WG7 summary and Science Plan

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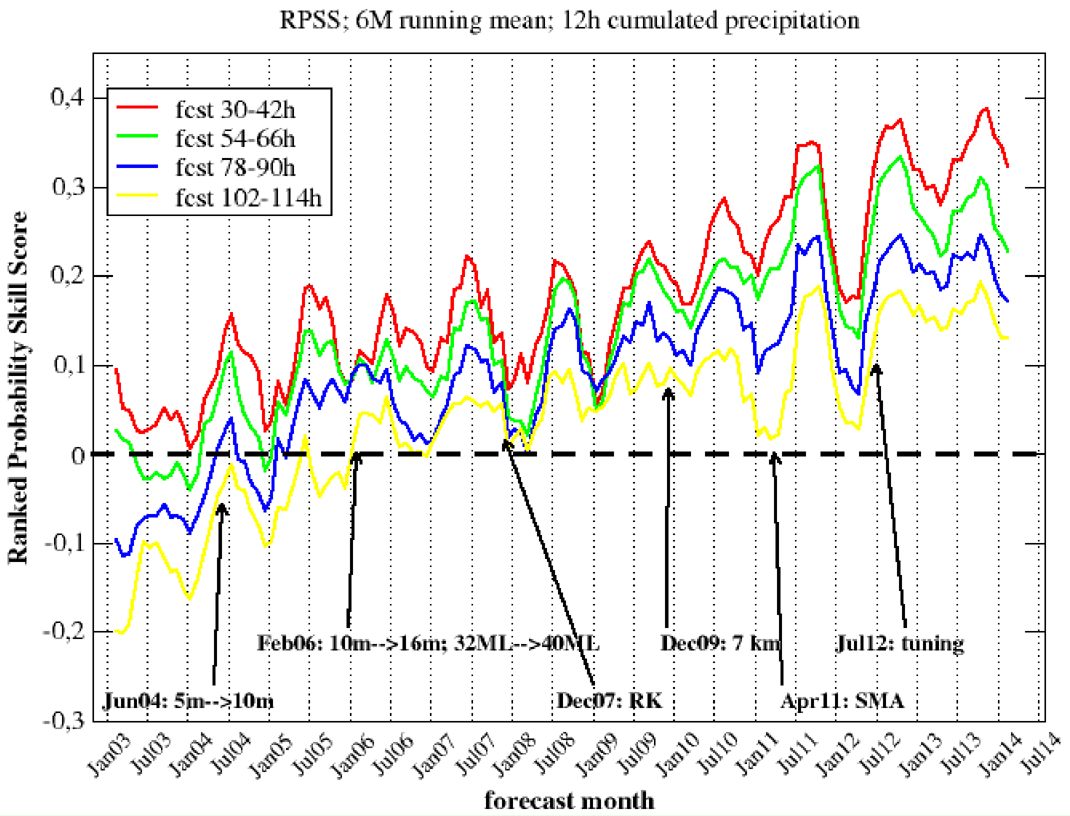
CONSORTIUM FOR SMALL SCALE MODELING
COSMO

WG7

- COTEKINO PP
  - SPPT
  - soil perturbation
  - coordination of activities on KENDA-based ICs for ensemble forecasting
  - physics perturbation
- COSMO-LEPS (ope)
- COSMO-DE-EPS (ope)
- COSMO-ME-EPS (pre-ope)
- COSMO-IT-EPS (dev)
- COSMO-E (dev)
- EPS verification with VERSUS (with WG5)

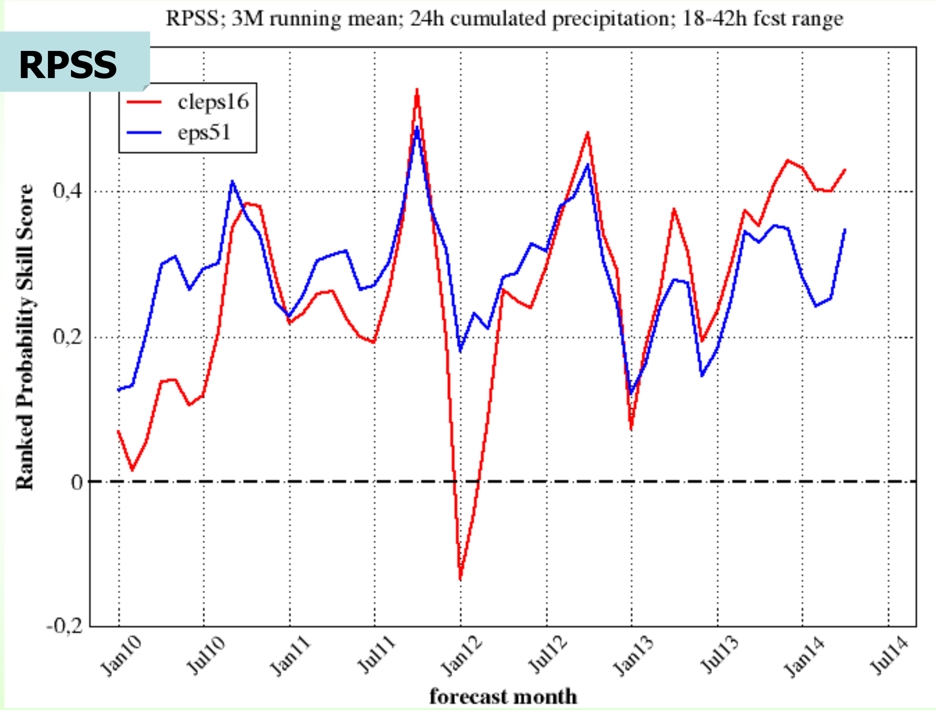
COSMO-LEPS

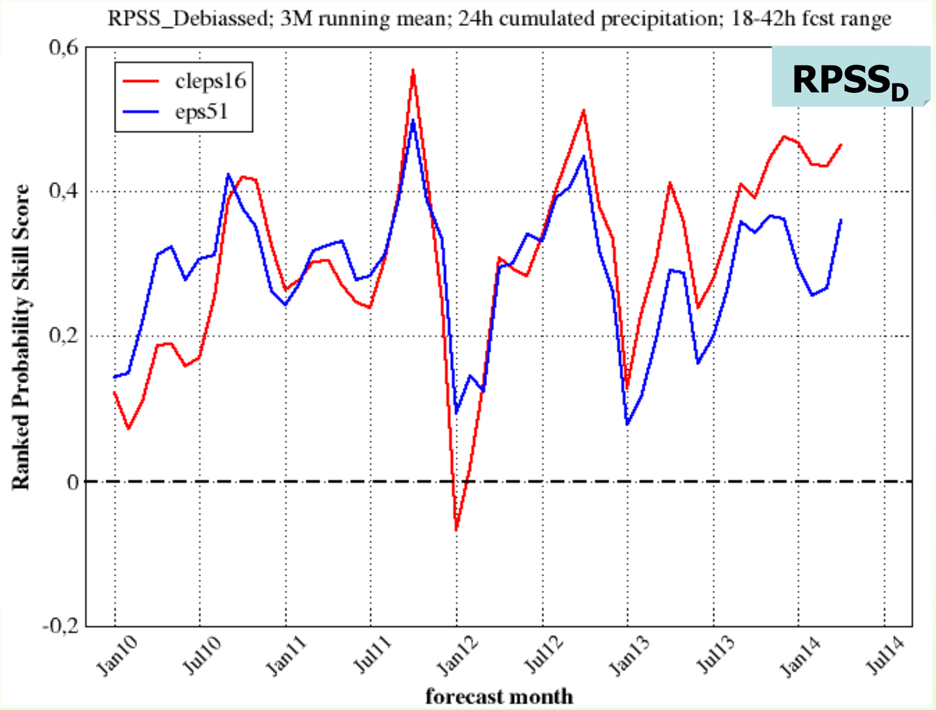
Ranked Probability Skill Score (RPSS)



Time series of Ranked Probability Skill Score maximum values (boxes 1.0 X 1.0) – 18-42h

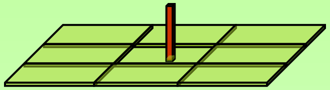
COSMO-LEPS 16 members
ECMWF ENS 51 members





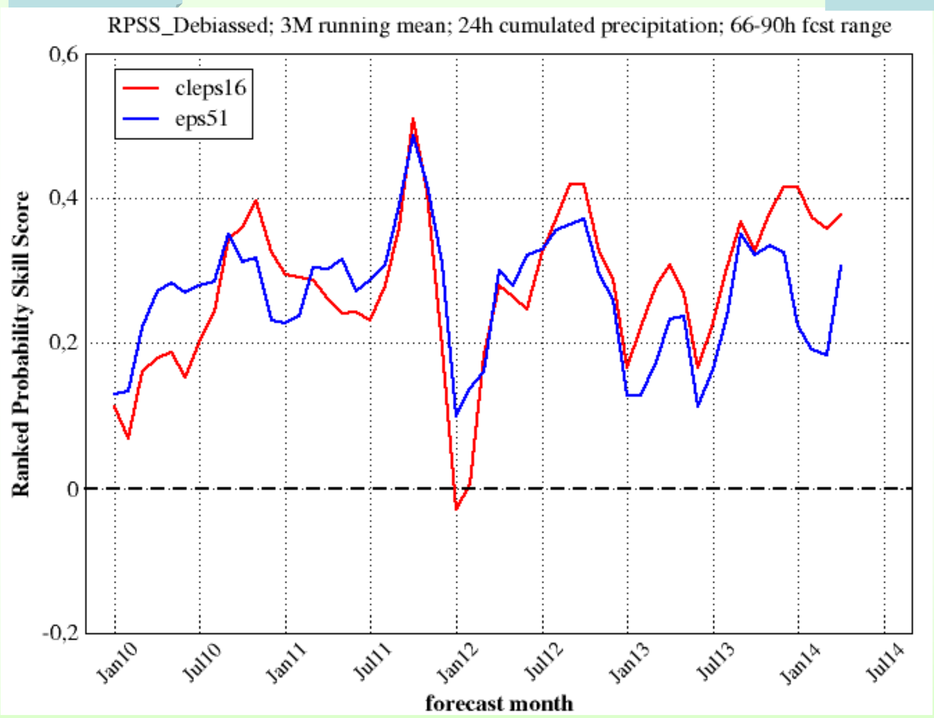
- Seasonal cycles of the scores; worse performance in winters, possibly related to the presence of snow (some stations are not heated).
- Either way (RPSS or $RPSS_D$), ECMWF-EPS had initially higher scores; then, COSMO-LEPS has had higher scores than ECMWF-EPS since 2013 in the short range, despite the lower ensemble size.

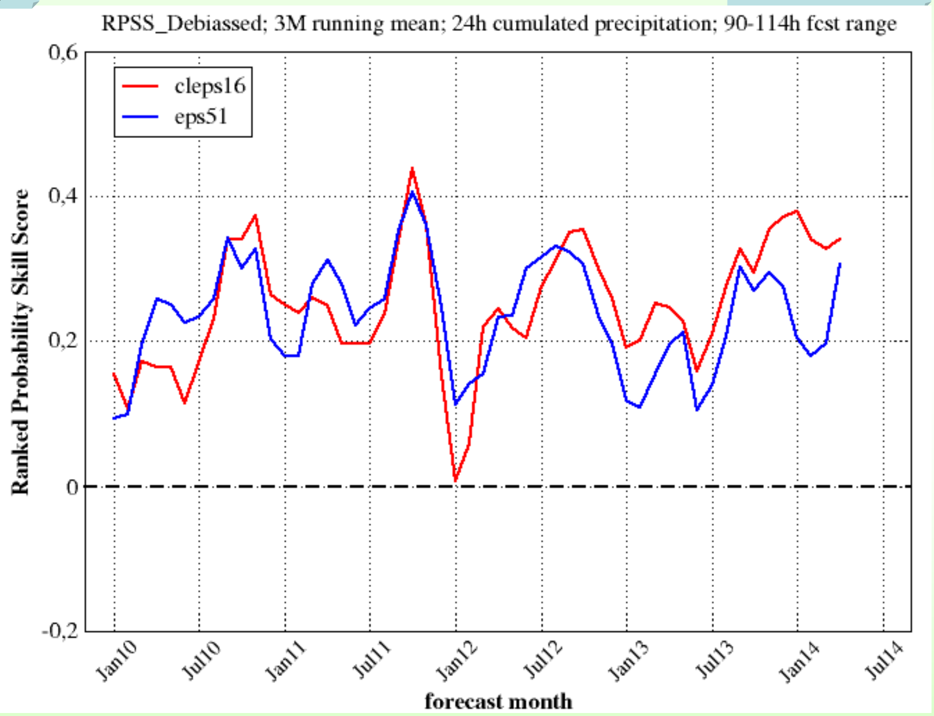
Time series of Ranked Probability Skill Score maximum values (boxes 1.0 X 1.0) – 66-90h



COSMO-LEPS 16 members
ECMWF ENS 51 members

66-90h **$RPSS_D$** **90-114h**





The same applies (COSMO-LEPS has higher scores than ECMWF-EPS) for all forecast ranges.

Types of convection schemes

With the introduction of COSMO V5.0, Kain-Fritsch convection scheme is no more supported:

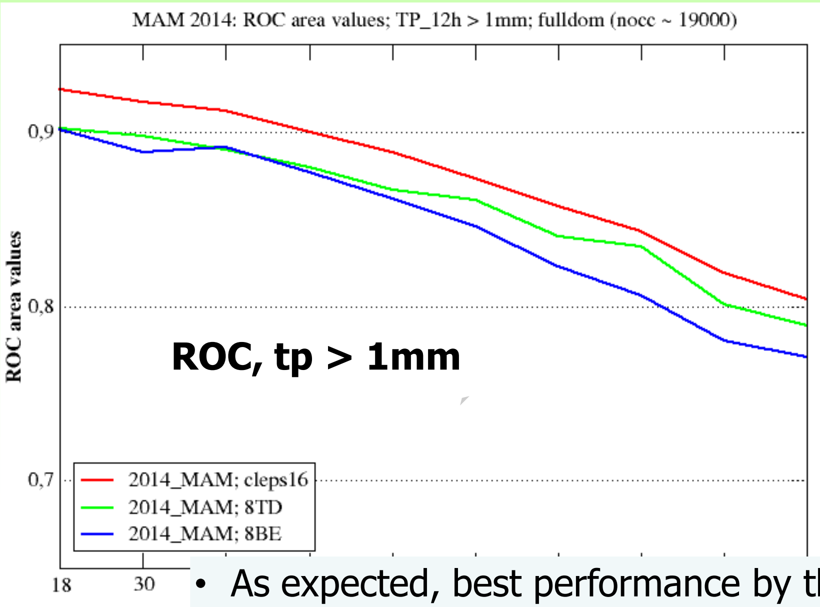
- members 1-8 use Tiedtke convection scheme (**8TD**),
- members 9-16 use IFS-Bechtold scheme (**8BE**).

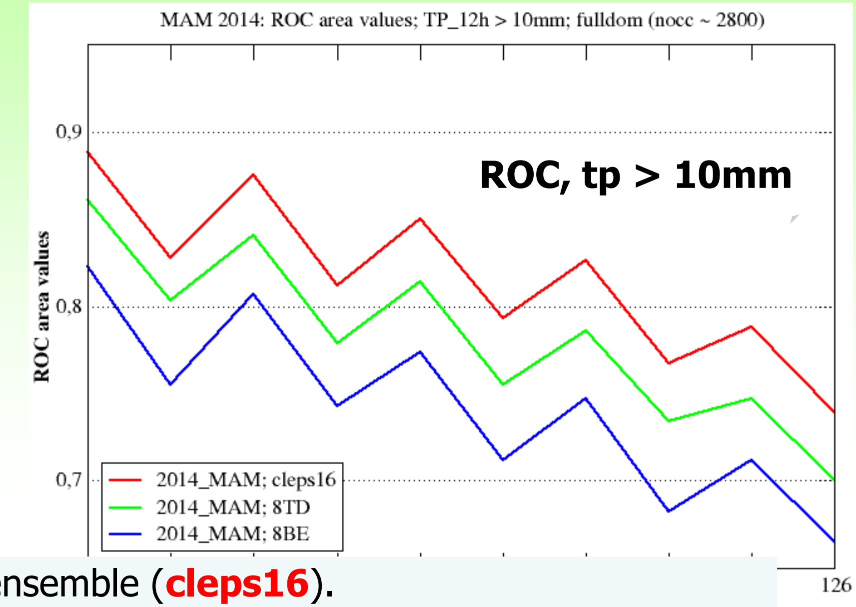
MAM 2014 (very rainy):

compare separately cleps16, 8TD, 8BE over the full domain

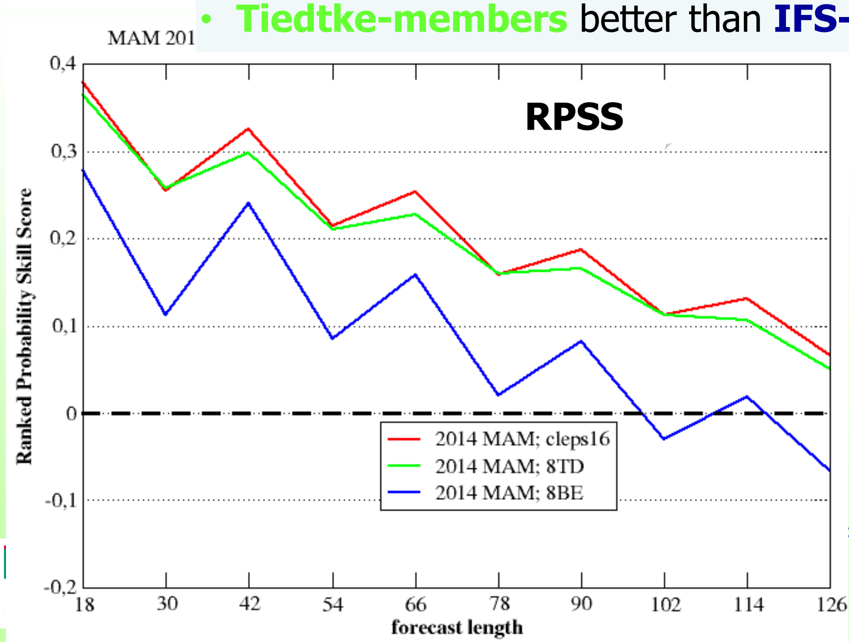
cleps16
8TD 8BE

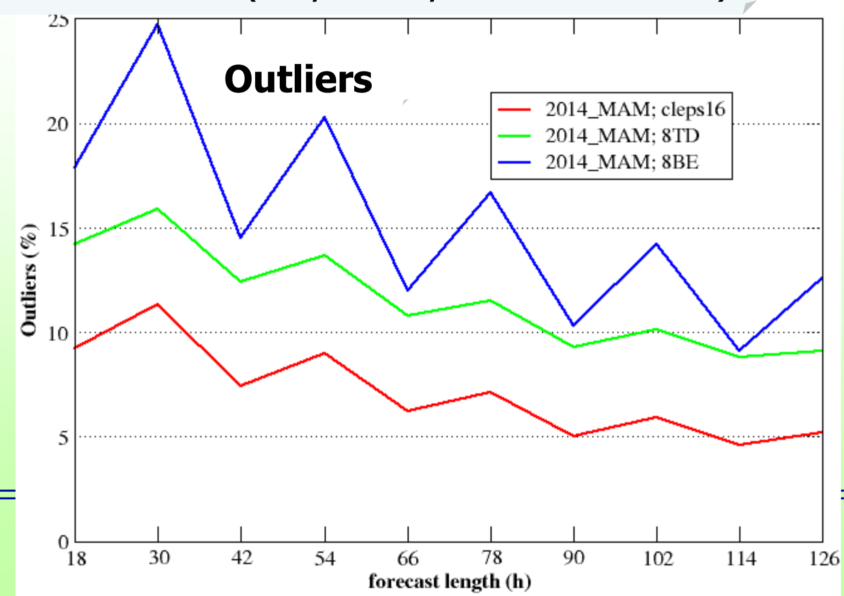
about the convection scheme





- As expected, best performance by the full ensemble (**cleps16**).
- **Tiedtke-members** better than **IFS-Bechtold members** (very clearly for some scores).





about the future plans

- **September 2014: adapt COSMO-LEPS suite to ECWMF forthcoming upgrades:**
  - change of super-computer: IBM → Cray;
- October 2014: test increase of COSMO-LEPS vertical resolution (40 → 50ML);
- Migration to GRIB2.
- Carry on study about the clustering methodology.
- *Analysis of the performance of COSMO-HYBEPS (COSMO-LEPS + COSMO runs nested on IFS/GME/GFS)*

Any request for modifications to the present configuration of COSMO-LEPS?

If IFS-Bechtold members are still much worse than Tiedtke members, what about using only one convection scheme?

Increase the integration domain of COSMO-LEPS (Greek request)?

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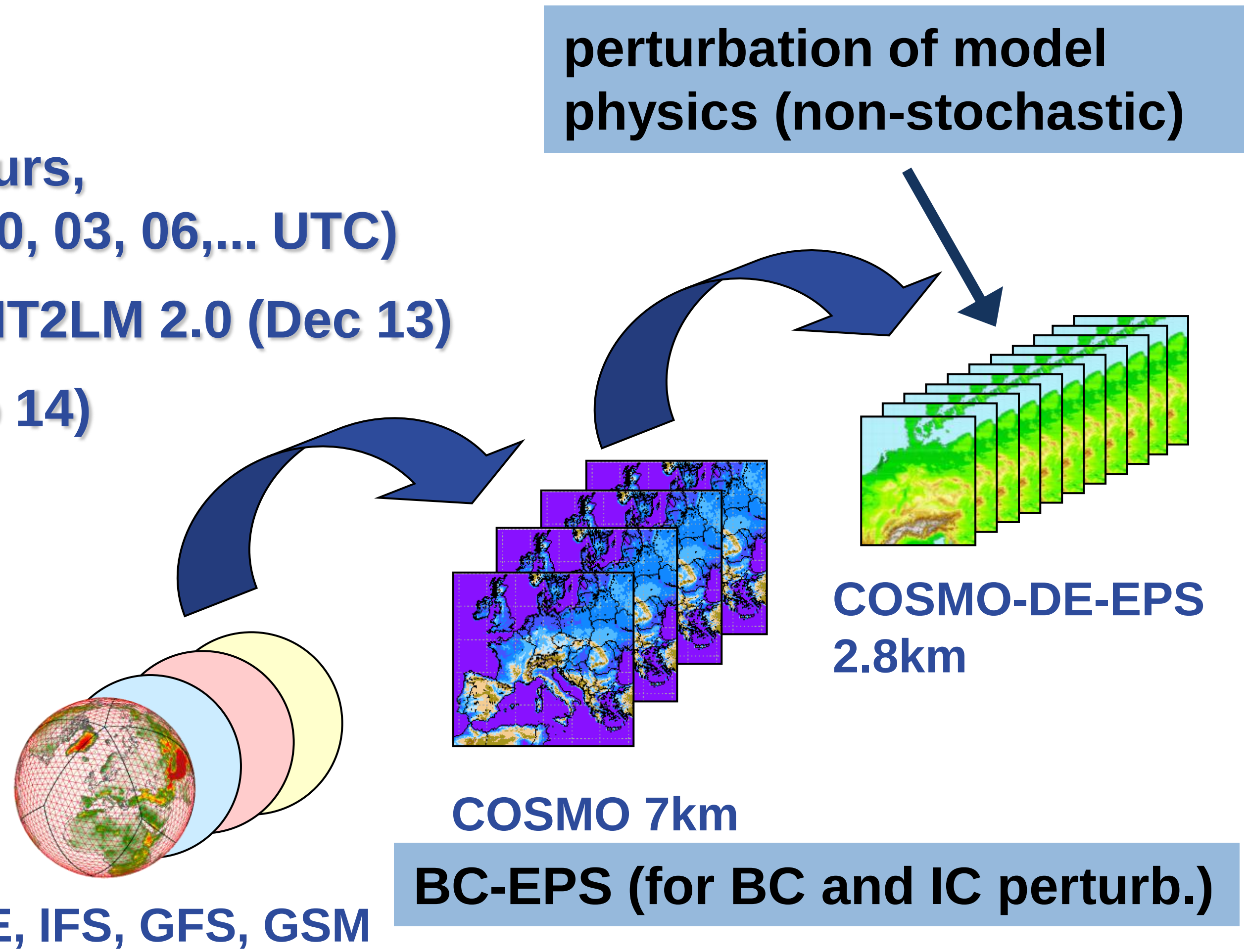
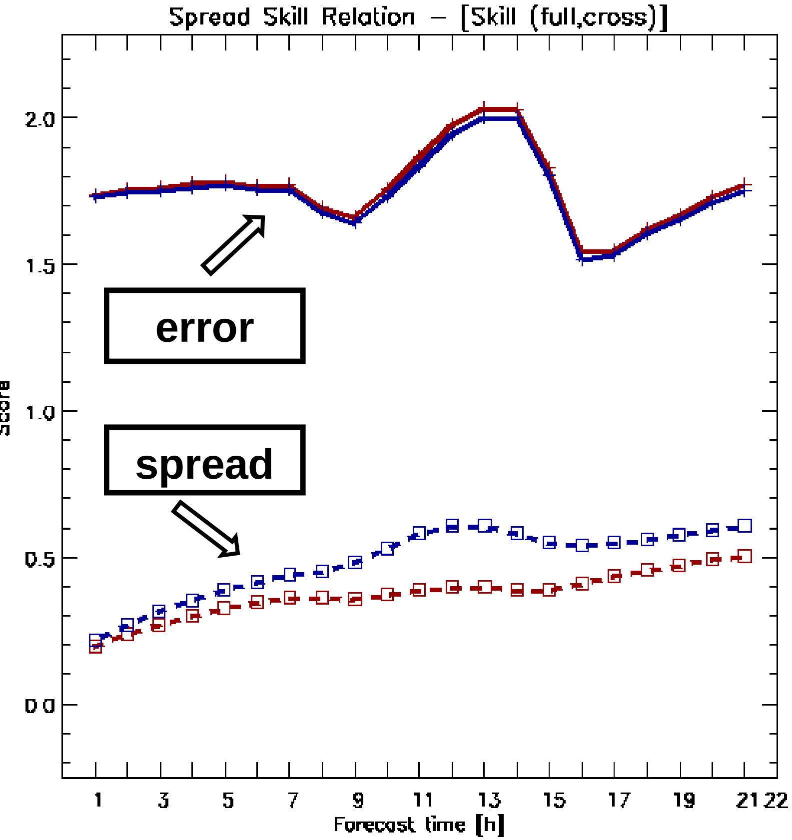
COSMO-DE-EPS operational set-up

- ➔ 20 members
- ➔ grid size: 2.8 km
- ➔ lead time: 0-27 hours,
  8 starts per day (00, 03, 06,... UTC)
- ➔ COSMO 5.0 and INT2LM 2.0 (Dec 13)
- ➔ COSMO 5.0.1 (Feb 14)
- ➔ GRIB 2 (Jun 14)



Perturbation of minimum diffusion coefficient

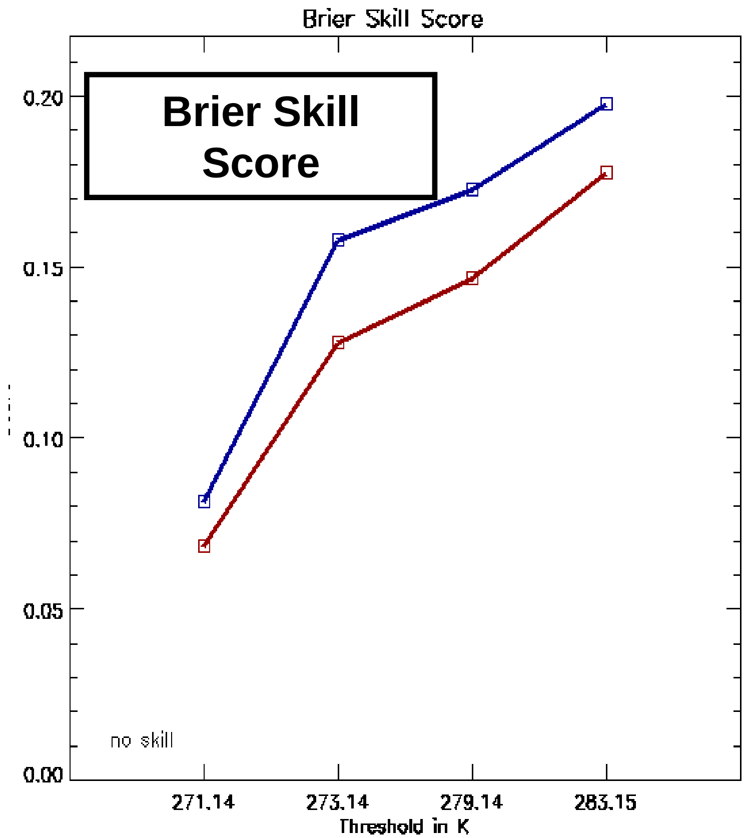
identical perturbation of coeff. for heat and momentum (tkhmin + tkmmin)



2m temperature

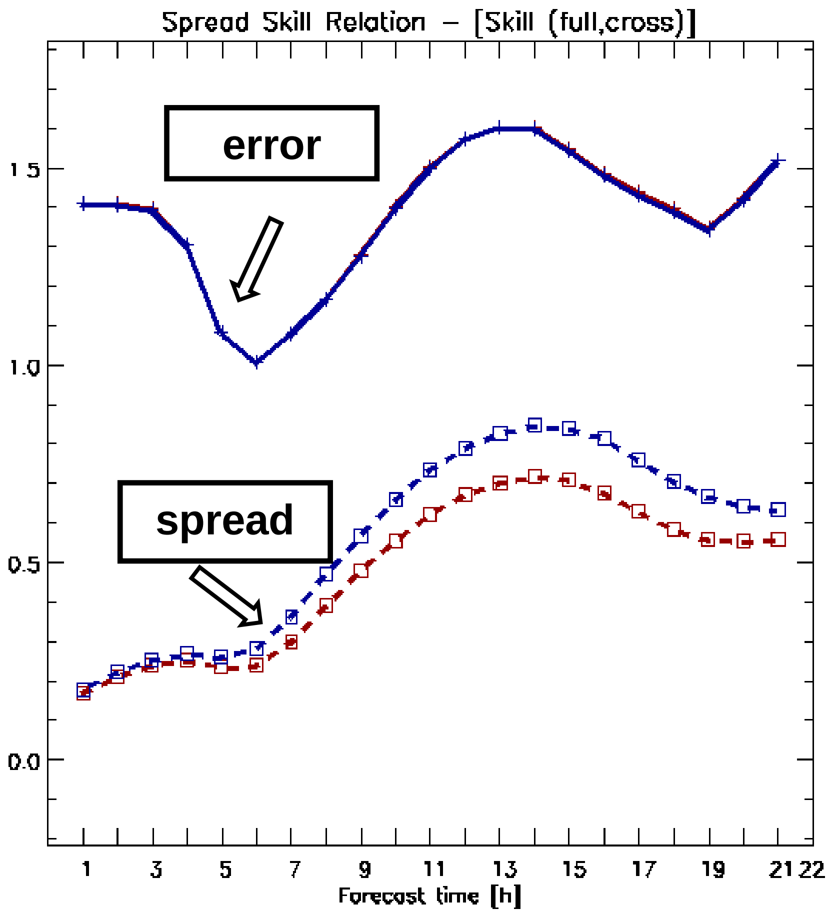
perturbed minimum diffusion

reference



Perturbation of soil moisture

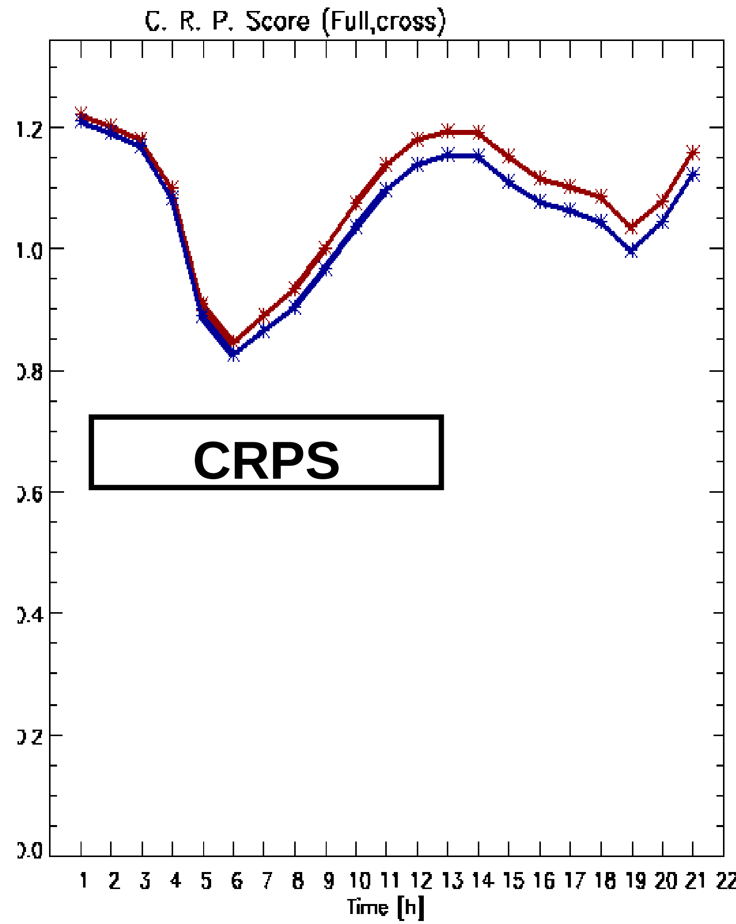
± half the difference between C-EU and C-DE soil moisture as anomaly in all layers but the lowest



2m temperature

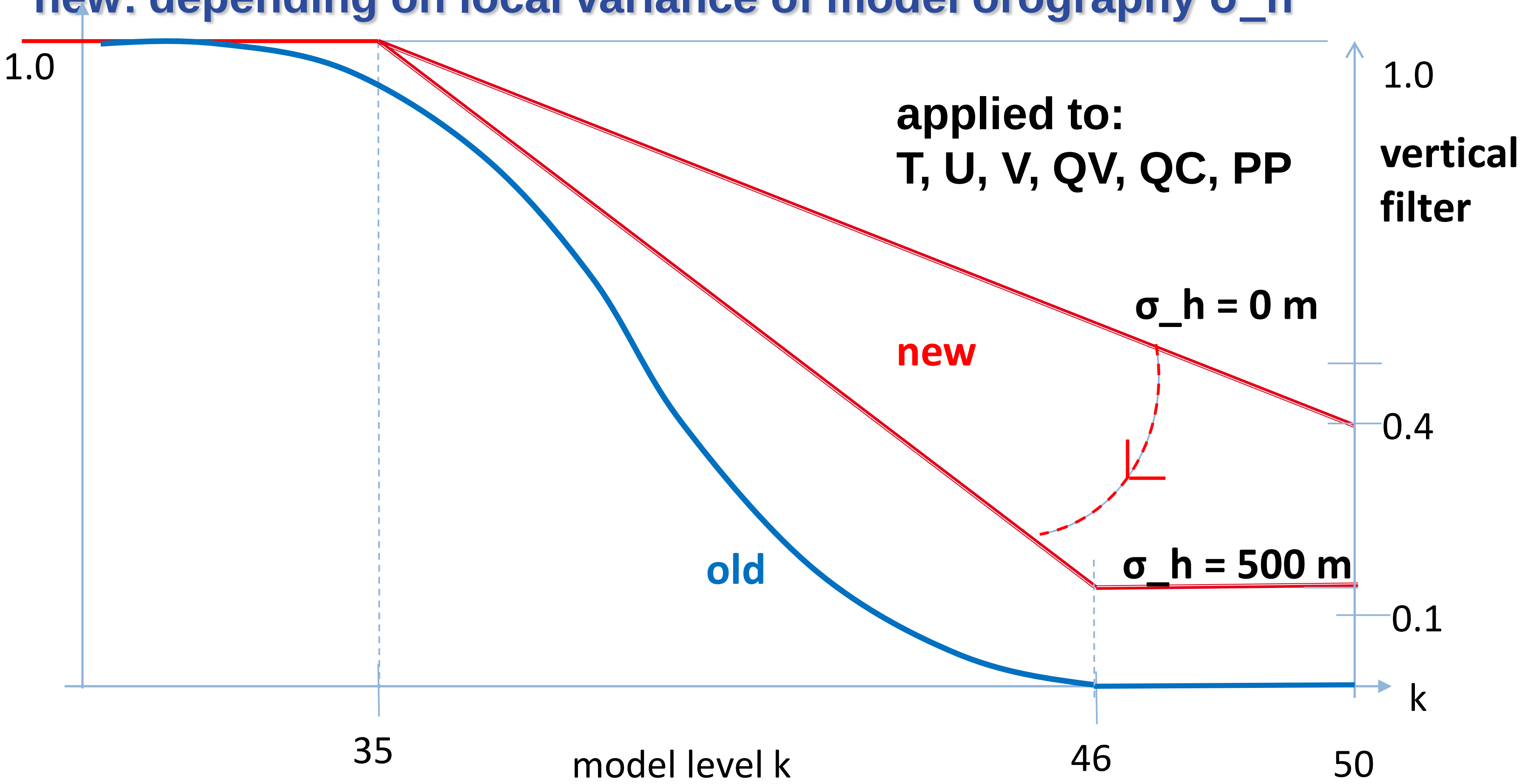
perturbed soil moisture

reference



Modified vertical filter of IC perturbations

new: depending on local variance of model orography σ_h



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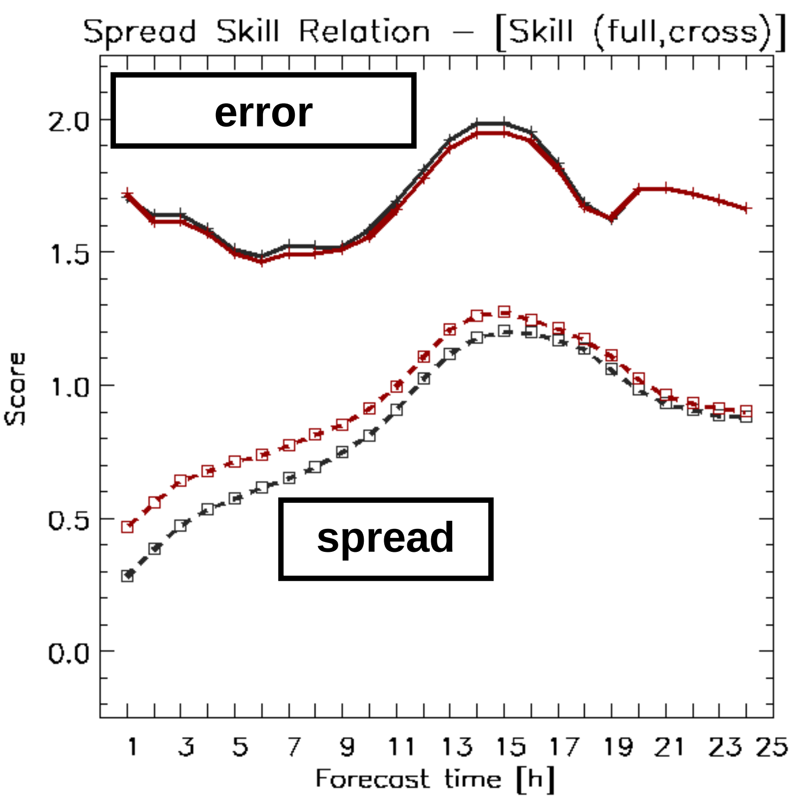
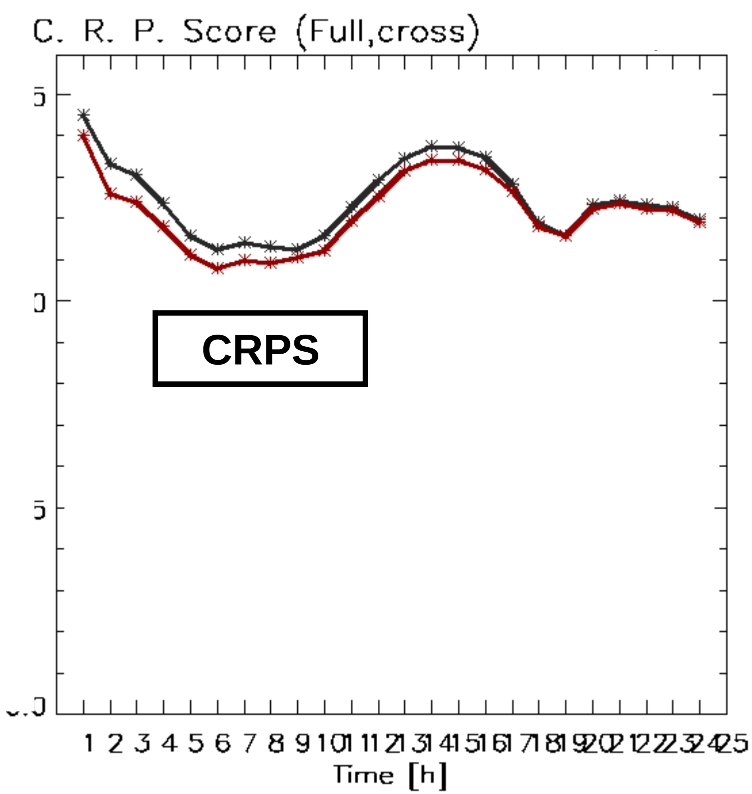


10m wind gusts

new IC pert

reference

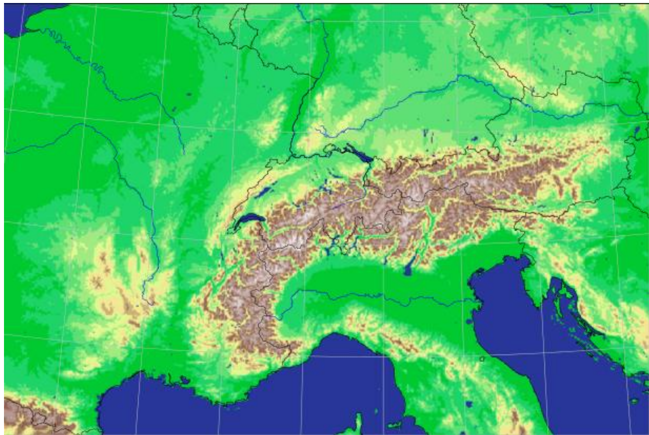


Current research & future plans

- ➔ extend to 40 Members (COSMO-LEPS as additional BCs)
- ➔ focus on forecast variability of other variables in the context of renewable energy projects (wind energy + photovoltaic)
- ➔ use of KENDA for IC perturbations
- ➔ use of ICON EPS for BC perturbations
- ➔ calibration of probabilistic products
- ➔ add new physics perturbations or alternative perturbation methods (e.g. stochastic physics)

COSMO-E

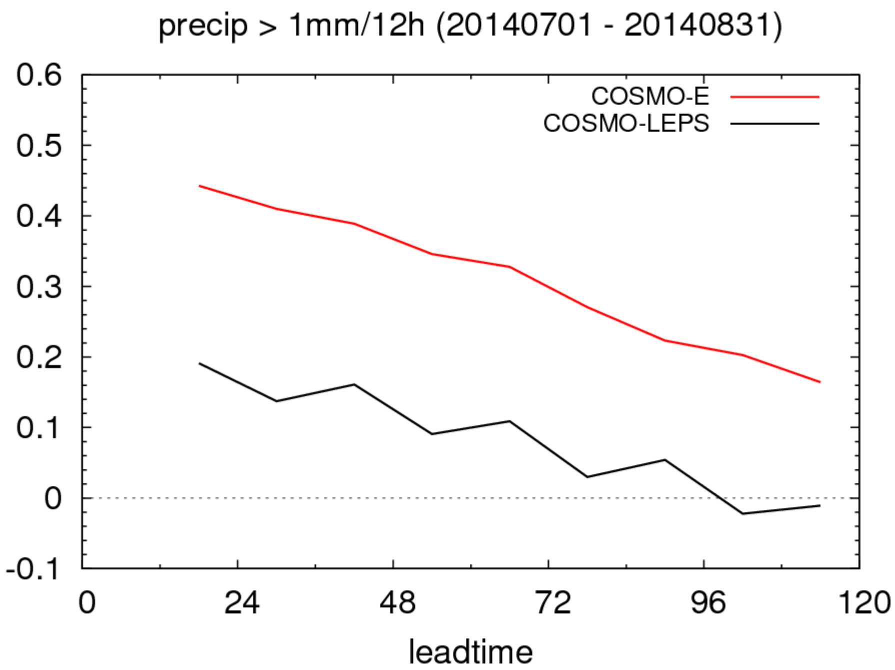
- Ensemble forecasts with convection-permitting resolution (2.2 km mesh-size, 60 vertical levels)
- 21 members, forecasts up to +120h, Alpine area (domain 25% larger as for COSMO-2)
- regular runs once per day started end of May, stable as of mid of June
- perturbations:
  - IC: downscaled/re-cycled soil (later KENDA)
  - LBC: IFS-ENS (members 0-20)
  - model errors: Stochastic Perturbation of Physical Tendencies (SPPT)
- COMO version 5.0 (single precision)

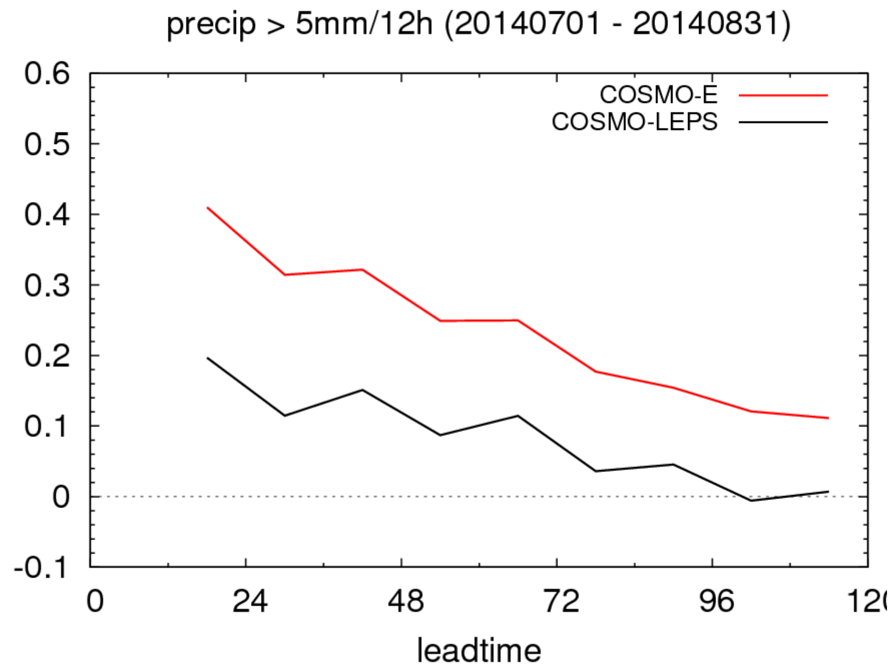


Brier Skill Score (BSS)

skill wrt climatology (2001-2010) based on 300 stations

COSMO-E
COSMO-LEPS



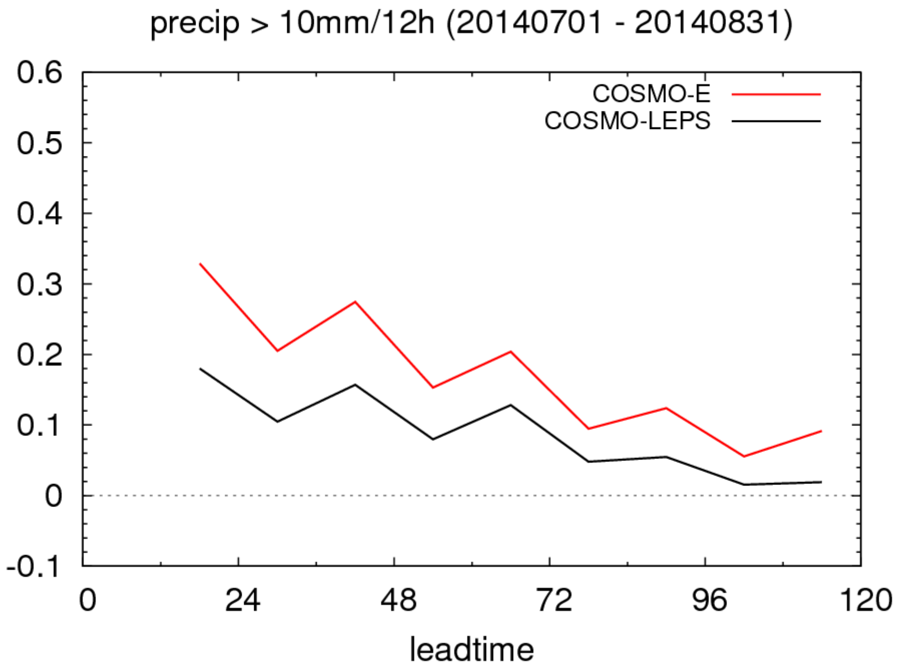


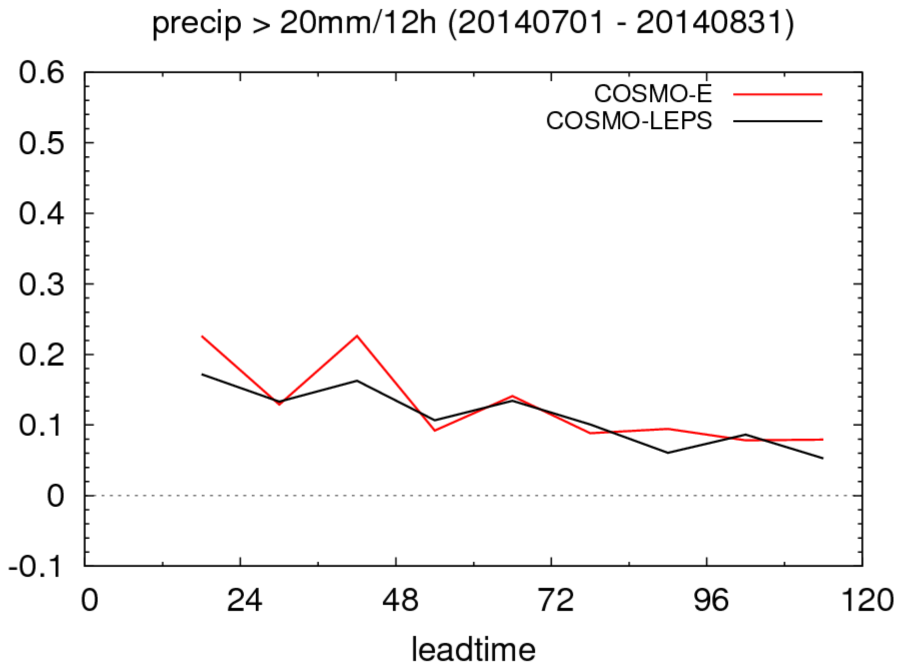
- COSMO-E shows significant skill until end of forecast range
- clearly better than COSMO-LEPS, even though 9 grid-points averages used for both

Brier Skill Score (BSS)

skill wrt climatology (2001-2010) based on 300 stations

COSMO-E
COSMO-LEPS

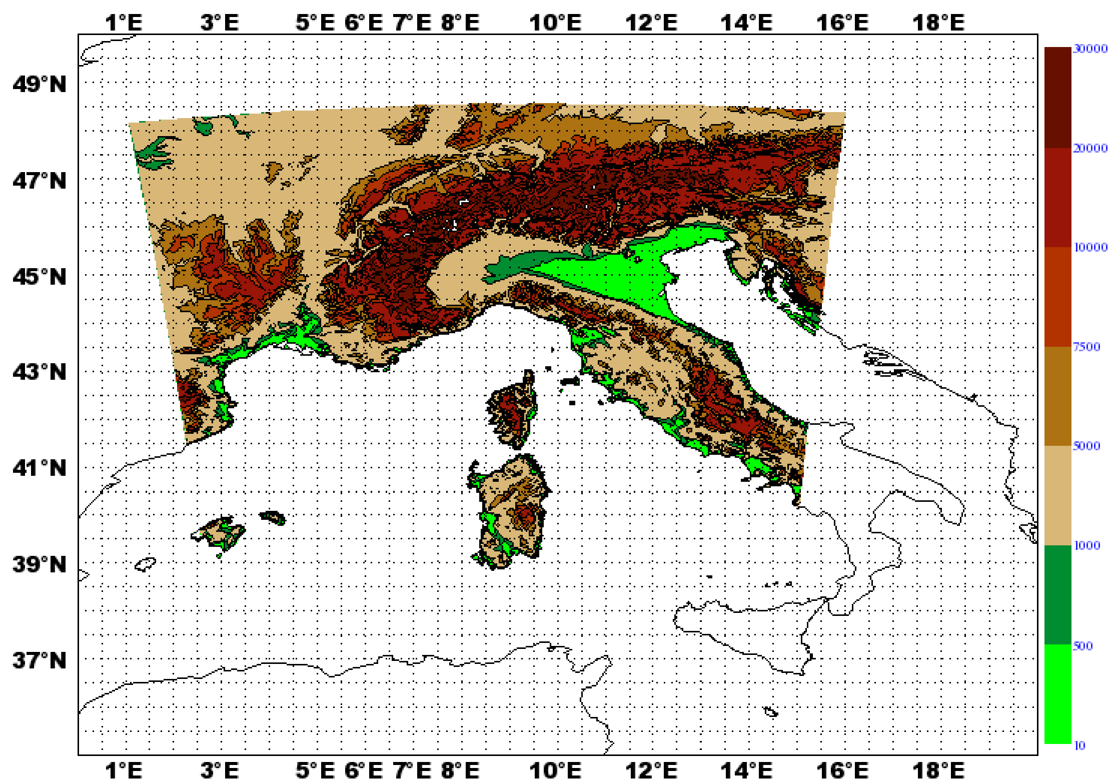




- COSMO-E shows significant skill until end of forecast range
- For large precipitation COSMO-E only slightly better than COSMO-LEPS

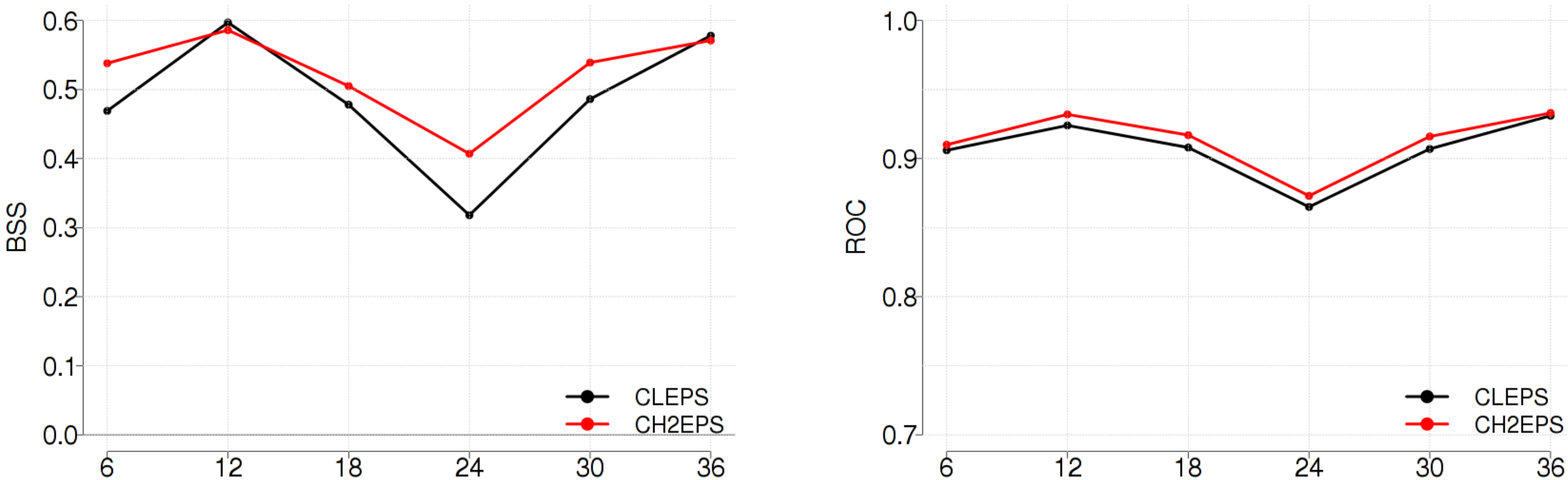
COSMO-IT-EPS
first experimentation for the Hymex project

- Hymex SOP: 6th Sept – 5th Nov 2012
- ensemble set-up:
  - IC and BC from COSMO-LEPS
  - parameter perturbations
  - 2.8 km, 50 levels
  - 10 members
  - run at 12 UTC
  - 36h forecast range

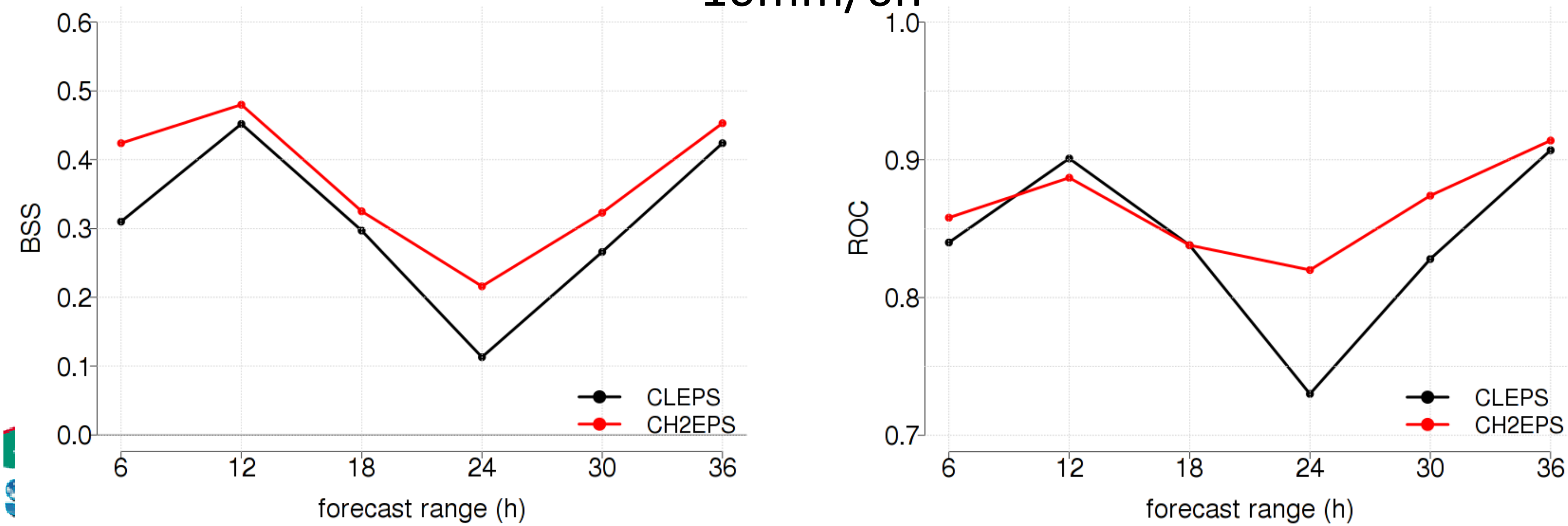


6h precipitation, average value over boxes of 0.2 x 0.2

1mm/6h

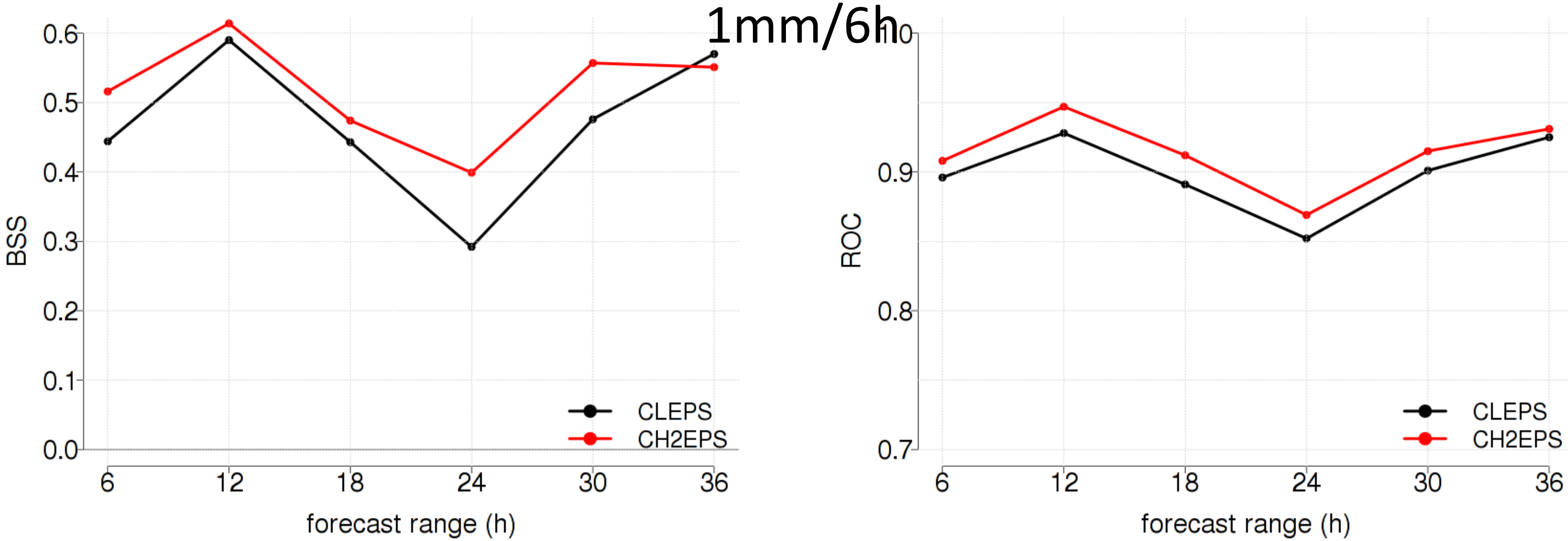


10mm/6h

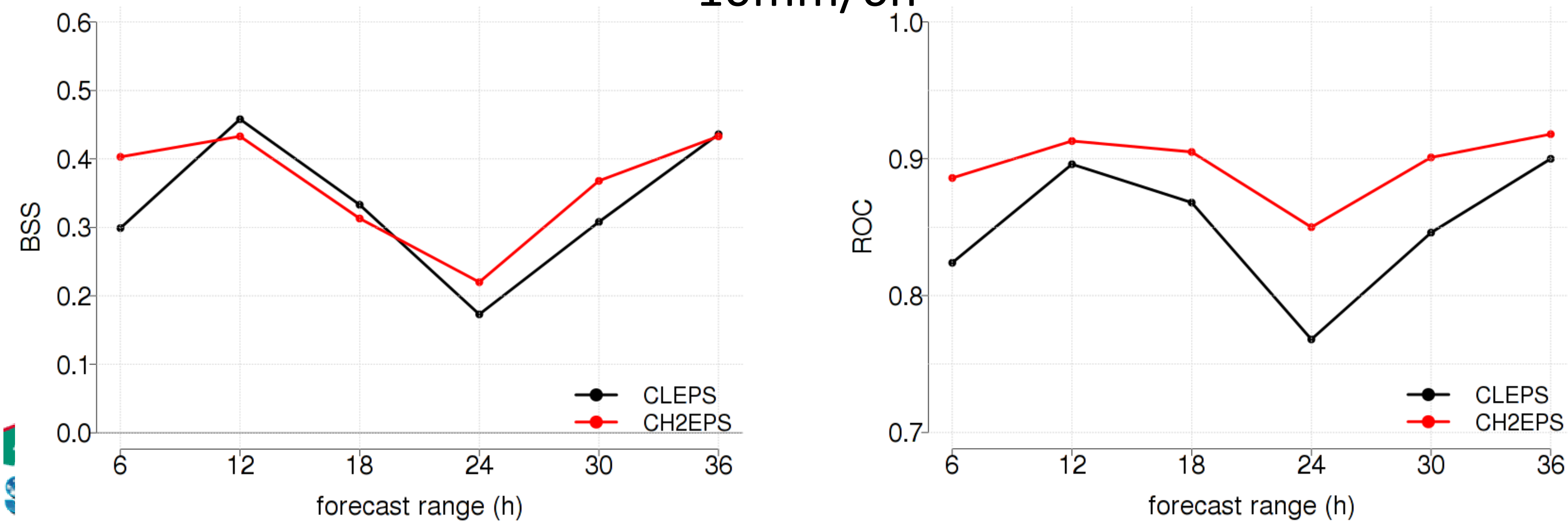


6h precipitation, maximum value over boxes of 0.2 x 0.2

1mm/6h

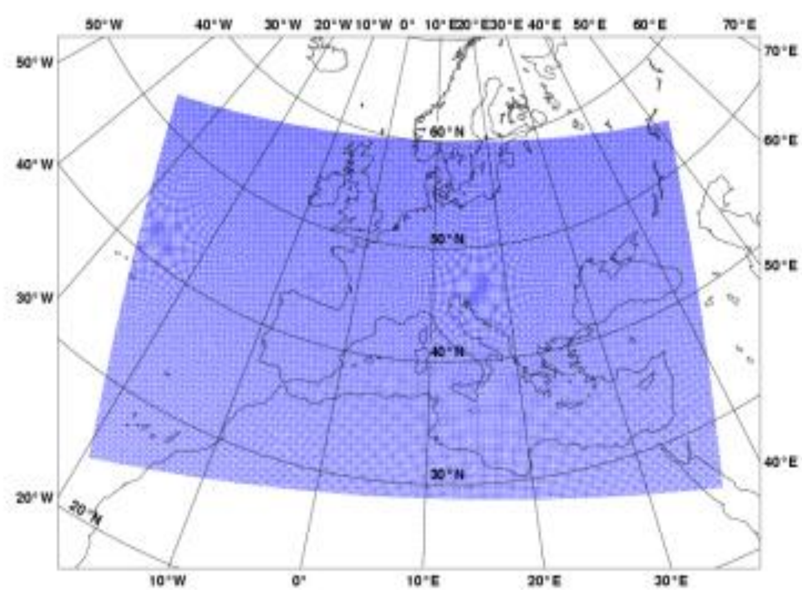


10mm/6h

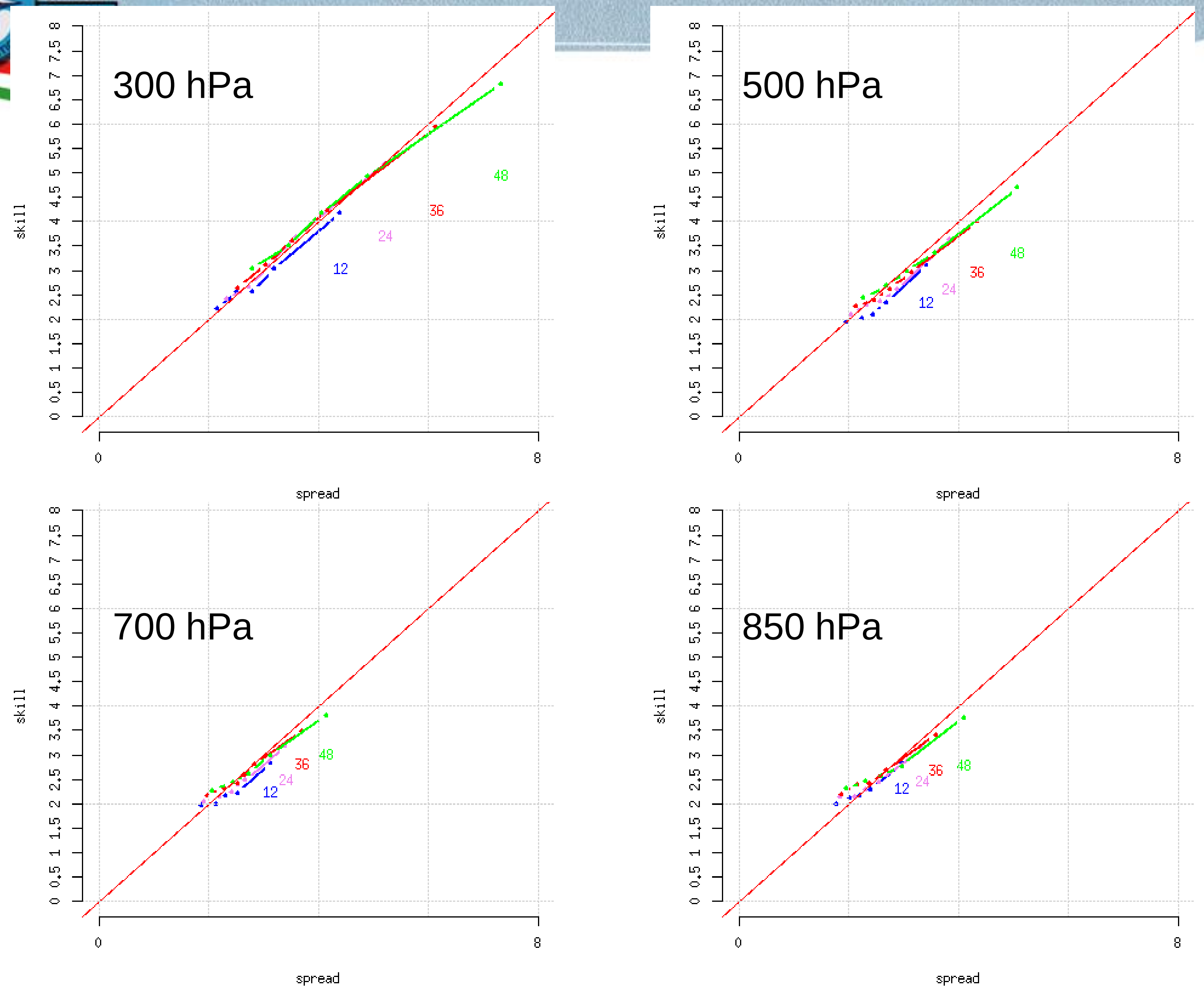


The COSMO-ME EPS SYSTEM

- Domain and resolution:
  - Mediterranean-European domain
  - 0.09° grid spacing (~10 km) and 45 vertical levels
  - 40+1 ensemble members
- IC and BC: initial conditions are derived every 6 hours from the CNMCA-LETKF system. Lateral boundaries conditions are from IFS deterministic run perturbed using ECMWF-EPS.
- Surface perturbations: climatological perturbed sea surface temperature.
- Model error: stochastics physics perturbation tendencies.
- Forecast range: the 40+1 COSMO forecast members will run up to 48 hours at 00 UTC.
- Under testing at CNMCA since july 2013

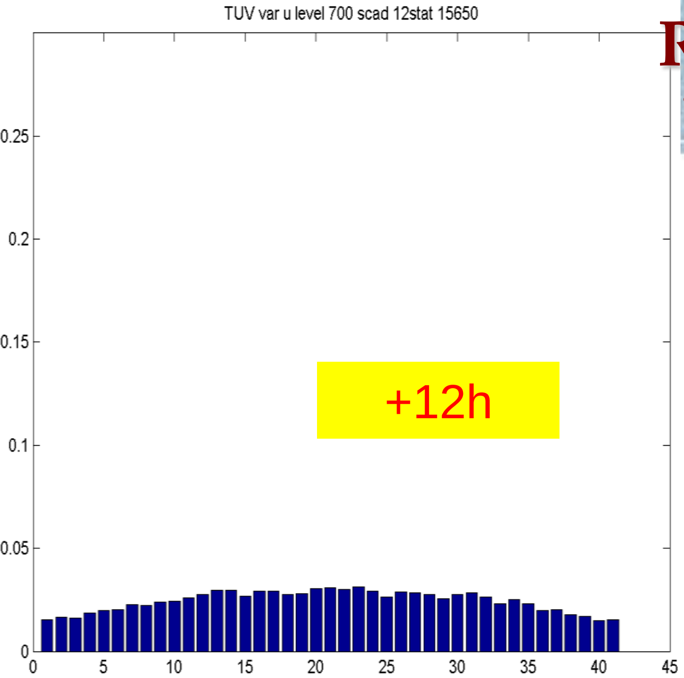


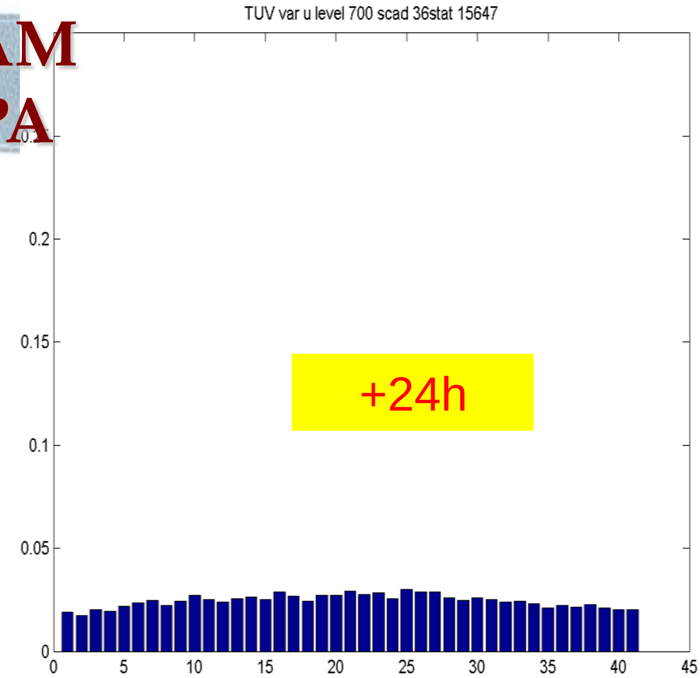
SPREAD-SKILL DIAGRAM U-WIND (5 BINS, OBS TEMP, ERR_OBS)



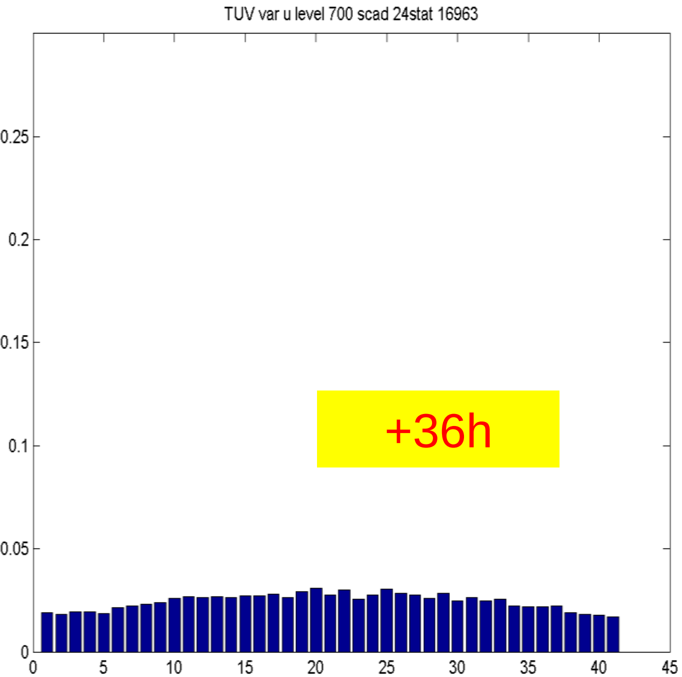
RANK HISTOGRAM U-WIND @ 700 HPA

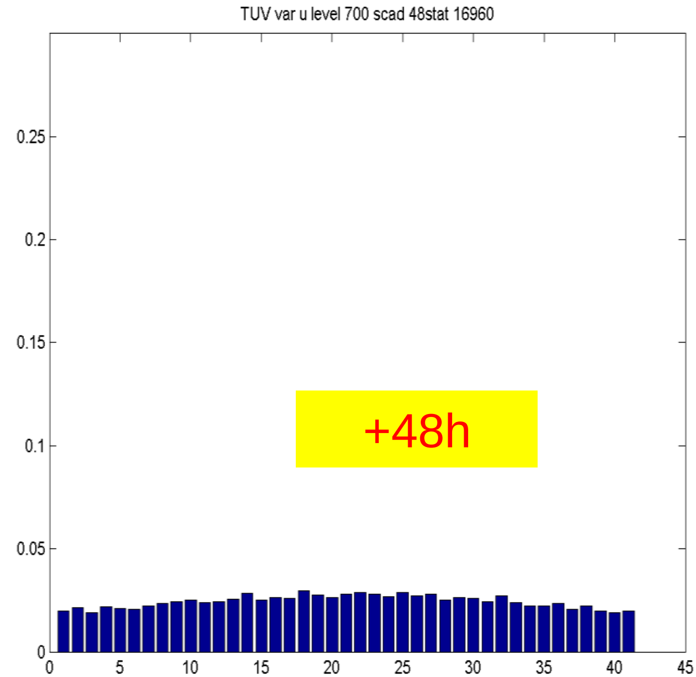
TEMP-OBS





ERR OBS





Science Plan issues

- derive ICs for CP ensemble forecasting systems from KENDA LETKF
  - test against downscaling/blending
  - back-up solution?
- evaluate perturbation of physics tendencies (SPPT)
- evaluate SKEB scheme
- stochastic physics
- develop lower boundary perturbations for O(1km) scale
  - Sensitivity study
  - Analysis of the role of the different types of perturbation

Science Plan issues

- FB: When developing model perturbations it seems essential to investigate where model error is important. Otherwise the risk is to add spread using the wrong kind of perturbation, which would not improve the end value of the ensemble. One must be careful not to mistake one source of spread for another (e.g. trying to compensate for missing spread in the LBCs)
  - > diagnostic approach
- JO: One should assess not only how many members one can afford (a practical but temporary limitation) but also how many one actually is likely to need … Some experiments focusing on this would be welcome
  - > not obvious how to assess, dependency on the resolution and on the quality measure