WG7 activities and SPRED PP

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Outline

- WG7 activities
  - ensemble development:
    - COSMO-LEPS
    - COSMO-DE-EPS
    - COSMO-E
- SPRED PP
  - Improving the spread/skill relation
  - Physics perturbation
  - Soil/surface perturbation
  - Calibration and products
  - ICs for the ensembles

Ensembles:

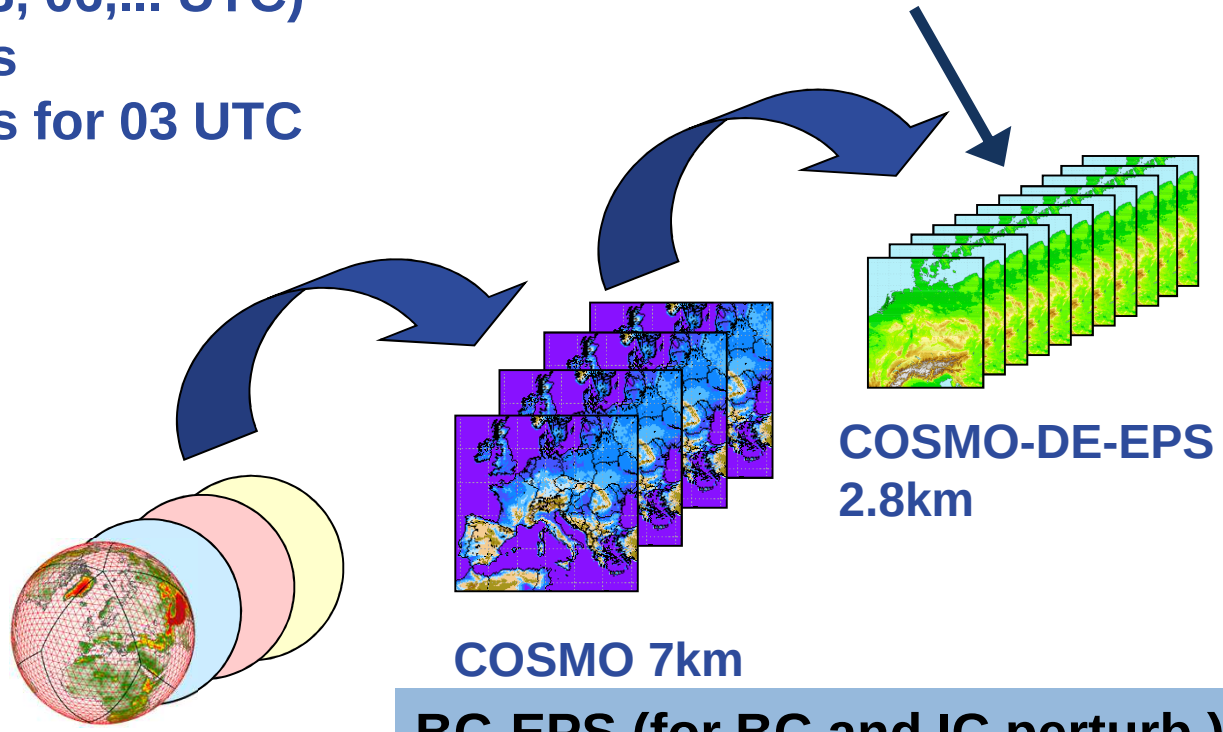
COSMO-DE-EPS

COSMO-DE-EPS operational set-up

➔20 members, grid size: 2.8 km

➔8 starts per day (00, 03, 06,... UTC)
lead time: 0 - 27 hours
0 - 45 hours for 03 UTC

perturbation of model physics (non-stochastic) and soil moisture



BC-EPS (for BC and IC perturb.)

ICON Ensemble

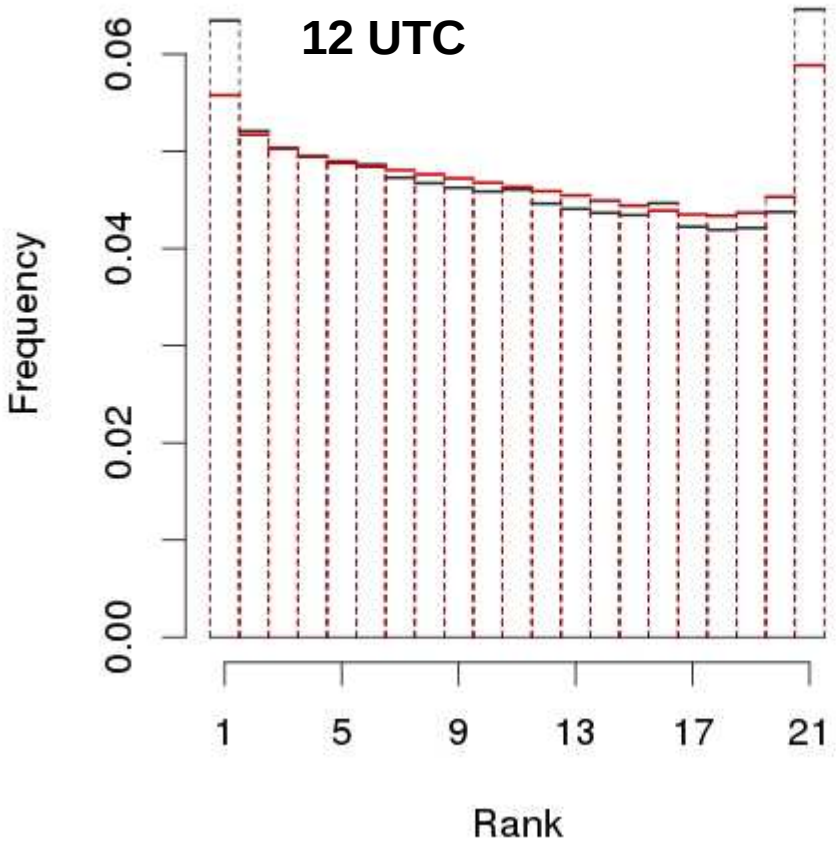
Pre-operational suite (start October 2015)

- 40 Member
- Global, 40 km (-> +180h)
- ICON-EU Nest, 20 km (-> +120h)
- 00 und 12 UTC
- Ensemble Data Assimilation
- Boundary Conditions for COSMO-DE-EPS

Andreas Rhodin, Harald Anlauf, Alexander Cress, Thomas Hanisch, Michael Buchhold, Michael Denhard

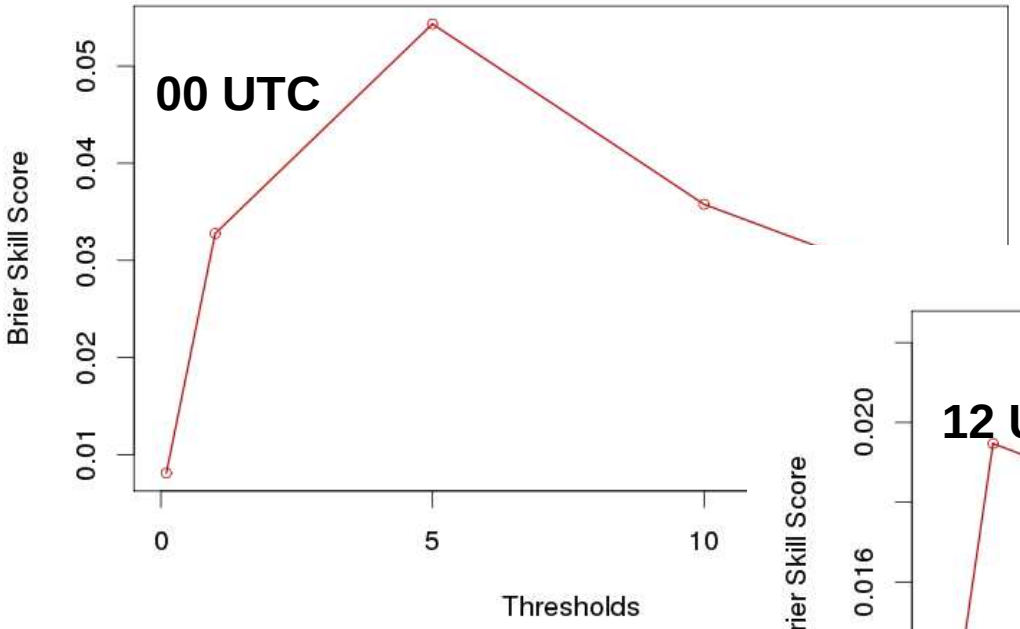
Rank histogram (hourly precipitation)

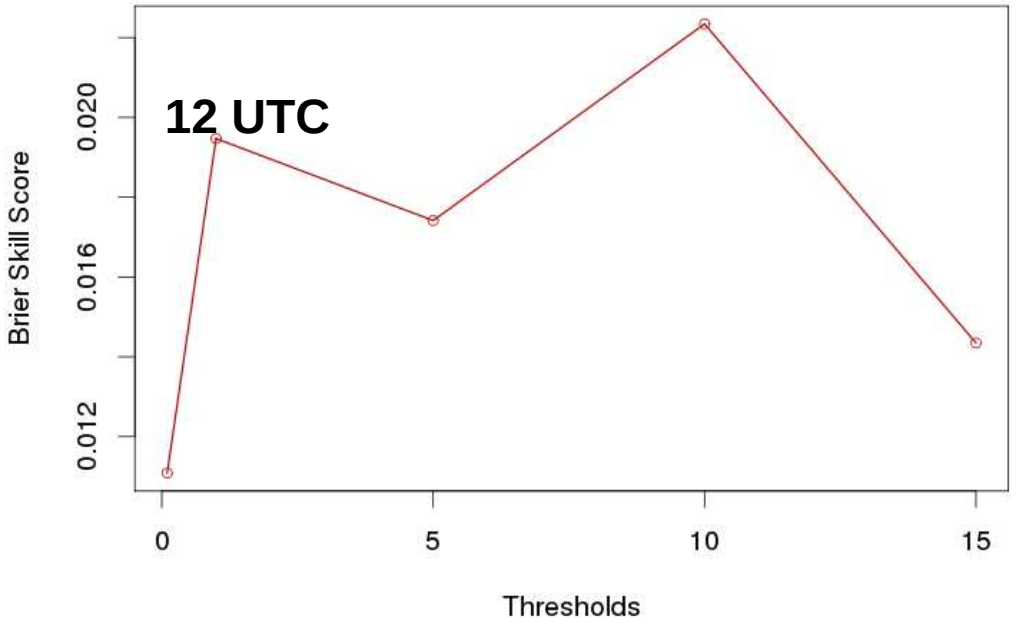
KENDA + ICON-EPS boundary
KENDA + BCEPS boundary



Brier Skill Score (hourly precipitation)

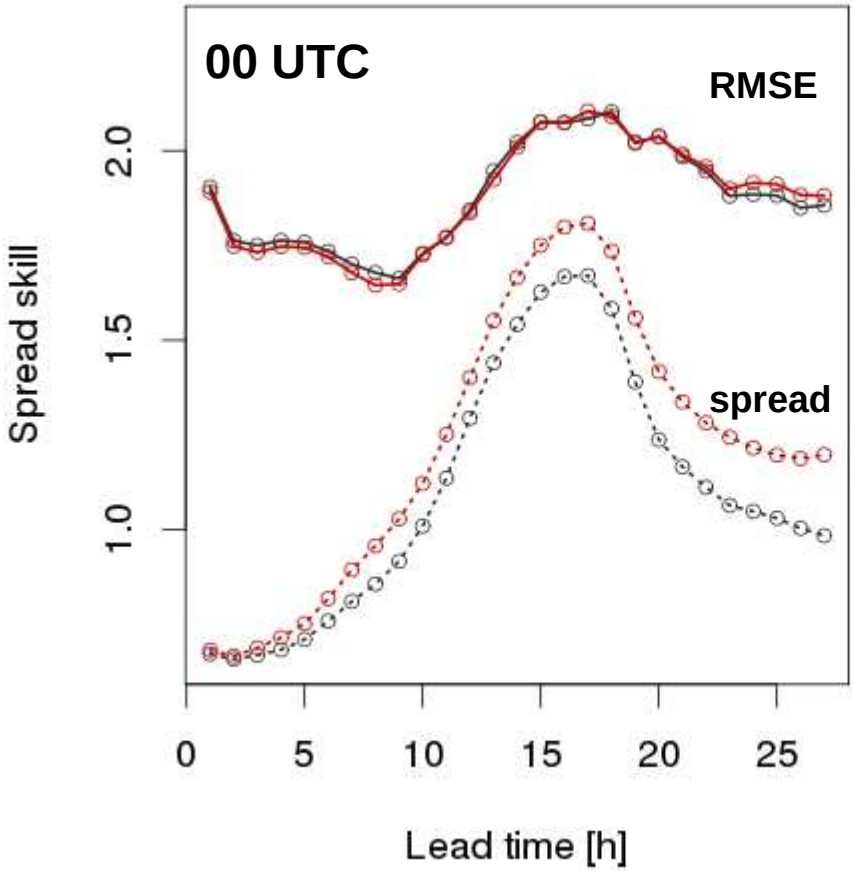
KENDA + ICON-EPS boundary (vs KENDA + BCEPS boundary)

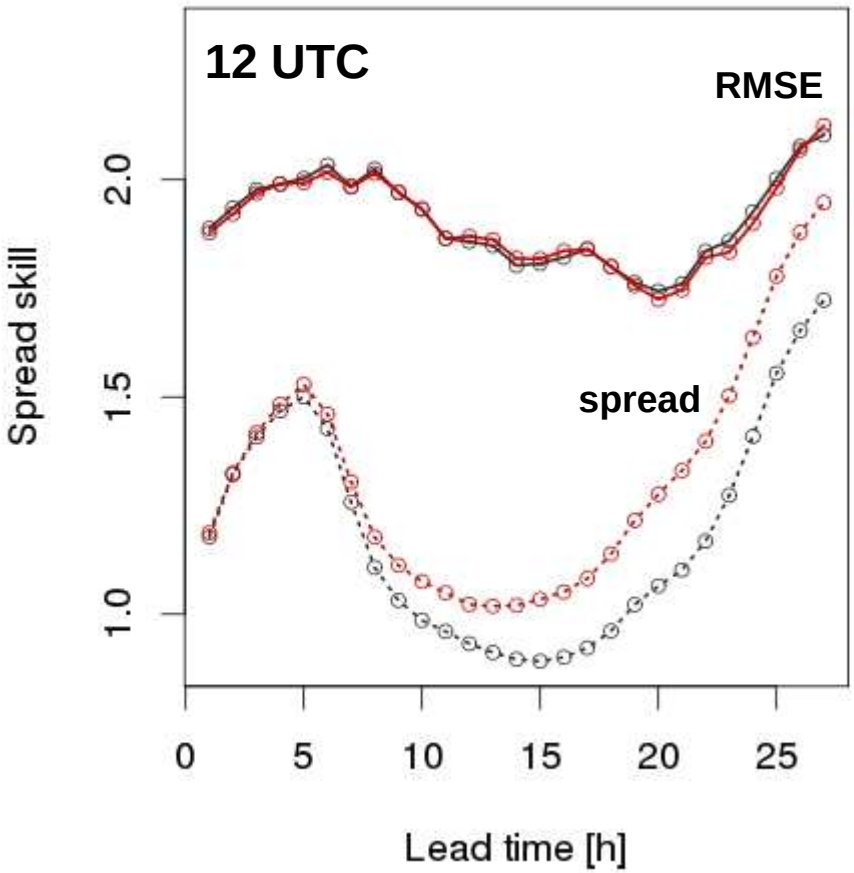




RMSE & spread (wind gusts)

KENDA + ICON-EPS boundary
KENDA + BCEPS boundary

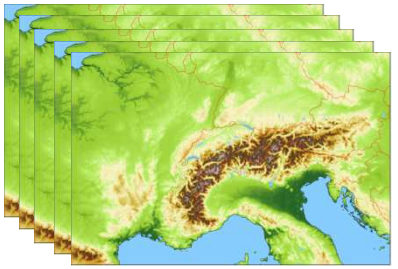




Ensembles:

COSMO-E

COSMO-E operational setup

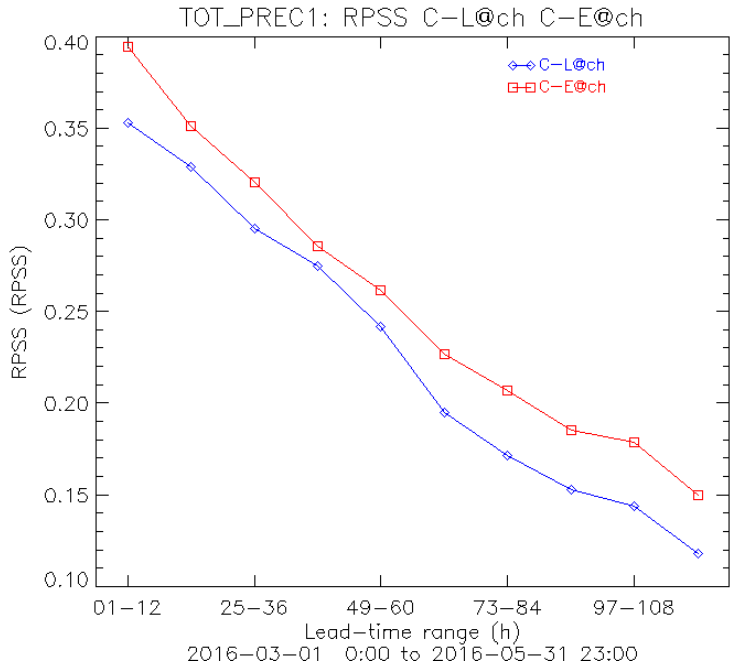


- 21 members (control and 20 perturbed runs)
- 2.2 km mesh-size, 60 levels
- two forecasts per day (00 and 12 UTC) up to +120h
- initial condition (perturbations): KENDA assimilation cycle
  - KENDA ensemble mean for control
  - KENDA members 1-20 (out of 40)
- lateral boundary condition (perturbations): IFS-ENS 18 & 06 UTC (i.e. 6h older LBCs):
  - IFS-ENS control for control
  - IFS-ENS members 1-20 (out of 50)
- model uncertainty: SPPT
- COSMO version 5.0+/GPU, single precision

RPSS, 1h precipitation, MAM 2016

COSMO-E
COSMO-LEPS

Switzerland



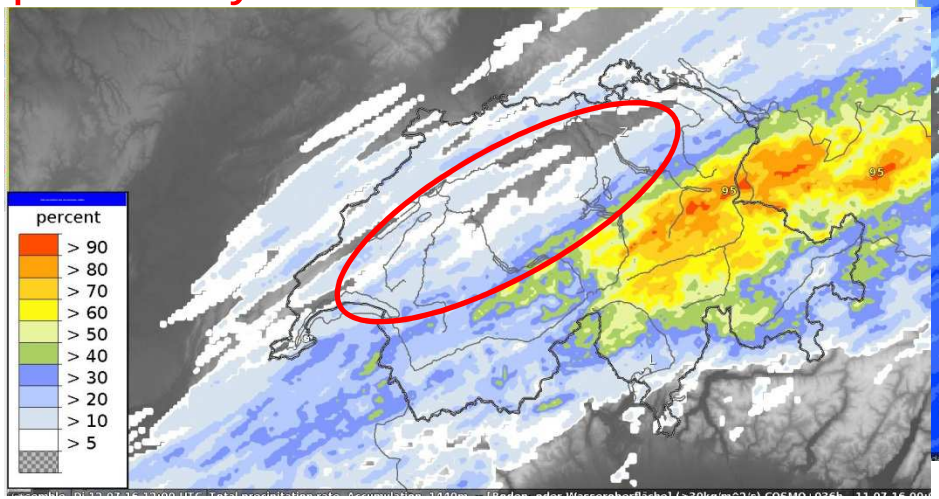
Thresholds: 0.1,0.2,0.5,1,2,5,10 mm

- COSMO-E shows skill until end of forecast range
- COSMO-E clearly outperforms COSMO-LEPS

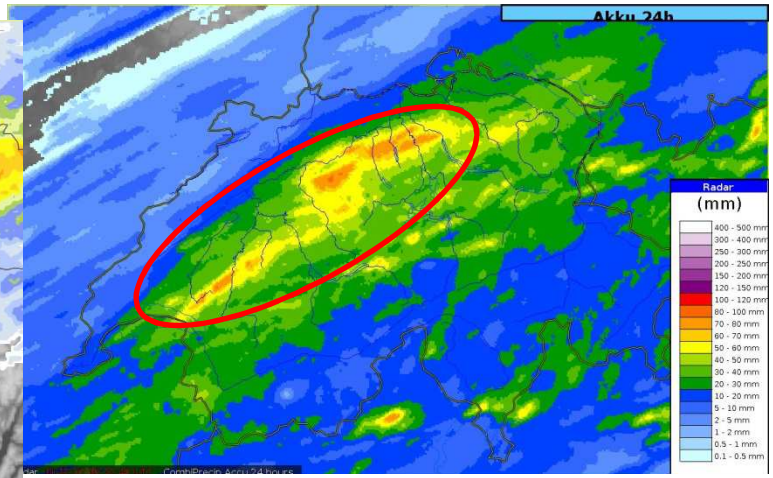
Main feedbacks from forecasters

- COSMO-E often triggers convection over the Alps only and misses it over the Swiss plateau:
  → lack of convective precipitation
  → missed warnings for thunderstorms
  → in particular with weak synoptic forcing
- Example:

probability TP > 30mm/24h:



TP sum, up to 70mm/24h:



SPRED PP

Spread/skill relation
SPPT

Evaluation of ensemble spread: SAL metric

- Aim: assess the impact of physics perturbations on precipitation
- What is the perturbation influencing?
  - Precipitation intensity
  - Precipitation structure
  - Localisation of the precipitation
  - Timing
- Use a spatial verification measure: SAL (Wernli et al 2008)
- 3 independent components:
  - Structure
  - Amplitude
  - Location
- Used here not for verification but for evaluating the similarity between fields, only forecasts

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COSMO-IT-EPS

- 2.8 km
- 10 members
- IC/BC from COSMO-ME-EPS
- testing period: October 2015
- 3 set-up for physics perturbations:
  - CTRL: no physics perturbations
  - SPPT: SPPT only
  - SPPT + PP: SPPT + Parameter Perturbation

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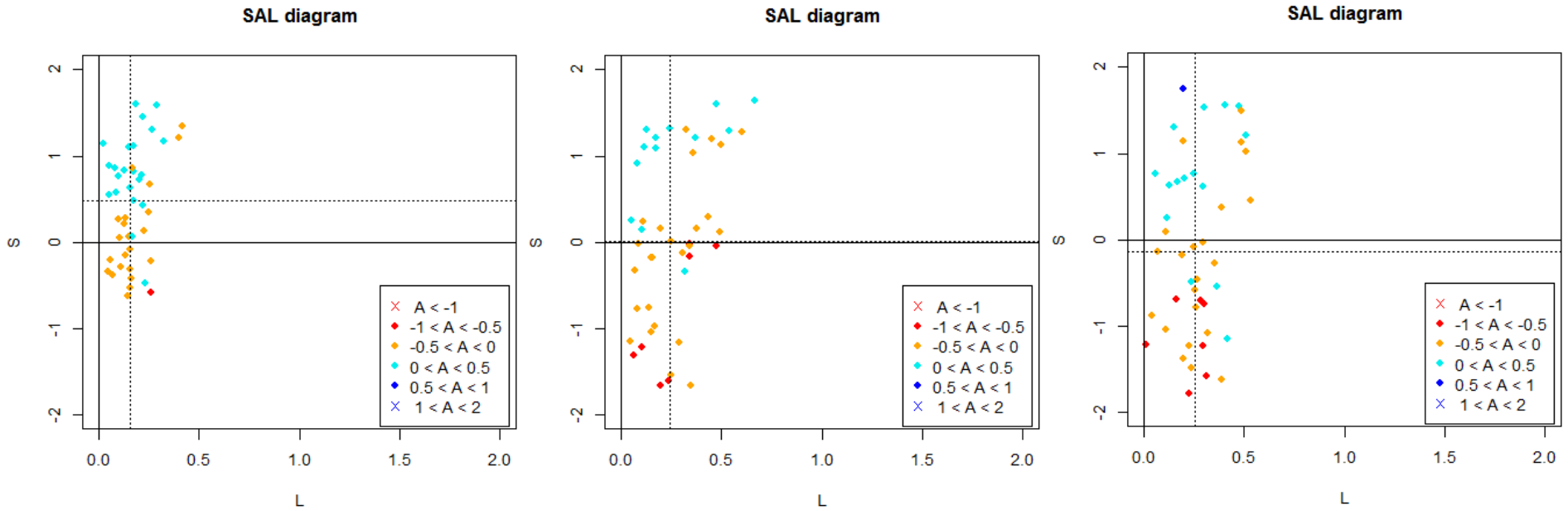
6 October 2015 – Liguria-Tuscany

50mm



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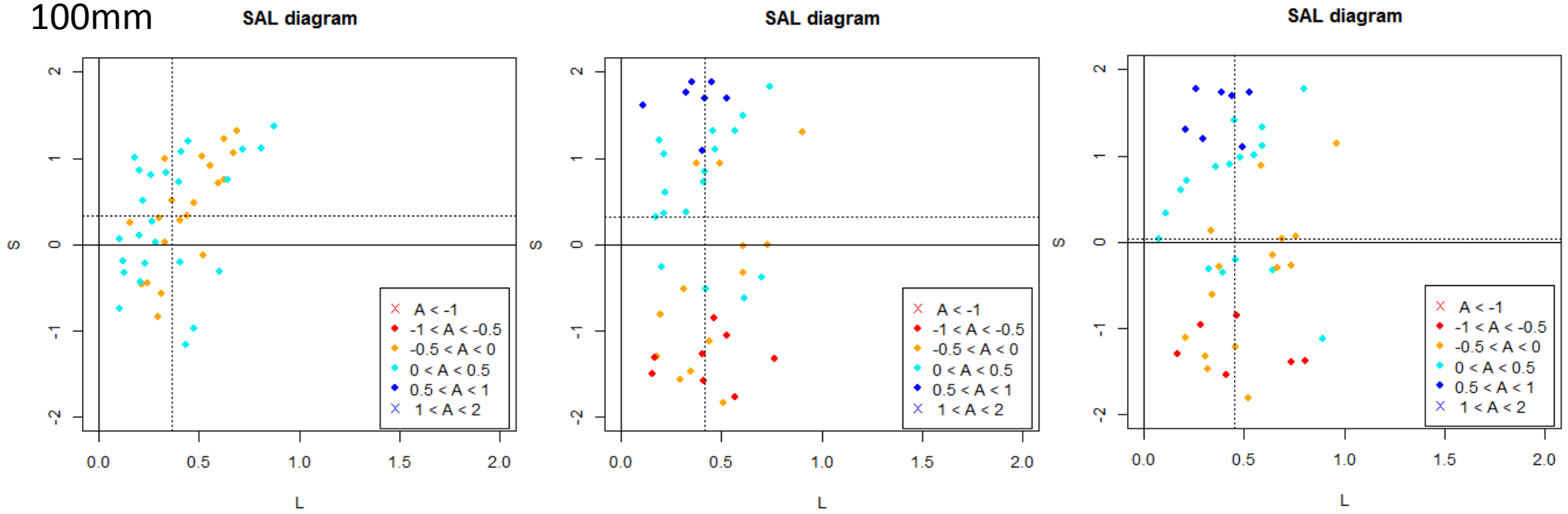
10 October 2015 – Tyrrhenian Sea

100mm



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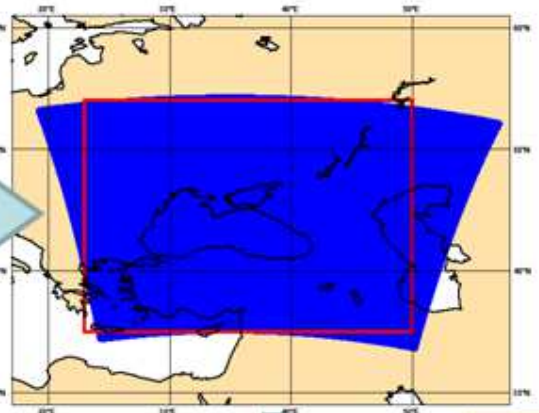
Ensemble organization for Sochi Olympics

ECMWF-EPS
Globe
T779L61 (Δx~30 km)
M51, fc+14d
ECMWF computer

Clustering
Nesting



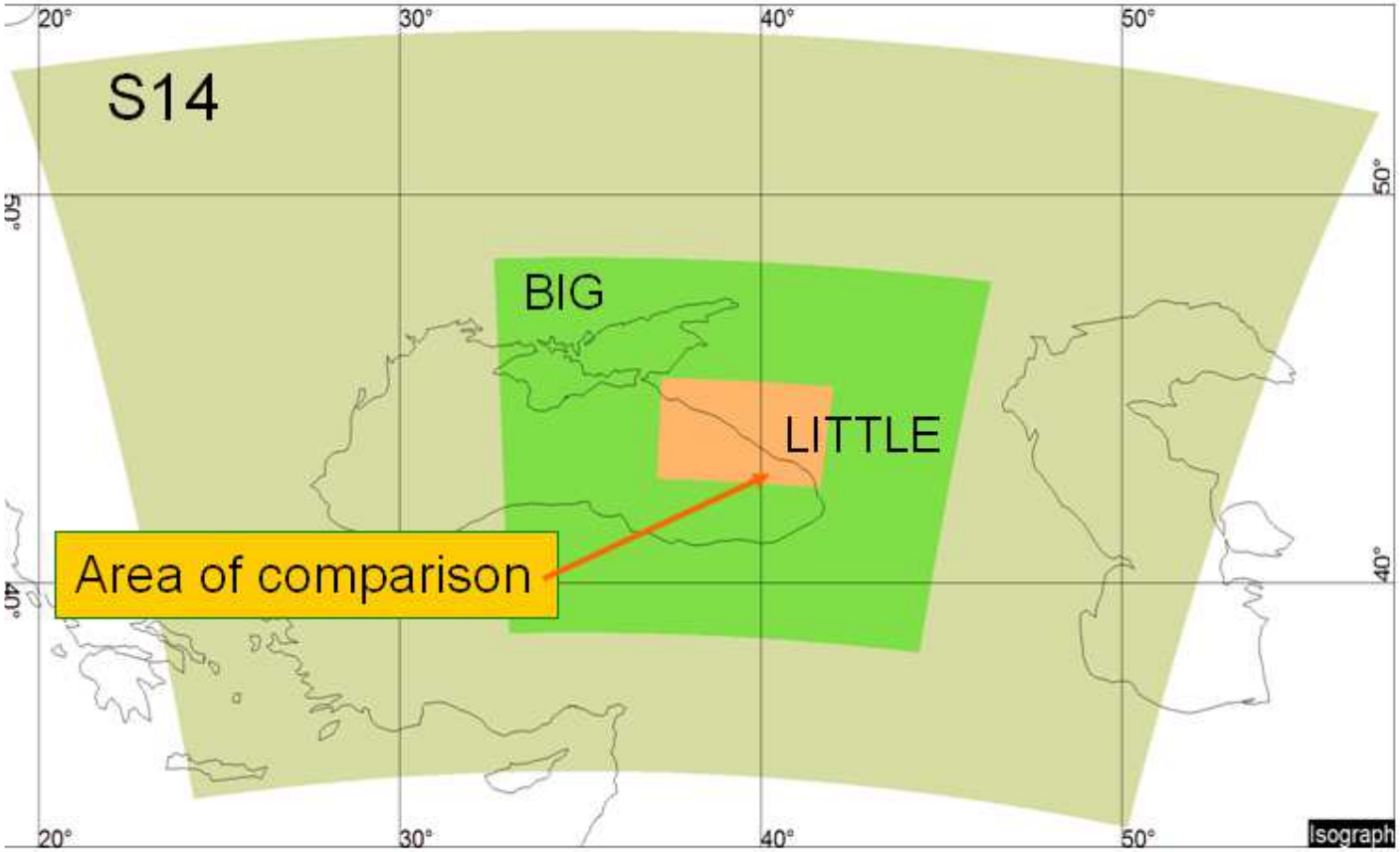
COSMO-S14-EPS
SOCHI DOMain
Δx~7km, L40
M10, fc+72h
ECMWF computer

Nesting

COSMO-Ru2-EPS
Sochi region
Δx~2.2 km, L51
M10, fc+48h
RHMC computer

Area of comparison

Experiment setting



COSMO-S14-EPS
7 km
Archive data

COSMO-Ru2-EPS
2.2 km
Rerun with v. 5.01

COSMO-Ru2-EPS
2.2 km
Rerun with v. 5.01

Differences between wind and temperature spread evolution for forecasts performed over LITTLE and BIG domains

Level, hPa	100-150	200-250	300	350-400	450	500-700	850-900	925	975	1000
T	▲	▲	▲	▲	▲	▲	▲	▲!!!	▲	▲
Wind	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲

▲ No visible differences

▲ Very slight differences

▲ Visible differences in structure, mainly for large lead times

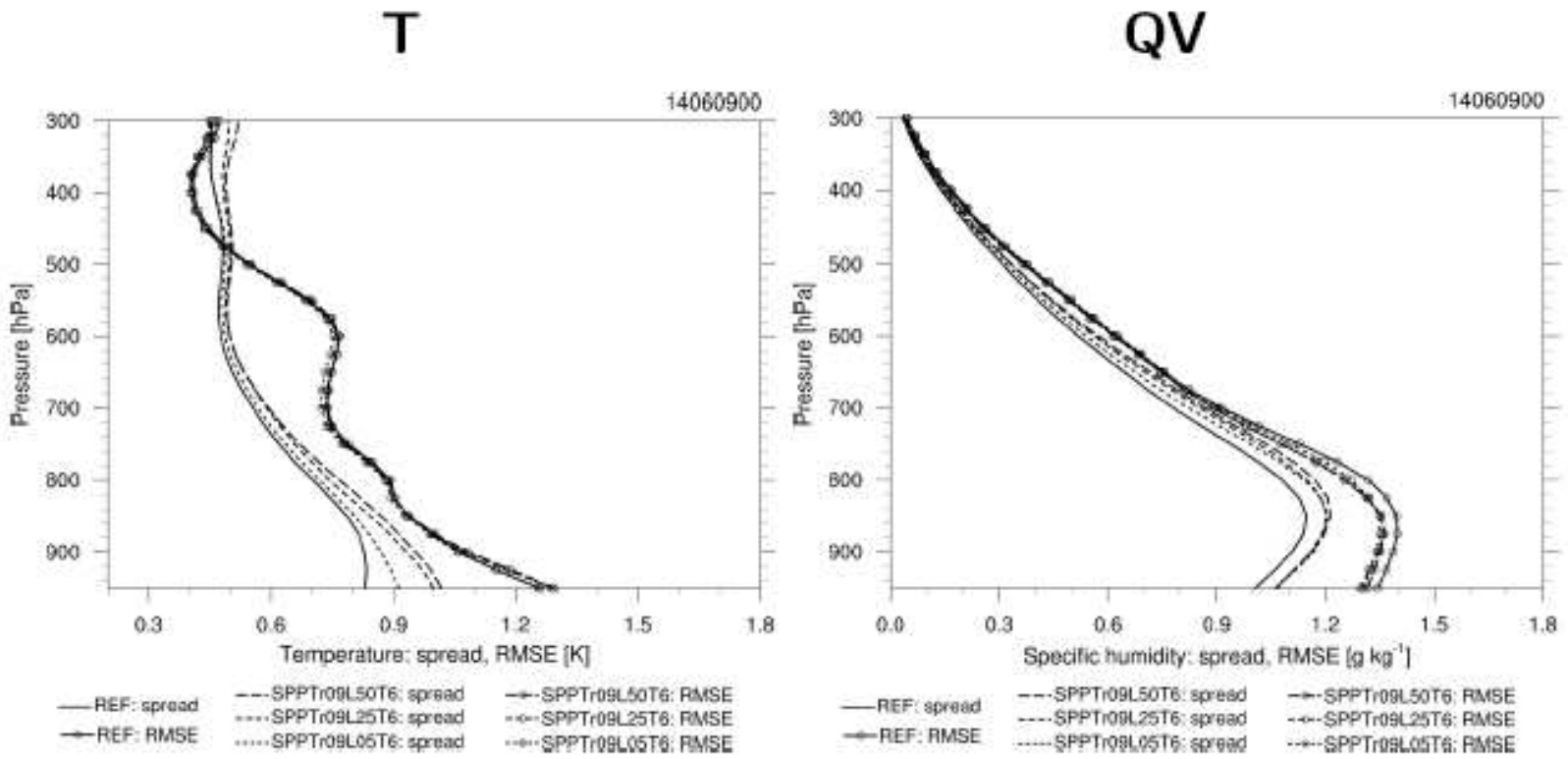
▲ Big differences in structure and values

▲!!! Very big differences in structure and values

Vertical profiles of spread & RMSE

Convective case (June 2014)

Impact of SPPT



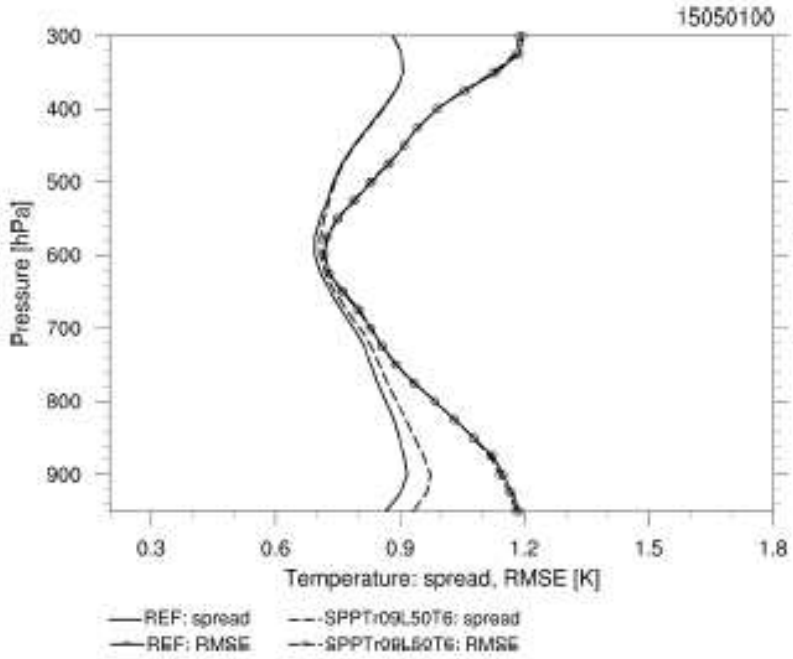
Solid & dashed	Spread
With markers	RMSE of ensemble mean
Experiments	REF and SPPT (5.0°, 2.5°, 0.5°)

Vertical profiles of spread & RMSE

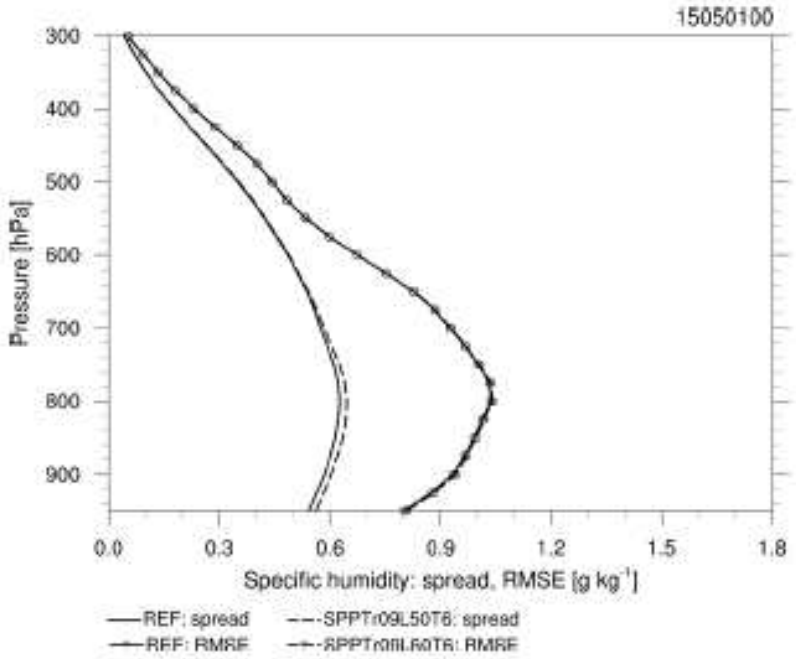
Advective case (May 2015)

Impact of SPPT

T



QV



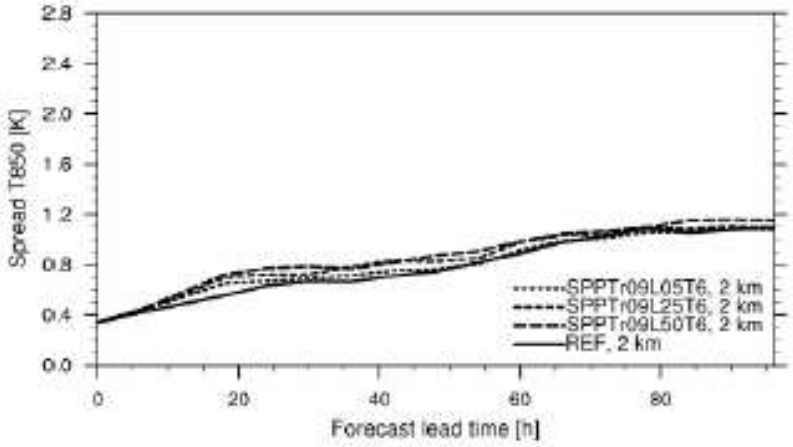
Solid & dashed	Spread
With markers	RMSE of ensemble mean
Experiments	REF and SPPT (5.0°)

Spread & RMSE as function of forecast

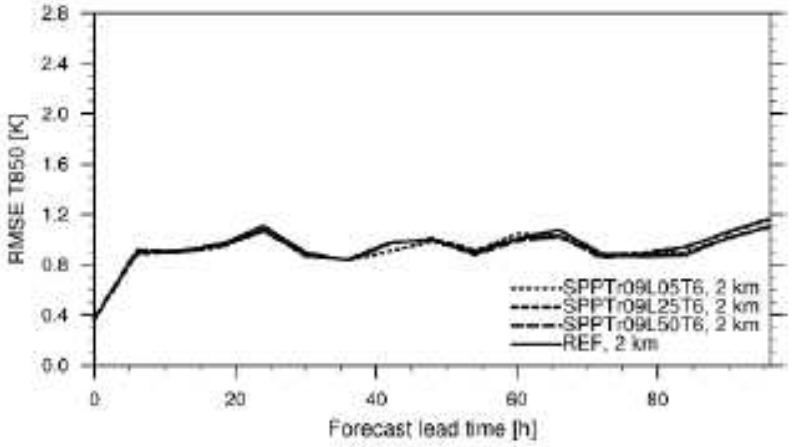
Convective case (June 2014)

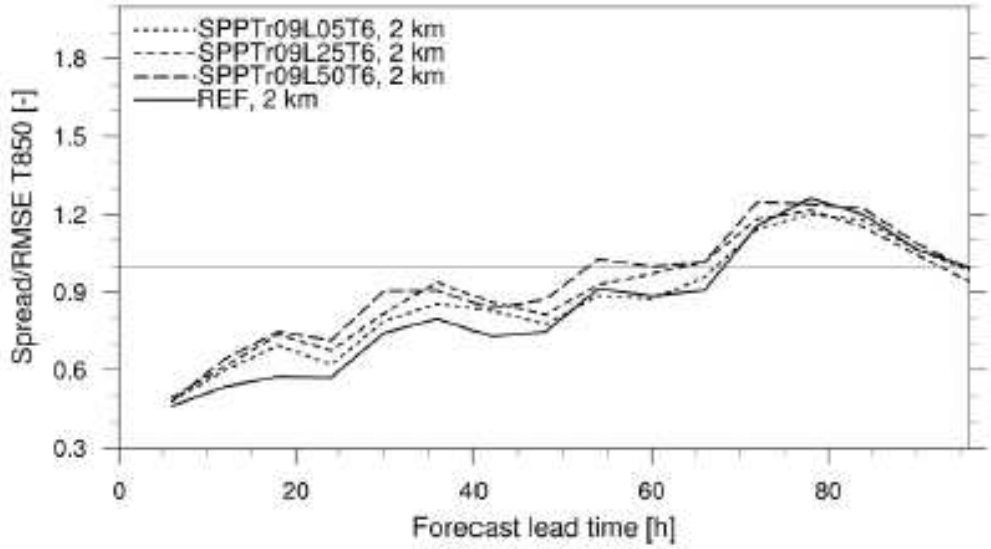
Impact of SPPT

Spread T850



RMSE T850





C. Klasa, MCH

SPRED PP

Lower boundary perturbations

Ensemble Prediction System – operational setup and status

Setup

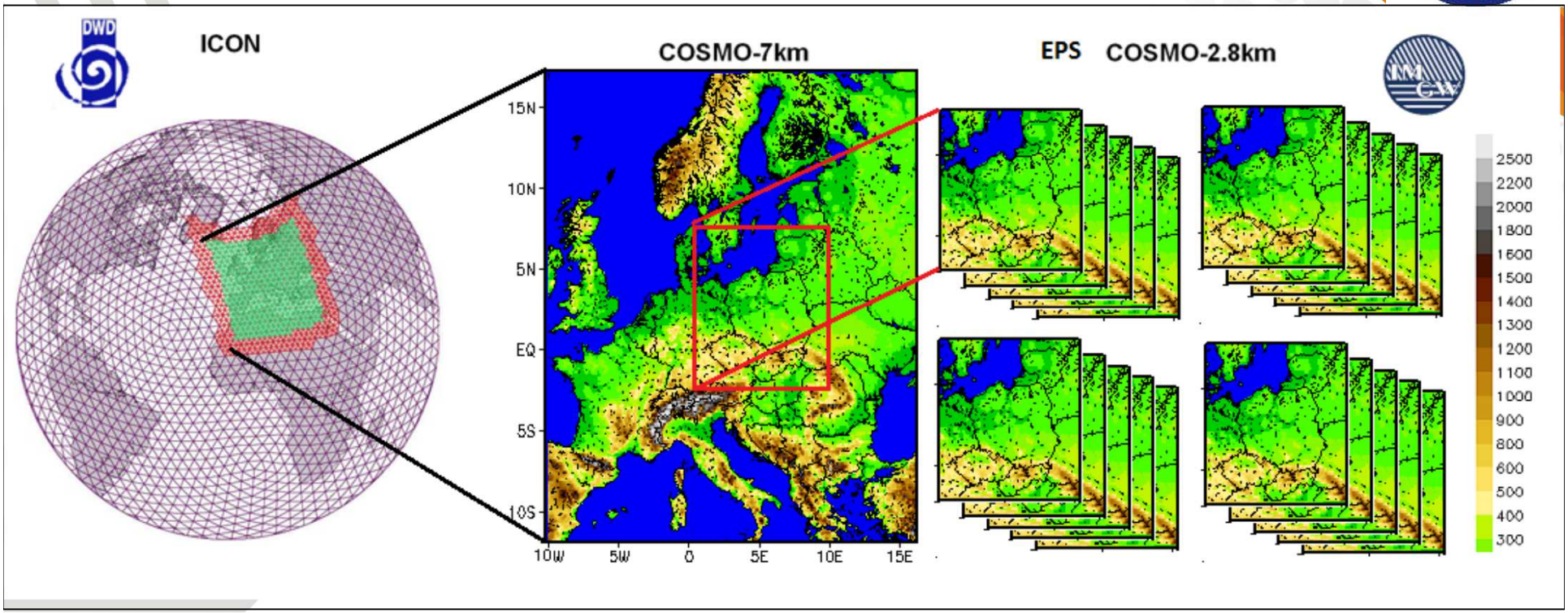
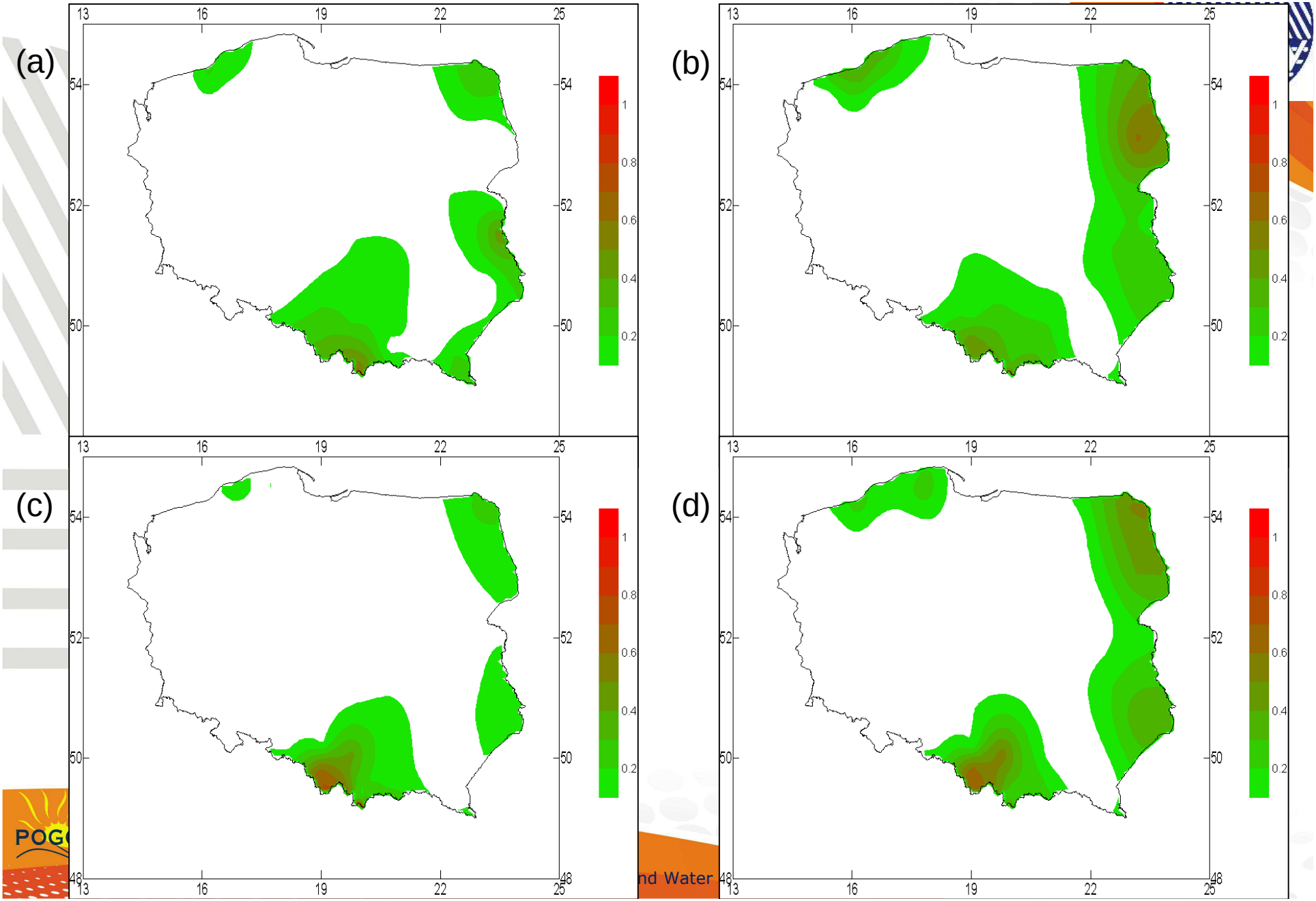


Table 1. Details of the deterministic models configuration.

Model	Resolution	Grid size NxMxL	Forecast length [h]
ICON (DWD)	13	2949120 triangles	78
COSMOv5.01	7	415x460x40	78
COSMOv5.01	2.8	380x405x50	36

Status of TL-EPS Running in IMWM; Activities Carried Out in the Frame of SPRED Priority Project

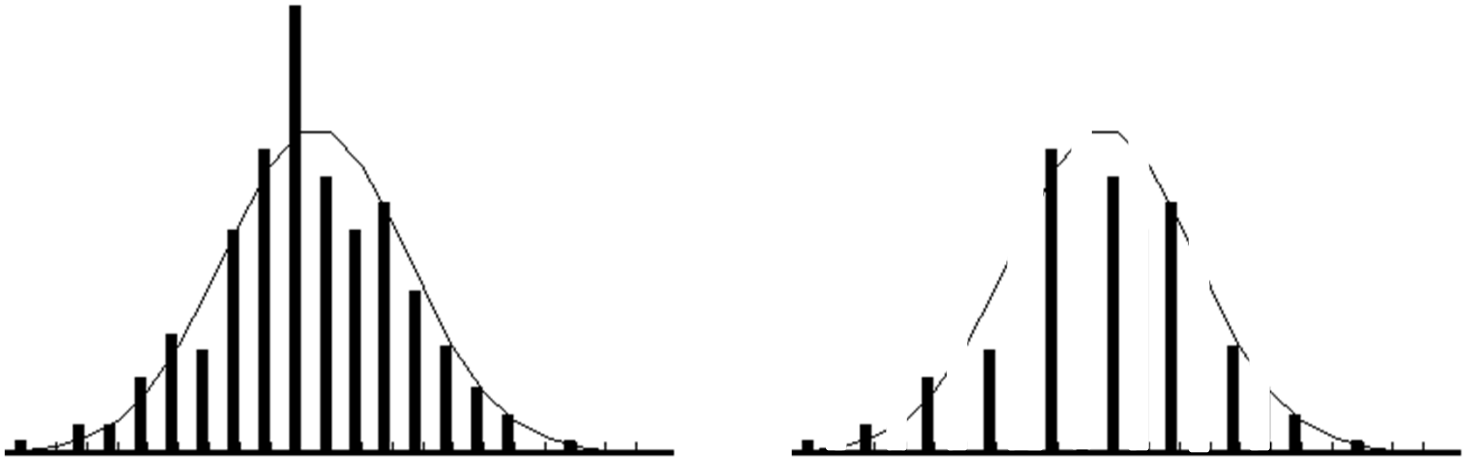
Spread of precipitation: (a) control, (b) RNG, (c) Ec, (d) soil sfc. temp., 21-06-2016, 12:00



SPRED PP

Member selection for CP ensembles

Goal: Keep the “shape of the PDF”

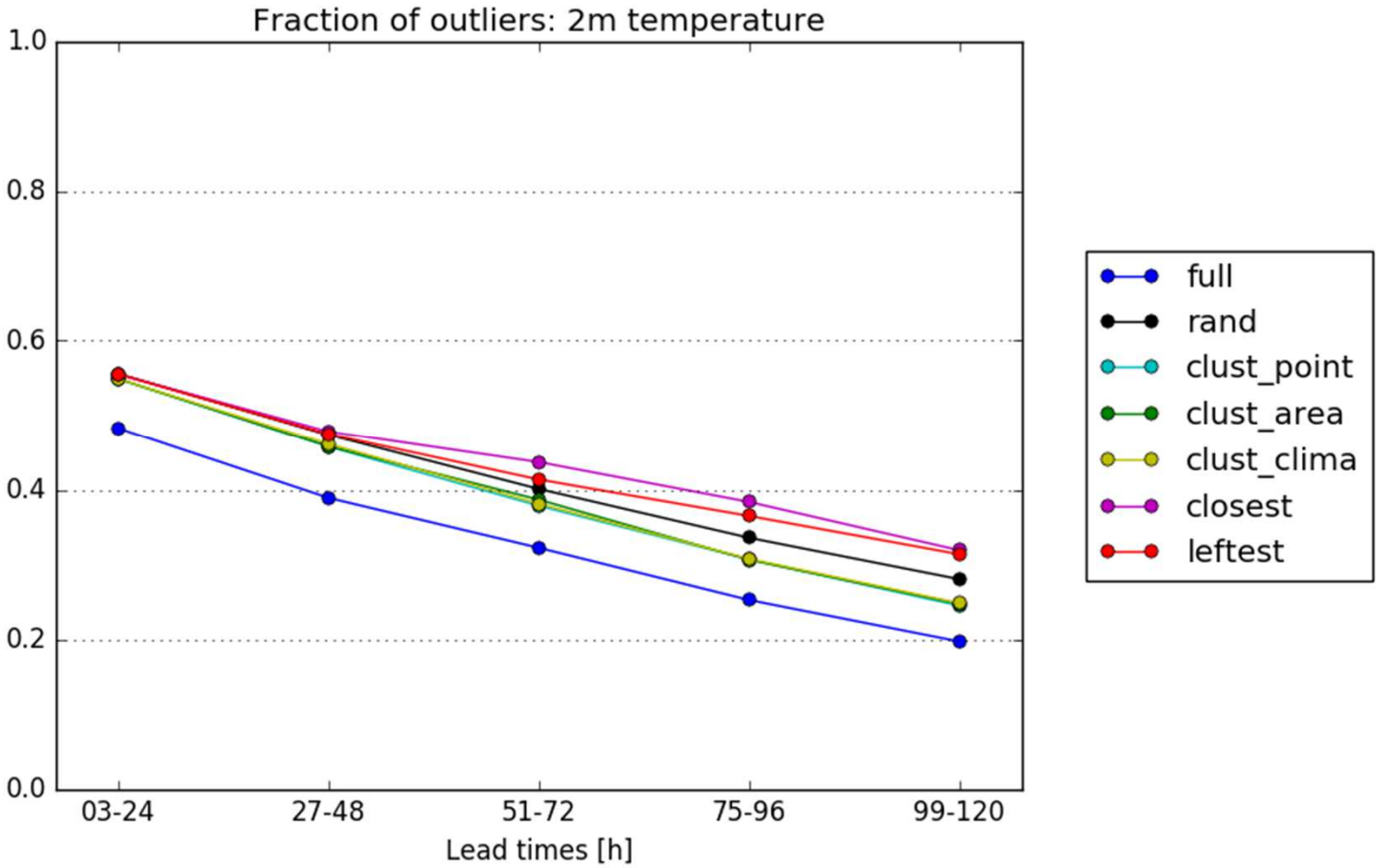


Problem: Multidimensionality (grid-points, variables)

→ reduce phase space and «make» it one-dimensional

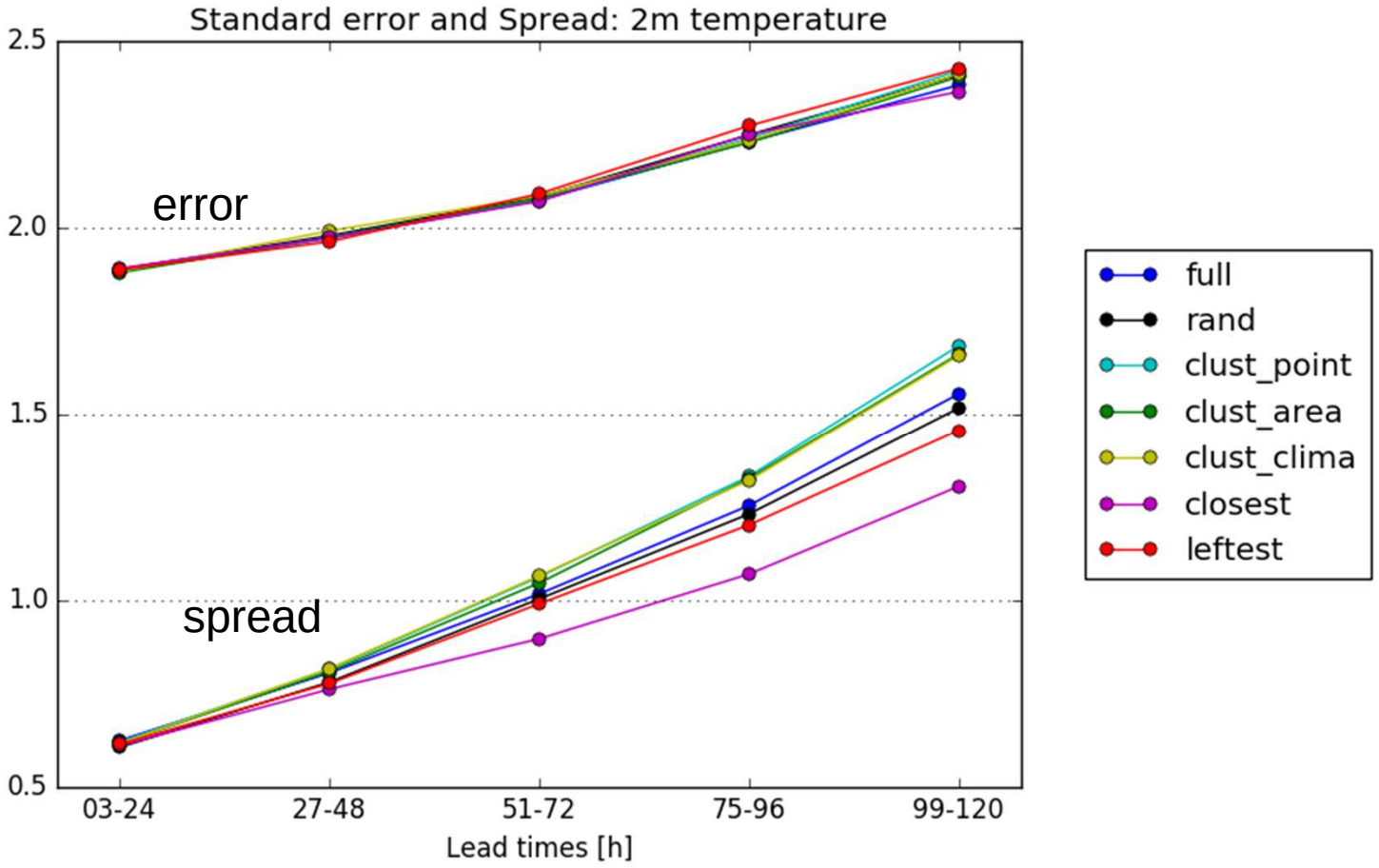
→ similar approach used as in COSMO-LEPS clustering:
3 variables: wind, temperature, humidity on 3 model levels (~850, 700, 500 hPa)

2m temperature, outliers



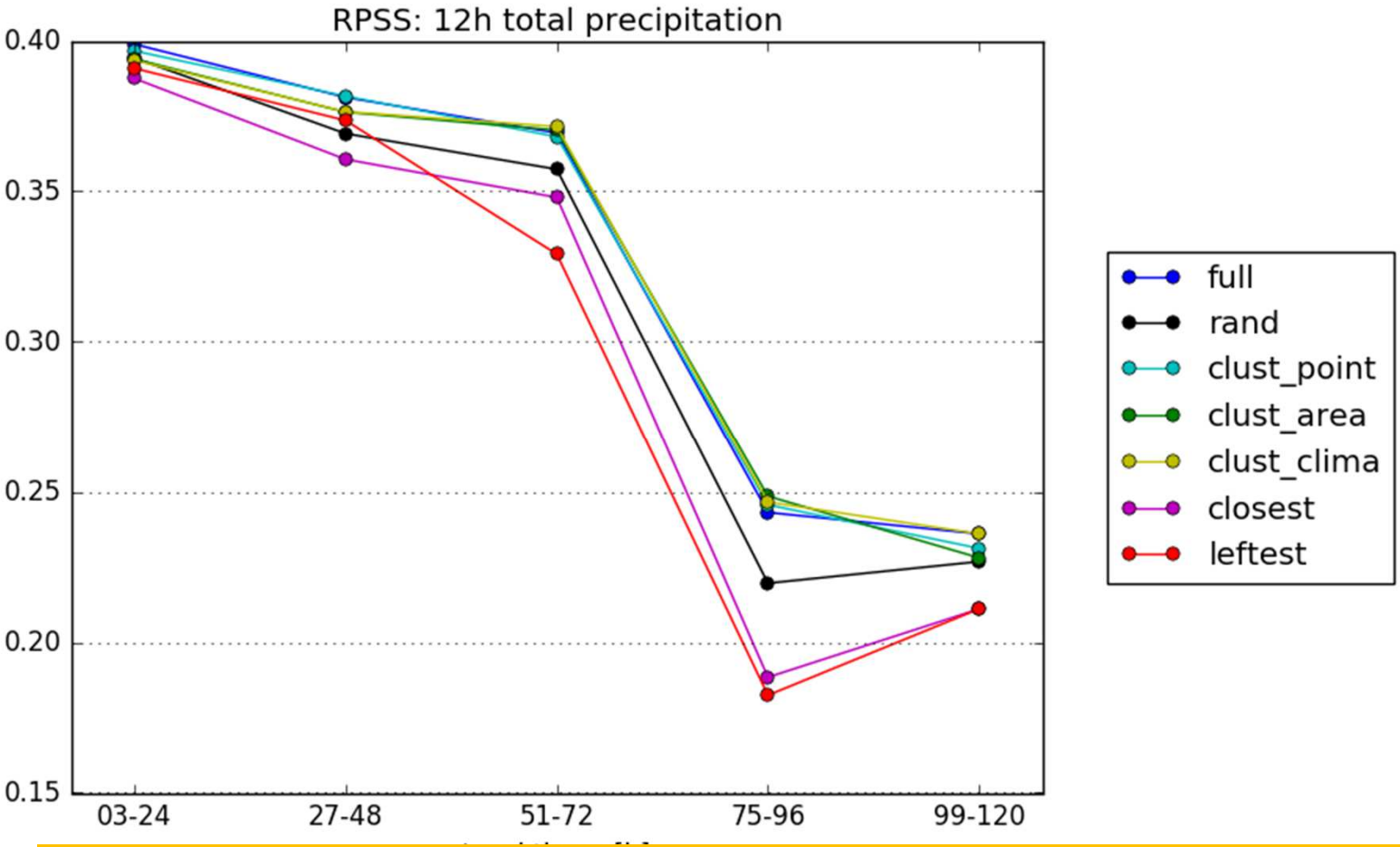
‘full’ best as expected, 3 clustering setups second and almost identical, than ‘rand’, ‘leftest’, ‘closest’ is worse

2m temperature, spread/error



- ‘clust’ shows larger spread than ‘full’! → tails ‘overpopulated’
- ‘rand’ third, ‘closest’ clearly worst

12h total precipitation, RPSS



similar results, but clustering as good as ‘full’ an ‘leftest’ worst

Concluding remarks

- CP ensembles well established
- More knowledge on SPPT impact
- Lower boundary perturbations part of the ensemble set-up
- Good result on usefulness of member selection for CP ensemble
- A report on the spread/skill assessment will be prepared, to summarise what we know (and what we don’t know) about the ensemble spread

Thank you!