

LATE REQUEST FOR A SPECIAL PROJECT 2017–2019

MEMBER STATE:ITALY.....

This form needs to be submitted via the relevant National Meteorological Service.

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Project Title: SPHERA – PRE (Special Project: High rEsolution ReAnalysis over Italy – PREliminary study)

If this is a continuation of an existing project, please state the computer project account assigned previously.	SP _____	
Starting year: <small>(A project can have a duration of up to 3 years, agreed at the beginning of the project.)</small>	2017	
Would you accept support for 1 year only, if necessary?	YES <input checked="" type="checkbox"/>	NO <input type="checkbox"/>

Computer resources required for 2017-2019: <small>(To make changes to an existing project please submit an amended version of the original form.)</small>	2017	2018	2019
High Performance Computing Facility (SBU)	3.200.000	x	x
Accumulated data storage (total archive volume) ² (GB)	4.015	x	x

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):
30-06-2017

Continue overleaf

¹The 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 developing interest of EU Community towards high resolution regional reanalysis is well expressed by the number of ongoing projects in this field: the recent call of Copernicus C3S_322 Regional Climate Reanalysis, the Framework Programme 7 projects UERRA (Uncertainties in Ensembles of Regional Reanalysis) and EURO4M (European Reanalysis and Observation for Monitoring).

In this framework, ARPAE-SIMC proposes the development of a high resolution atmospheric regional reanalysis over Italy, SPHERA, performed with the COSMO non-hydrostatic Limited Area Model. COSMO is developed in the framework of the COSMO (CONsortium for Small scale MOdelling, Schättler et al., 2011) consortium cooperation. It is used in the operational NWP suites in Italy, as well as in several other ECMWF Member States (Switzerland, Germany, Greece) and Co-operating States (Romania, Israel).

SPHERA will be performed by means of a dynamical downscaling of the COSMO-REA6 reanalysis (Bollmeyer et al., 2015) and by employing observational nudging during the model integration. SPHERA will cover 25 years and will produce three-dimensional hourly model output. COSMO-REA6 is a 6 km-resolution reanalysis covering the CORDEX European domain, driven by ERA-interim, whose development is currently on going thanks to a cooperation between the DWD, Deutscher Wetterdienst, the University of Bonn and Cologne within the Hans Ertel Center for Weather Research. Our effort will complement, even with some implementation differences, what is under development in Germany in the convection permitting reanalysis project COSMO-REA2 (Wahl et al., 2017).

The SPHERA reanalysis aims at:

- having a high resolution, space and time consistent, description of the past decades climate characteristics in term of some Essential Climate Variables (ECV, Bojinsky et al., 2004) over Italy and its surrounding Seas;
- evaluating the trends of these ECVs during the last decades also in connection to high impact severe weather event occurrences;
- providing accurate and long-term estimate of the atmosphere state on specific sites for specific purposes (e.g. for renewable energy or tracer dispersion applications);
- having a COSMO reference climate for COSMO applications in different scenarios associated to Climate Change over Italy;
- providing the atmospheric and surface boundary conditions to high-resolution model applications, e.g. sea state and ocean modelling, marine sediment transport and coastal-erosion modelling, air pollution modelling, etc..
- having a COSMO model validation based on long term performance, to be used as a reference for the operational forecast in Italy and in the other Countries using COSMO operationally (previously mentioned). This point is particularly relevant since the COSMO model is currently undergoing deep revisions (mainly regarding the physical packages of turbulence and microphysics);
- calibrating the COSMO based forecasting systems (e.g. COSMO-LEPS, Montani et al., 2011).

In order to match the mentioned purposes, SPHERA archive will include the upper air variables: pressure, temperature, wind speed and direction, specific humidity and specific content of 6 micro-physical species (i.e. cloud water and ice, rain, snow, graupel and hail), cloud properties, turbulent kinetic energy, and the surface variables: air temperature, wind speed and direction, water vapour, pressure, precipitation, surface radiation budget, surface fluxes and soil temperature and soil moisture content of water and frozen water. The integration domain is reported in Figure 1.

As mentioned before, the assimilation of the conventional observations (PILOT, TEMP, AIREP AMDAR, ACARS, SYNOP, SHIP, DRIBU) will be performed by using the continuous nudging technique, which is the consolidated assimilation scheme of COSMO.

The reanalysis time span is planned to range between 1995 and 2019; extensions to previous years will be evaluated during the project development, depending on the availability of the forcing model COSMO-REA6.

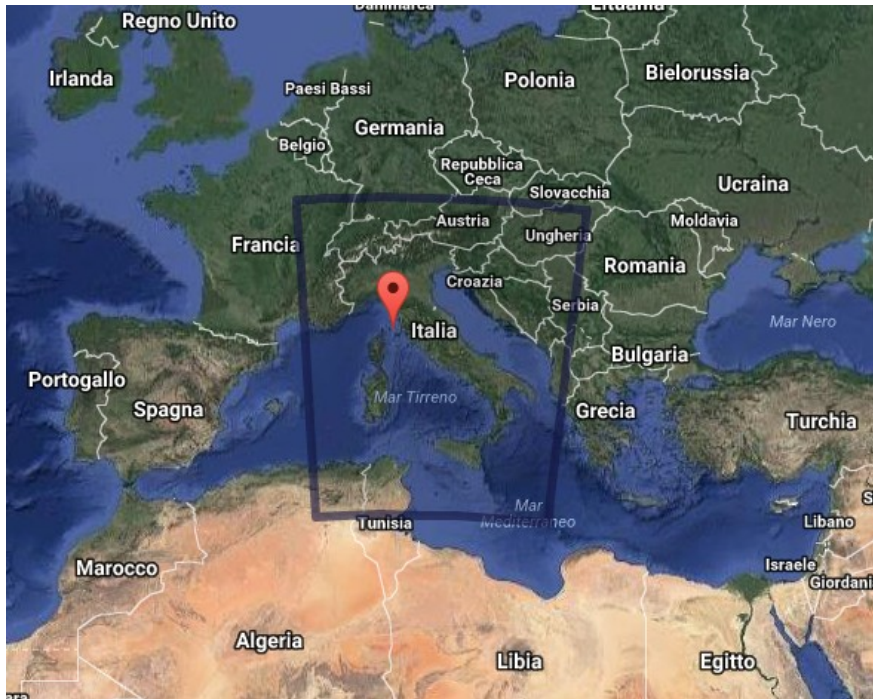


Figure 1. Integration domain of SPHERA reanalysis archive

This late special project, named SPHERA-PRE, aims at accomplishing the preliminary tests necessary for the development of SPHERA, including the suite set up and specific experiments to define the optimal model configuration (details in the following paragraph). An application for a special project 2018-2020 for the production and evaluation of SPHERA has been also submitted.

SCIENTIFIC PLAN

1. Preliminary tests for SPHERA

The first phase of the SPHERA-PRE project will aim at identifying a suitable model configuration for the reanalysis production. ARPAE-SIMC boasts a solid experience with the limited area model COSMO, given that it is a developing member of the COSMO Consortium and considering that the model has been run operationally at the Service since 2000. Based on this experience, the more critical issues related to a reanalysis archive over Italy will likely regard:

- the definition of the optimal soil surface boundary condition (the sea surface temperature, deep soil temperature and humidity)
- the definition of an optimal set up of the model configuration
- the definition of the dataset to be assimilated

Specific experiments over a limited period of study (Apr-May-Jun 2007) will tackle these critical points.

In particular the first listed point will need a special attention as small inaccuracies at the soil level can trigger systematic errors associated to the soil hydrological cycle. Due to the large soil inertia, tests to identify a potential deviation of the soil features will be also performed considering longer period of test than Apr-Jun 2007.

2. Development of a verification tool box

Several observational sources will be taken into account for the evaluation of the reanalysis performance. They are:

- long-term observational analysis based on high-resolution local networks (e.g. ERACLITO, Antolini et al. 2015; ARCIS, Pavan et al. 2013). These climatic datasets include the surface variables (total precipitation, temperature) from 1961 to near present, respectively over Emilia-Romagna region and over Northern-Italy;

- observational dataset based on high density local networks, including total precipitation, temperature, humidity and wind speed and direction. This dataset covers the Northern and Central Italy and it extends for more than 10 years in the past;
- European-based gridded observational dataset (e.g. E-OBS, Haylock et al. 2008).

3. Set up of the SPHERA production suite

The last phase of SPHERA-PRE will aim at developing an operational automatic system for the reanalysis production, which will run on the ECMWF supercomputer (HPC). The initial and boundary conditions will come from COSMO-REA6 archive, whose fields already site on HPC. Observational data will be extracted from MARS database. The pre-processing and the model computation will be divided in 24h-long runs in order to facilitate the management. A 24h run will be performed in about 30min and the model output will be approximately 18Gb. After post-processing and compression, the final output will be about 5.5Gb for every 24h simulated and will be stored on the ECFS storage space of ECMWF. The system of routines will be managed by ECFLOW package.

4. Time table

An estimate of the computational, memory storage and computing time requirements for SPEHRA-PRE has been obtained by considering that the preliminary tests will consume approximately the same amount of resources as 2 years of SPHERA reanalysis (since the reference period selected for the tests is 3 months).

The requirements for 1 year of SPHERA reanalysis have been derived by extending the results of a 24h-long run of SPHERA performed at the HPC supercomputer. The results are reported in Table1.

	24hours	1year
High Performance Computing Facility (SBU)	4.400	1.600.000
Accumulated data storage (Gb)	5,5	2.007,5
Computing time required to simulate (hour)	0,5	182,5

Table 1. Computational, memory storage and computing time requirements for 24hours of SPHERA reanalysis and the estimates for 1 year.

5. Conclusion

This late special project aims at performing the preliminary activities for the SPHERA reanalysis production (the application for the special project SPHERA has been submitted for years 2018-2020). Further follow-up of these preliminary tests will be accomplished also during the first months of 2018 in the framework of SPHERA, if that project will be approved.

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