Status and future steps of the SRNWP-EPS II Project

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38th EWGLAM and 23th SRNWP Meeting
3rd – 6th October 2016 - Rome, Italy

Outline

- Status of the project (October 2016)
  - Survey on ensemble systems: usage and lines of development
  - Application Task
  - Research Task
- Some ideas about the User Group
- Some ideas about the extension to 2018
- Brainstorming about the new SRNWP EPS Ph. III (2019-?)

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

The SRNWP-EPS II Project

- This means that 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

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 is already planned an extension of the by project twelve months, until 31st of December 2018

Participating Members

GOBIERNO DE ESPAÑA
MINISTERIO DE AGRICULTURA, ALIMENTACIÓN Y MEDIO AMBIENTE
AEMet Agencia Estatal de Meteorología

EUMETNET
EUROPEAN METEOROLOGICAL SERVICES NETWORK

arpae
agenzia prevenzione ambiente energia emilia-romagna

GOBIERNO DE ESPAÑA
MINISTERIO DE MEDIO AMBIENTE Y MEDIO RURAL Y MARINO
AEMet Agencia Estatal de Meteorología

Organization

Institution	Role	Key personnel
AEMET – Spain	Project Manager	Jose A. Garcia-Moya
Arpae-SIMC - Italy	Scientific coordinator	Chiara Marsigli
COMET - Italy	National coordinator for Italy	Francesca Marcucci
Expert Team	Informing the Project Manager about strategic developments in Europe in the field of Ensemble Prediction System and probabilistic forecast	Chair-person: Scientific coordinator
Users' Group	Consultancy about the Application Tasks developments and their use in an operational environment	Chair-person: Scientific coordinator

Work Packages

WP 1	**Application Work Package** Develop new products and methodologies for calibration of LAM ensembles for extremes and probabilistic prediction of thunderstorms and fog
WP1.1	Inventory of existing methods and SW already developed by the Members and literature review
WP1.2	Define and develop new products and methodologies for computation/elaboration: • calibration of ensembles, mainly for extremes (wind, precipitation, temperature, …) • products for probabilistic prediction of thunderstorms (clear benefit, link with research, link with EMMA), fog

WP 2	**Research Work Package** Understanding the sensitivity of ensemble prediction systems to soil conditions and PBL and their effect on the prediction of selected phenomena (fog and thunderstorms)
WP2.1	Investigating sensitivity of models to soil moisture and PBL
WP2.2	Investigating the ratio of sensitivity to different sources of surface and upper air uncertainty at the CP scale

Activities of the first year

- Application Task:
  - survey of available methods and needs in the NMSs
  - literature review
  - start development of methods (calibration and products)
- Research task:
  - organize common testing
  - Special Project proposal to ECMWF
- Coordination:
  - Workshop on “Probabilistic prediction of severe weather phenomena”, 17-19 May 2016, Bologna (I)
  - talks and reports available at: http://www.arpae.it/dettaglio_notizia.asp?idLivello=32&id=7654

The survey

- Summarize the status of the ensemble systems in the different NMSs and their planned developments
- Clarify their methods for the post-processing of the ensembles, including forecasters' feedback
- Summarize the methodologies adopted for ensemble calibration and for the generation of forecasts of thunderstorms and fog in the NMSs
- Express the requirements of the participants with respect to the project

Use of ensembles

Centre	name	ope	civil prot.	energy	aviation	project	various customers	public (web)
AEMET	IFS-ENS GLAMEPS SREPS	X	X	x	x	PreFlexMS	electric power network	
Arpae SIMC	COSMO-LEPS IFS-ENS	X	X	X		X	x	
COMET	COSMO-ME-EPS	X	X					
IMGW	TLE-	X				X COSMO PP		
IPMA	IFS-ENS GLAMEPS	X	X		x			
KNMI	GLAMEPS IFS-ENS	X	X		X			
MCH	IFS-ENS COSMO-LEPS COSMO-E	X	X	X (media n)			hydrological forecast (coupling)	
MeteoFrance	PEARP ECMWF	X	X	X	X		X	
Met.no	IFS-ENS GLAMEPS	X	x	X				
Met Office	MOGREPS-UK MOGREPS-G IFS-ENS	X					Coastal flood Fluvial flood (coupling)	
OMSZ	IFS-ENS ALADIN-EPS	X	X			X PROFORCE		
SHI	IFS-ENS PEPS ALADIN-LAEF NCEP GEFS	X		x			road maintenance, ski resorts	
SHMU	IFS-ENS ALADIN-LAEF lagged ensemble	x	x	x		X POVAPSYS II EFAS		x
SMHI	IFS-ENS GLAMEPS	x	x	x				X
ZAMG	ALADIN-LAEF IFS-ENS	x		x				

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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

Calibration

Centre	Status	variable	method	application	focus on extremes
AEMET	plan	t, wind, tp	not decided	no	no
Arpae SIMC	ope	tp	analog	hydrology	no
COMET	devel	tp (both for point and gridded values)	Reliability calibration, quantile-quantile mapping + Bremnes	no	no interest: t, tp, wind
IMGW	plan	t, wind, mslp, tp	Multiple LR, LG for tp	no (road and energy considered)	no interest: t, tp, wind. users: road and energy
KNMI	ope	wind, t, tp	Gaussian, Box-Cox-t	no	no
MCH	ope	tp, t, wind	Quantile mapping (reforecast)	no	yes (same)
MeteoFrance	ope	tp, reflectivity, gusts	Quantile optimization	yes	no
Met.no	plan	tp, t, wind, cloud, lightning	Fit statistical distribution (gamma for tp)	no	no
Met Office	devel	t, tp, wind	EMOS	no	no (interest: tp, wind)
ZAMG	devel	t, tp, wind	LG, BMA, NGA	no	no

Requirements – 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**

Requirements – 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**

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 (wind, precipitation, temperature, …) -> **AEMET**
  - products for probabilistic prediction of thunderstorms and fog (focus on selected phenomena) -> **COMET**

- Methods with more positive references

Parameter	Method	Successful cases
Temperature	BMA	Baran (May 2014); Baran (September 2014); Erickson (2012); Marrocu and Chessa (2008); Raftery (2005); Wilson (2007)
Precipitation	ELR	Bouallègue (2013); Hamill (2008 and 2012); Messner (August 2014); Roulin and Vannitsem (2012); Schmeits and Kok (2010)
Wind	BMA	Bao (2010); Baran (July 2014); Courtney (2013); Sloughter (2013); Traiteur (2012)
Visibility	BMA	Chmielecki (2011); Roquelaure (2008 and 2009)

Conclusion

FOG:

- The idea is to create a tool that combines selected methods in order to maximize the benefits of each one, reducing false alarm. Further tests will be done in this direction.

THUNDERSTORM:

- Similarly to the approach of fog forecasting, the idea for thunderstorm forecasting tool is to combine different stability indices, helicity and lightning indices.

Fog forecasting: summary of literature review

A(z) rId5 azonosítójú képrész nem található a fájlban.

More accurate results taking into account the physics of fog's formation

High computational and maintenance costs

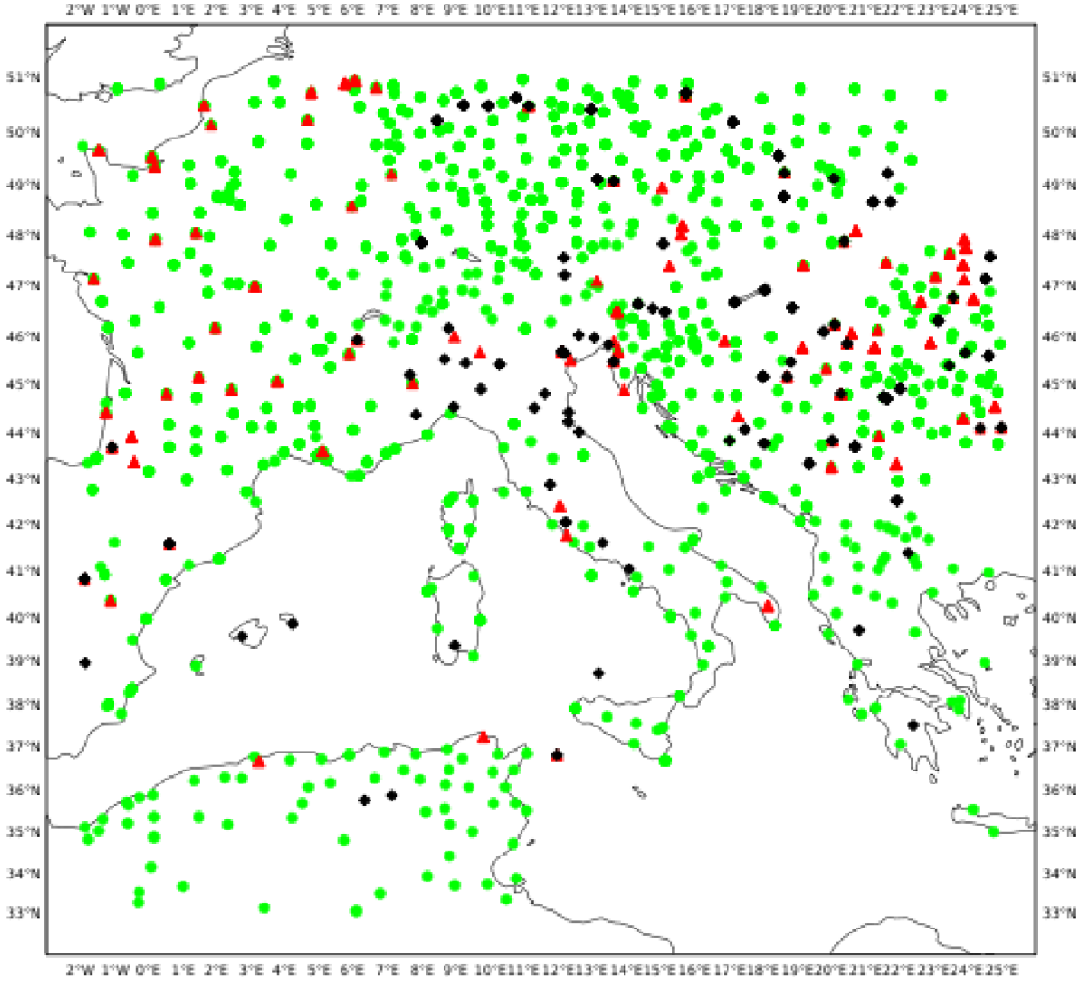
Fast tools with low computational and maintenance costs

Less consideration of the physics of fog's formation

Test case: synop observation

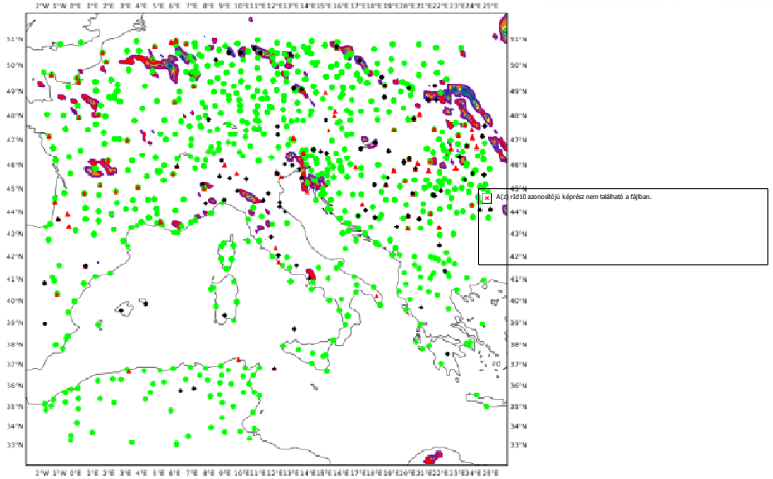
Recently, on 2016/02/02 there was a event of persistent fog

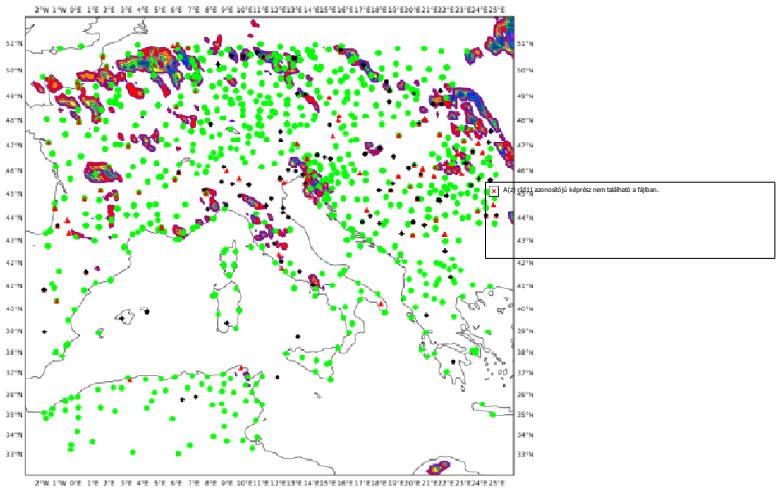
From 04 UTC to 07 UTC



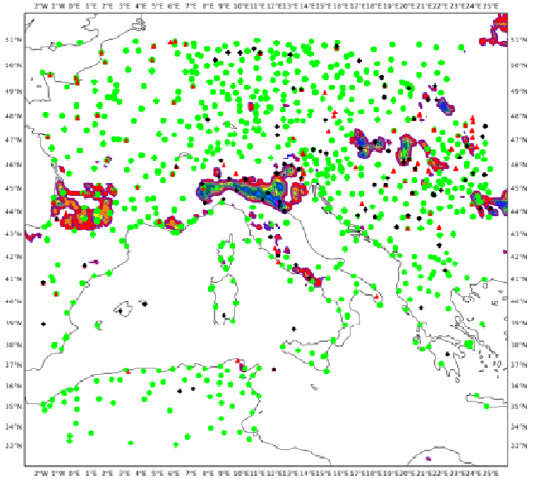
COSMO-ME EPS:
Vis from asymptotic approach

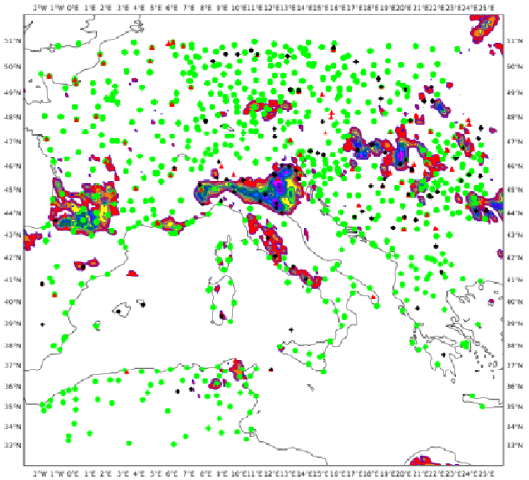
Probability of fog



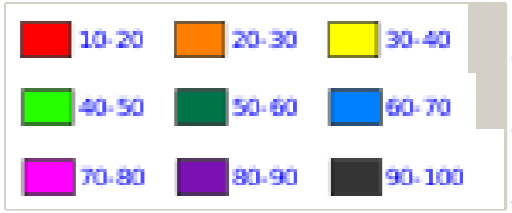


Probability of mist

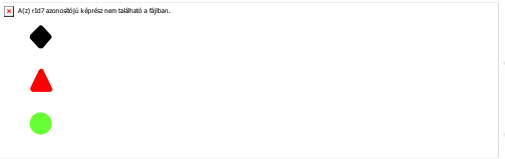




Probability (%):

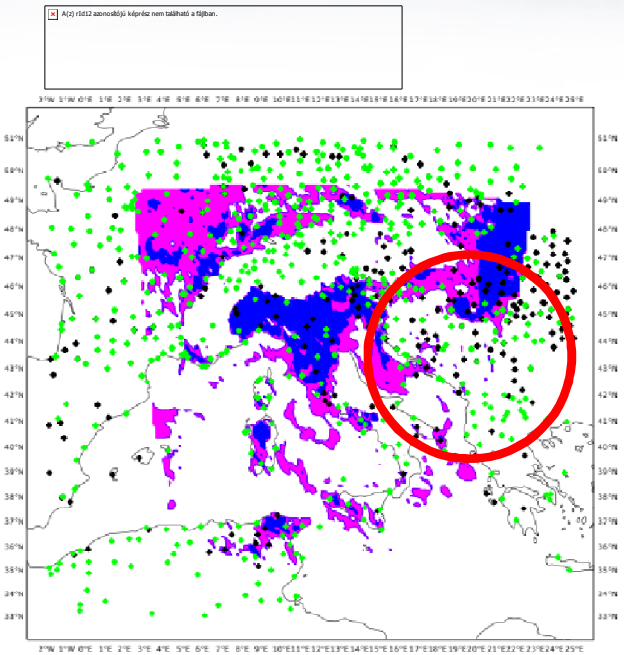


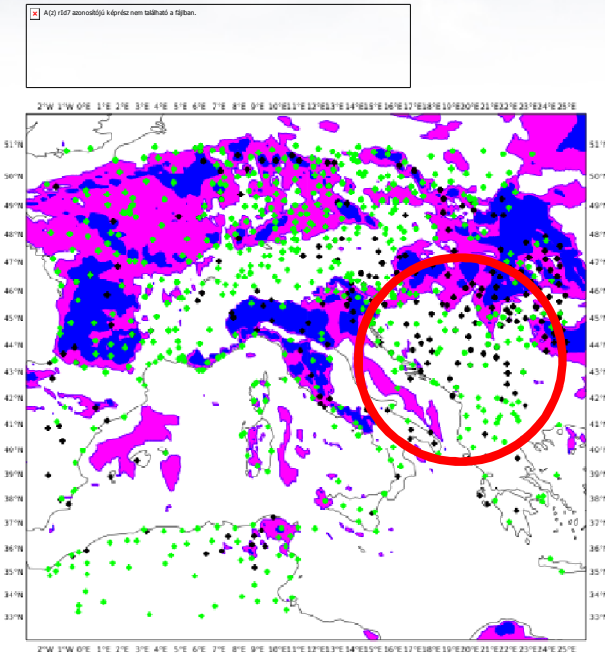
Observations:

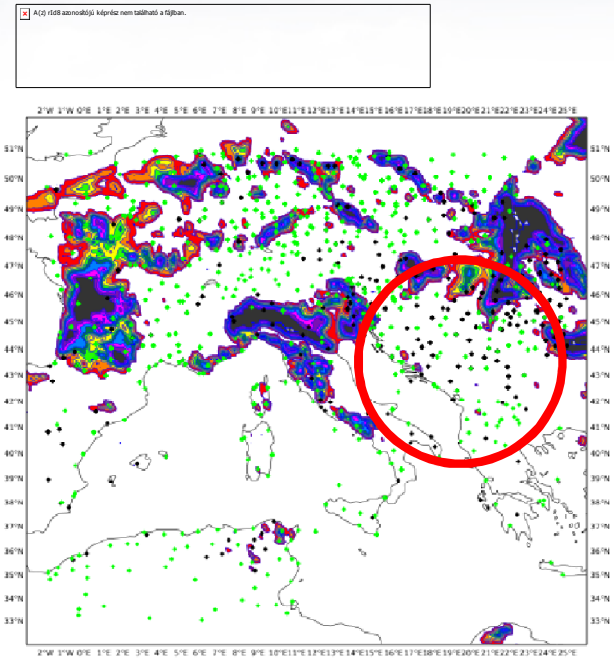


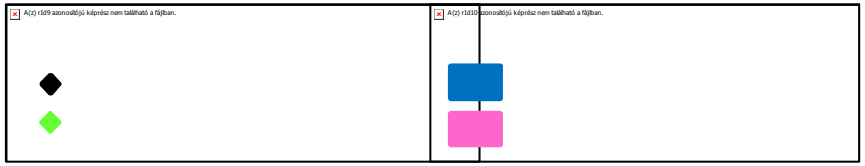
Also in this case there are
1) Good performance in the Po Valley
2) False allarme in France Region
3) Missed events in the Balkain region

Relative humidity:
Observations *vs* Forecast

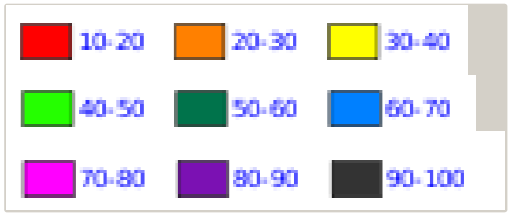








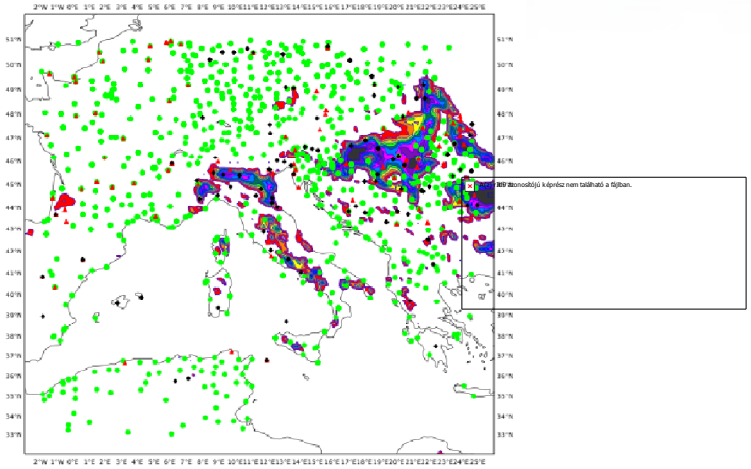
Probability of RH>95 % :

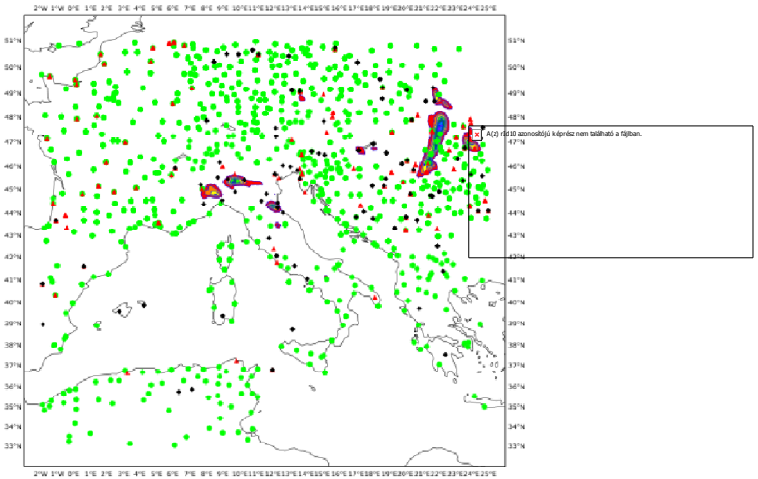


Also EPS members underestimate RH, so there are not the trigger condition for the asimptotic approach.

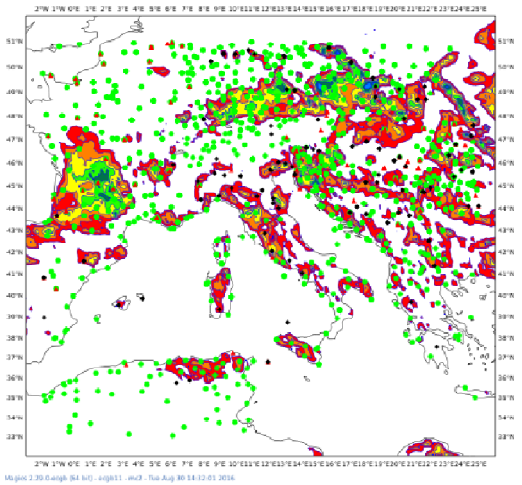
COSMO-ME EPS:
Vis from UPS approach

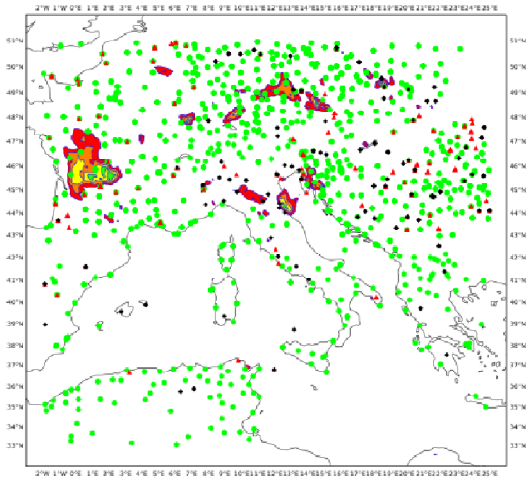
Probability of fog



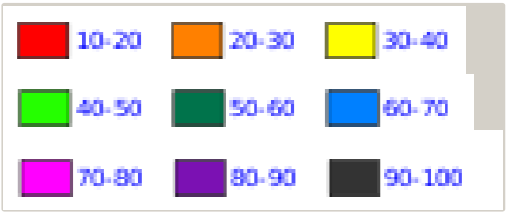


Probability of mist





Probability (%):



Observations:

Further investigations are necessary to find better performace in terms of false allarme and missed events.

Research task

- This task is aimed at addressing uncertainties related to **surface and soil properties** and their relevance for convection-permitting EPS, as well as uncertainties associates to **PBL modeling**
- Research focuses on topics such as:
  - 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

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

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.

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

Request of computing resources

- Submit a Special Project request to ECMWF in order to require computing resources for this work
- Italy, Norway & Sweden, Spain
- About 9 MSBU needed for 3 ensembles, for 2 years

User Group

- A User Group (UG) will be formed including representatives of National Institutions, interested in use of probabilistic information for weather forecasting
- A special called for the Energy Sector in Europe will be made to include representatives of that sector in the Users' Group on a voluntary basis
- A link with SESAR will also be established to ensure proper coordination, also aiming at feed-backs from the aviation sector
- ECOMET will invite to the UG to properly represent the private sector

- It's being very difficult to find volunteers to form the UG committed to participate in any Project meeting. Because:
  - No additional funding for UG members travels to the meeting.
  - It is a "***phenomena oriented***" project not a "User oriented".

Extension to 2018 – ET meeting

- STAC/PFAC decided to extend EUMETNET programs and projects ending in 2017 one year more.
- The reason is that EUMETNET has to sign a new EIG agreement in 2019.
- Funding for 2018 will be the same than 2017.
- Project coordinators have to include additional tasks for 2018 but aligned with the main aim of the projects.
- EPS Ph II new tasks for 2018:
  - Application tasks:
    - Calibration: Extremes
    - Products: Aviation (CAT, Icing,…)

Brainstorming of ideas for EPS Ph. III – Also ET meeting

- Proposal for a new EPS Project PH III will be discussed at the ET during 2017-2018.
- Ideas are very welcome:
  - Extension of Ph II
    - Calibration. Refinement of techniques (Machine Learning…)
    - Products: new phenomena like…
  - A complete “user oriented project”
    - Based on User Group with additional funding to get people from the user side working in the project and to fund workshop participation.
    - Key sectors like renewable energies, road traffic, marine routing,…
  - A very ambitious consortia to run at ECMWF a 1 Km EPS over Europe based on the multimodel approach.
    - Each participant will take responsibility of their own model.
    - SBUs from special project at ECMWF

Brainstorming of ideas for EPS Ph. III – Also ET meeting

Comments and ideas will be very welcome…

More in the ET meeting on Thursday afternoon