The SRNWP-EPS Programme

Chiara Marsigli

Arpae SIMC

The SRNWP-EPS II Project

- 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
- The EUMETNET SRNWP-EPS Phase II has a main general aim: to contribute to build very high-resolution ensemble systems in Europe, resolving the convection-permitting scale phenomena

Project Structure

- The coordination of the project is the result of a close collaboration among the Italian and Spanish Met Services and the Arpae-SIMC of Emilia-Romagna region
- The project has two main legs: the Application and the Research WPs and their internal coordination play a key role in the way to reach the main aim of the project
- The project had a planned duration of 30 months, from the 1st July 2015 till the 31st of December 2017, but it has been extended until 31st of December 2018

Participating Members

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MINISTERIO DE MEDIO AMBIENTE Y MEDIO RURAL Y MARINO

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The SRNWP-EPS II Project

The work in the project is ***phenomena oriented:***

- Recognized that it is impossible to tackle all the topics for cooperation on ensemble in a single project, priority has been given to products for the high impact weather, here **thunderstorms and fog**
- This has oriented also the research work of the project, focused on understanding complementarity of the different European modeling systems in describing the uncertainties in **PBL and soil model** formulation

The SRNWP-EPS II Project

⇒ 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 and fog are developed
- 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

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Activities until now

- Application Task:
  - survey of available methods and needs in the NMSs
  - literature review
  - development of methods (calibration and products)
- Research task:
  - organize common testing
  - Special Project proposal to ECMWF
  - run and verify experiments
- Coordination:
  - Workshop on “Probabilistic prediction of severe weather phenomena”, 17-19 May 2016, Bologna (I)
  - Organize a second workshop in Madrid, 24-26 October 2017

The survey: forecasters' feedback

- **Useful features**:
  - forecast in terms of probability (especially useful for severe weather/ extreme events), provides estimation of uncertainty, long range forecast available in ECMWF ENS
- **Drawbacks**:
  - lack of spread, lower spatial resolution, lack of consistency, uncertainty in the interpretation of the probabilities

The survey: requirements w.r.t. thunderstorms

- **Expected end users** are, beside the forecasters, in the sectors of aviation, energy, road and traffic management, civil protection, hydrology and the general public
- Probabilistic products should cover:
  - **thunderstorm location, intensity and time**
  - **lightning activity**
  - **convective precipitation amount**
  - **wind gusts and wind shear**
  - **different types of precipitation**
- Spatial resolution: of the order of **1 km**, but probabilities are often required over an area (geographical/administrative)
- Temporal resolution: of the order of **1 h**

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The survey: requirements w.r.t. fog

- **Expected end users** are, beside the forecasters, in the sectors of aviation, energy, road and traffic management, civil protection and also general public
- Probabilistic products should cover:
  - **visibility**
  - **spatial and temporal extent of the phenomenon**
  - **cloud base**
- Spatial resolution: of the order of **1 km**, but probabilities are often required over an area (geographical/administrative)
- Temporal resolution: of the order of **1 h**

The survey: main research lines

- Addressing (or improving) the representation of the initial condition uncertainty (ensemble data assimilation methods)
- Improving the representation of the model error (stochastic perturbation of tendencies or perturbation of physical processes)
- Including perturbation of land surface (initial conditions, parameters, SPPT)
- Multi-physics and random parameters
- Work on lagged-based approach and post-processing

Application task

- Define and develop new products and methodologies for computation/elaboration:
  - calibration of ensemble outputs, mainly for extremes (wind, precipitation, temperature, …) -> **AEMET**
  - products for probabilistic prediction of thunderstorms and fog (focus on selected phenomena) -> **COMET**

Research task: common testing

- common testing of ensembles run on different regions -> **focus on “similar” events**
- the common focus on the selected weather phenomena (mainly thunderstorms and fog) provides the common basis of this work, allowing a meaningful exchange of the results
- periods and cases can be different for the different NMSs but they should include “similar” phenomena
- each project participant has identified test periods including cases of significant thunderstorms and fog
- each NMS tests the impact of their own perturbation method(s) on their own ensemble and on their own domain

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Research task: participation

Denmark:

Harmonie-DKA domain, horizontal resolution 2.5 km; 65 vertical levels.

Hungary:

AROME-EPS, horizontal resolution 2.5 km; 60 vertical levels.

Italy:

COSMO-IT-EPS, horizontal resolution 2.2 km; 65 vertical levels.

Norway and Sweden:

Sweden and Norway have a shared convection permitting ensemble system.

MEPS is based on Harmonie, horizontal resolution 2.5 km; 65 vertical levels.

Poland:

TLE-MVE ensemble (COSMO), horizontal resolution 2.8 km; 50 vertical levels.

Spain:

gSREPS, based on a multi-model, horizontal resolution 2.5 km.

UK:

MOGREPS-UK; horizontal resolution 2.2 km; 40 vertical levels.

Perturbation methods (I)

Denmark:

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

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: perturbations to the turbulence scheme in MEPS, to begin with to a parameter which represents the transport term of TKE. This would influence the top entrainment and with it the clouds.

Perturbation methods (II)

Poland:

- Perturbation of surface area index of evaporating fraction
- Perturbation of IC/BCs of soil surface temperature
- Perturbation of rainfall/snowfall efficiency coefficient

Spain:

- Different strategies to test perturbation schemes for the model surface will be defined within the framework of HIRLAM C Consortium
- Ideally, surface perturbations should be time dependent. Each surface parameter that is sensitive to be perturbed has to be associated with a perturbation patter which is still to be determined.

UK:

- Perturbed parameter scheme (RP scheme) and stochastic perturbations in the BL.
- Possibility of including soil moisture perturbations, and perturbed parameters in the land-surface scheme.

Concluding remarks

- The development of convection-permitting ensemble predictions in Europe is crucial to improve severe weather prediction
- Focus on phenomena: thundarstorms and fog
- Focus on soil/surface and PBL perturbations
- Two legs:
  - an Application Task, to deliever methodologies for calibration of ensemble outputs and generation of probabilistic products for the selected phenomena
  - a Research Task, to improve the perturbation strategy of the ensembles by addressing their complementarity (focus on similar phenomena and methods)
- Results at the next project workshop, Autumn 2017 in Madrid

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SRNWP-EPS Phase II

Thank you for your attention!

Participants

Institution	Country
CHMI	Czech
DHMZ	Croatia
DMI	Denmark
FMI	Finland
IMGW	Poland
IMO	Iceland
IPMA	Portugal
KNMI	The Netherlands
Met Eireann	Ireland
Met No	Norway
Met Office	UK
MeteoSwiss	Switzerland
OMSZ	Hungary
RHMSS	Serbia
RMI	Belgium
SEA	Slovenia
SHMU	Slovakia
SMHI	Sweden
ZAMG	Austria

Test periods (I)

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 defined later.

Italy:

- 18th of June - 8th of July 2016: thunderstorms
- To be defined later for fog.

Norway and Sweden:

- 30 May - 15 June 2016: many cases of thunderstorms in Sweden and Norway, but it also includes interesting cases of fog.
- To be defined later a period with more fog cases.

Test periods (II)

Poland:

- The warm season of 2013: thunderstorms and lightning.
- more than 25 confirmed tornado/gustnado/funnel clouds occurrences in Poland for the period.

Spain:

- Summer and Autumn 2016 for thunderstorms: as the summer and fall seasons progress, cases of significant thunderstorms will be identified
- 7th January 2013: fog had a severe impact on the International Airport of Madrid-Barajas (Middle Spain).

UK:

- July 2015: several thunderstorm events
- November 2015: several fog events

Diagnostics

- 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)
- Upscaling methods and spatial verification methods can also be applied.

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Request of computing resources

- Special Project at to ECMWF in order to require computing resources for this work (SPITSREP)
- Italy, Norway & Sweden, Spain
- About 9 MSBU needed for 3 ensembles, for 2 years