

LATE REQUEST FOR A SPECIAL PROJECT 2016–2018

MEMBERSTATE: Italy

Principal Investigator¹: Chiara Marsigli

Affiliation: Arpae SIMC

Address: Viale Silvani 6

40122 Bologna

Italy

E-mail: cmarsigli@arpae.it

Other researchers: Francesca Marucci
Inger-Lise Frogner
José Antonio Garcia-Moya
Andrew Singleton
Ulf Andrae
Bjorn Stensen

Project Title: Testing perturbation of surface/soil conditions and of PBL for the prediction of thunderstorms and fog in the framework of the SRNWP-EPS Phase II Project.

| | | |
|---|------------------------------|-----------------------------|
| Would you accept support for 1 year only, if necessary? | YES <input type="checkbox"/> | NO <input type="checkbox"/> |
|---|------------------------------|-----------------------------|

| Computer resources required for 2016-2018: (The project duration is limited to a maximum of 3 years, agreed at the beginning of the project.) | 2016 | 2017 | 2018 |
|---|-------------|-------------|-------------|
| High Performance Computing Facility (units) | 9 M | 9 M | - |
| Data storage capacity (total archive volume) (gigabytes) | 500 | 500 | - |

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.

Principal Investigator: Chiara Marsigli

Project Title:

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.

Motivation

The enhancement of cooperation on Limited-area Ensemble Prediction System (LAM-EPS) was recognized as a high priority goal by EUMETNET members when composing the Forecasting Roadmap. The development of convection-permitting ensemble prediction capabilities in Europe is crucial for forecasting a range of weather phenomena and in particular to improve severe-weather prediction.

Therefore the EUMETNET SRNWP-EPS Phase II (EPS-II) Project was initiated in July 2015, with the main aim to contribute to build very high-resolution ensemble systems in Europe, resolving the convection-permitting scale phenomena.

The activity is organized as two complementary tasks: an application task, where new products and methodologies for calibration of LAM ensembles for extremes and for probabilistic prediction of thunderstorms are developed, and a research task, where the sensitivity and complementarity of the models to soil conditions and PBL are studied on the basis of the forecast of selected phenomena (identified in the application task), on different areas with different LAM ensemble systems.

The coordination of the project is the result of a close collaboration among the Italian and Spanish Met Services and the Arpa-SIMC from Emilia-Romagna. The project is organized in three work packages and will have two main legs. The Application and the Research WPs and their internal coordination will play a key role in the way to reach the main aim of the project.

The project has a duration of 30 months.

The institutions involved in the project management have a long experience in the field of ensemble predictions systems and probabilistic forecast.

Project participants are: Spain, Italy, Czech, Croatia, Denmark, Finland, Poland, Iceland, Portugal, The Netherlands, Ireland, Norway, UK, Switzerland, Hungary, Serbia, Belgium, Slovenia, Slovakia, Sweden and Austria.

The aim of the Research Task (understanding the sensitivity of ensemble prediction systems to soil conditions and PBL and their effect on the prediction of selected phenomena (fog and thunderstorms)) is to address the uncertainties related to surface and soil properties and their relevance for convection-permitting EPS, as well as uncertainties associates to PBL modelling. Research focuses on topics such as (but not being limited to):

- Assimilation of surface/soil property data
- Perturbations of soil scheme and PBL scheme parameters
- Introduce uncertainty of land use data in the perturbations.

Exchange of experience in these fields is fostered by the Project and followed by research work (in-kind) in coordination with the work done in the Application WP.

The idea of this specific research for the Research Task emerged during the June 2013 Madrid Physics-EPS workshop (organized as a deliverable of the EPS Phase I), highlighting the necessity of closer cooperation between physics and ensemble communities. In particular, it was proposed to initiate a synergic effort, in which ensembles are used as a diagnostic tool to evaluate the response to model physics uncertainties, with the final aim of helping the development of new truly stochastic physics schemes. This idea has been incorporated in the project proposal for Phase II through the link between the Application and the Research Task. Their interaction permits to use EPS as a tool to analyse and validate model physics parameterization, and to improve description of those model uncertainties which are more relevant for the weather phenomena of interest for operational weather forecasts.

During the Workshop “Probabilistic prediction on severe weather phenomena” held in Bologna from 17 to 19 May 2016, organized in the framework of the SRNWP-EPS II Project, the activities to be carried out in the Task 2 of the Project (understanding the sensitivity of ensemble prediction systems to soil conditions and PBL and their effect on the prediction of selected phenomena (fog and thunderstorms)) have been defined.

In particular, it has been agreed that

each participant will test the impact of their own perturbation method(s) on their own ensemble system and on their own domain. The common focus on the selected weather phenomena (mainly thunderstorms and fog) will provide the common basis of this work, allowing a meaningful exchange of the results obtained.

This will be achieved through a test of the perturbations on two periods long enough to permit some statistical evaluation and including events relative to the selected weather phenomena.

The Members taking part to this test are: Denmark, Spain, Italy, Hungary, Norway, Poland, Sweden, The Netherland, UK.

This proposal for a Special Project is aimed at executing the ensemble runs which are needed for the tests by a group of Participants: Italy, Norway, Spain and Sweden.

Scientific Plan

The organization of the test work is here described.

- Each project participant identifies one or two test periods including cases of significant thunderstorms and fog.
- Periods and cases can be different for the different NMSs but they should include “similar” phenomena.

This has been done and the test periods selected by the participants are listed here below.

Denmark:

24 Aug - 5 Sep 2015: dominated by unstable conditions over Denmark with several thunderstorm events throughout the period.

1 - 7 Nov 2015: is a period with stable conditions and local fog in many places.

Hungary:

To be provided

Italy:

18th of June to 8th of July 2016: unstable conditions in Italy with several thunderstorms in different parts of the country.

For the fog, we will address this part later, likely in Autumn with the operational ensemble.

Norway and Sweden:

30 May - 15 June 2016: many cases of thunderstorms in Sweden and Norway, but it also includes interesting cases of fog.

Later it will also be considered a period with more fog cases.

Poland:

The warm season of 2013: this period would pertain to T2m / precipitation (accumulated / rates) / U10m verification. Same period would be relevant to thunderstorms and lightning verification.

Spain:

Summer and Autumn 2016 for thunderstorms: as the summer and fall seasons progress, cases of significant thunderstorms that take place over the Iberian Peninsula will be identified by AEMET staff when their meteorological features match the dynamic forcing conditions we are looking for to trigger deep-convection processes.

7th January 2013 for fog: a heavy fog episode had a severe impact on the International Airport of Madrid-Barajas (Middle Spain) closing the airport during early hours in the morning.

UK:

July 2015: several thunderstorm events

November 2015: several fog events

- Each participant tests the impact of their own perturbation method(s) on their own ensemble and on their own domain.
- There will be some overlap between the methods tested by the different NMSs, but even if in case of methods tested only by one NMS, the common focus on the test cases will help demonstrate the impact and may motivate other centres to test the same approach. The methods which will be applied by the different participants are listed here below.

Denmark:

Study the impact of random perturbations of selected Surfex fields in Harmonie.

Hungary:

To be provided

Italy:

Test of combination of SPPT and Parameter Perturbation (parameters in microphysics, turbulence and soil).

Test of perturbation of soil moisture.

Norway and Sweden:

Test and develop the surface perturbation scheme (from Meteo France).

Plan experiments with perturbations to the turbulence scheme in MEPS, to begin with to a parameter which represents the transport term of TKE.

Poland:

Perturbation of surface area index of evaporating fraction

Perturbation of IC/BCs of soil surface temperature

Perturbation of rainfall/snowfall efficiency coefficient – mainly for precipitation forecasts

Spain:

Different strategies to test perturbation schemes for the model surface in terms of experiments and verification scores over the Iberian Peninsula will be defined within the framework of HIRLAM C Consortium over the course of this year.

UK:

Perturbed parameter scheme (RP scheme) and stochastic perturbations in the BL.

Explore the possibility of including soil moisture perturbations, and perturbed parameters in the land-surface scheme.

- A list of common diagnostic methods has been agreed upon. Evaluation will be in terms of (not all of them for every method/period):

- T2m / precipitation (accumulated / rates) / U10m
- Wind gusts / visibility / fog / thunderstorms / lightning

Diagnostics will include:

- RMSE / bias
- spread / skill relation, rank histograms
- reliability assessment (reliability diagrams)
- skill of each member (FBI, FAR etc.)
- probabilistic skill (BS, BSS, ROC curve, CRPS, CRPSS)

The runs of the ensembles are scheduled to take place between October 2016 and May 2017. Then the results will be elaborated and compared and they were reported at the next Workshop of the Project, to be held in Madrid in Autumn 2017.

Justification of the computer resources requested.

Italy:

A single run of the COSMO-IT-EPS ensemble (10 members, 2.2 km, 65 levels, Italian domain) costs about 115,000 SBU, therefore 1 month of runs (or 2 sets of 15 days each) costs about 3.5 MSBU. This permits to run one experiment (of 1 month) per year with the SBU provided by the project (about 1/3 of the total). Therefore only one experiment per year will be carried out within the Special Project.

In particular, the experimental suite run with these SBUs will test surface perturbations in 2016 and turbulence perturbations in 2017.

Norway and Sweden:

A three week period with MEPS (or HarmonEPS), 2 times per day to +36 h, with 10+1 members, 2.5 km horizontal resolution and 65 vertical levels on the MetCoOp domain costs about 3.4 MSBUs.

This permits to run one experiment (of three week) per year with the SBU provided by the project (about 1/3 of the total). Therefore only one experiment per year will be carried out within the Special Project. In particular, the experimental suite run with these SBUs will test surface perturbations in 2016 and turbulence perturbations in 2017.

Spain:

Running an HarmonEPS with several members using Harmonie model running at 2.5 Km resolution and 65 vertical levels on the testing cases selected by Spain (up to 1 month of run) costs about 3 MSBU.

This permits to run one experiment per year with the SBU provided by the project (about 1/3 of the total). Therefore only one experiment per year will be carried out within the Special Project.

With the purpose of keeping the resources required by the SP within an affordable limit, the part of the computing resources exceeding the amount allocated by the Special Project, which is estimated to be small (less than 500,000 SBU per country), will be provided by National resources,

Technical characteristics of the code to be used.

COSMO-IT-EPS ensemble.

The COSMO model will be run at a resolution of 2.2 km with 65 vertical levels, on an Italian domain. Experiments with a similar set-up of COSMO-IT-EPS has already been performed at ECMWF, thanks to the SPITCONV Special Project. An sms suite already implemented at ECMWF will be adapted in order to perform these runs.

HarmonEPS is run at 2.5 km horizontal resolution and with 65 vertical levels. It has the possibility to run both Arome and Alaro physics. Different domains will be used, Norway and Sweden will use their operational common domain, Spain the Iberian domain and Denmark and the Netherlands their operational domains.