including a scientific plan, a justification of the computer resources requested and the technical characteristics of the code to be used. The Scientific Advisory Committee and the Technical Advisory Committee review the scientific and technical aspects of each Special Project application. The review process takes into account the resources available, the quality of the scientific and technical proposals, the use of ECMWF software and data infrastructure, and their relevance to ECMWF's objectives. - Descriptions of all accepted projects will be published on the ECMWF website.

This special project aims at the development of a number of limited-area ensemble initiatives carried out jointly by ARPA-SIMC and CNMCA. The main activities within this project will include the following:

- (1) generation of an "Italian-targeted" limited-area ensemble system with these characteristics:
 - a) initial conditions of the ensemble members: generated starting from the CNMCA-developed LETKF (Bonavita et al., 2008 and 2010);
 - b) boundary conditions of the ensemble members: interpolated from the deterministic IFS run and/or some selected ECMWF EPS members;
 - c) ensemble size: up to 40 members;
 - d) forecast range: 48 hours;
 - e) grid length: 7 km with 40 model levels;
 - f) domain: Mediterranean region.

The main features of this new ensemble will be explored and compared to that of COSMO-LEPS and COSMO-SREPS, in order to assess its added value of this system for the short-range prediction of high-impact weather. The possibility of a dynamical downscaling to 2.8 km will be also explored.

- (2) COSMO-LEPS time-critical application will be downscaled up to 2.8 km of horizontal resolution for a number of high-impact weather events recently occurred over Italy. The attention will be focussed on the probabilistic prediction of heavy precipitation with particular care to the timing and intensity of the predicted rainfall features. The added value of enhanced resolution will be assessed comparing the skill in the short-range of this system with both COSMO-LEPS and the ensemble system developed in (1).

For both activities, the implementation of a full post-processing application to generate output fields (including probabilities) encoded in both GRIB1 and GRIB2 format will be also implemented. A number of migration tests from one format to the other will be performed to assess the flexibility of the application.

In all initiatives, the following F90 codes will be used:

- "int2lm_f90", an interpolation program which performs the interpolation from coarse grid model data to COSMO initial and/or boundary data. The following coarse grid models are possible (at the moment): GME (the global German grid point model on a icosahedral grid), IFS (the global ECMWF spectral model), GFS (global US model), UM (UK Met Office Unified Model) and COSMO (when the COSMO model is nested into itself);
- "cosmo", the code performing the actual numerical weather prediction with the nonhydrostatic limited-area atmospheric prediction model COSMO. This code has been designed for both operational forecasts and various scientific applications on the meso-beta (from 5 to 50 km) and meso-gamma (from 500 m to 5 km) scale. COSMO model is based on the primitive thermo-hydrodynamical equations describing compressible flow in a moist

atmosphere. The model equations are formulated in rotated geographical coordinates and a generalized terrain following height coordinate. A variety of physical processes are taken into account by parameterisation schemes.

Since the very beginning of the code development, both “int2lm” and “cosmo” have been parallelised using the MPI library for message passing on distributed memory machines. With regard to the more demanding code “cosmo”, it has to be underlined that this code is portable and can run on any parallel machine providing MPI. At the moment, “cosmo” is implemented for both operational and research use on several platforms, including IBM SP pwr6 (the ECMWF machine where the COSMO-LEPS time-critical application runs, using 6 nodes for a total of 384 tasks), NEC SX8 and INTEL/AMD Linux clusters.

References

- Bonavita M., Torrisi L., Marcucci F., 2008. The ensemble Kalman filter in an operational regional NWP system: preliminary results with real observations. *Q. R. Meteorol. Soc.*, **134**, 1733-1744.
- Bonavita M., Torrisi L., Marcucci F., 2010. Ensemble data assimilation with the CNMCA regional forecasting system. *Q. R. Meteorol. Soc.*, **136**, 132-145.
- Montani A., Cesari D., Marsigli C., Paccagnella T., 2011. Seven years of activity in the field of mesoscale ensemble forecasting by the COSMO-LEPS system: main achievements and open challenges. *Tellus*, **63A**, 605-624.