REQUEST FOR A SPECIAL PROJECT 2015–2017

MEMBER STATE: Italy

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Project Title:

Short-Range Ensemble Prediction System

If this is a continuation of an existing project, please state the computer project account assigned previously.	**SP** ITLEKF	
Starting year: (Each project will have a well defined duration, up to a maximum of 3 years, agreed at the beginning of the project.)	2015	
Would you accept support for 1 year only, if necessary?	YES X☐	NO ☐

Computer resources required for 2015-2017: (The maximum project duration is 3 years, therefore a continuation project cannot request resources for 2017.)	**2015**	**2016**	**2017**
High Performance Computing Facility (units)	6000000	8000000	9000000
Data storage capacity (total archive volume) (gigabytes)	1000	1500	2000

*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):

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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.

Over the past two decades, weather forecasting has experienced a paradigm shift towards probabilistic forecasts, which take the form of probability distributions over future weather quantities and events. Ensemble forecasts allow for optimal decision making for many purposes, including aviation, civil protection and energy market.

A probabilistic approach is appropriate for strategic planning horizons, for which deterministic weather forecasts are significantly less accurate and an ensemble of forecasts may provide guidance about the weather (and impact) uncertainty

At moment the operationally provided weather products are deterministic in the sense that, while significant errors associated with these products are widely acknowledged, no quantitative information on their magnitude is available.
Forecasters would be better able to make informed decisions if they knew not only the best phenomena/parameter estimate but also the associated uncertainty and/or range that most likely includes the actual value that occurred. The Italian National Met Service intends to address this shortcoming of the existing products for high-resolution short-range forecasts by preparing a comprehensive plan for development of a new set of tools for the probabilistic forecast.

The goal of this study is to improve the existing short-range ensemble prediction system based on the Ensemble Kalman Filter (EnKF) approach (CNMCA-LETKF, Bonavita, Torrisi and Marcucci, 2008, 2010) for the data assimilation component (estimation of the initial conditions) and the COSMO regional model (www.cosmo-model.org) for the prognostic one.

The CNMCA-LETKF data assimilation system is operationally used since june 2011 to initialize the high-resolution non-hydrostatic model COSMO integrated over the Mediterranean-European region (called COSMO-ME, Fig.1). The atmospheric short-range ensemble prediction system (COSMO-ME EPS) based on the LETKF system and the COSMO model is under testing at CNMCA since july 2013.

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

Planned activities for next year include following topics:

- Treatment of model error (investigation of alternative techniques such as stochastic physics perturbation tendencies)
- Implementation of a specific verification tool oriented to a quantification of the uncertainty associated with products to be given as additional information for decision making
- Calibration of probabilistic outputs
- Definition of new products together with the standard one (EPSgrams, probability maps,…)

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

- Development of post-processed parameters (aviation, civil protection,…)
- Combination with other modelling products
- Downscaling
- Tools to combine elementary products for end users

Use of the requested computer resources

The computer resources will be used mainly for running the CNMCA-LETKF analysis with a 6-h data assimilation cycle and the COSMO-ME model in ensemble mode.
COSMO-ME EPS forecasting system should be tested up to 72h forecast with different configurations of model error representation, which makes the use of computer resources substantial. As example a test run of 72h forecast with 50 ensemble members at 7 km resolution and 45 vertical levels initialized with the operational CNMCA-LETKF analysis, required about 140000 BU.

Use of ECMWF software and data infrastructure

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

Technical characteristics of the code to be used

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

Relevance to ECMWF's objectives

The relevance to ECMWF's objective resides mainly in assessing the usefulness of ECMWF-EPS boundaries up to 72 hours forecast lead time to drive a regional system.
Furthermore different methods of model error representation (inflation techniques and stochastic physics approach) will be tested, results should be useful for any center running an EnDA system.