Latest developments around the LAMEPS in Hungary

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- Special thanks to colleagues who worked on this area:
  - *Edit Hagel*
  - *Andras Horanyi*
  - *Mate Mile*
- Thanks to the whole Hungarian NWP community

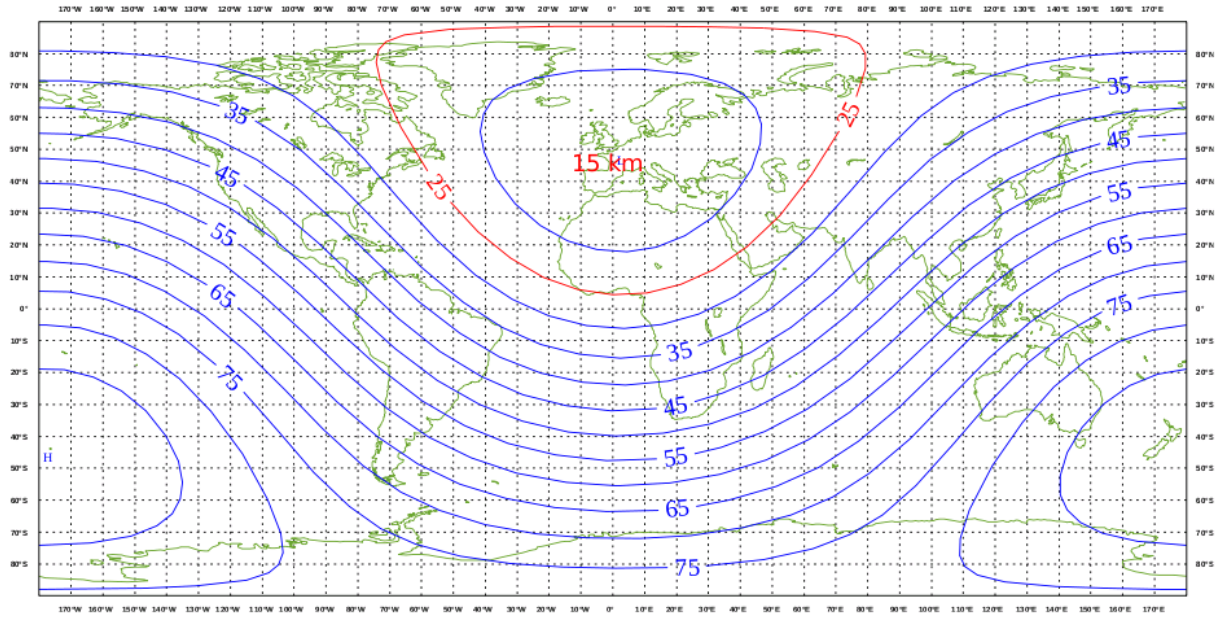
History and outline

- The Hungarian LAMEPS was introduced in February 2008
- Introduction of 8km version with ALARO physics in November 2011
- Introduction of EDA system is a plan for the near future

- Operational system
  - Downscaling of PEARP
  - Characteristics of operational LAMEPS
- Implemented changes – better single forecasts
  - Finer resolution
  - Better physics parametrization
- Planned changes – better ensemble system
  - Global model
  - Local observations
  - Local perturbations

Operational system
Simple downscaling of PEARP

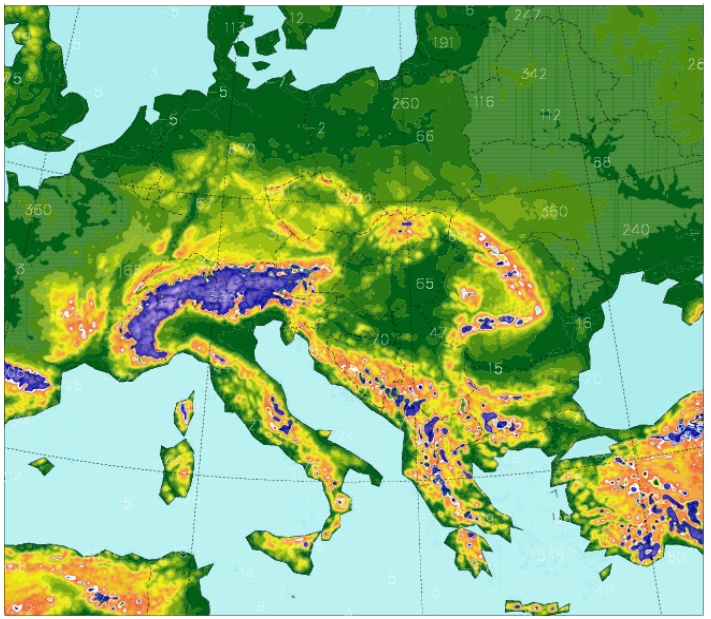
- Resolution of ARPEGE EPS is about 18km over Hungary
- Run at 06UTC and **18 UTC**
- The evolution of PEARP:



	PEARP 1.5	PEARP 2.0	PEARP 3.0
Introduction	January 2008	December 2009	December 2010
Perturbation	Svs+Blend. Breed.	SV+EDA	SV+EDA
Model error	No	Yes	Yes
Resolution	T358C2.4L55	T358C2.4L65	T538C2.4L65
Num. of mem.	11	35	35

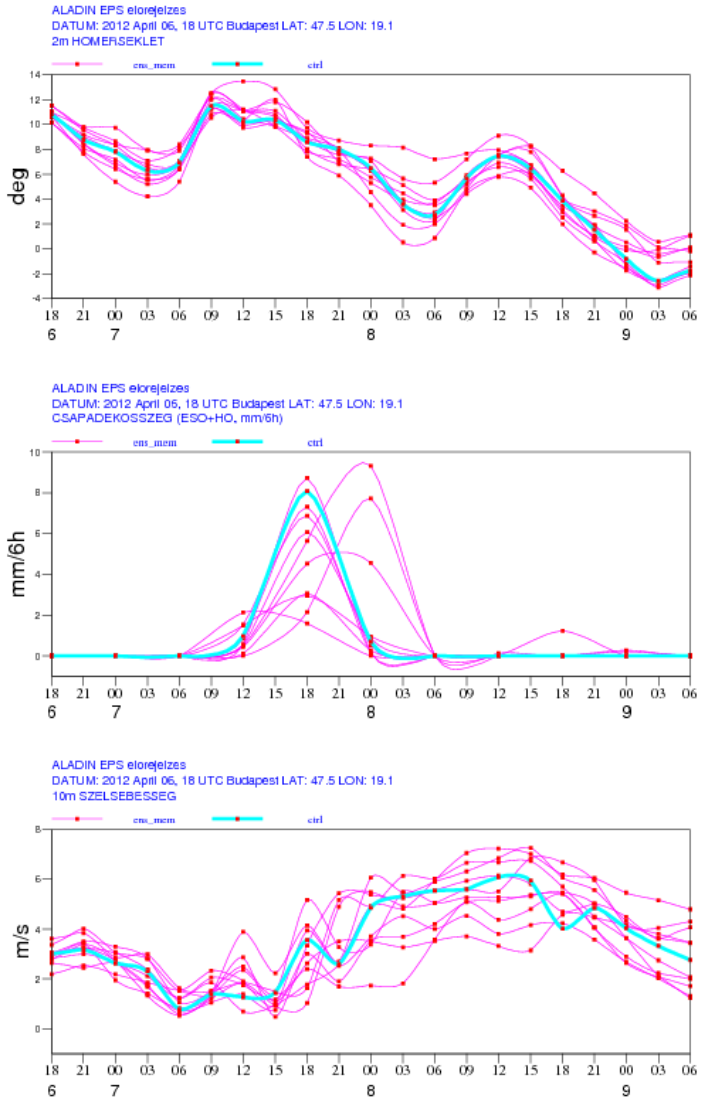
Operational system
Characteristics of Hungarian LAMEPS

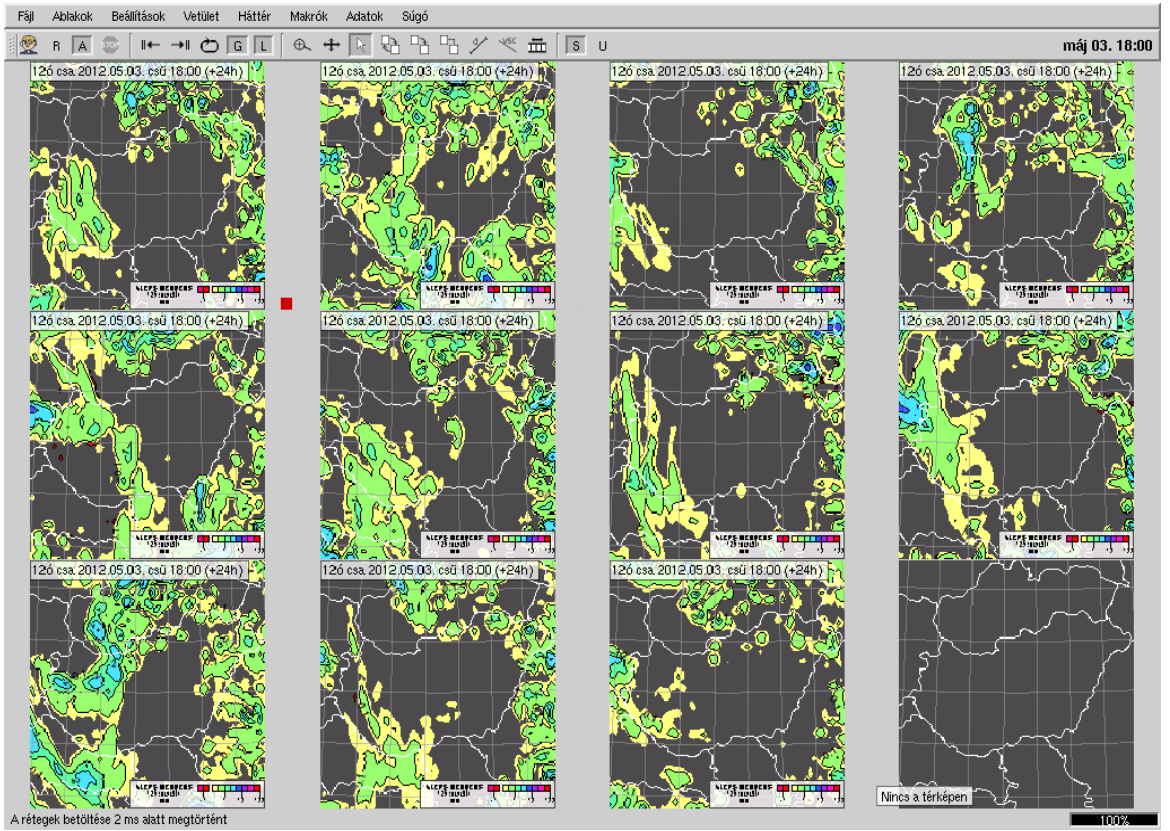
- Some changes were implemented in November 2011
- The aim was to improve the quality of the single members



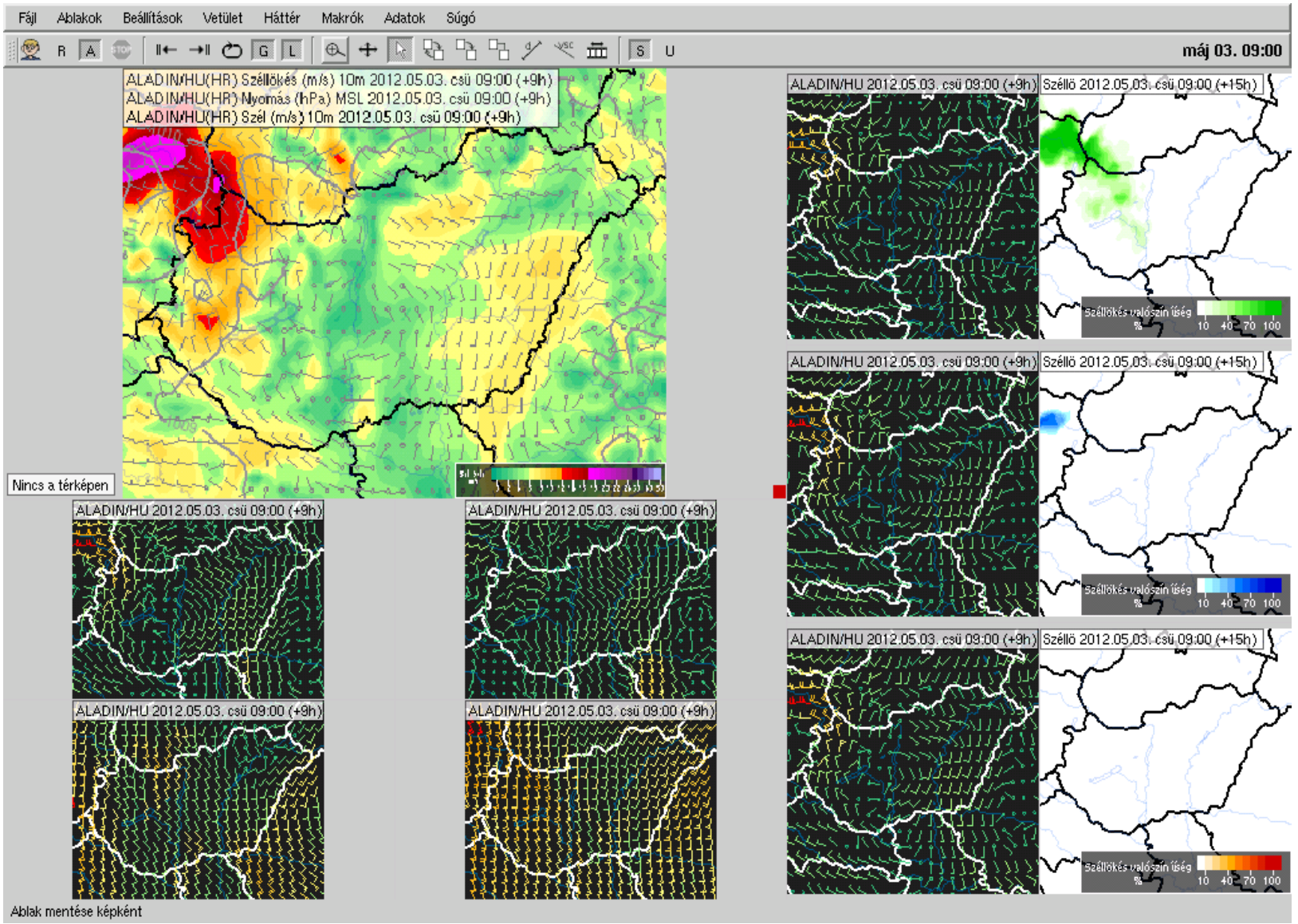
	old version	**new version**
Runs	at 18UTC for +60hours	**at 18UTC for +60hours**
Horizontal res.	12km	**8km**
Vertical res.	46 levles	**49 levels**
Timesteps	450 s	**300 s**
Physics	old ALADIN	**ALARO**
Num. of mem.	11	**11**
Local perturbations	No	**No**
Local observations	No	**No**

Operational system
Products for forecasters



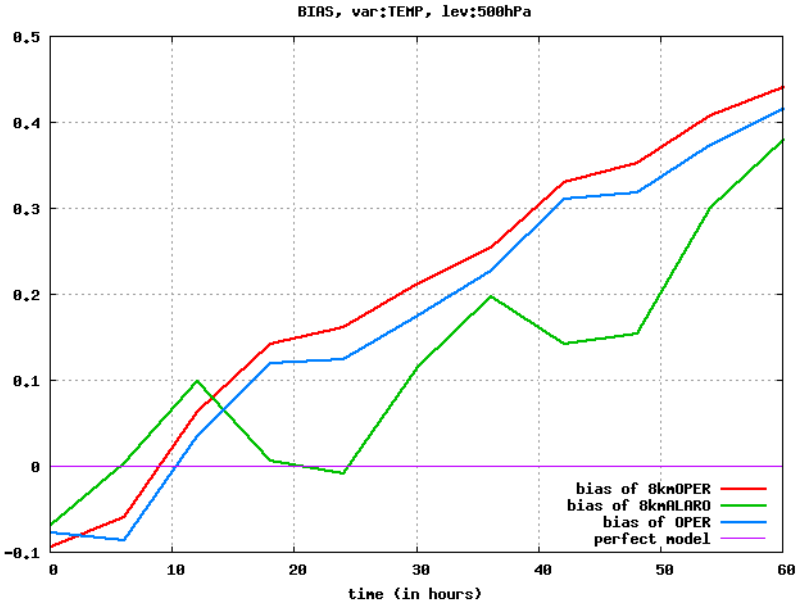


Operational system
Products for forecasters

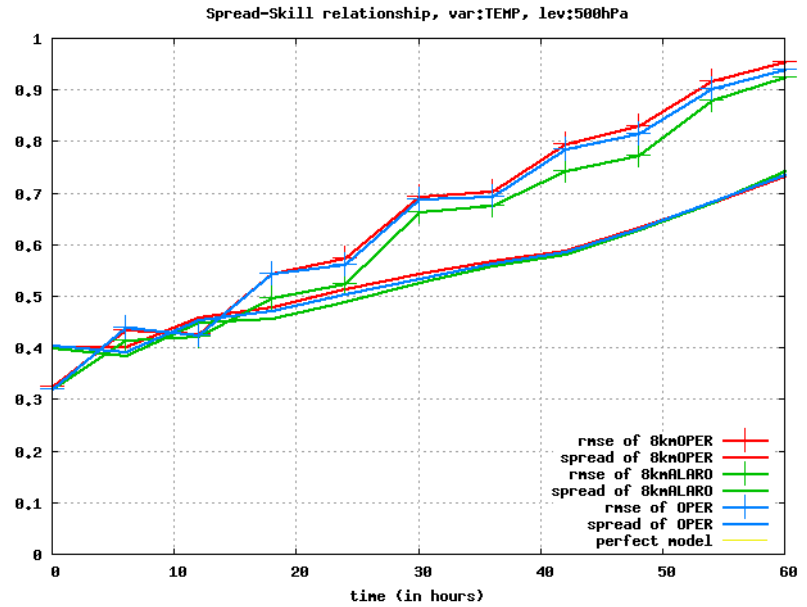


Experiences with ALARO

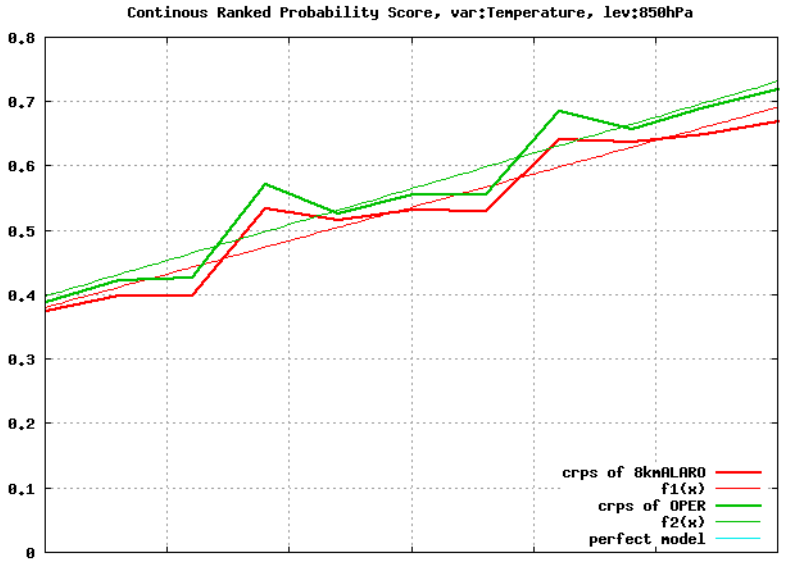
- 500hPa temperature
- Blue: 12km, ALADIN
- Red: 8km, ALADIN
- Green: 8km, ALARO



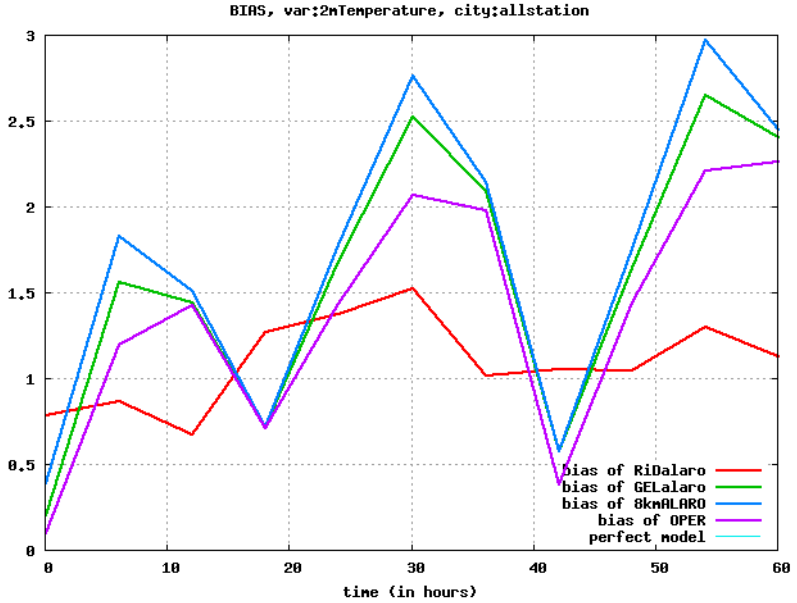
- The resolution increase - on its own - does not bring clear benefit
- The new physics package made a slight improvement in scores



Experiences with ALARO



- 850hPa temperature CRPS
- The improvement was obvious in probabilistic scores as well in high-atmosphere



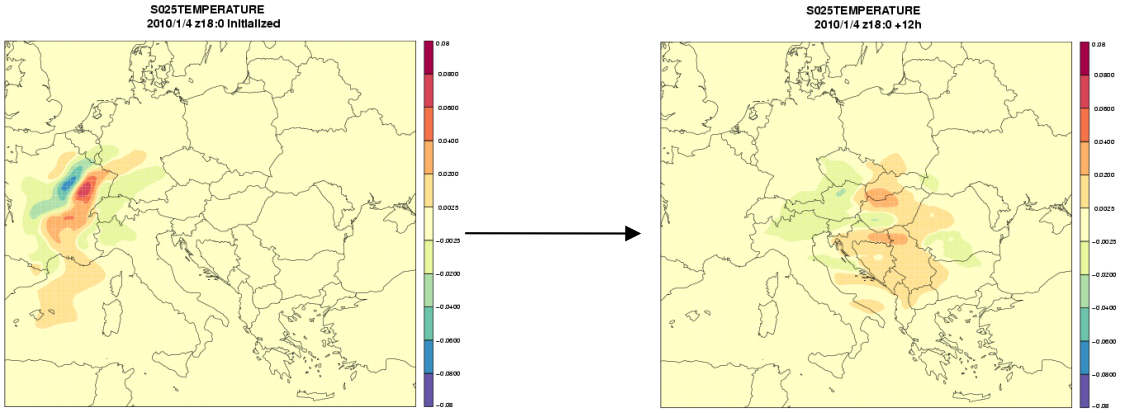
- A new scheme was necessary for screen level diagnostics
- Purple: ALADIN
- Blue: ALARO with original ALARO diagnostics
- Green: ALARO with ALADIN diagnostics
- Red: ALARO with new diagnostics

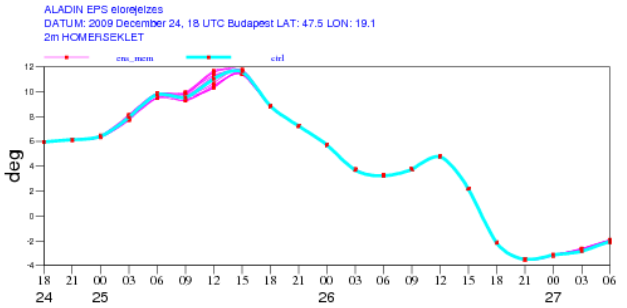
Possibilities to improve LAMEPS

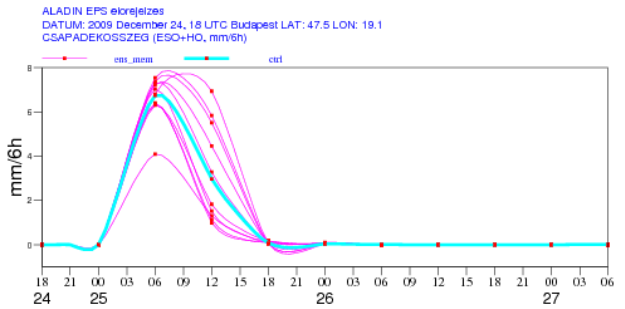
- Two methods of local perturbation generation have been examined:
  - Singular vector experiments
  - CANARI surface perturbations
- Addition of local observation (now there is no local data assimilation in LAMEPS)
- Find the best way of coupling (global model, frequency)

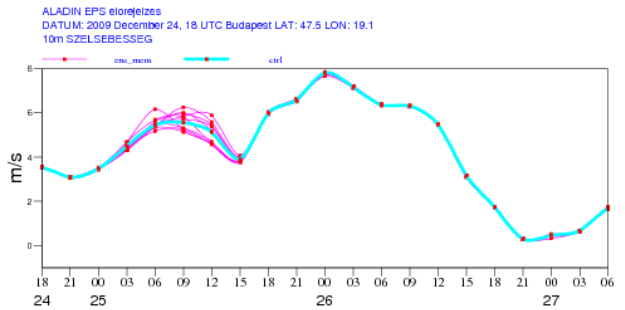
Singular vector experiments

- There were only a limited number of experiments because of the high computational cost
- Targeted SVs can be useful but
  - Not easy to find the way of rescaling the perturbations
  - The impact of SVs is limited in time



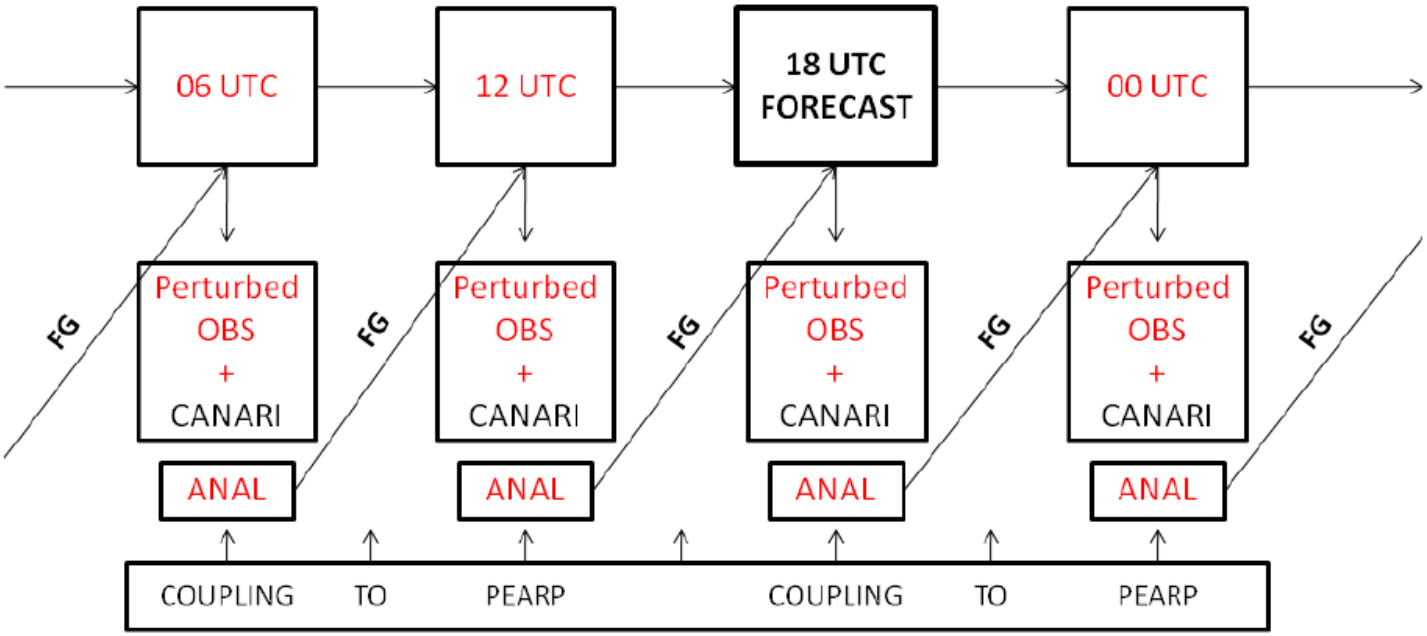






CANARI surface perturbations

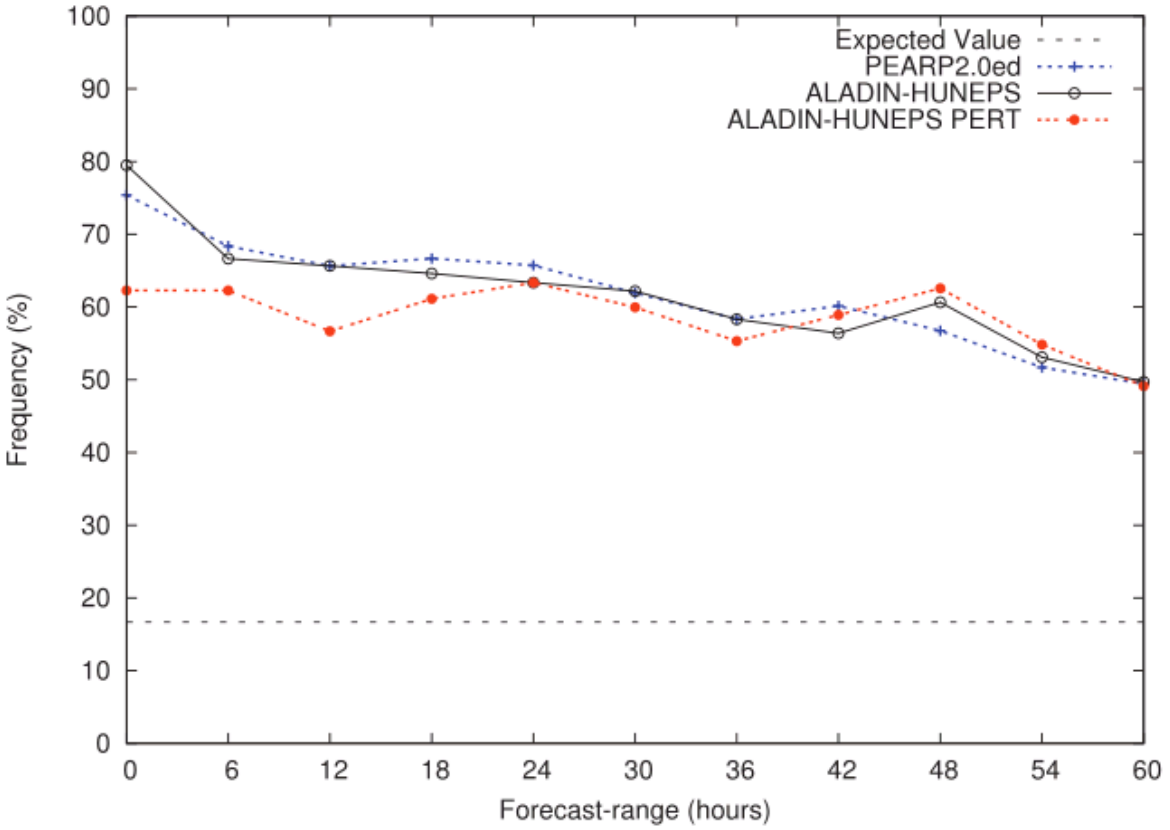
- An ensemble set of CANARI OI data assimilation cycles was installed



- The observations in CANARI OI were perturbed
- 6-hour cycle which was coupled to PEARP (run only at 18UTC)
- Forecasts were started at 18UTC

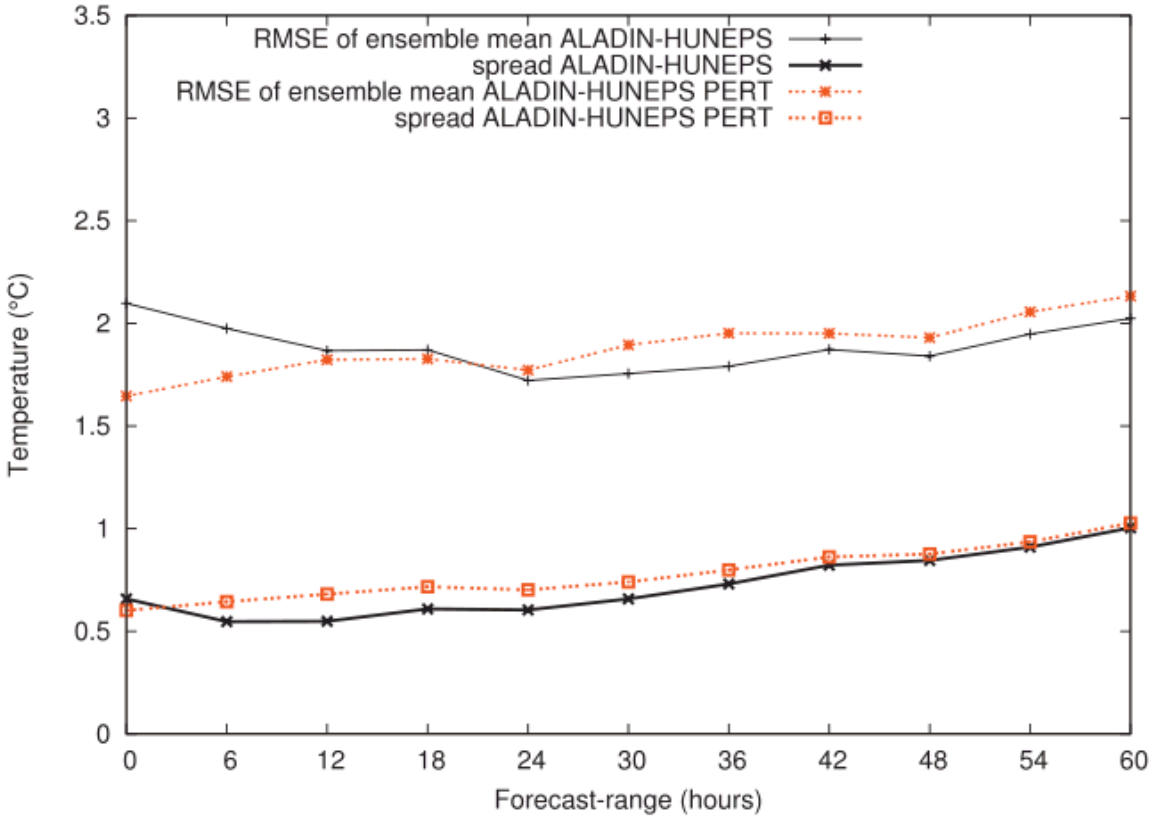
CANARI surface perturbations

- The method decreases the percentage of the outliers of 2meter temperature
- Black: unperturbed
- Blue: original PEARP
- Orange: perturbed



CANARI surface perturbations

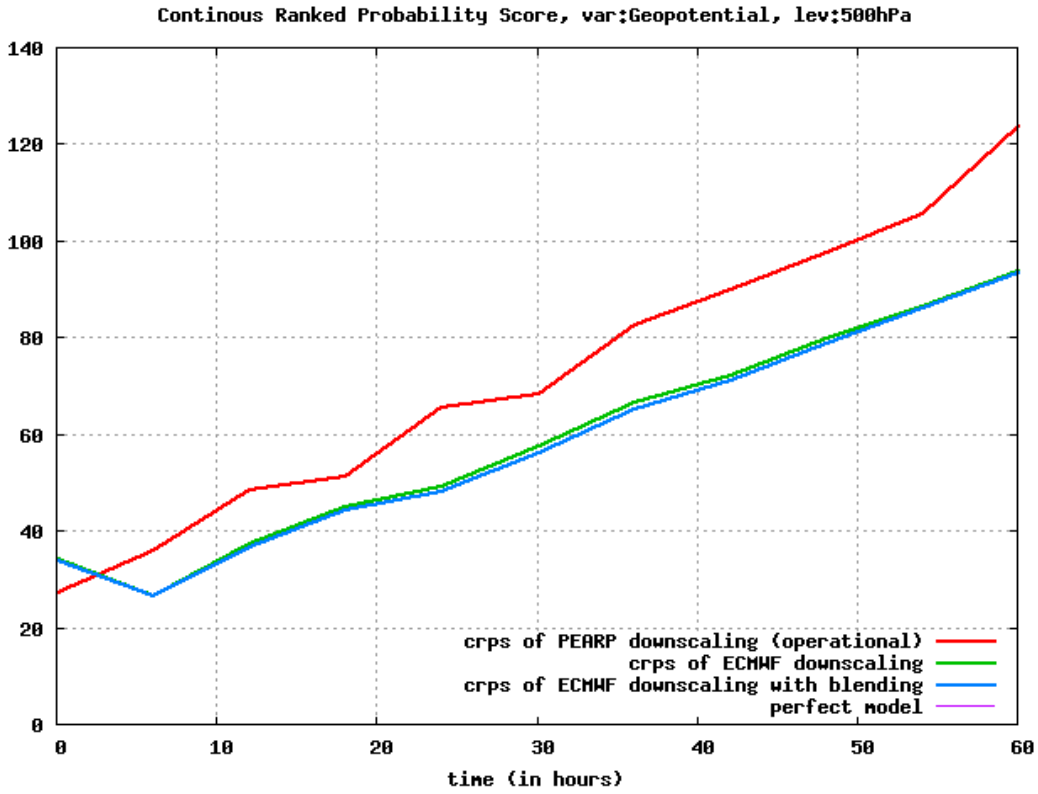
- It made not just a perturbation which increased the spread but improved the quality of the ICs
- Local perturbations and observation can be introduced



Coupling to the ECMWF EPS

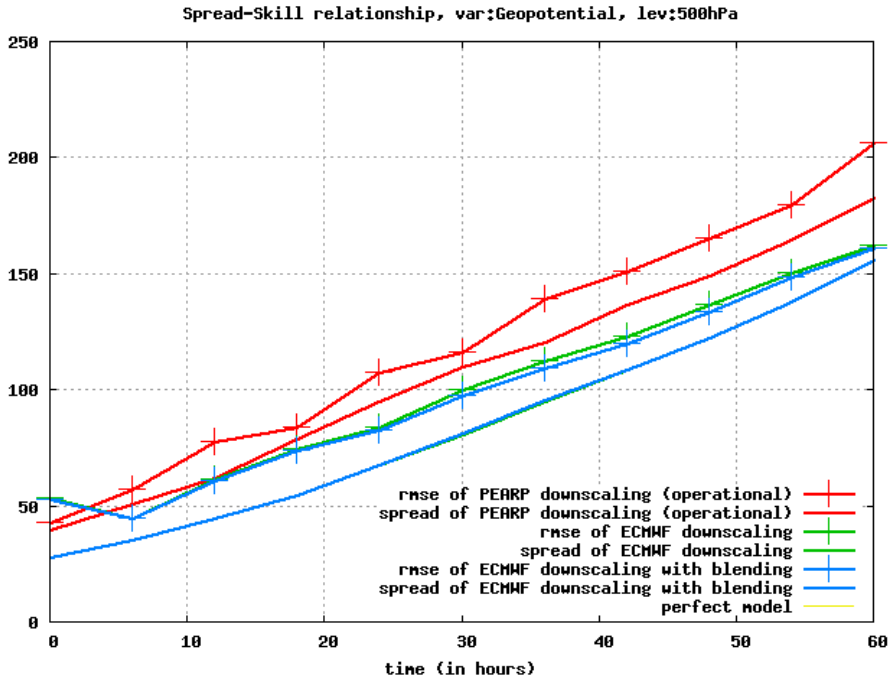
- Experiments in a framework of an ECMWF's special project

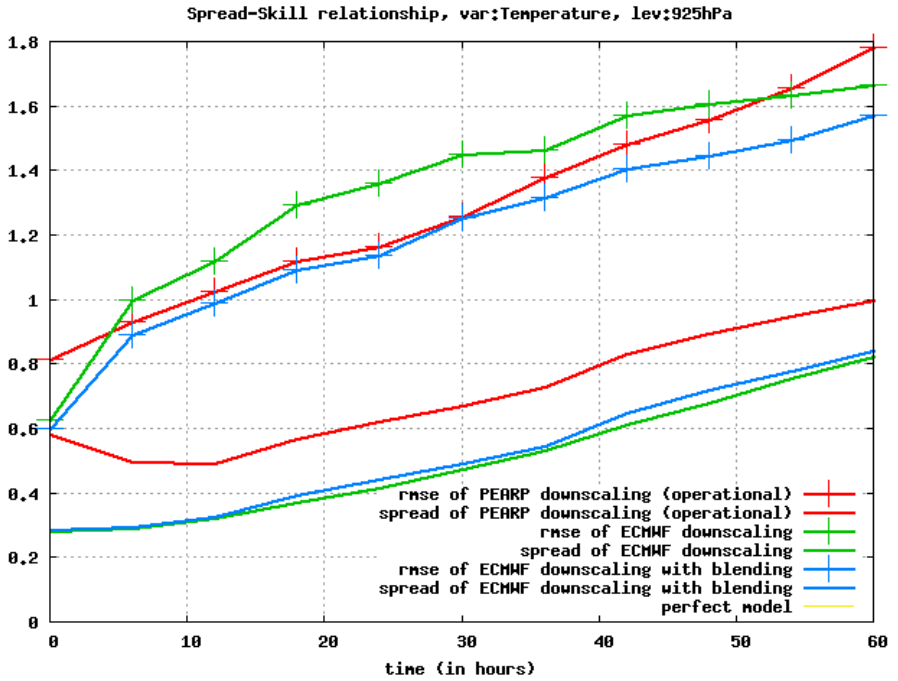
- Verifications made from about 50 cases
- 12UTC ECMWF EPS run is used to our 18UTC run
- Positive impact in high-atmosphere (500hPa geopotential)



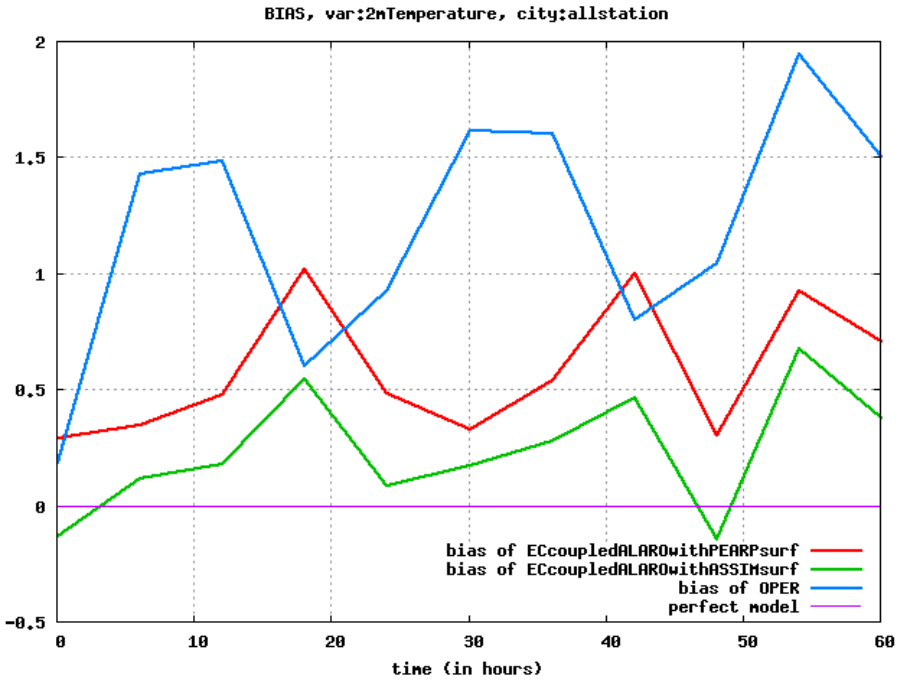
Coupling to the ECMWF EPS

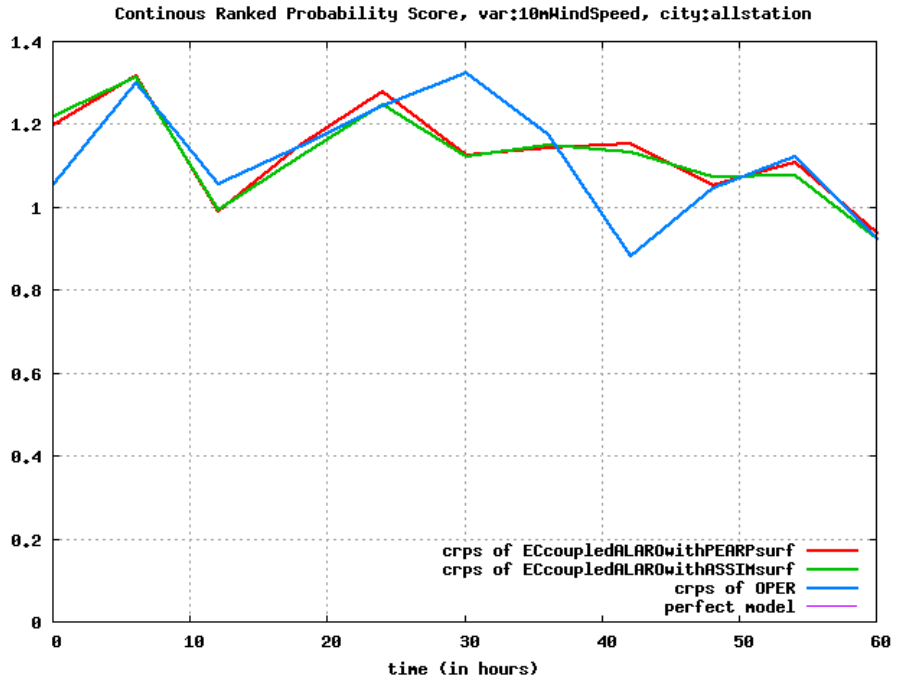
- Usually PEARP coupled system has higher rmse and higher spread
- The positive impact is less closer to the surface
- In blue version the surface fields are changed from ARPEGE





Coupling to the ECMWF EPS





- A configuration was installed where surface fields are from our 'deterministic' model (coupled to IFS, data assimilation is used)
- In 2m temp BIAS it improved a lot but there are problems with 10m wind CRPS
- Technically it works but there are some inconsistencies

Future plans

- Construction of an operational ensemble data assimilation system
  - The aim is to use and perturb as many observation as possible
- Further investigation around the question of LBCs
- Long-term plans with mesoscale EPS
  - In the framework of an ECMWF's special project
  - With AROME model

Thank you for your attention!

Questions?