LATE REQUEST FOR A SPECIAL PROJECT 2018–2020

MEMBER STATE: Italy

Principal Investigator[1]: Massimo Milelli (mcy)

Affiliation: Arpa Piemonte

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Other researchers:

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Project Title:

Very high resolution simulations of past flood events with COSMO model and ERA5

If this is a continuation of an existing project, please state the computer project account assigned previously.	**SP** _____	
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 ☒	NO ☐

Computer resources required for the years: (To make changes to an existing project please submit an amended version of the original form.)		**2018**	**2019**	**2020**
High Performance Computing Facility	(SBU)	x	500000	x
Accumulated data storage (total archive volume)[2]	(GB)	x	600	x

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.

[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.

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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.

Requests asking for 1,000,000 SBUs or more should be more detailed (3-5 pages).

Following submission by the relevant Member State the Special Project requests the evaluation will be 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.

All accepted project requests will be published on the ECMWF website.

Motivation and work plan

In November 1994, a great flood affected Piemonte region causing about 70 casualties and damages all over the region. This year, for the 25th anniversary, there will be a workshop involving the local authorities, the National Civil Protection, the National Research Centre and the local weather service (Arpa Piemonte).
In this framework, the aim is to assess the progresses achieved in 25 years of operational meteorology, both from the numerical modelling and the procedural point of view.
In particular Arpa Piemonte will run the operational model COSMO (www.cosmo-model.org) at very high horizontal resolution (about 1 km), using the initial and boundary conditions given by ERA5 project. The runs in analysis mode will generate a proxy for the observed variables (mainly precipitation) because the observation network was poor in 1994. The runs in forecast mode (operational setup, CTRL run) will show the changes due to the improvement of the operational models. Moreover it could be interesting to perform extra runs with other set-ups, for instance:

- tests with the Bechtold convection scheme (the default in the Cosmo model is Tiedtke);
- test to define the best nested domain in terms of grid points;
- test to determine the best configuration (IFS@9km → Cosmo@1km or IFS@9km → Cosmo@5km → Cosmo@1km).

Computer resources

Although the runs will be deterministic (no use of the EPS is foreseen), the enhanced horizontal resolution will require a relatively large number of Billing Units (hereafter BUs) and of storage capacity. Also in consideration of the different set-ups that will be tested. Therefore an overall cost of about 500000 BUs is envisaged. Eventually, depending on the results, the set-ups of the system could be partly modified and it might be possible to have other simulations.

Technical characteristics of the codes

In the framework of this special project, the following F90 codes will be used:

- INT2LM, 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): ICON (the global German grid point model), 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 non-hydrostatic limited-area atmospheric prediction model. 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 1 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 parametrisation schemes.

Since the very beginning of the code development, both software have been parallelised using the MPI library for message passing on distributed memory machines. It has to be underlined that these codes are portable and can run on any parallel machine providing MPI. At the moment, they are implemented for both operational and research use on several platforms, including Cray XC40 clusters, NEC SX8, INTEL/AMD Linux clusters.