REQUEST FOR A SPECIAL PROJECT 2019–2021

MEMBER STATE: Italy

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Project Title: Improvement of a convection-permitting Ensemble Prediction System over Italy

If this is a continuation of an existing project, please state the computer project account assigned previously.	**SP** ITEPS	
Starting year: (A project can have a duration of up to 3 years, agreed at the beginning of the project.)	2019	
Would you accept support for 1 year only, if necessary?	YES X ☐	NO ☐

Computer resources required for 2019-2021: (To make changes to an existing project please submit an amended version of the original form.)		**2019**	**2020**	**2021**
High Performance Computing Facility	(SBU)	9500000	9500000	9500000
Accumulated data storage (total archive volume)[2]	(GB)	5000	6000	7000

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 annual progress reports of the project's activities, etc.
[2] If e.g. you archive x GB in year one and y GB in year two and don't delete anything you need to request x + y GB for the second project year etc.

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Extended abstract

The completed form should be submitted/uploaded at https://www.ecmwf.int/en/research/special-projects/special-project-application/special-project-request-submission.

All Special Project requests should provide an abstract/project description including a scientific plan, a justification of the computer resources requested and the technical characteristics of the code to be used.

Following submission by the relevant Member State the Special Project requests will be published on the ECMWF website and evaluated by ECMWF as well as the Scientific and Technical Advisory Committees. The evaluation of the requests is based on the following criteria: Relevance to ECMWF's objectives, scientific and technical quality, disciplinary relevance, and justification of the resources requested. Previous Special Project reports and the use of ECMWF software and data infrastructure will also be considered in the evaluation process.

Requests asking for 1,000,000 SBUs or more should be more detailed (3-5 pages). Large requests asking for 10,000,000 SBUs or more will receive a detailed review by members of the Scientific Advisory Committee.

The development of convection-permitting ensemble prediction capabilities is crucial for forecasting a range of weather phenomena and in particular to improve severe weather prediction. The Italian Air Force Met Service (ITAF-MS) over the last year invested a lot of resources on the improvement of its high-resolution short-range NWP system and on the development of a new set of tools for probabilistic forecast to support aeronautical activities. In fact the ITAF-MS, together with the Spanish weather Agency (AEMET) and the Arpae-SIMC Emilia-Romagna, coordinates the EUMETNET SRNWP-EPS Phase II (EPS-II) Project, initiated in July 2015 with the aim to contribute to build very high-resolution ensemble systems in Europe resolving the convection-permitting scale phenomena. In particular COMET, the Operational Centre for Meteorology of ITAF-MS, supervised one of the two application packages, funded by the project, for the development of new products for probabilistic prediction of fog and thunderstorms.

The goal of this study is to improve the convection permitting ensemble prediction system COSMO-IT EPS, over the Italian domain, based on the Ensemble Kalman Filter (EnKF) approach for the data assimilation component (estimation of the initial conditions) and the COSMO regional model (www.cosmo-model.org) for the prognostic one. The outputs of this system could then be used to generate new probabilistic products for aeronautical support, taking advantage also of the developed tools for fog and thunderstorm prediction developed in the framework of the EPS-II Project.

In the COSMO Consortium (www.cosmo-model.org) a LETKF (Local Ensemble Transform Kalman Filter) scheme for providing COSMO model analyses at the km-scale (KENDA system [Schraff C. Et al., 2016] has been developed. This system should be used in the project to provide ICs for the convection permitting ensemble. BCs condition will be instead provided by the atmospheric short-range ensemble prediction system (COSMO-ME EPS), operational since July 2014, based on the Ensemble Kalman Filter (EnKF) approach (COMET-LETKF, Bonavita, Torrisi and Marcucci, 2008, 2010) for the data assimilation component and the COSMO regional model integrated over the Mediterranean-European region for the prognostic one. Together with this configuration also BCs from ECMWF-EPS forecast will be evaluated.

A further work of tuning and calibration of the developed ensemble is planned in order to provide to our forecasters the best possible support for specific operational applications.

Planned activities for next year include following topics:

- test the KENDA code for the data assimilation with the COSMO model at 2.2km with a 20 members ensemble, 3hour data assimilation cycle and BCs from operational COSMO-ME EPS;
- Evaluation of performances with respect to the operational configuration of COSMO-IT (initialization by nudging) using the single precision version of COSMO model;
- test the sensitivity of the system using different parameterizations of the shallow convection in COSMO model (Tiedtke versus Becthold scheme);
- Implementation of convective permitting ensemble with BCs from most recent ECMWF-EPS run and evaluation of performances with respect to the configuration with BCs from COSMO-ME EPS;
- Definition of new products together with the standard ones (EPSgrams, probability maps, etc.).

Definition includes the development of the methodologies to compute/elaborate the products, e.g.:

- Production of post-processed products for fog and thunderstorm forecast (code developed in the framework of the EPS-II project) and evaluation of the their quality;
- Development of new post-processed parameters (aviation);
- Combination with other modelling products;
- Tools to combine elementary products for end users.

Both COSMO, KENDA-LETKF and other utilities are written in f90 and make use of GRIB and BUFR data input.

The computer resources will be used mainly for running the KENDA-LETKF analysis with a 3-h data assimilation cycle and the COSMO-IT model in ensemble mode.
COSMO-IT EPS forecasting system should be tested up to T+48h forecast which makes the use of computer resources substantial. As example a test run of 48h forecast with 20+1 ensemble members at 2.2 km resolution and 65 vertical levels initialized with the KENDA-LETKF analysis, required about 450000 SBU.

ECMWF GRIB and BUFR utilities will be necessary.
The data obtained from the experiments will be stored in the ECFS system.

The relevance of this project to ECMWF's objective resides mainly in assessing the possibility to use, without loss of quality, the ECMWF-EPS fields (also from the optional BC project), interpolated at high resolution, to drive a regional system instead of using BCs from a LAM EPS.
Furthermore, the shallow version of the Bechtold convection scheme used in the IFS model will be tested in COSMO model. The comparison results using double wrt single precision numerical model should be useful for any center running convection permitting ensemble.

References

C. Schraff H. Reich A. Rhodin A. Schomburg K. Stephan A. Periáñez R. Potthast (2016), Kilometre-scale ensemble data assimilation for the COSMO model (KENDA)
https://doi.org/10.1002/qj.2748