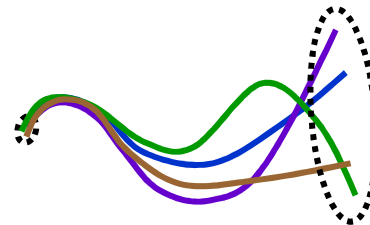# COSMO-DE-EPS

Status, developments & plans

-- WG 7 parallel session --

**Christoph Gebhardt, Susanne Theis,
Michael Buchhold, Regina Kohlhepp, Richard Keane**

Deutscher Wetterdienst, DWD

Outline
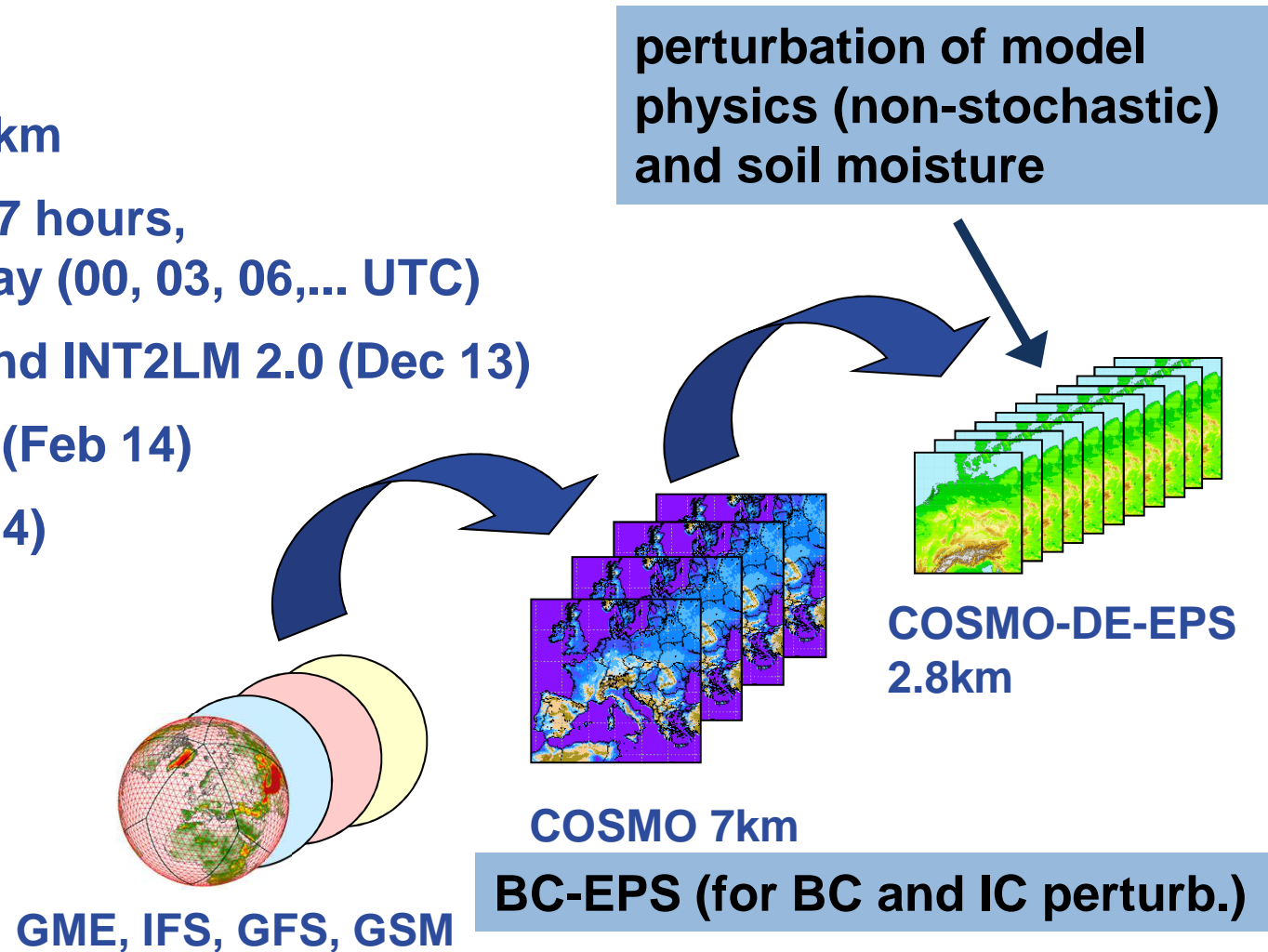
➔ **operational set up**

➔ **changes since last COSMO GM** *STATUS*

➔ **current research**

➔ **projects / applications** *DEVELOPMENTS &*

➔ **future plans** *PLANS*

STATUS

COSMO GM 2014, Eretria   C. Gebhardt, DWD   4

Operational changes since COSMO GM 2013

➜ **new operational probabilistic products
(sim. radar refl, CAPE, cloud cover, T_surface)**   *Dec 2013*

➜ **perturbation of minimum diffusion coefficient**   *Jan 2014*

➜ **perturbation of soil moisture**   *Jan 2014*

➜ **modified vertical filter of IC perturbations
(now depending on variance of model orography)**   *Sep 2014*

Perturbation of minimum diffusion coefficient

➔ **perturbation of tkhmin, tkmmin**

➔ **range: [0.2 ,0.4, 0.7]**

➔ **in all members: tkhmin = tkmmin**
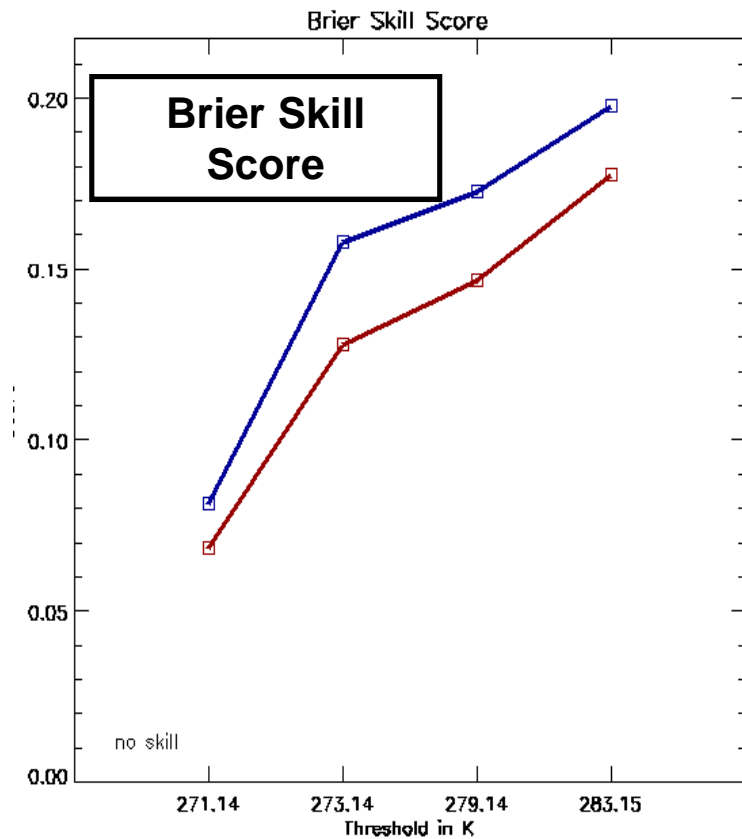
➔ **test period: November 2011, 00 UTC runs**
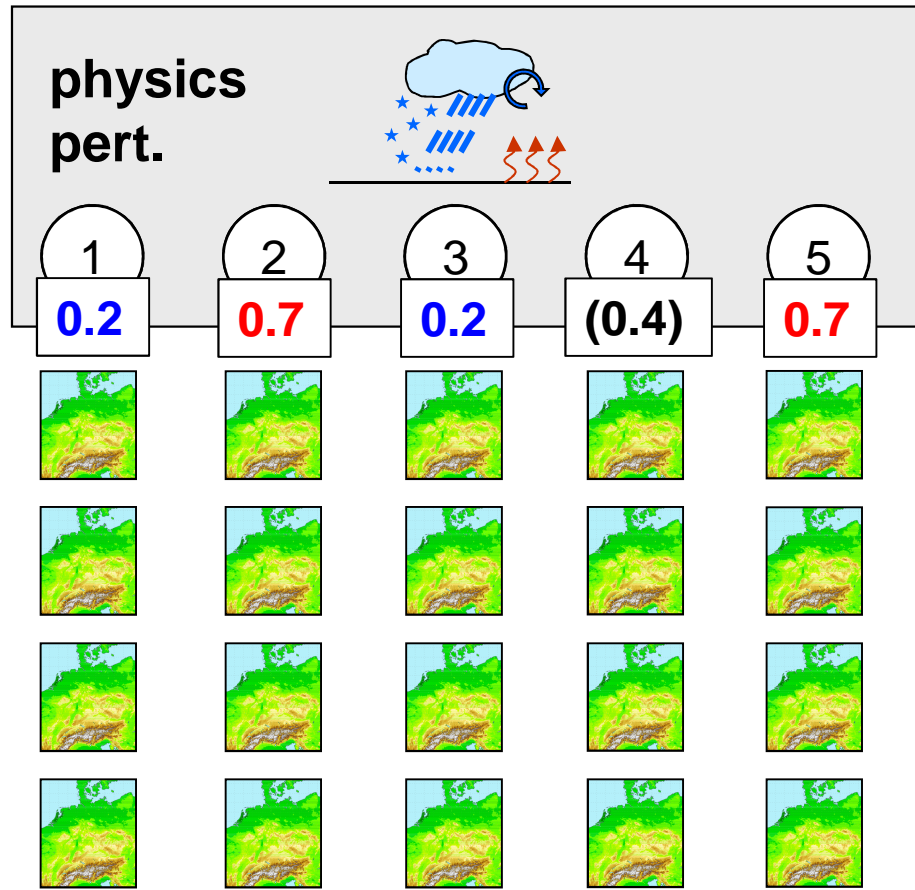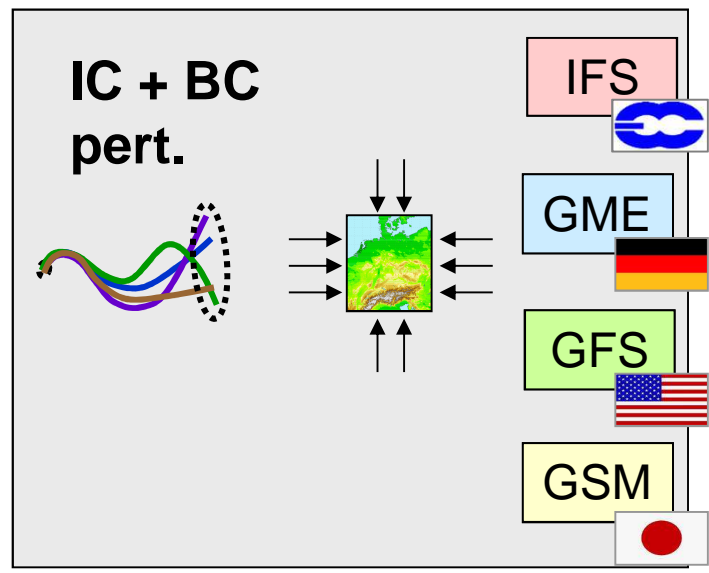
Perturbation of minimum diffusion coefficient

Spread Skill Relation – [Skill (full,cross)]

error

spread
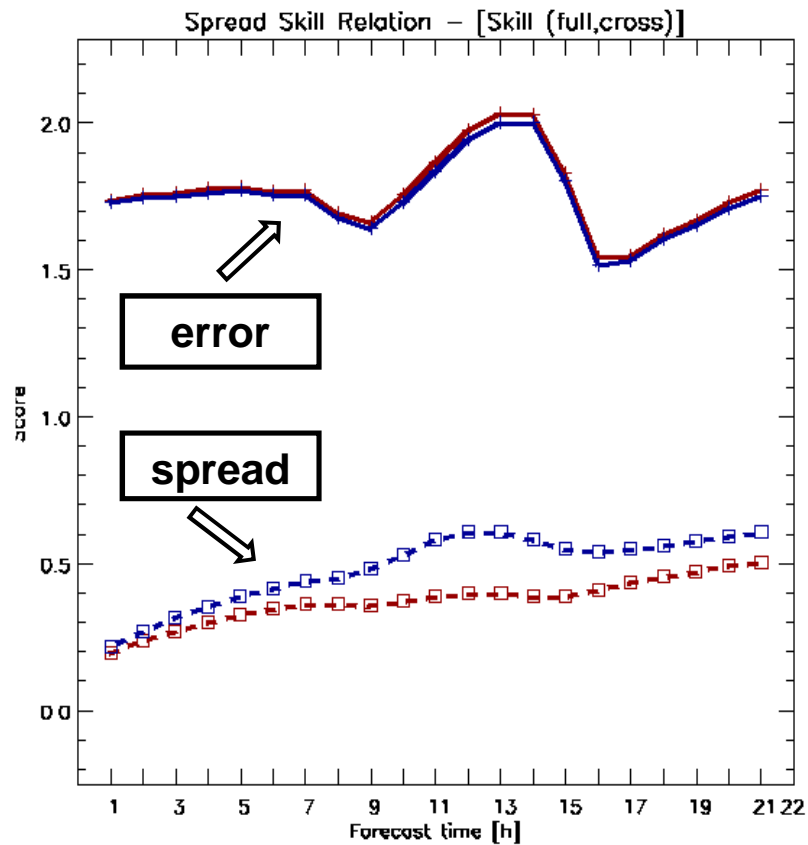
2m temperature

perturbed minimum diffusion

reference

Brier Skill Score

Brier Skill Score

no skill

20 EPS members

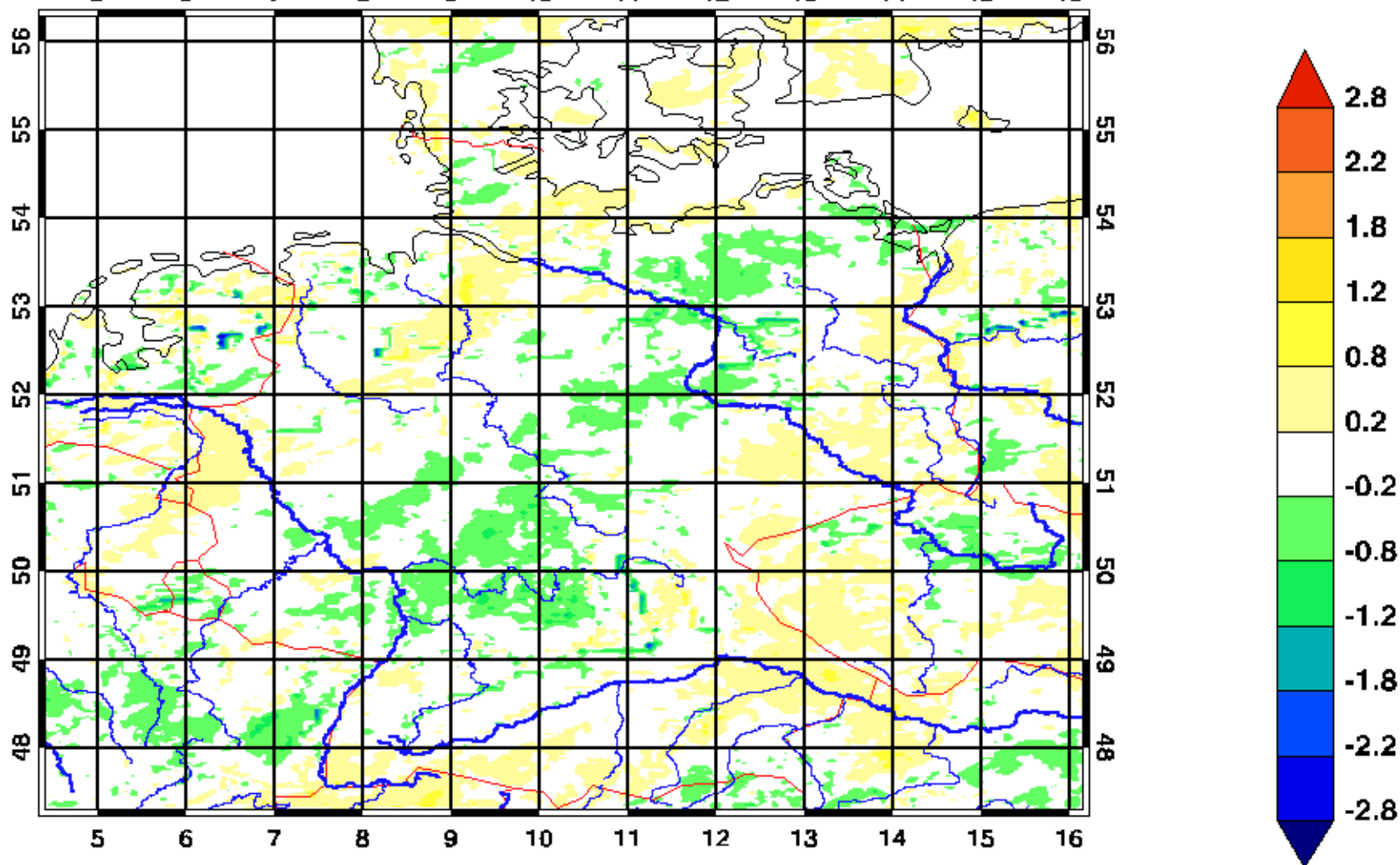tkhmin und tkmmin =
0.2 / 0.4 / 0.7

Perturbation of soil moisture

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

test period June/July 2012

soil moisture perturbation lv=2cm member=2 20120731
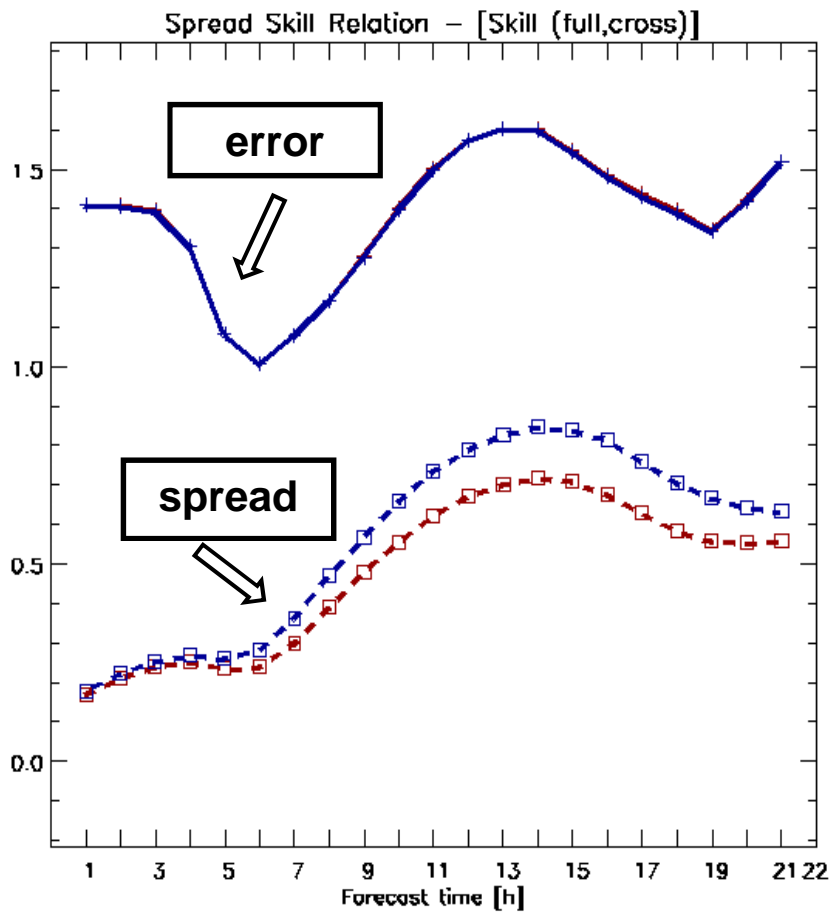mean: 0.03 std: 0.27 min: -2.89 max: 1.45

Perturbation ~10% of layer water content
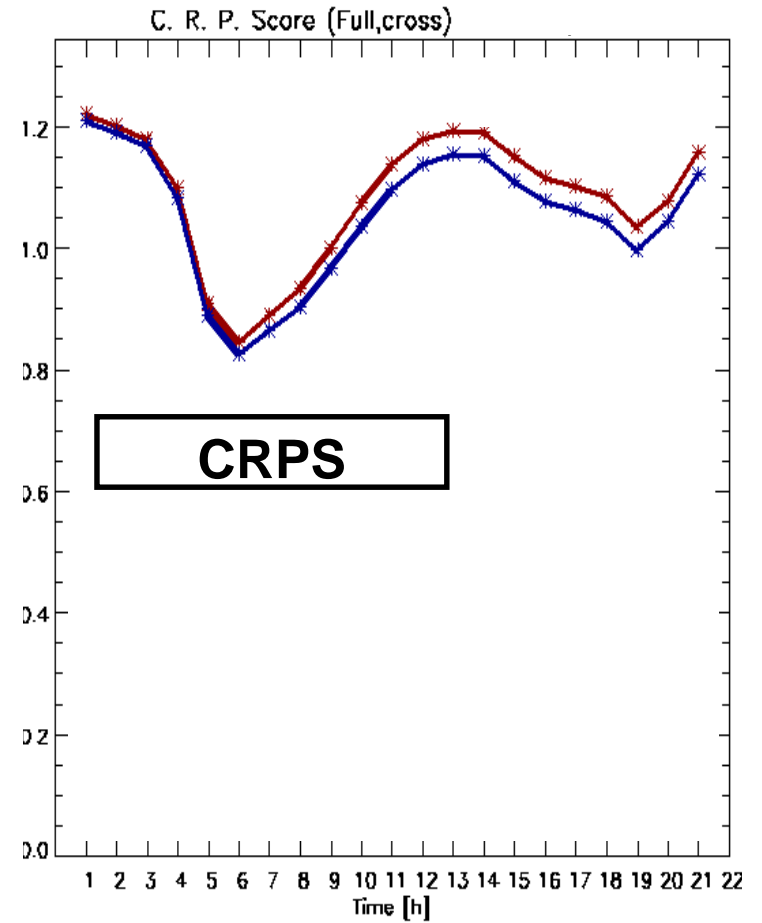**units: kg/m²**   COSMO GM 2014, Eretria   C. Gebhardt, DWD   10

Perturbation of soil moisture

2m temperature

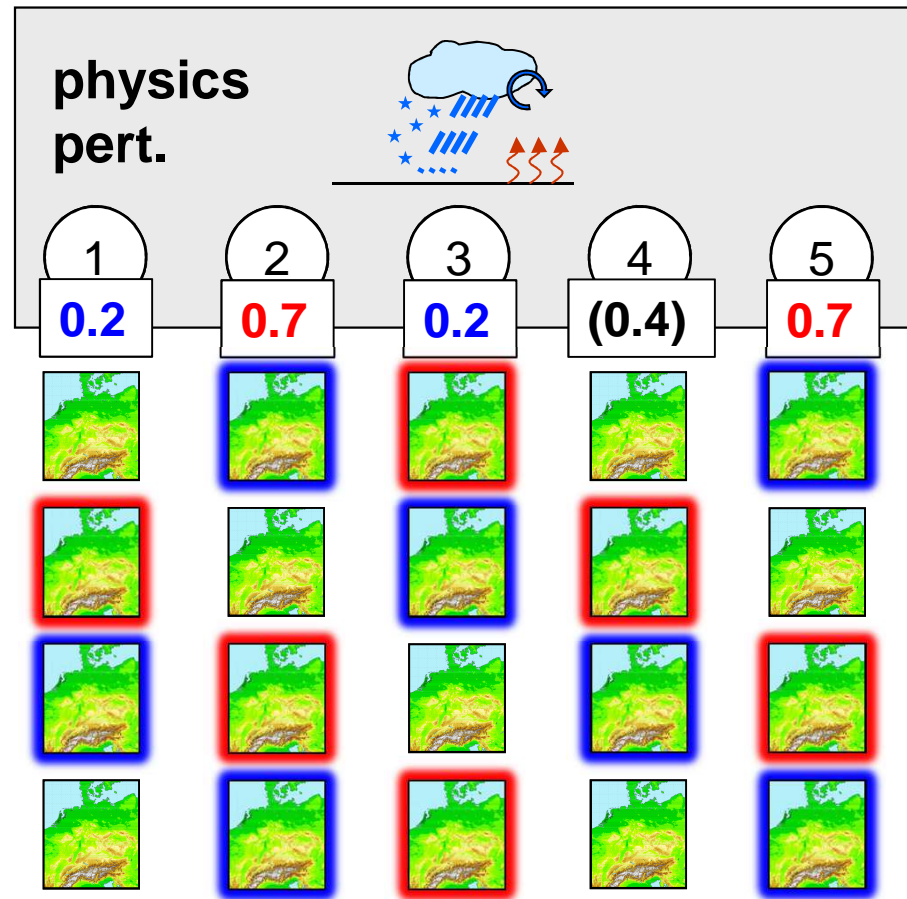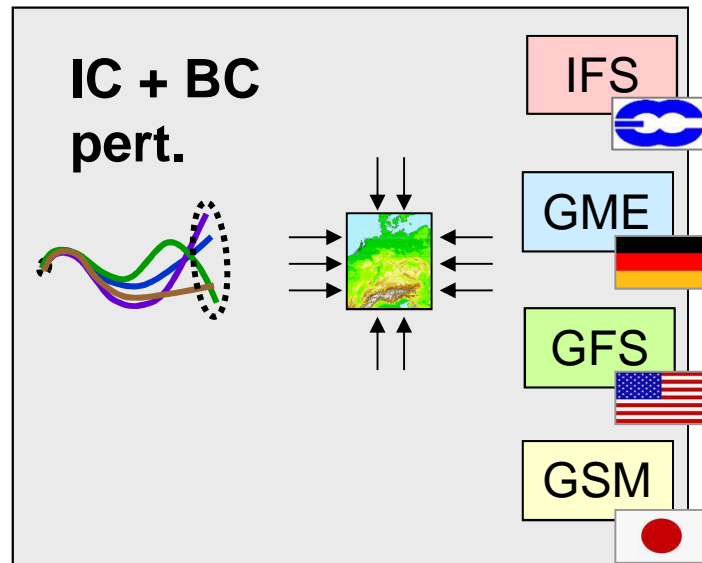**perturbed soil moisture**

reference

CRPS

20 EPS members

"+" soil moisture anomaly

"-" soil moisture anomaly

physics pert.

1	2	3	4	5
0.2	0.7	0.2	(0.4)	0.7

IC + BC pert.

IFS

GME

GFS

GSM

Modified vertical filter of IC perturbations

→ **General approach:**

- ▪ **add anomalies to operational COSMO-DE analysis fields for selected variables**

- ▪ **Anomaly: BC-EPS minus short-range forecast (latest COSMO-EU)**

- ▪ **Filter anomalies near the surface**

Modified vertical filter of IC perturbations

➔ **General approach:**

- **add anomalies to operational COSMO-DE analysis fields for selected variables**

- **Anomaly: BC-EPS minus short-range forecast (latest COSMO-EU)**

- **Filter anomalies near the surface**

➔ **Old vertical filter**

- **Full anomaly above model level ~ 25, no perturbation below m.l. 40**

Modified vertical filter of IC perturbations

➔ **General approach:**

- **add anomalies to operational COSMO-DE analysis fields for selected variables**

- **Anomaly: BC-EPS minus short-range forecast (latest COSMO-EU)**
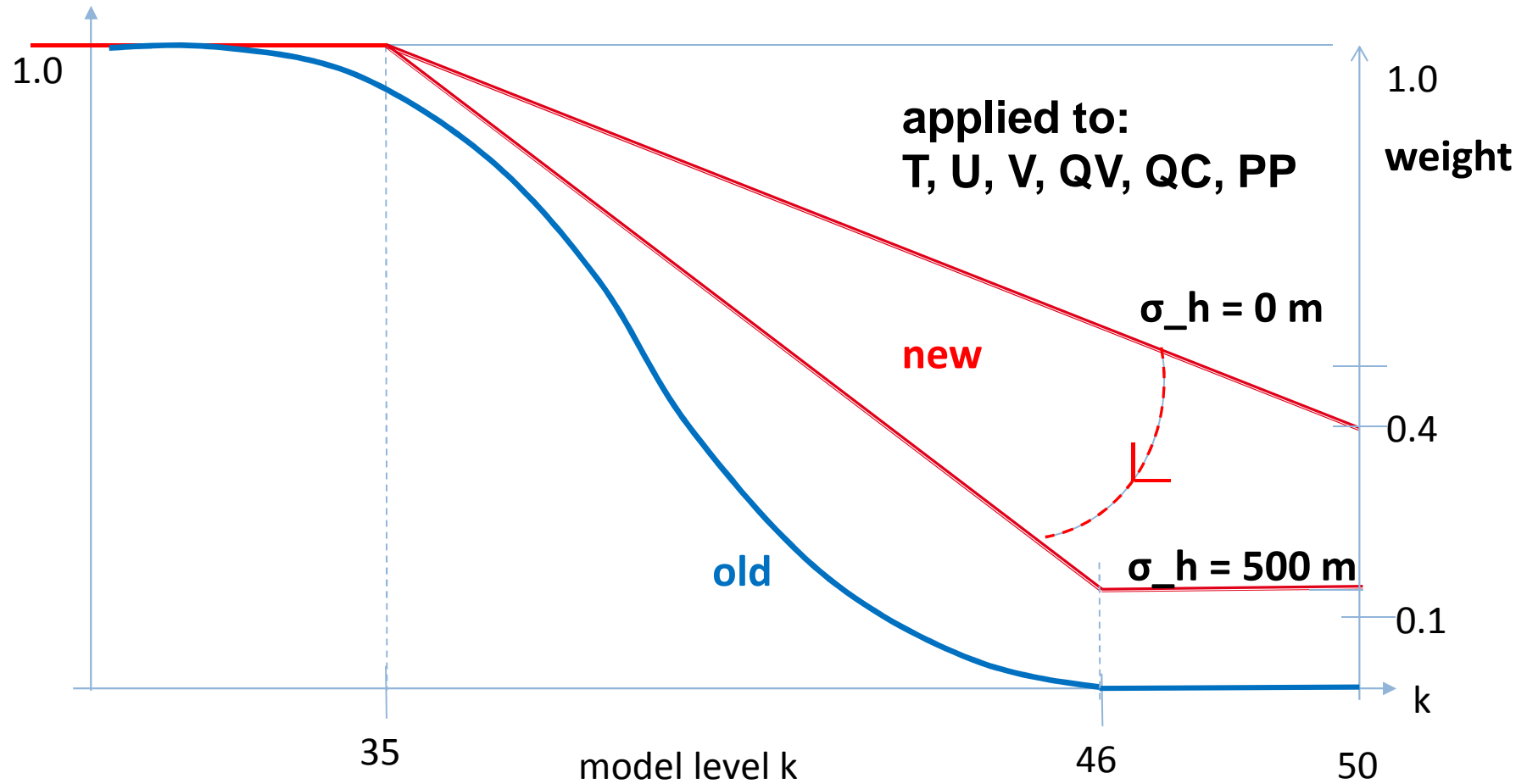
- **Filter anomalies near the surface**

➔ **Old vertical filter**

- **Full anomaly above model level ~ 25, no perturbation below m.l. 40**

➔ **New vertical filter**

- **Degree of perturbation depends on spatial variance of orography σ_h**

- **The "smoother" the orography, the higher the degree of perturbation near the surface**

- **Full surface pressure perturbation (weight = 1.)**

- **Horizontal smoothing of all initial perturbations (radius: 5 GP)**
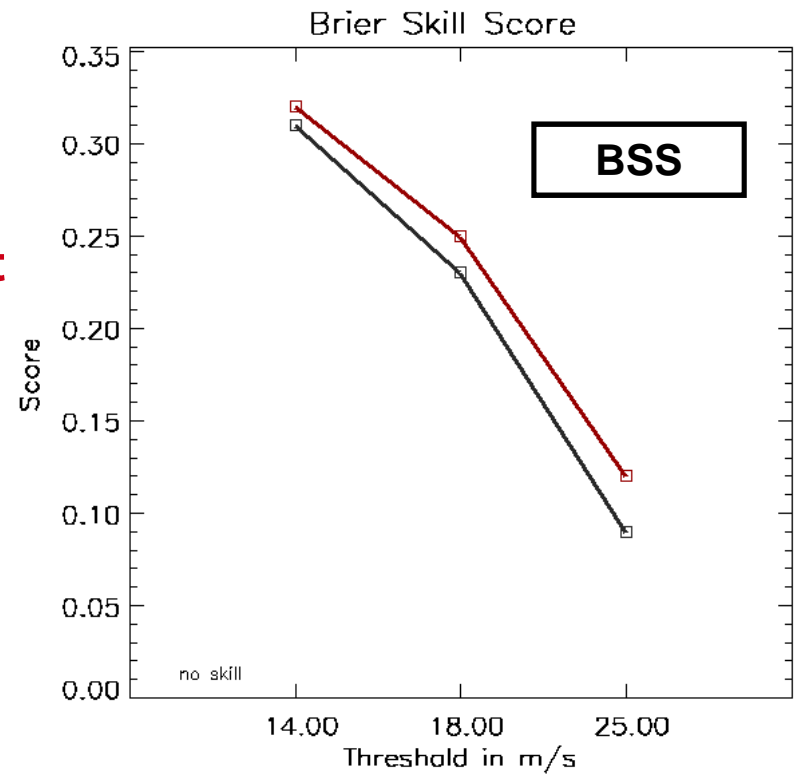
Modified vertical filter of IC perturbations

applied to:
T, U, V, QV, QC, PP

σ_h = 0 m

new

old

σ_h = 500 m

weight

1.0

0.4

0.1

1.0

35   model level k   46   50

k

Modified vertical filter of IC perturbations

Test period: 15 May – 30 June 2014, 00 UTC runs
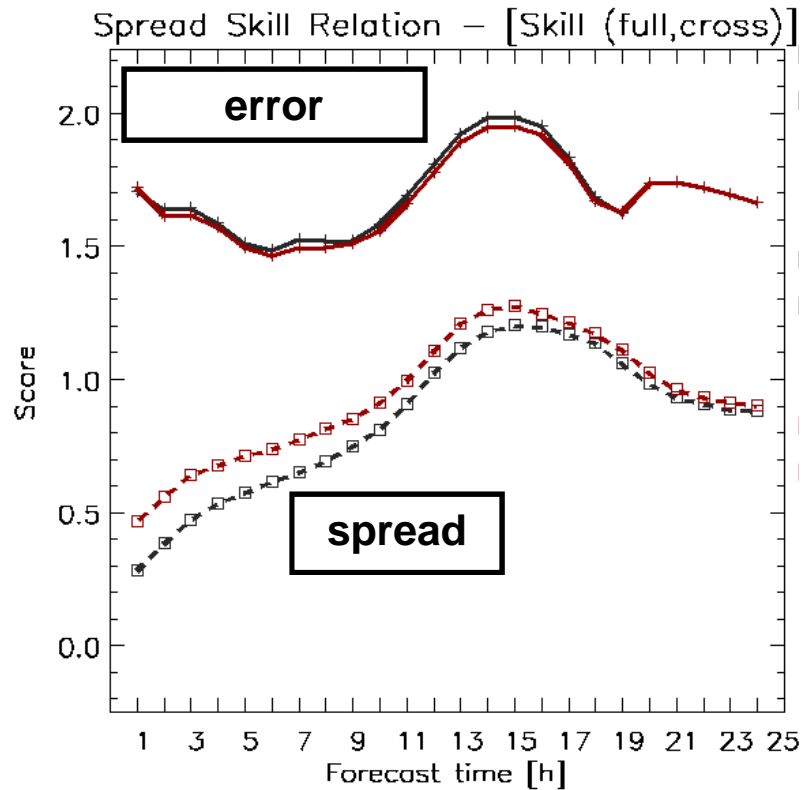
10m wind gusts

new IC pert

reference

DEVELOPMENTS
&
PLANS

Current research, projects / applications

➔ **use of KENDA for IC perturbations**

➔ **extension to 40 Members (COSMO-LEPS as additional BCs)**

➔ **calibration of probabilistic products**

➔ **applications for renewable energy and air traffic management**

➔ **contribution to TIGGE-LAM dataset**

Use of KENDA for IC perturbations

First tests in step-by-step replacement of current approach

➔ **operational nudging analysis + perturbation anomalies from BC-EPS replaced by 20 (of 40) KENDA ICs (T, U, V, QV, QC, PP)**

➔ **no radar data / no latent heat nudging**

➔ **BC-EPS BC as in COSMO-DE-EPS**

➔ **physics perturbations as in COSMO-DE-EPS**

➔ **No soil moisture perturbation**

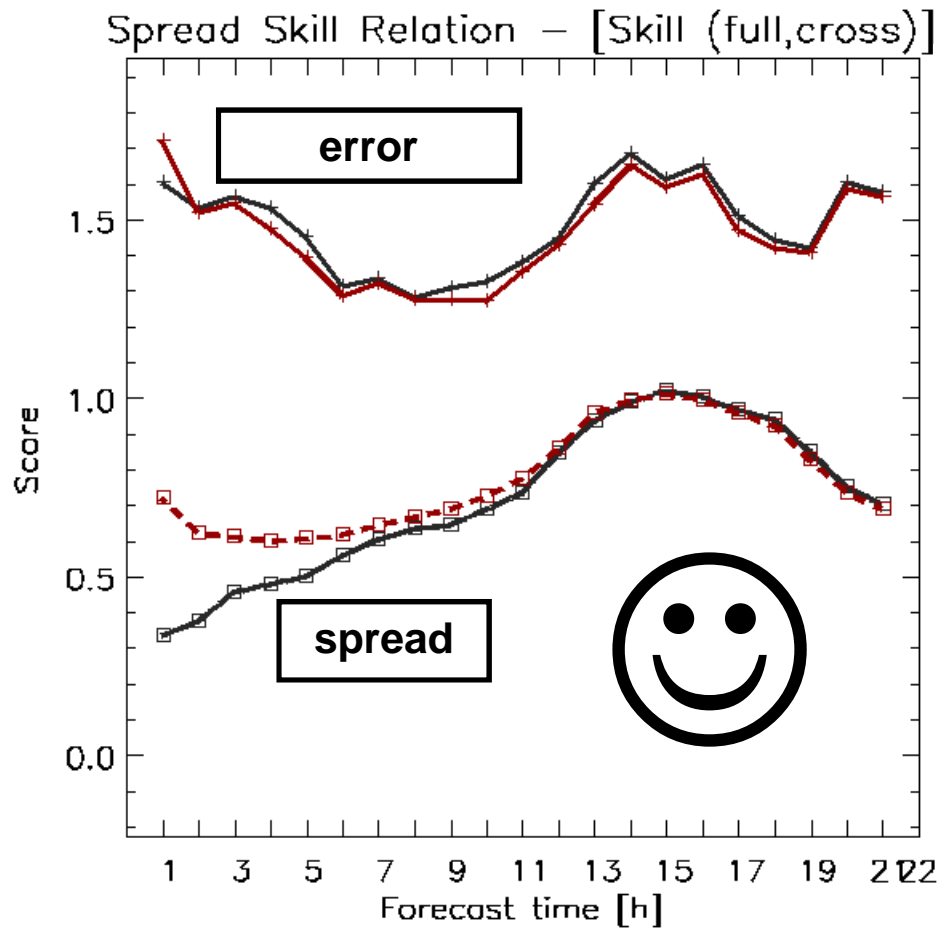➔ **Short (!) test period : 20-25 July 2012**

Use of KENDA for IC perturbations
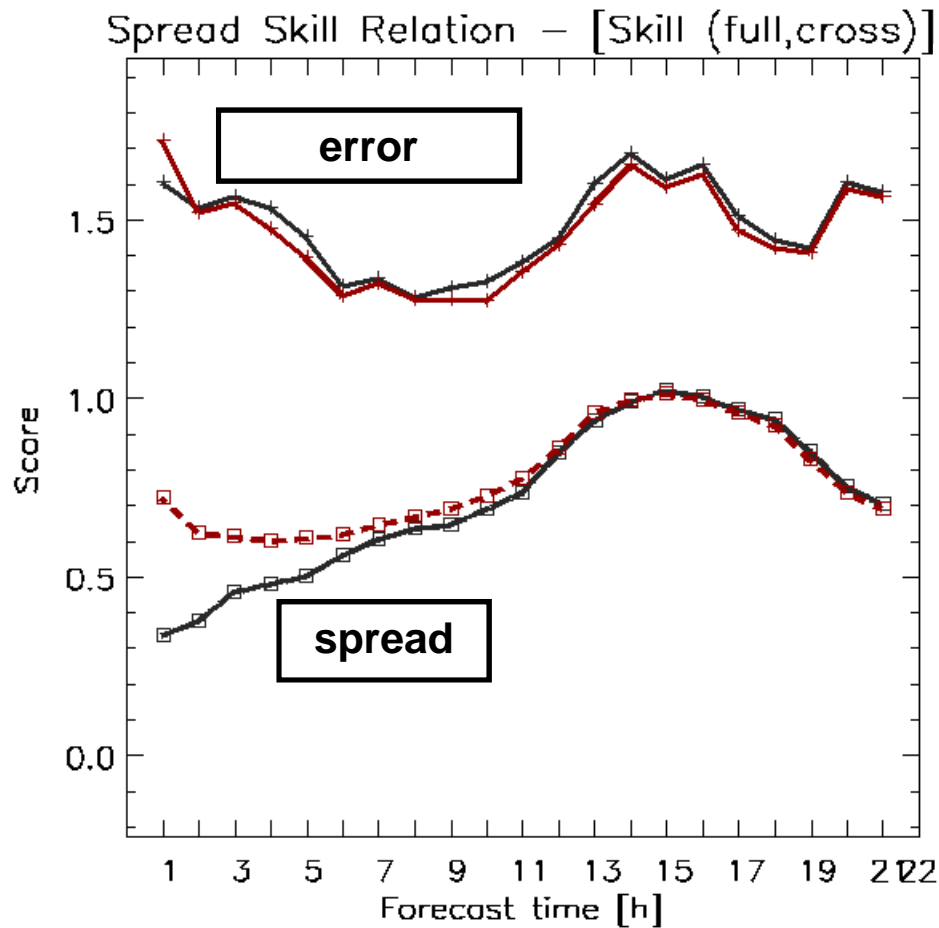
VMAX_10M

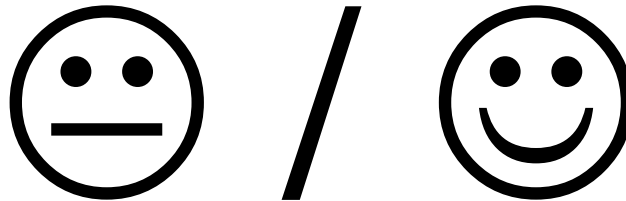**operational**

using KENDA

Use of KENDA for IC perturbations

VMAX_10M

operational

using KENDA

# Use of KENDA for IC perturbations

T_2M

TOT_PREC

😐 / ☺

➔ **longer time series including more relevant cases needed for a robust evaluation**

➔ **first steps of bringing KENDA IC and COSMO-DE-EPS together**

➔ **more refinements to come**

Extension to 40 members using COSMO-LEPS as BC/ICs

→ **use COSMO-LEPS members 1 to 4 as boundary forecasts and for IC perturbations**
(no systematic difference between any two COSMO-LEPS members out of members 1- 8)

→ **physics and soil moisture perturbations as in operational 20 members**

→ **results in 20 additional members**

→ **mixed results for several different test periods and test set-ups (COSMO / INT2LM version, LEPS physics, time lag of IFS EPS member…)**
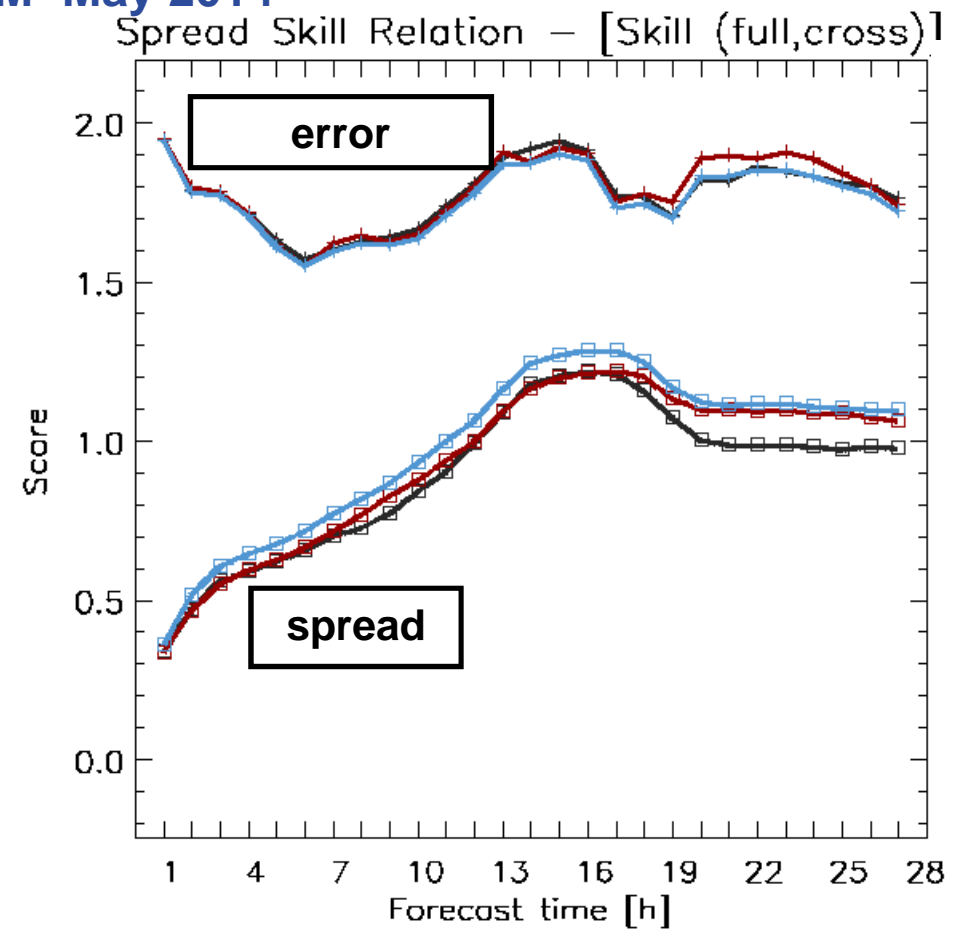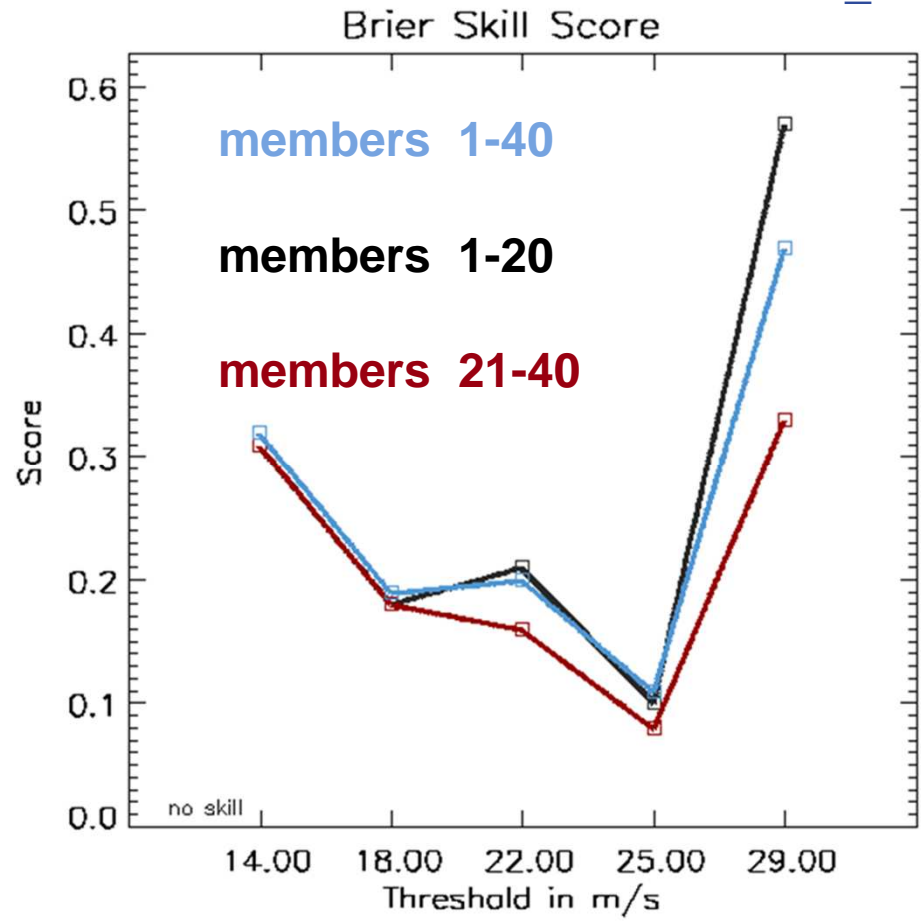
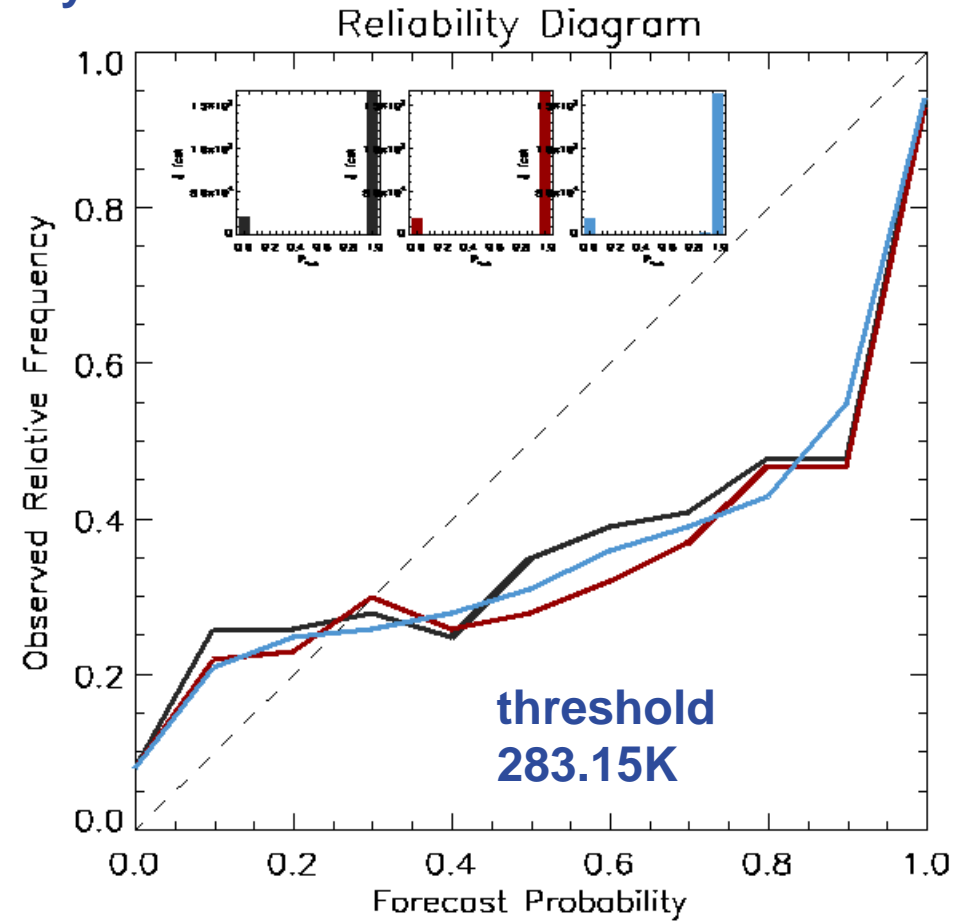# Extension to 40 members using COSMO-LEPS as BC/ICs

TOT_PREC May 2014
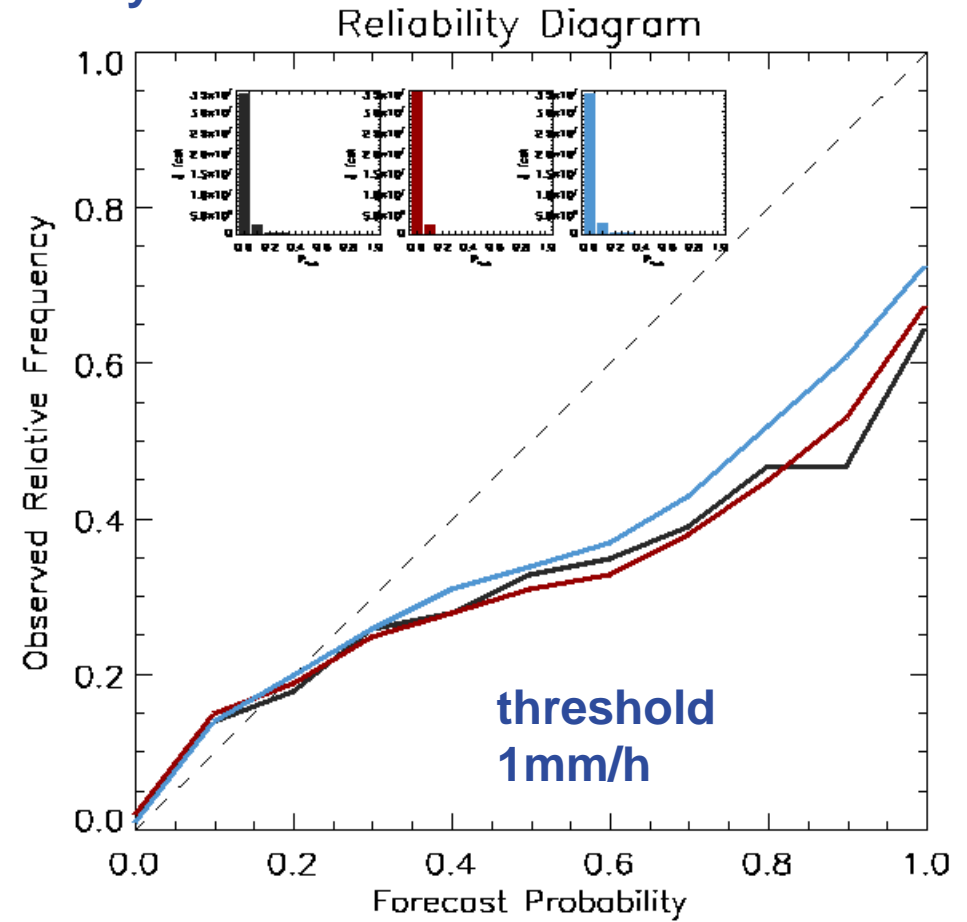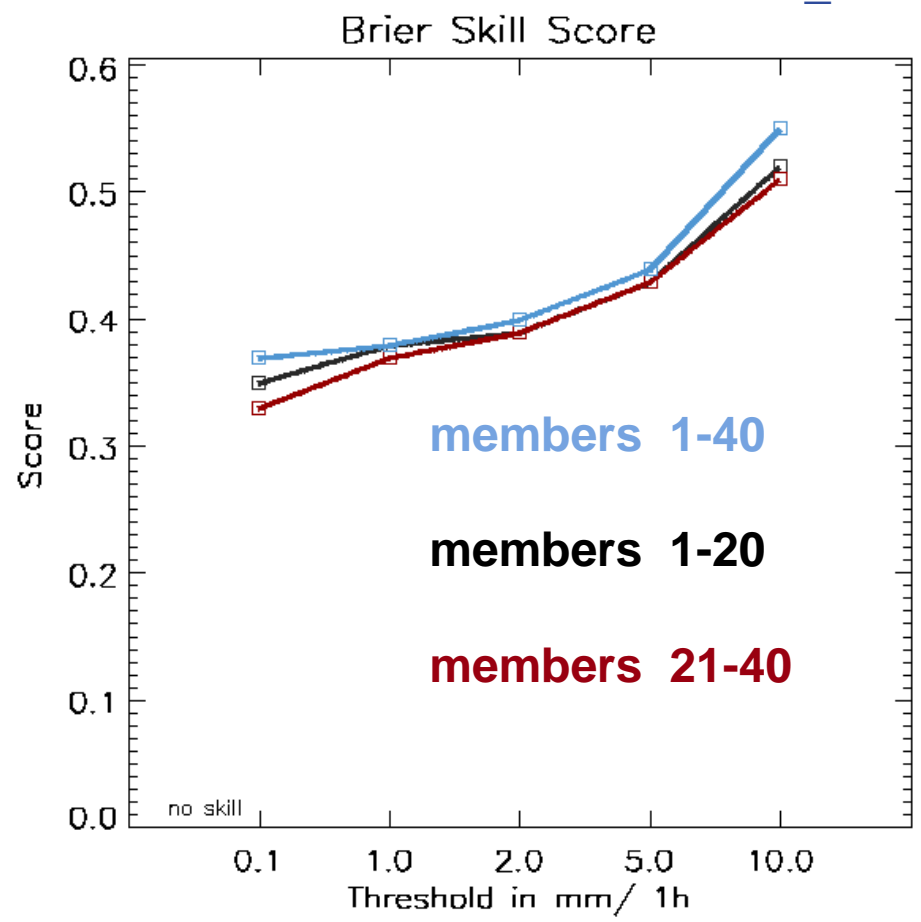
Extension to 40 members using COSMO-LEPS as BC/ICs

VMAX_10M May 2014

Extension to 40 members using COSMO-LEPS as BC/ICs
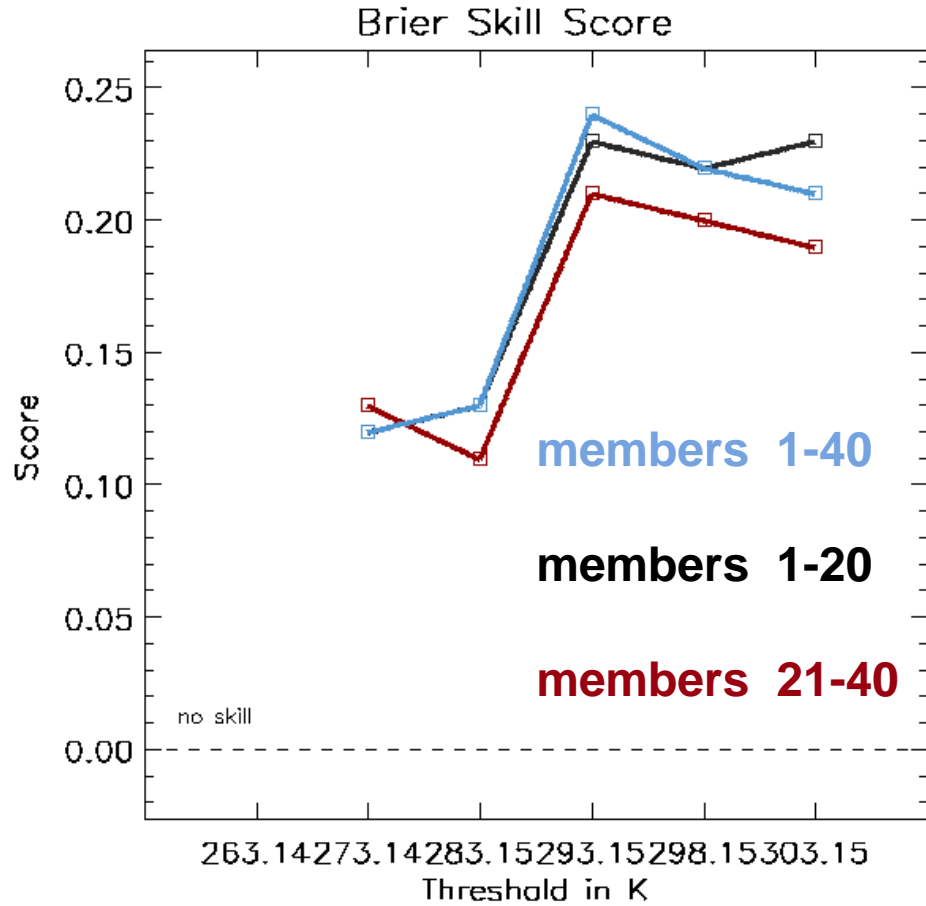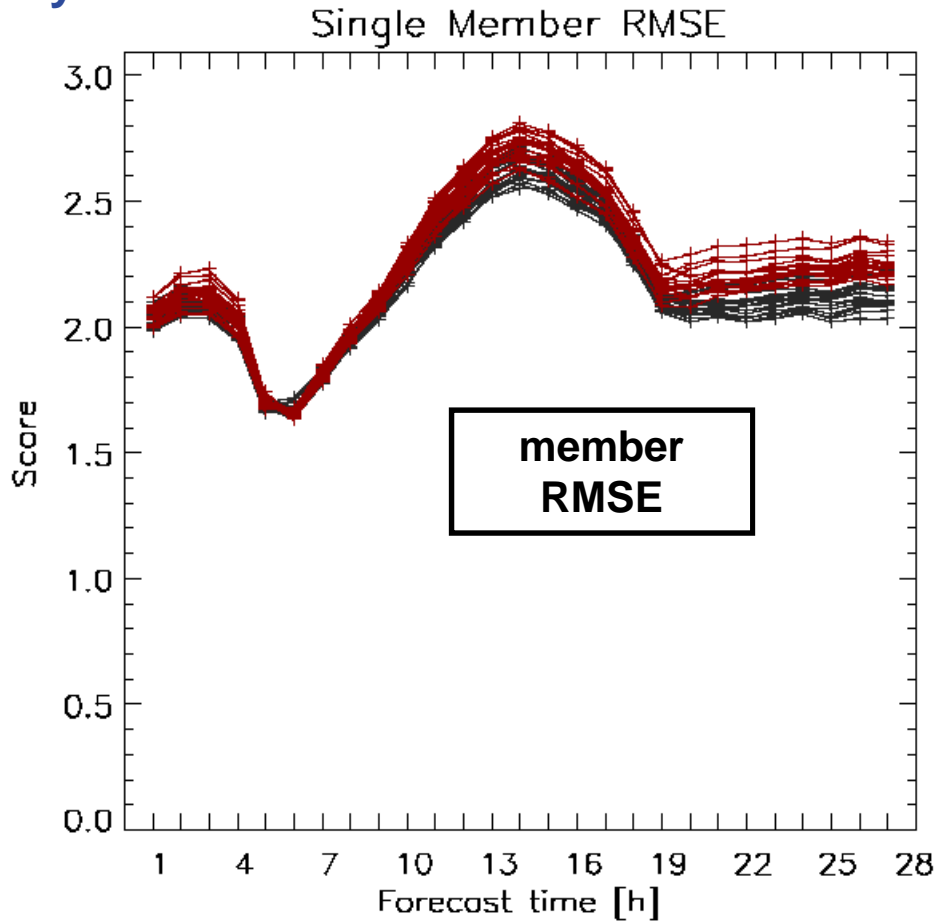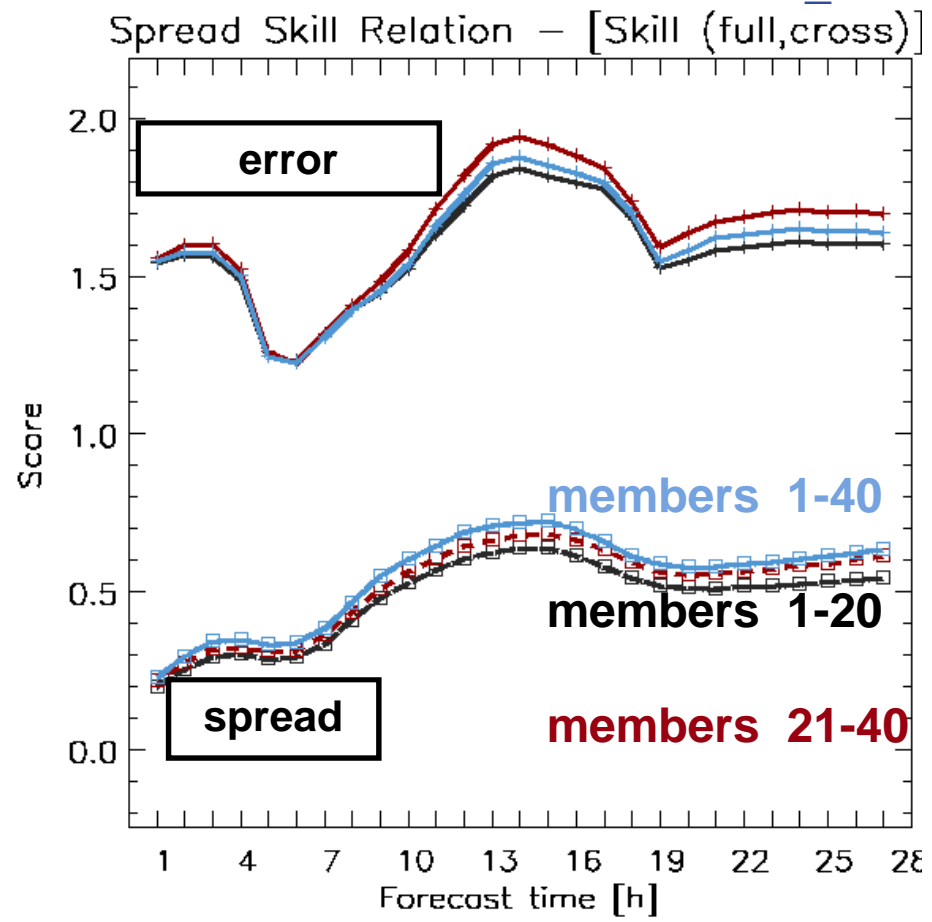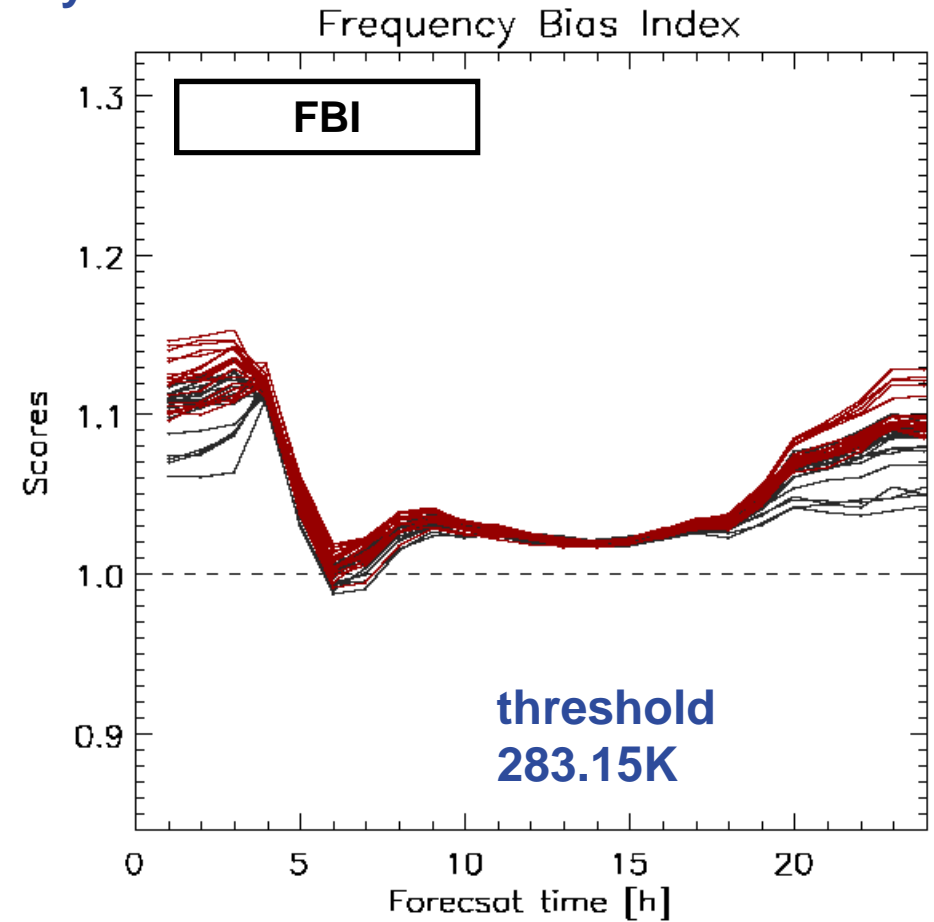
T_2M May 2014

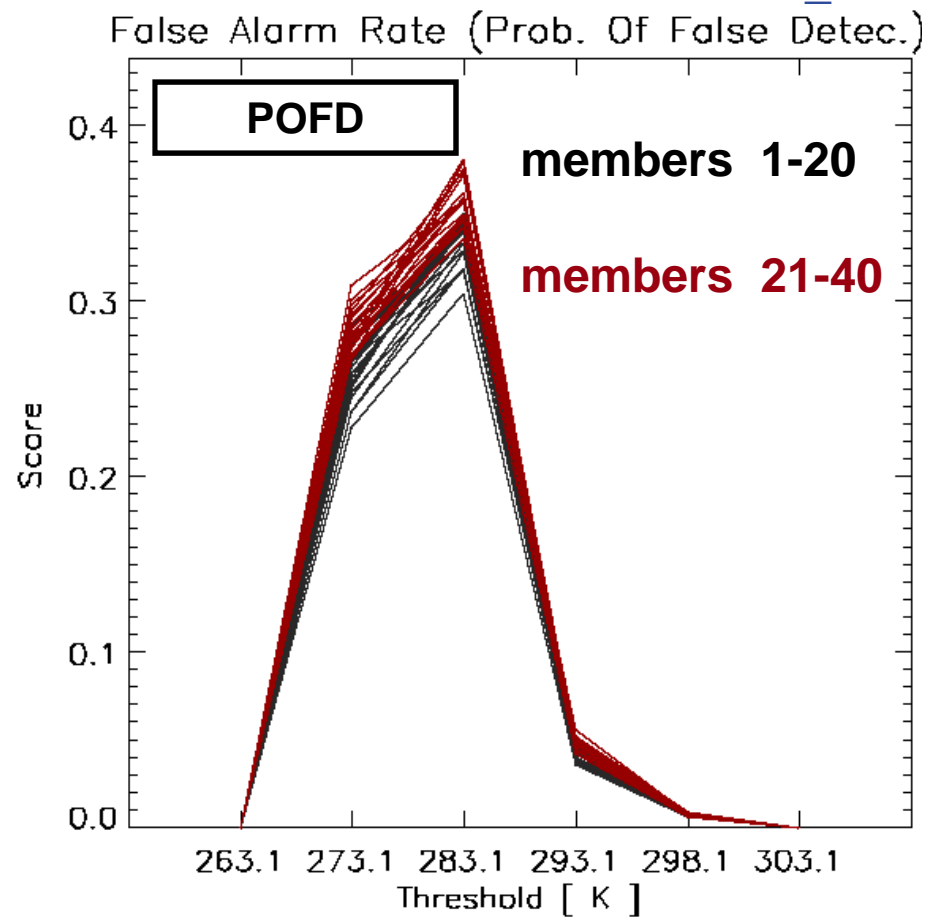# Extension to 40 members using COSMO-LEPS as BC/ICs

T_2M May 2014

Extension to 40 members using COSMO-LEPS as BC/ICs

T_2M May 2014

Extension to 40 members using COSMO-LEPS as BC/ICs

➔ **the 20 additional members have skill by themselves**

➔ **but they do not add remarkable skill to the existing system**

➔ **in particular T_2M seems to be problematic**

➔ **more research needed …**

Contribution to TIGGE-LAM data set

➔ **COSMO-DE-EPS available since 1st Jan 2014**

➔ **00, 06, 12, 18 UTC**

➔ **all members with 27h forecast range**

➔ **selected variables**

➔ **https://software.ecmwf.int/wiki/display/TIGGE/TIGGE-LAM**
  (TIGGE-LAM info)

➔ **http://apps.ecmwf.int/datasets/data/tigge_lam/**
  (TIGGE-LAM data portal)

Future plans

➔ **use of ICON EPS for BC perturbations**

➔ **add new physics perturbations or alternative perturbation methods (e.g. stochastic physics)**