Verification Overview

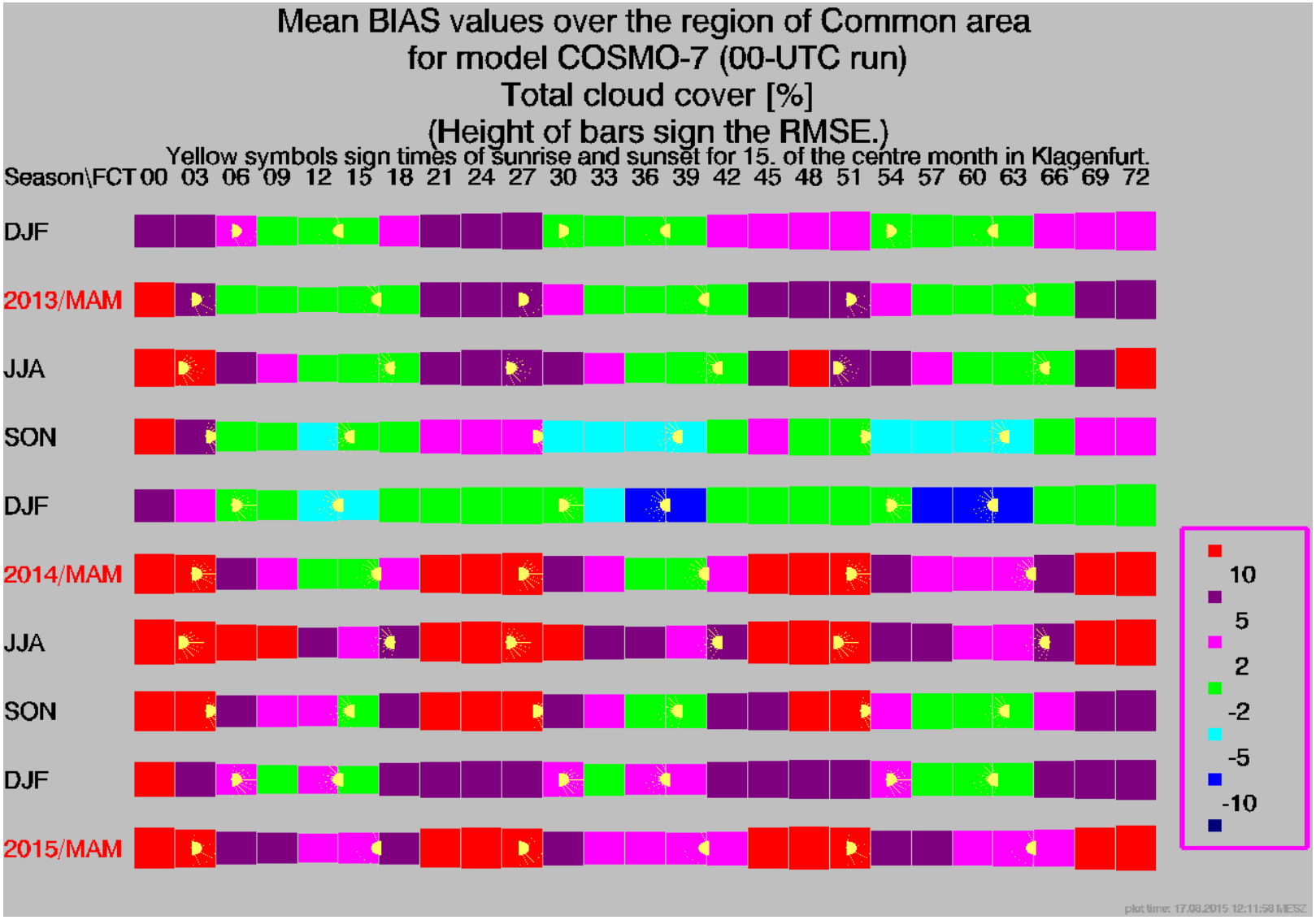
Ulrich Damrath and all Verificators

Ulrich.Damrath@dwd.de

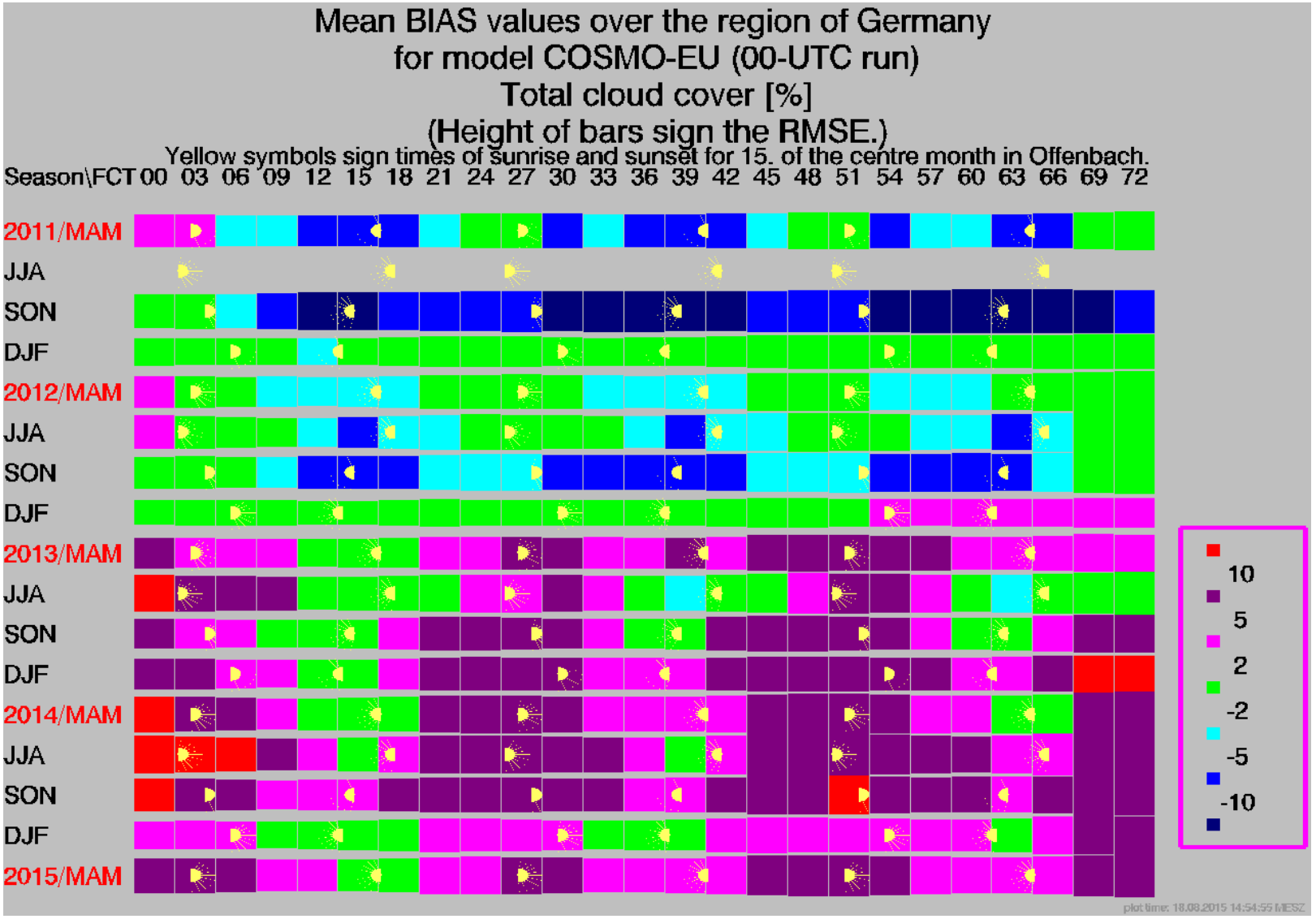
Overview of the talk

- Present state of verification with VERSUS (exchanged data for the common plot suite)
- **Most important results got during last year**
  - ***What are common forecast errors for different model setups?***
  - ***What are differerent forecast errors for different model setups?***
  - ***Trend since 2012***
- **Long term trends in verification results for surface weather elements**
  - ***General trend***
    - ***The COSMO-Index – trend and single event ranges***
    - ***and its components***
  - ***Special consideration of quantitative precipitation forecast***
    - ***Observation data base: SYNOP***
    - ***Observation data base: high resolution networks***
    - ***Observation data base: radar data***
- **Only examples can be shown!!!**

Common error behaviour
Total cloud cover COSMO 7

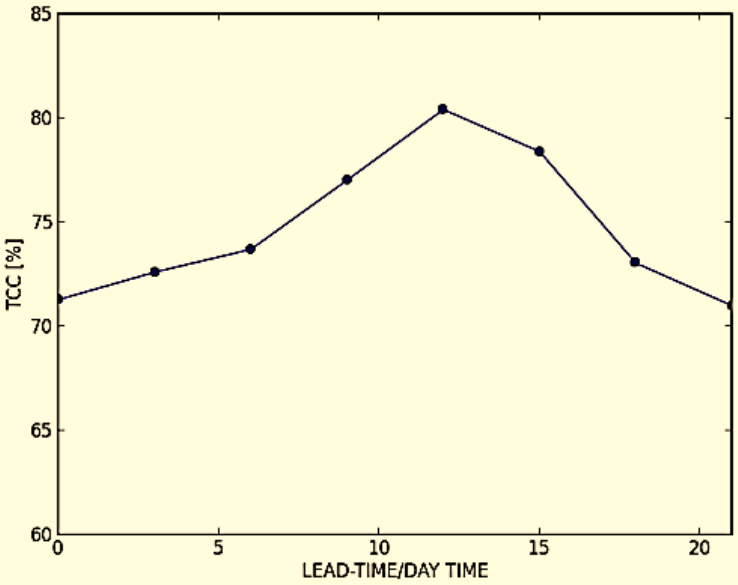


Common error behaviour
Total cloud cover COSMO EU (Germany)

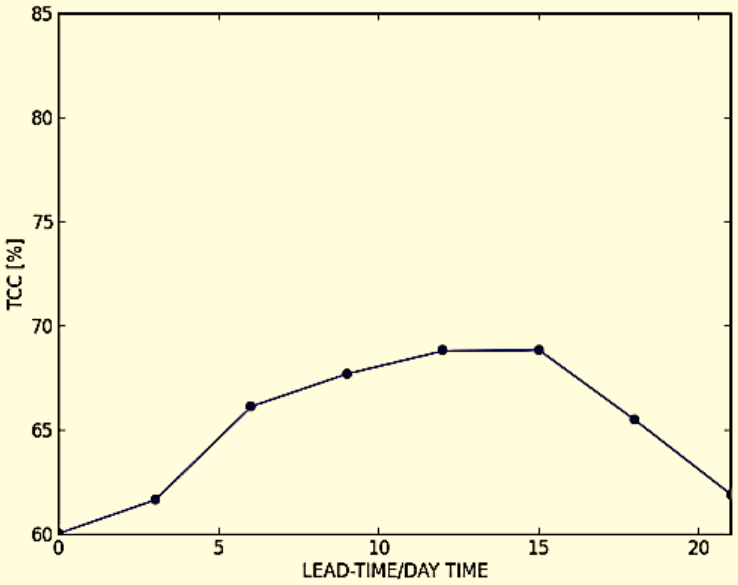


Diurnal Cycle in TCC
05/2012 – 05/2013

MSG/SEVIRI CM



SYNOP TCC



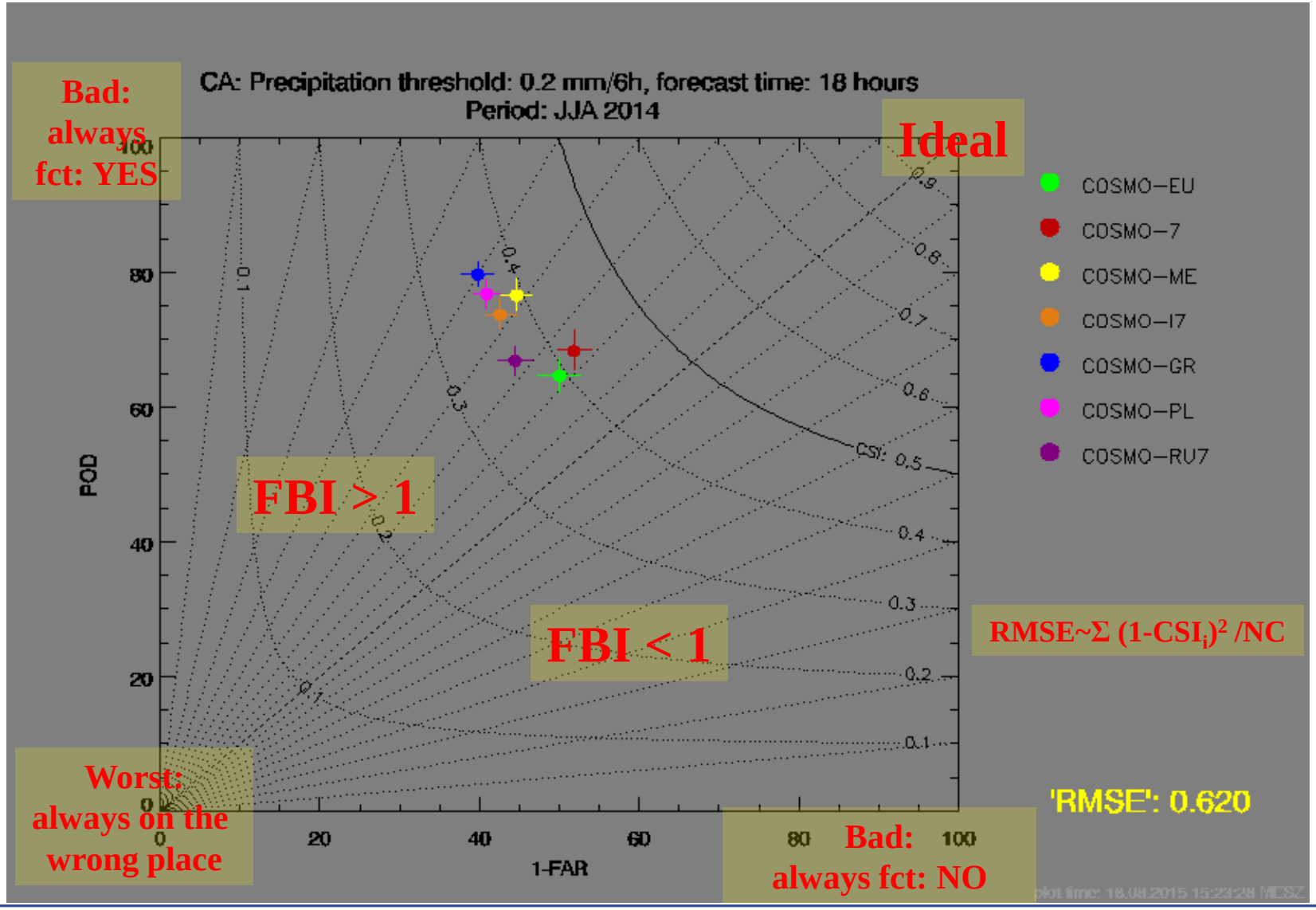
Mean difference: ~+10%

Mean Bias now: ~ +10%

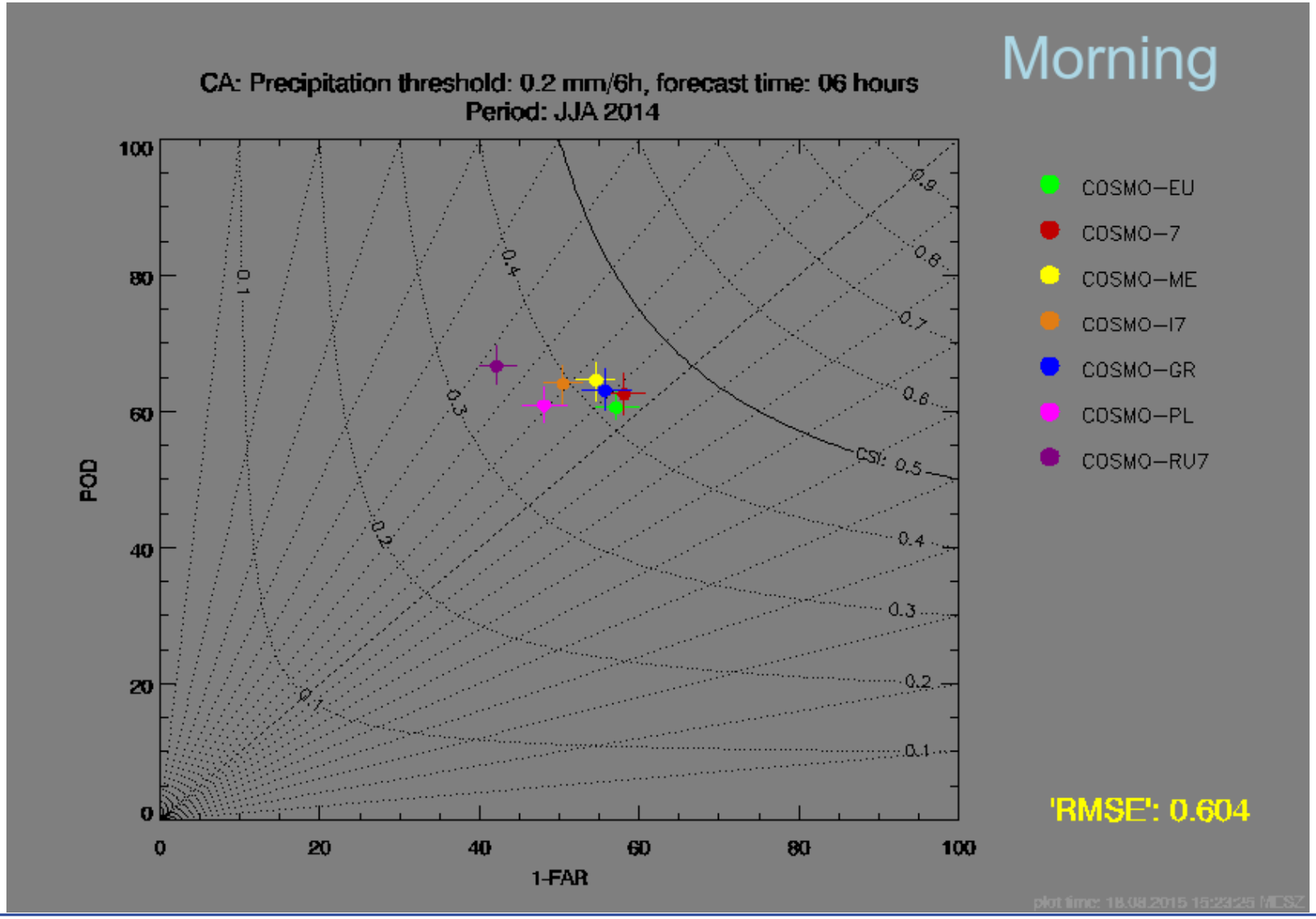
Is there a real BIAS in the TCC forecast?

By courtesy of Felix Fundel

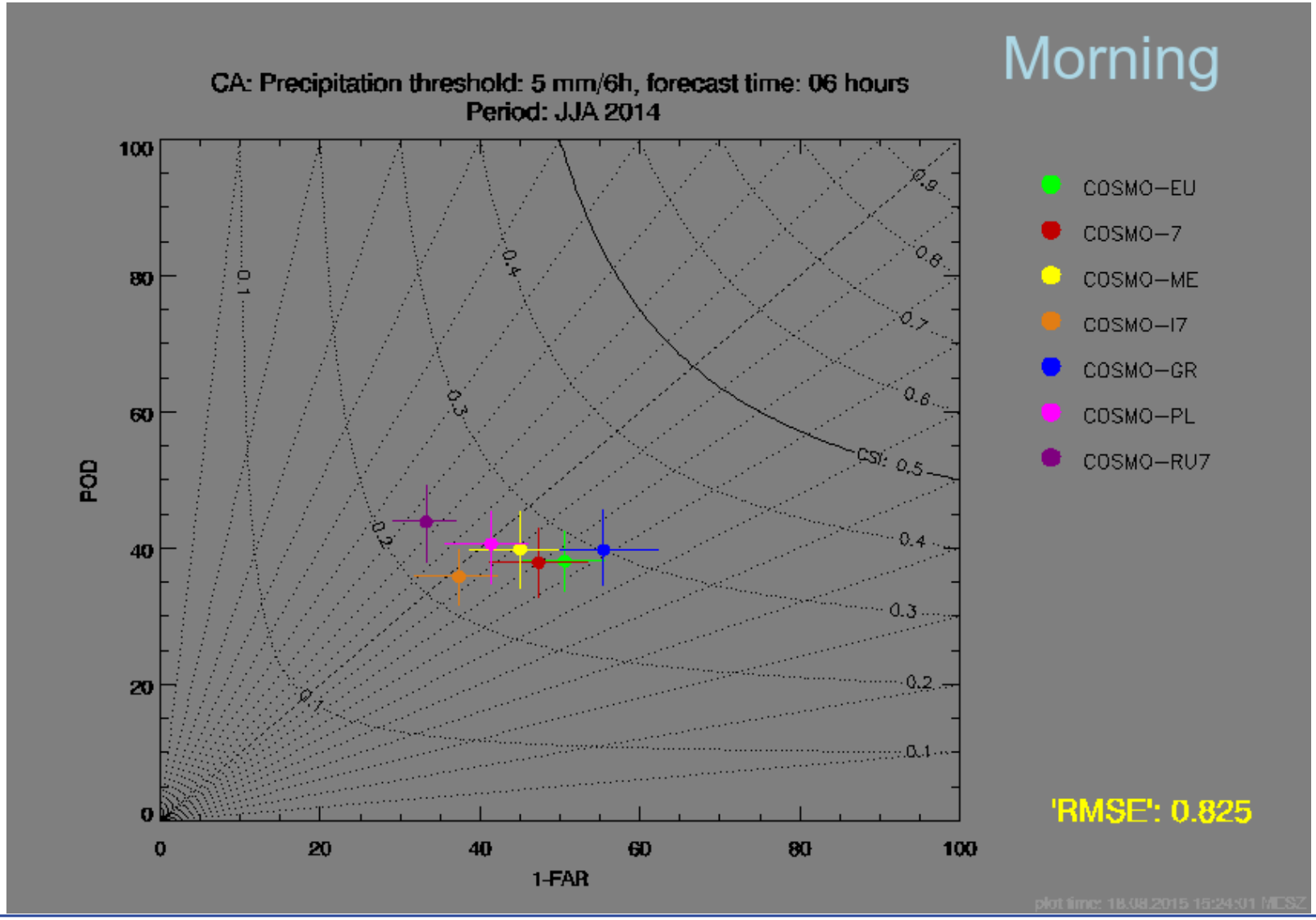
Performance diagram precipitation (example)



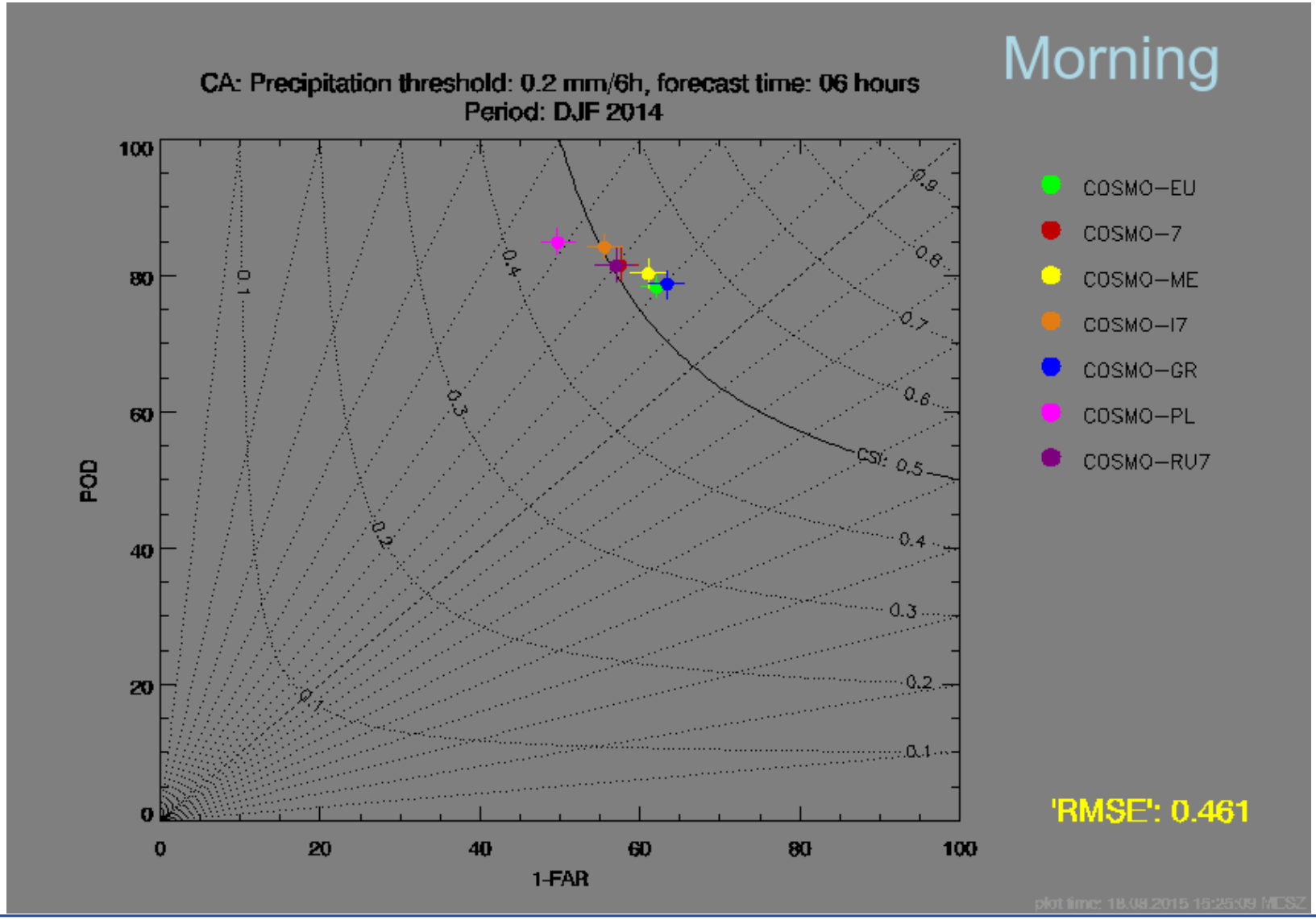
Performance diagram precipitation
JJA 2014 0.2mm/6h



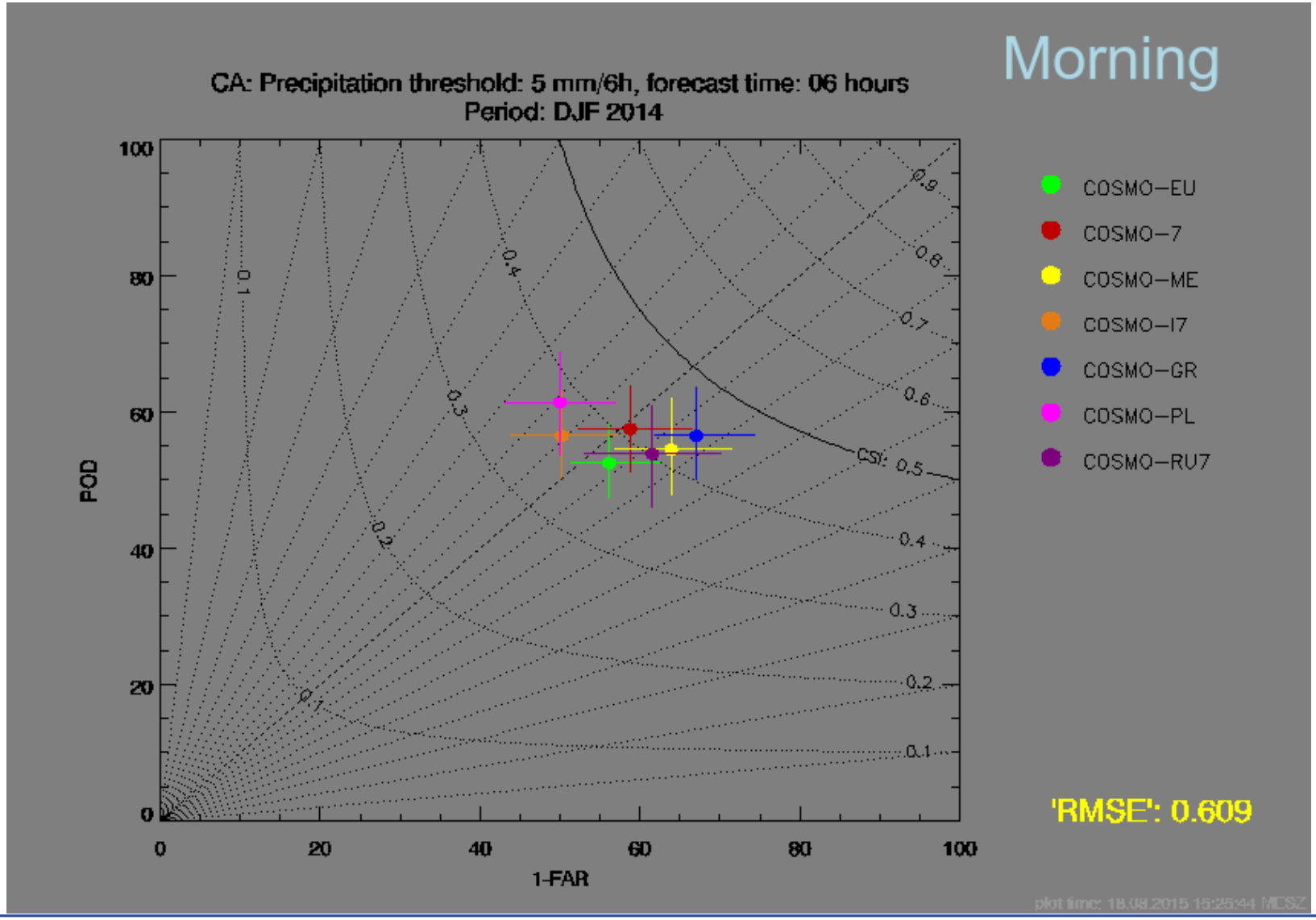
Performance diagram precipitation
JJA 2014 5 mm/6h



Performance diagram precipitation
DJF 2014/2015 0.2mm/6h



Performance diagram precipitation
DJF 2014/2015 5 mm/6h



ETS precipitation (rank)
JJA 2014 0.2 mm/6h

ETS JJA 2014 accumulation period: 06 H threshold: 0.2 mm COMMON area

FCT\RANK	1	2	3	4	5	6	7
6	IFS ***	DWD **	IFS **	IFS **	IFS *	DWD	DWD
12	DWD *****	IFS *****	IFS ****	IFS	IFS	DWD	DWD
18	IFS ***	DWD ****	IFS **	DWD	IFS	DWD	IFS
24	IFS **	DWD	IFS	IFS	IFS	DWD	DWD
30	DWD *	IFS *	IFS *	IFS	IFS	DWD	DWD
36	DWD *****	IFS *****	IFS **	DWD *	IFS *	IFS	DWD
42	DWD **	DWD *	IFS *	IFS *	IFS *	IFS	DWD
48	IFS	DWD	IFS	IFS	IFS	DWD	DWD
54	IFS *	IFS *	IFS	IFS	DWD	DWD	DWD
60	IFS *****	IFS **	DWD *	IFS *	DWD *	IFS	DWD
66	IFS ***	IFS **	DWD	IFS *	IFS	DWD	DWD
72	IFS ***	IFS ***	IFS *	IFS *	DWD	DWD	DWD

Asterisks sign the version with significant different results to the version left of these.

Confidence information: Gaussian, Average rank DWD: 3.625 IFS: 3.375, WILCOXON: 1.690 (NS)

ETS precipitation (rank)
JJA 2014 10 mm/6h

ETS JJA 2014 accumulation period: 06 H threshold: 10 mm COMMON area

FCT\RANK	1	2	3	4	5	6	7
6	IFS	IFS	DWD	IFS	DWD	DWD	IFS
12	IFS	DWD	IFS	DWD	DWD	IFS	IFS
18	IFS **	IFS	IFS	DWD	DWD	IFS	DWD
24	IFS	IFS	IFS	IFS	DWD	DWD	DWD
30	IFS	IFS	DWD	DWD	IFS	DWD	IFS
36	IFS	DWD	IFS	DWD	IFS	IFS	DWD
42	DWD	IFS	DWD	DWD	IFS	IFS	IFS
48	DWD	IFS	IFS	DWD	IFS	DWD	IFS
54	IFS **	IFS	DWD	IFS	DWD	IFS	DWD
60	IFS *	IFS	IFS	IFS	DWD	DWD	DWD
66	IFS ****	IFS *	IFS *	DWD	DWD	IFS	DWD
72	IFS **	IFS *	IFS	IFS	DWD	DWD	DWD

Asterisks sign the version with significant different results to the version left of these.

Confidence information: Gaussian, Average rank DWD: 3.562 IFS: 3.438, WILCOXON: 1.555 (NS)

ETS precipitation (rank)
DJF 2014/2015 0.2 mm/6h

ETS DJF 2014 accumulation period: 06 H threshold: 0.2 mm COMMON area

FCT\RANK	1	2	3	4	5	6	7
6	IFS ***	DWD ***	IFS *	IFS *	IFS *	DWD *	DWD
12	IFS ***	IFS **	DWD *	IFS *	DWD *	IFS *	DWD
18	IFS ***	DWD **	IFS **	IFS *	IFS *	DWD	DWD
24	IFS ****	IFS **	DWD *	IFS *	IFS *	DWD *	DWD
30	IFS ***	IFS **	IFS **	DWD *	DWD *	IFS	DWD
36	IFS **	IFS *	DWD *	IFS *	IFS *	DWD *	DWD
42	IFS **	IFS **	IFS **	DWD **	IFS **	DWD	DWD
48	IFS **	IFS **	IFS **	IFS **	DWD *	DWD	DWD
54	IFS **	IFS **	IFS **	DWD **	IFS *	DWD	DWD
60	IFS **	IFS **	IFS **	IFS *	DWD *	DWD	DWD
66	IFS ***	IFS ***	IFS *	IFS *	DWD	DWD	DWD
72	IFS ****	IFS ***	IFS **	IFS *	DWD	DWD	DWD

Asterisks sign the version with significant different results to the version left of these.

Confidence information: Gaussian, Average rank DWD: 4.146 IFS: 2.854, WILCOXON: 3.073 (S 1%)

ETS precipitation (rank)
DJF 2014/2015 10mm/6h

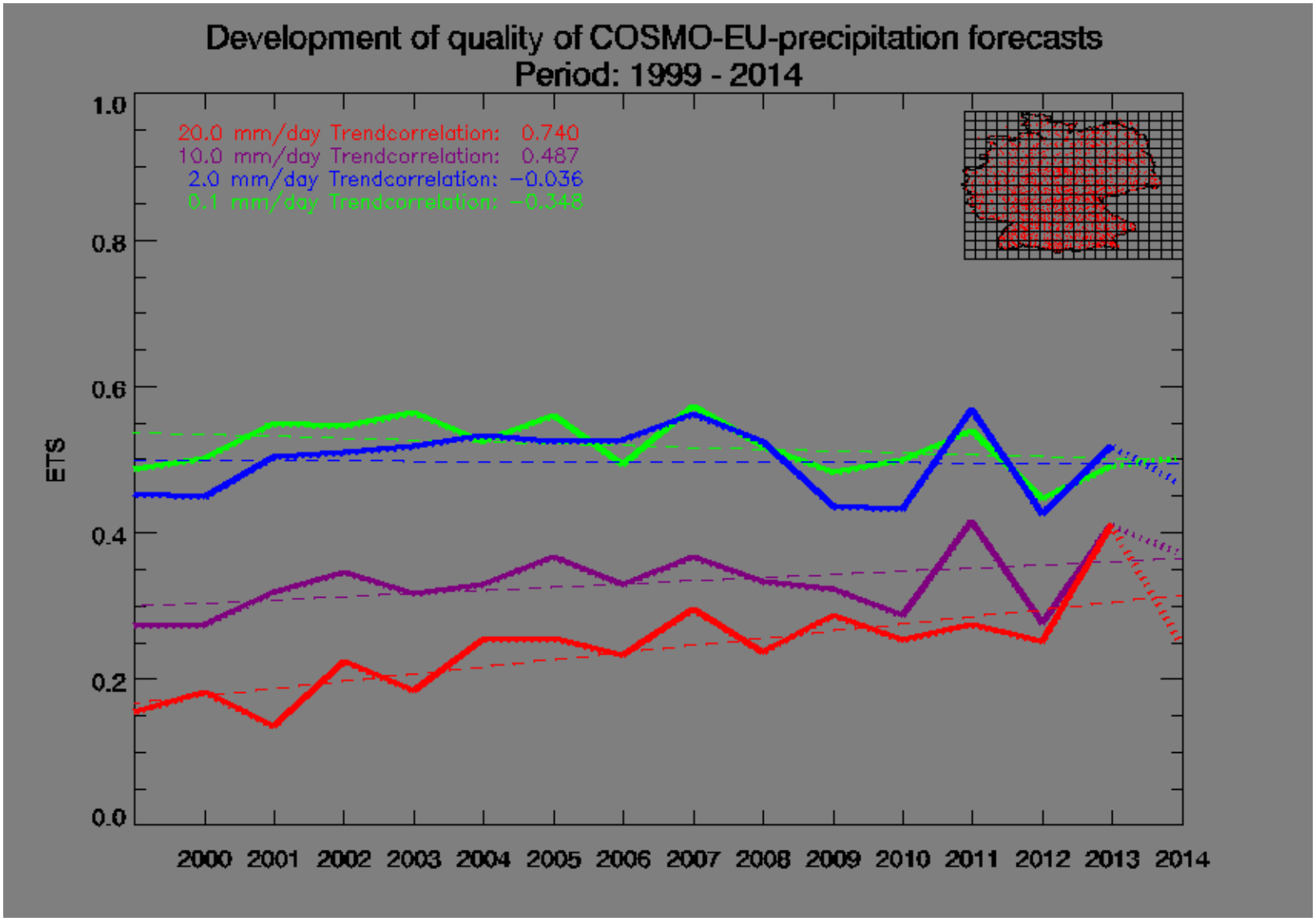
ETS DJF 2014 accumulation period: 06 H threshold: 10 mm COMMON area

FCT\RANK	1	2	3	4	5	6	7
6	IFS	IFS	DWD	IFS	IFS	DWD	DWD
12	IFS	DWD	IFS	IFS	DWD	IFS	DWD
18	DWD	IFS	DWD	IFS	IFS	IFS	DWD
24	IFS	IFS	IFS	DWD	DWD	DWD	IFS
30	DWD	DWD	IFS	DWD	IFS	IFS	IFS
36	IFS	IFS	IFS	DWD	IFS	DWD	DWD
42	DWD	IFS	IFS	DWD	IFS	IFS	DWD
48	IFS *	IFS	DWD	IFS	IFS	DWD	DWD
54	IFS	DWD	DWD	DWD	IFS	IFS	IFS
60	DWD	IFS	DWD	IFS	IFS	IFS	DWD
66	IFS	IFS	DWD	IFS	DWD	IFS	DWD
72	IFS	IFS	IFS	IFS	DWD	DWD	DWD

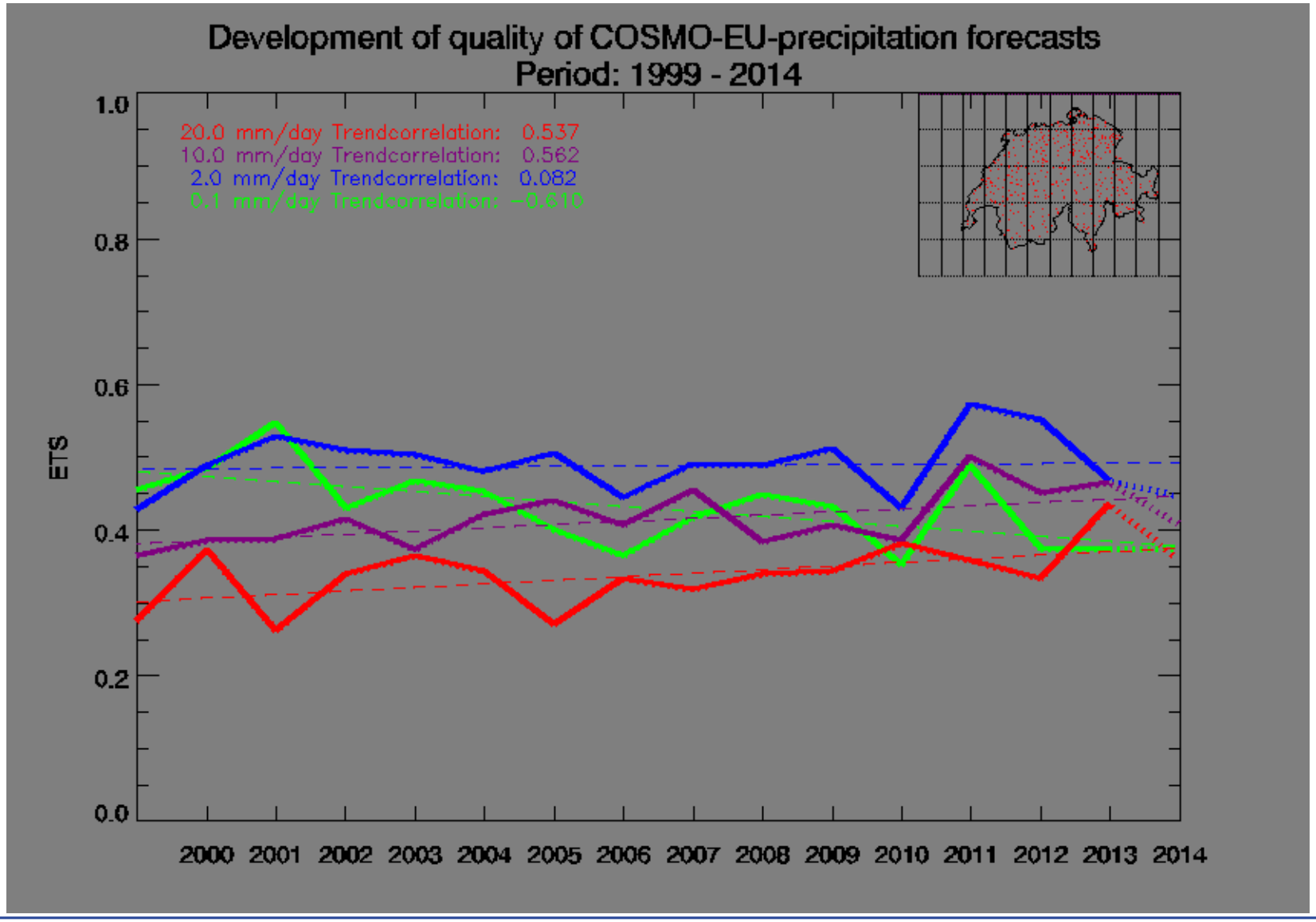
Asterisks sign the version with significant different results to the version left of these.

Confidence information: Gaussian, Average rank DWD: 3.354 IFS: 3.646, WILCOXON: 1.193 (NS)

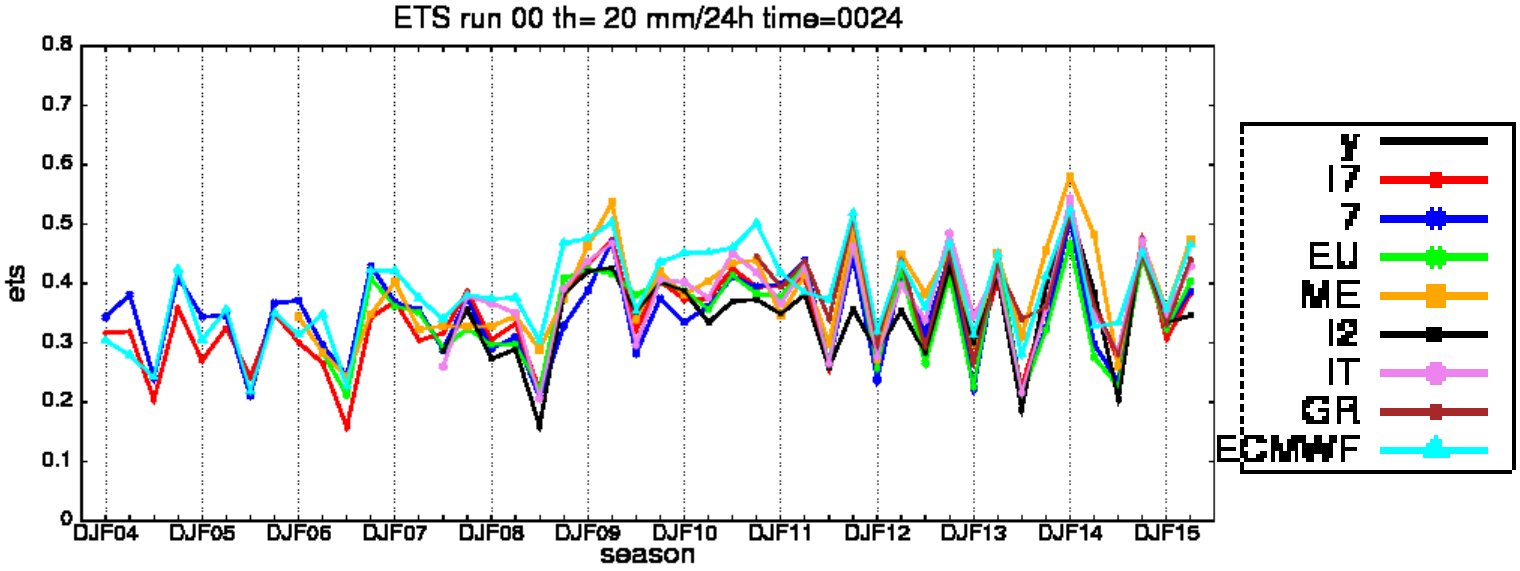
Long term trend for precipitation, COSMO-EU over Germany

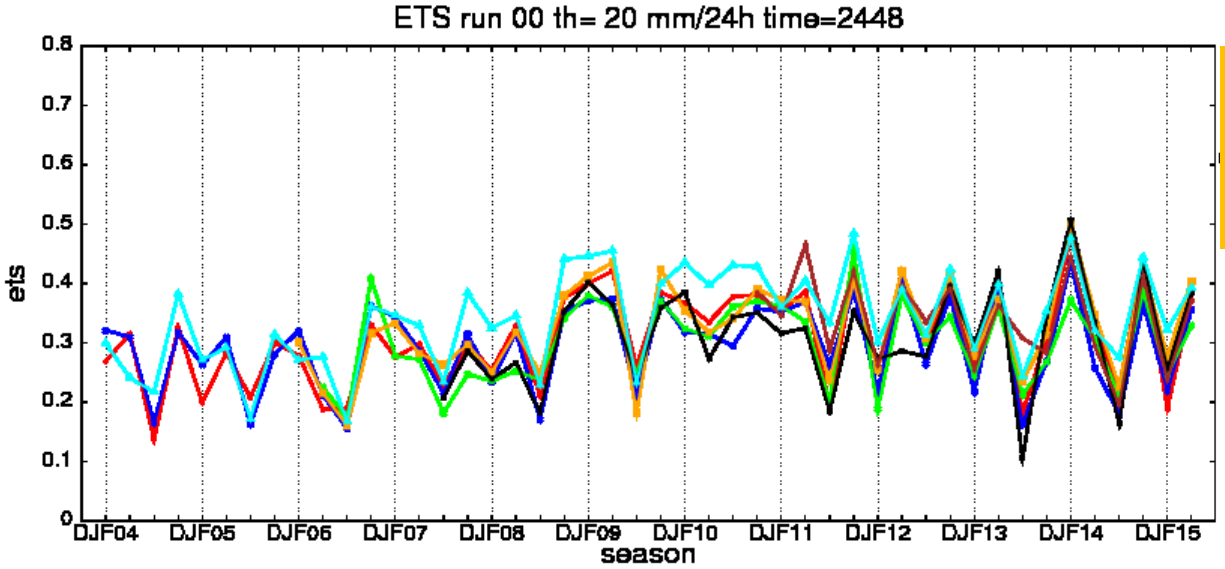


Long term trend for precipitation, COSMO-EU over Switzerland



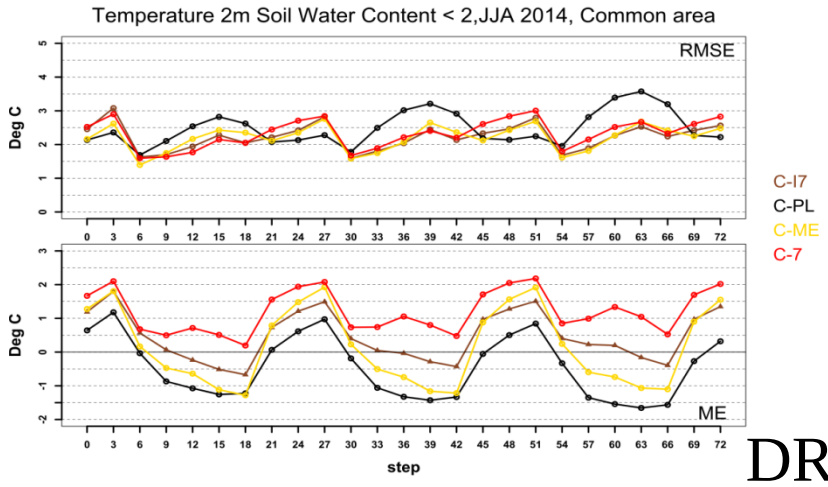
LONG TREND PRECIPITATION with high resolution stations over Italian alert areas



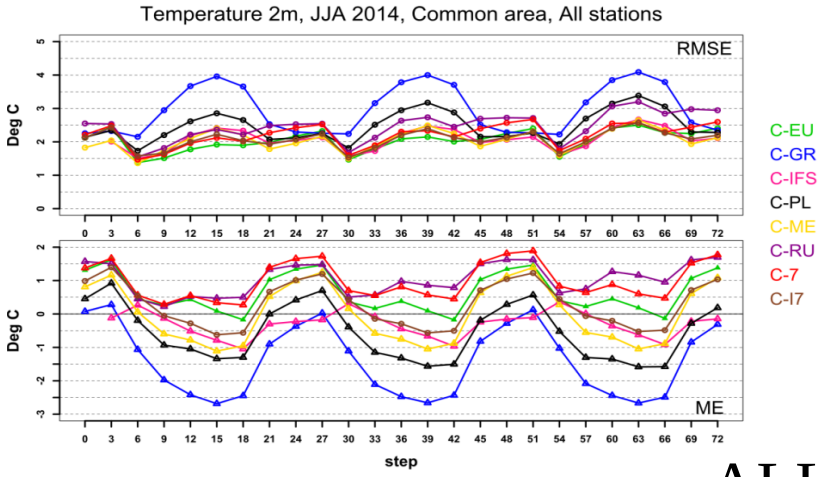


HIGH THRESHOLDS

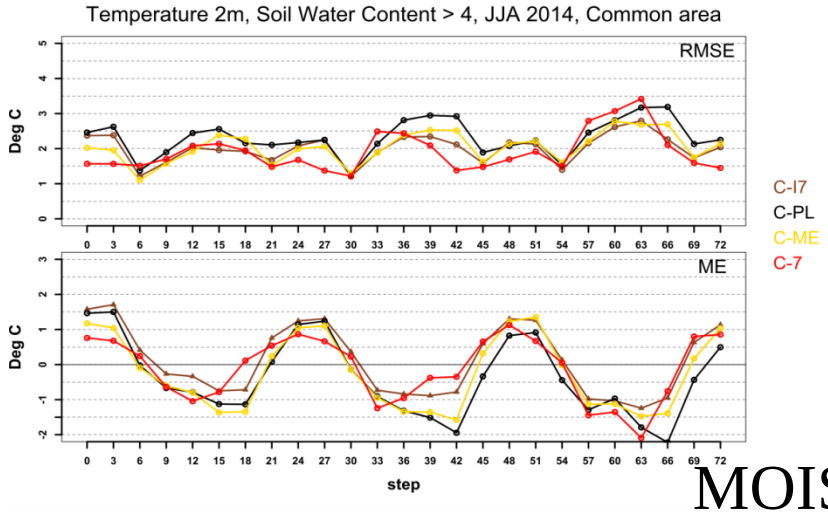
Conditional verification for T2m depending on soil moisture



DRY



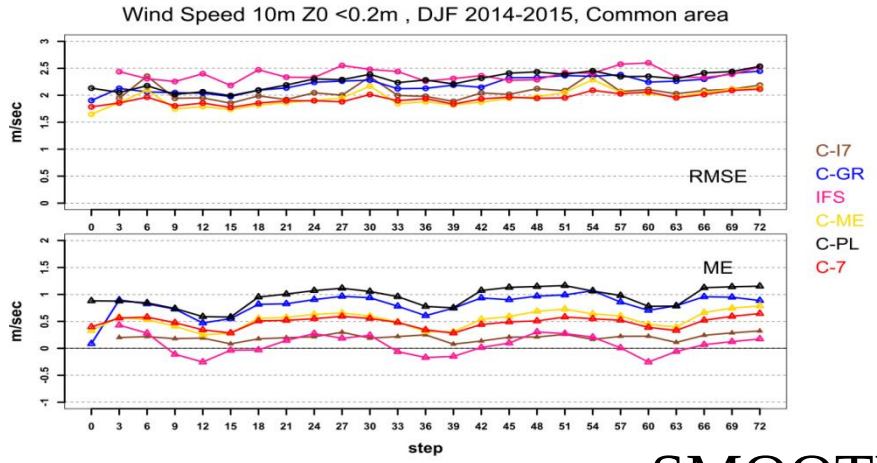
ALL



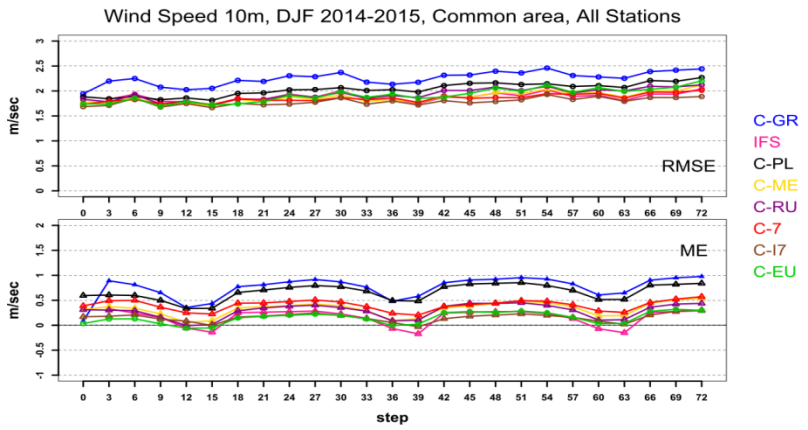
MOIST

DRY and MOIST have Similar diurnal variation, except for C-7, MOIST models grouped together.

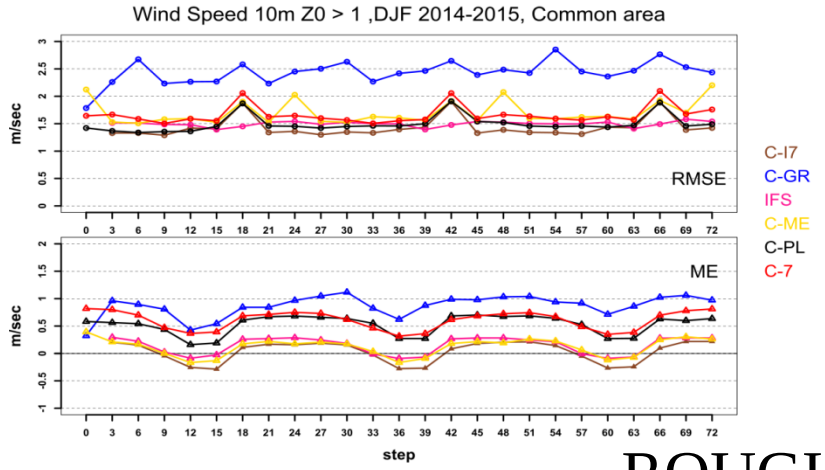
Conditional verification for WS 10m DJF 2014/2015 depending on roughness length



SMOOTH



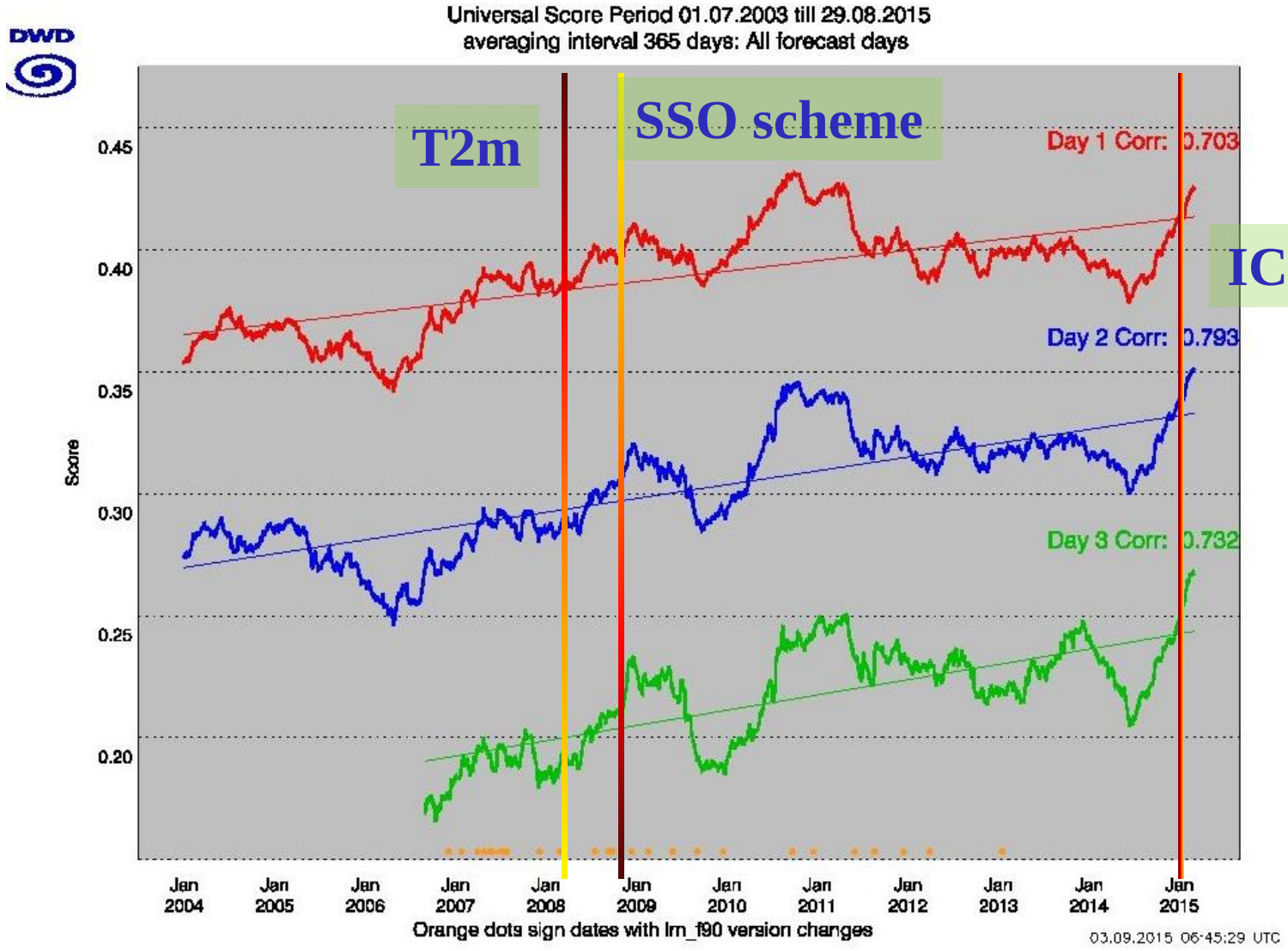
ALL



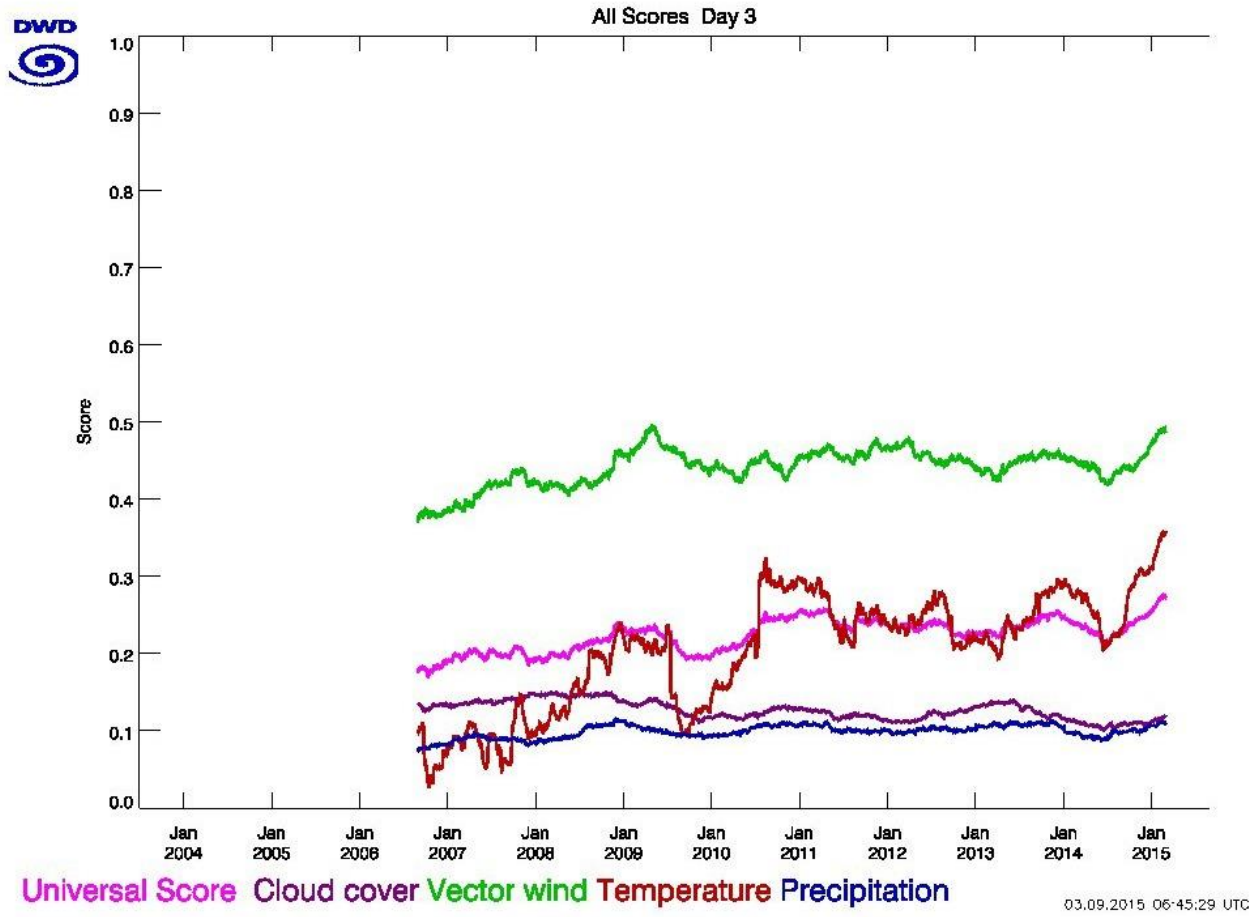
ROUGH

ROUGH and SMOOTH ME cycles are now similar to ALL

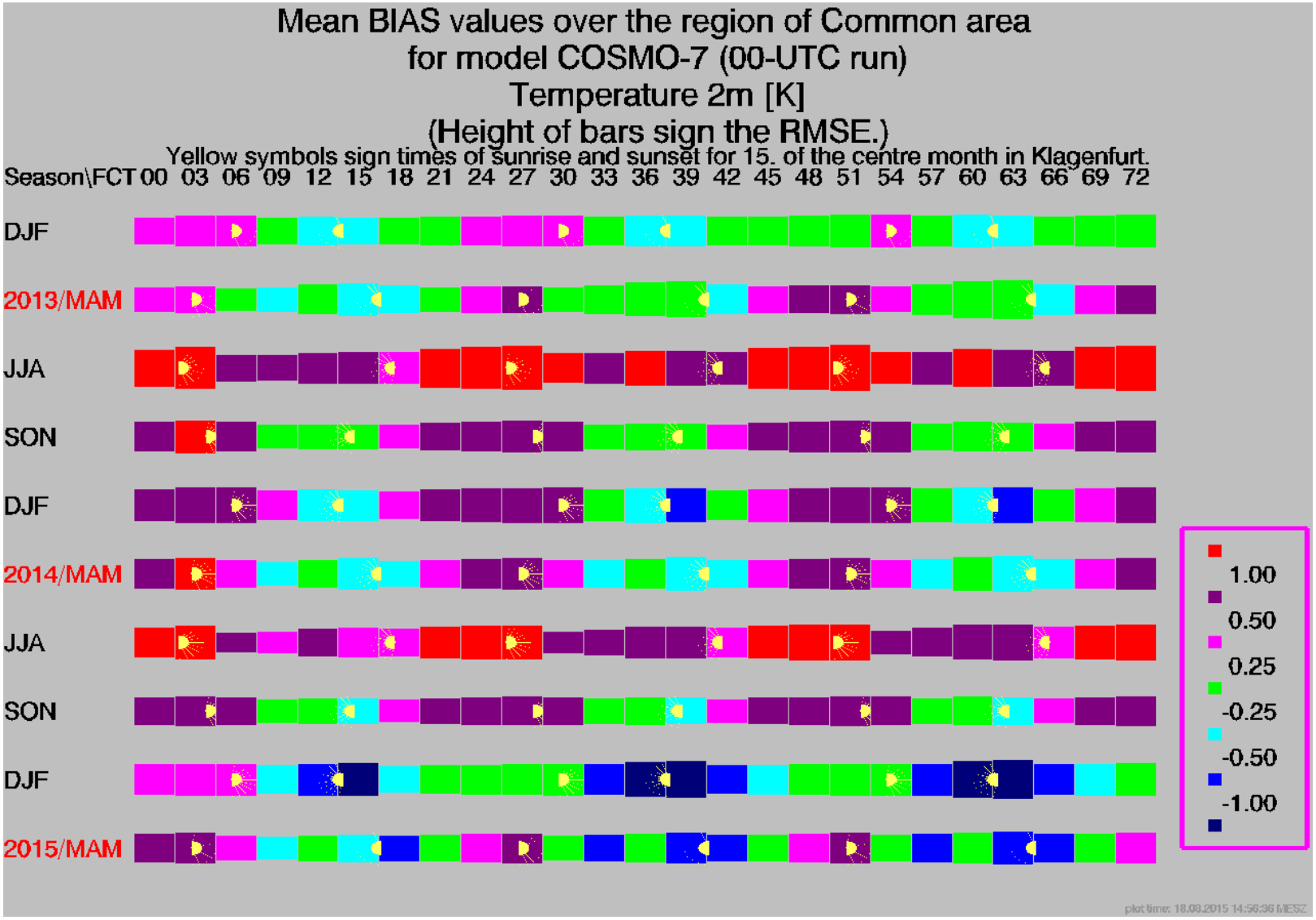
The COSMO-Index



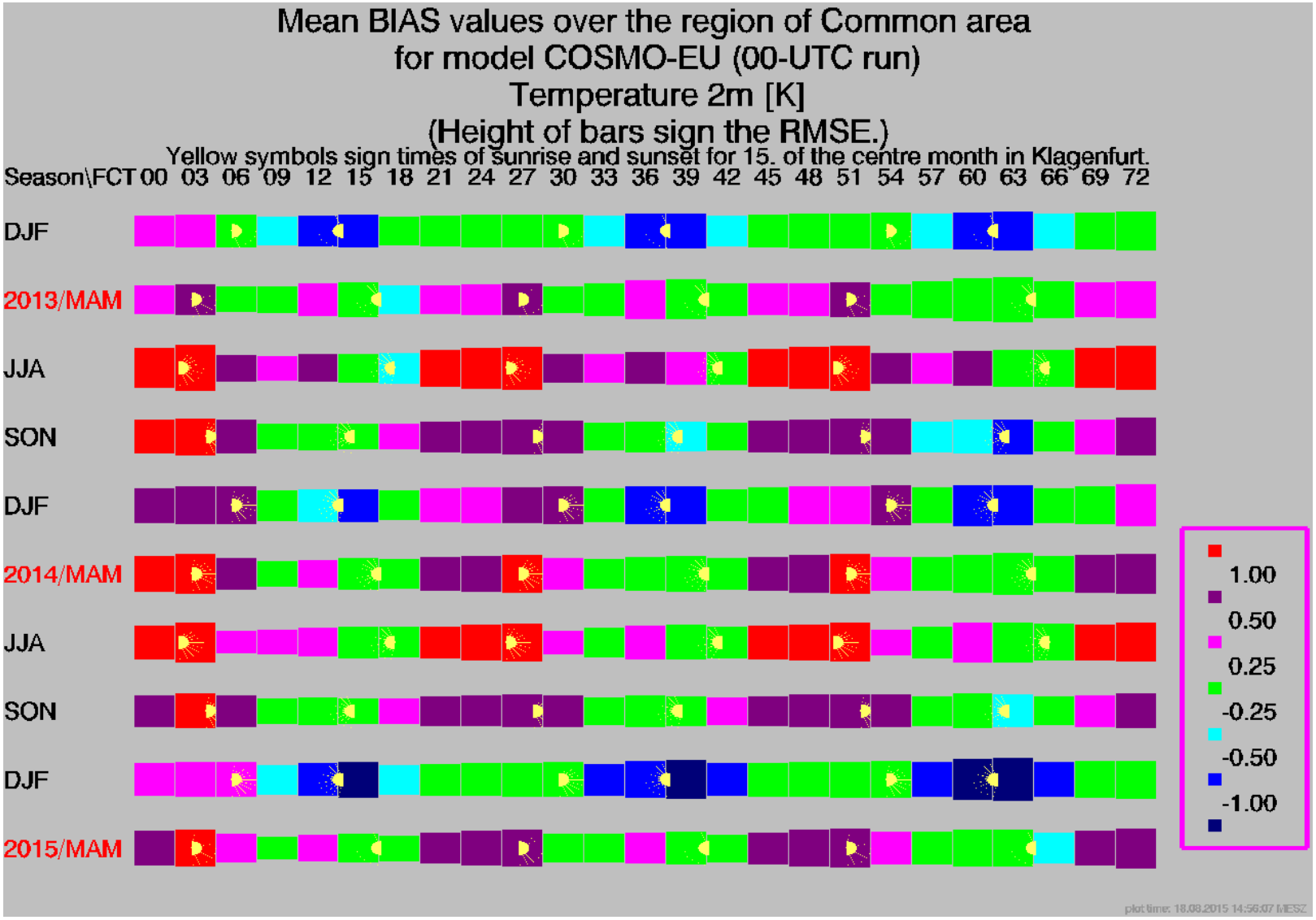
The COSMO-Index
Day 3



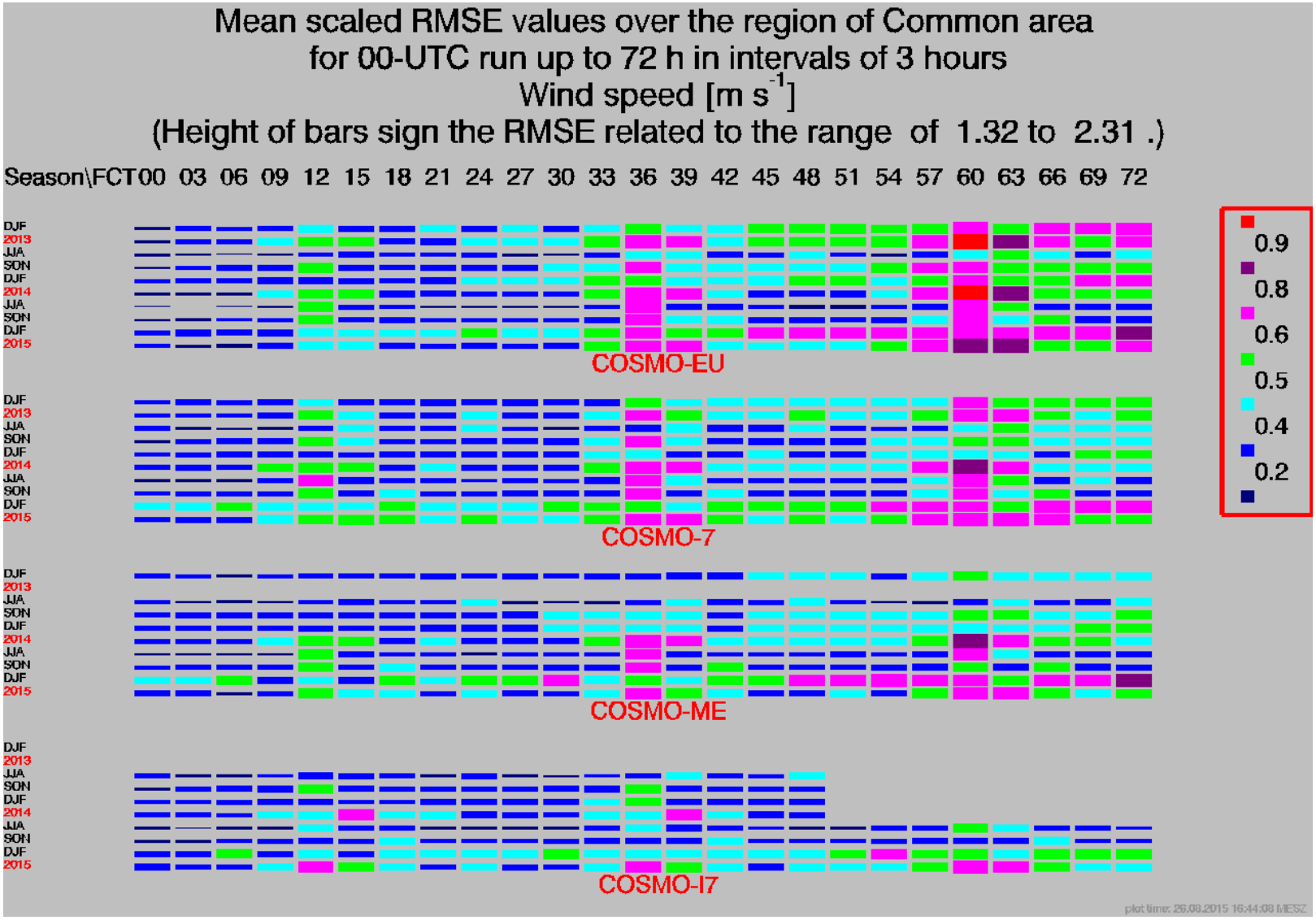
Common error behaviour
T2m COSMO 7



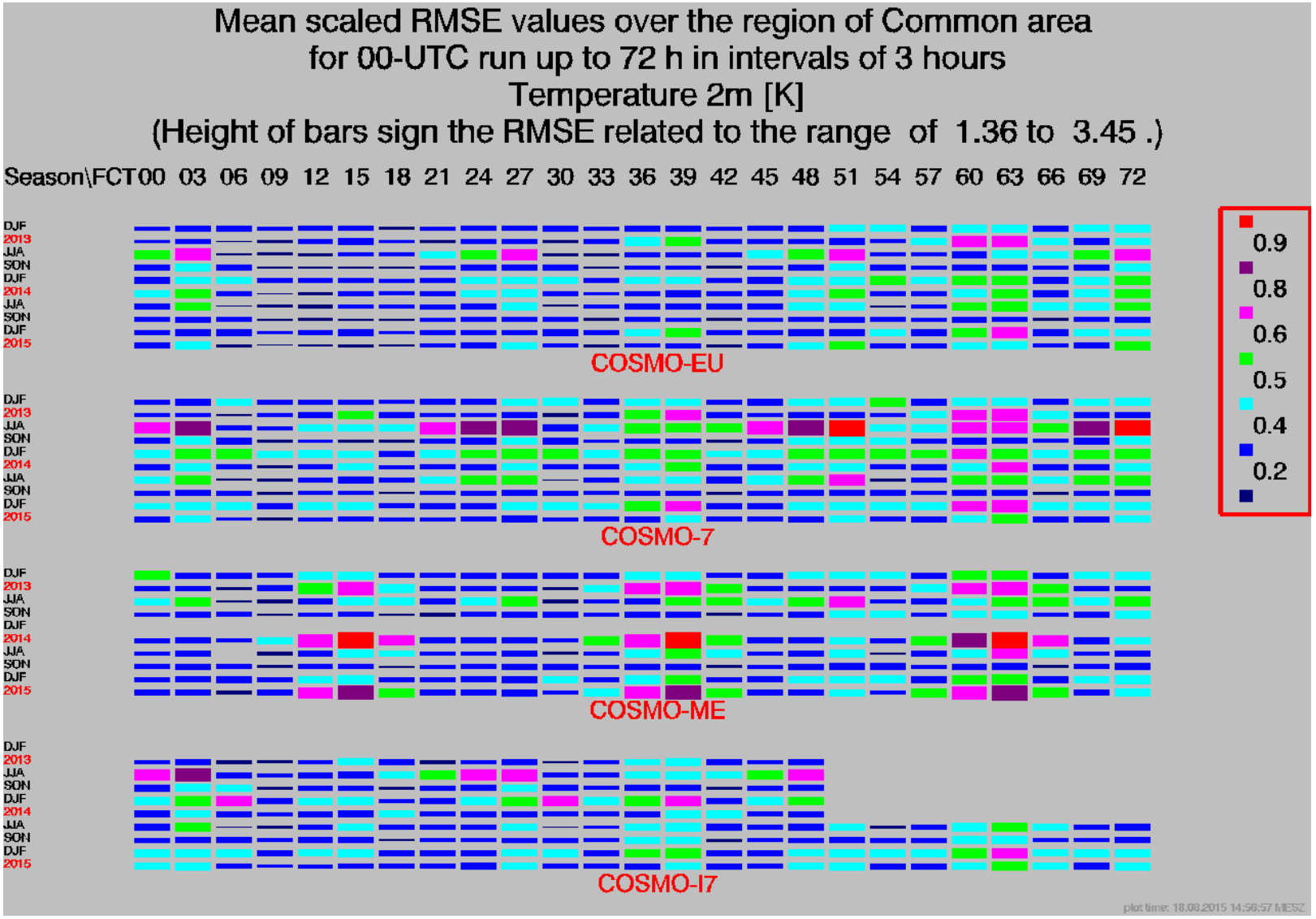
Common error behaviour
T2m COSMO EU



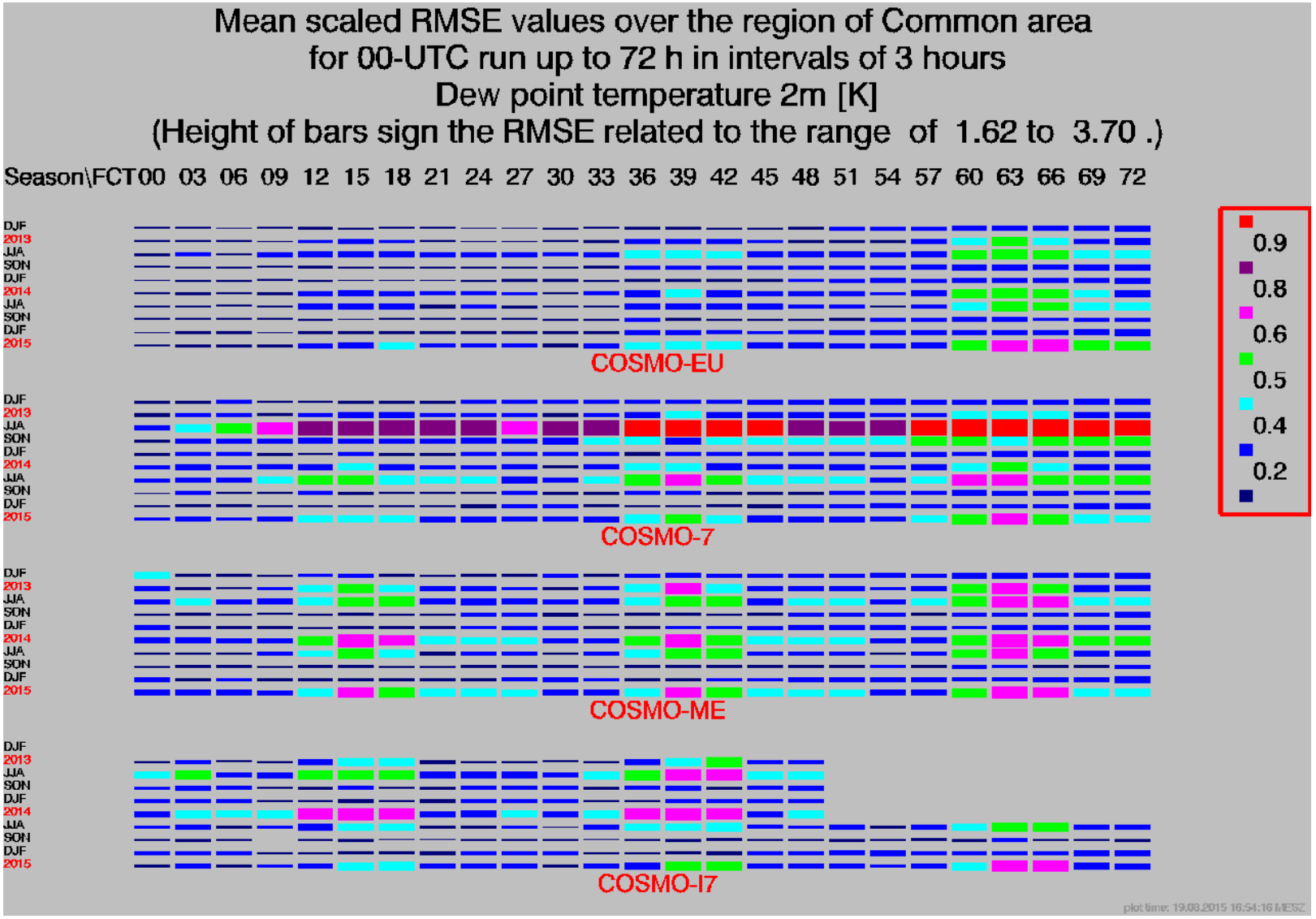
Common error behaviour
Mean scaled RMSE for WS 10m



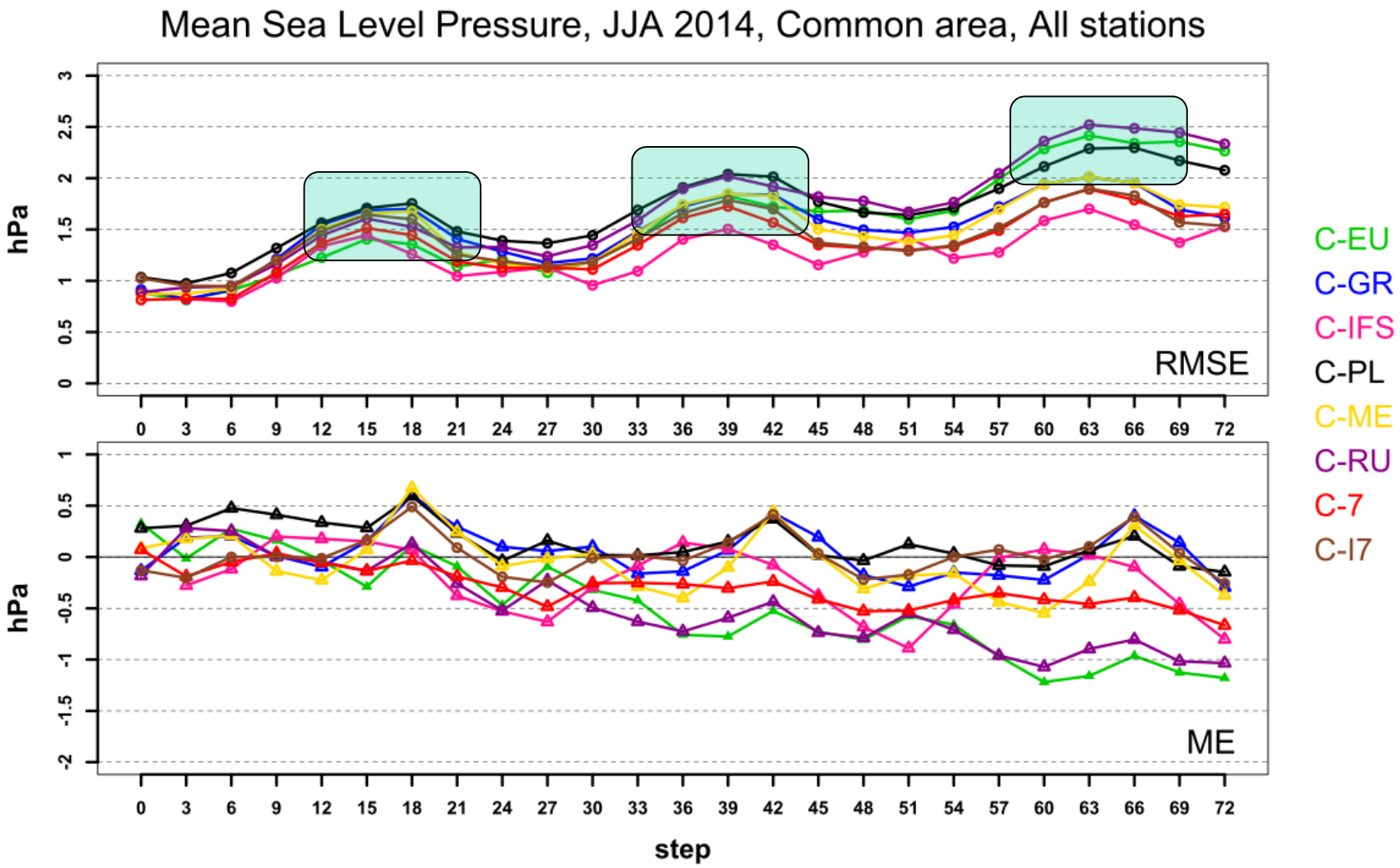
Common error behaviour
Mean scaled RMSE for T2m



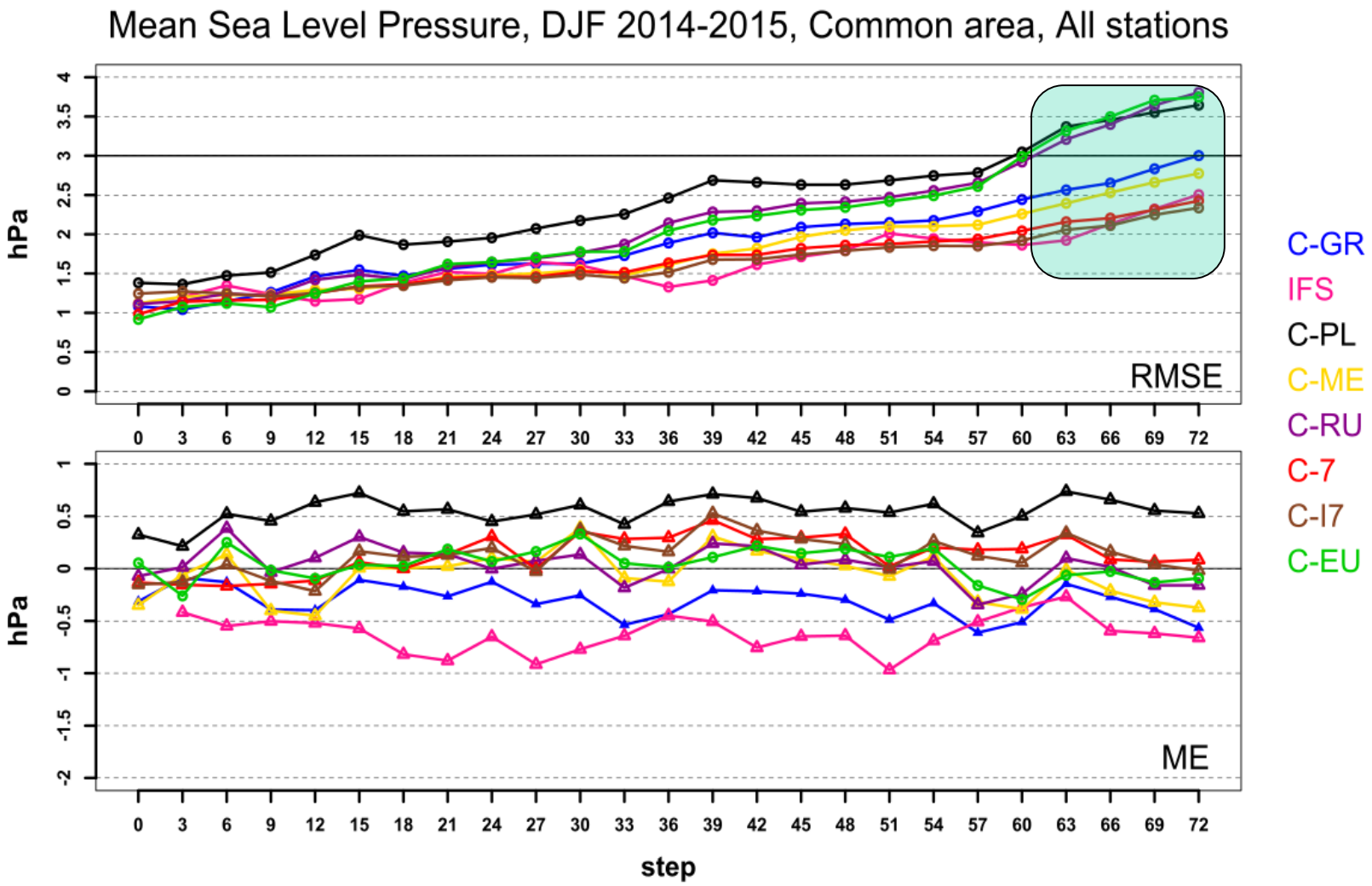
Common error behaviour
Mean scaled RMSE for Tdew 2m



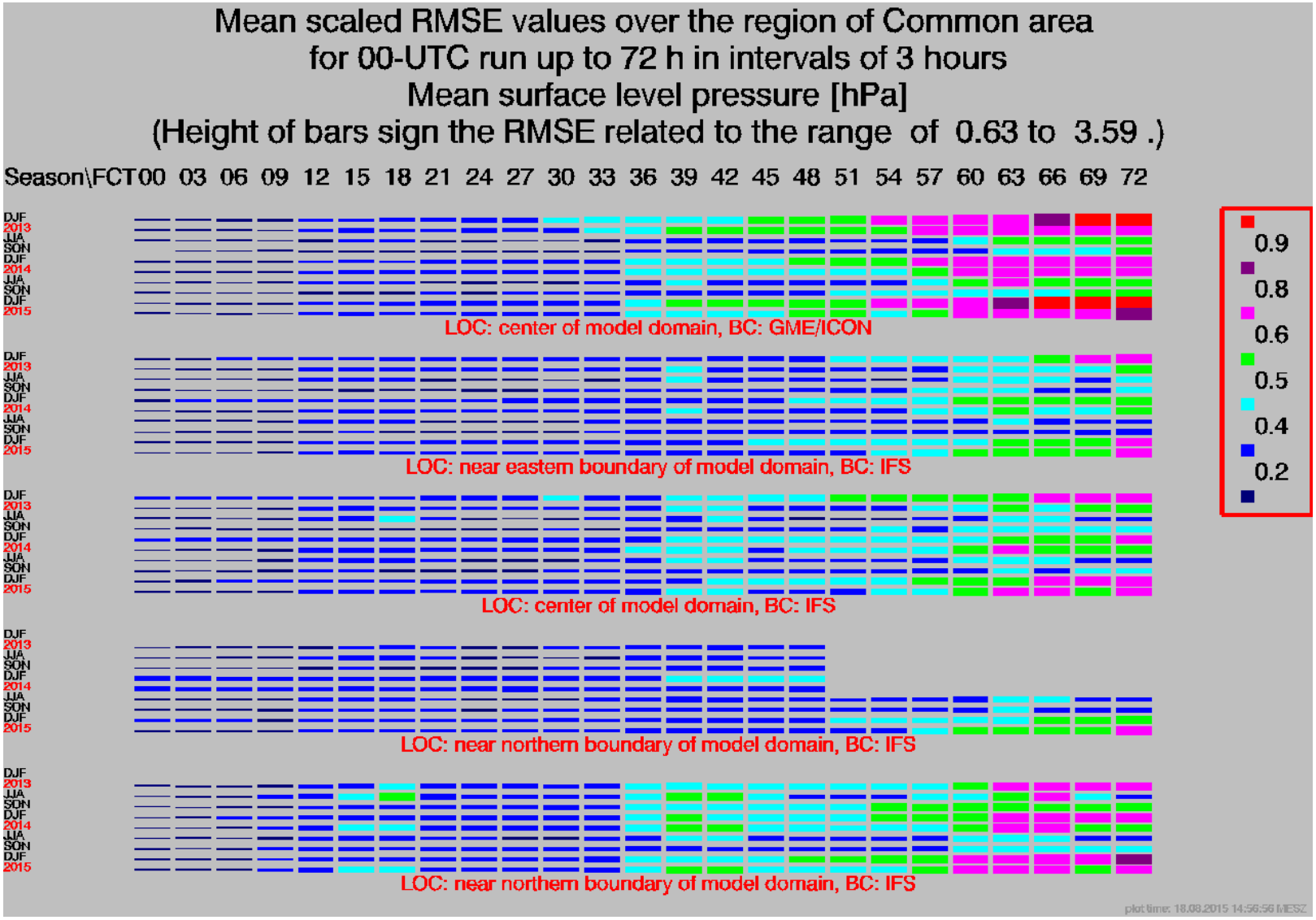
Different error behaviour
MSLP JJA 2014



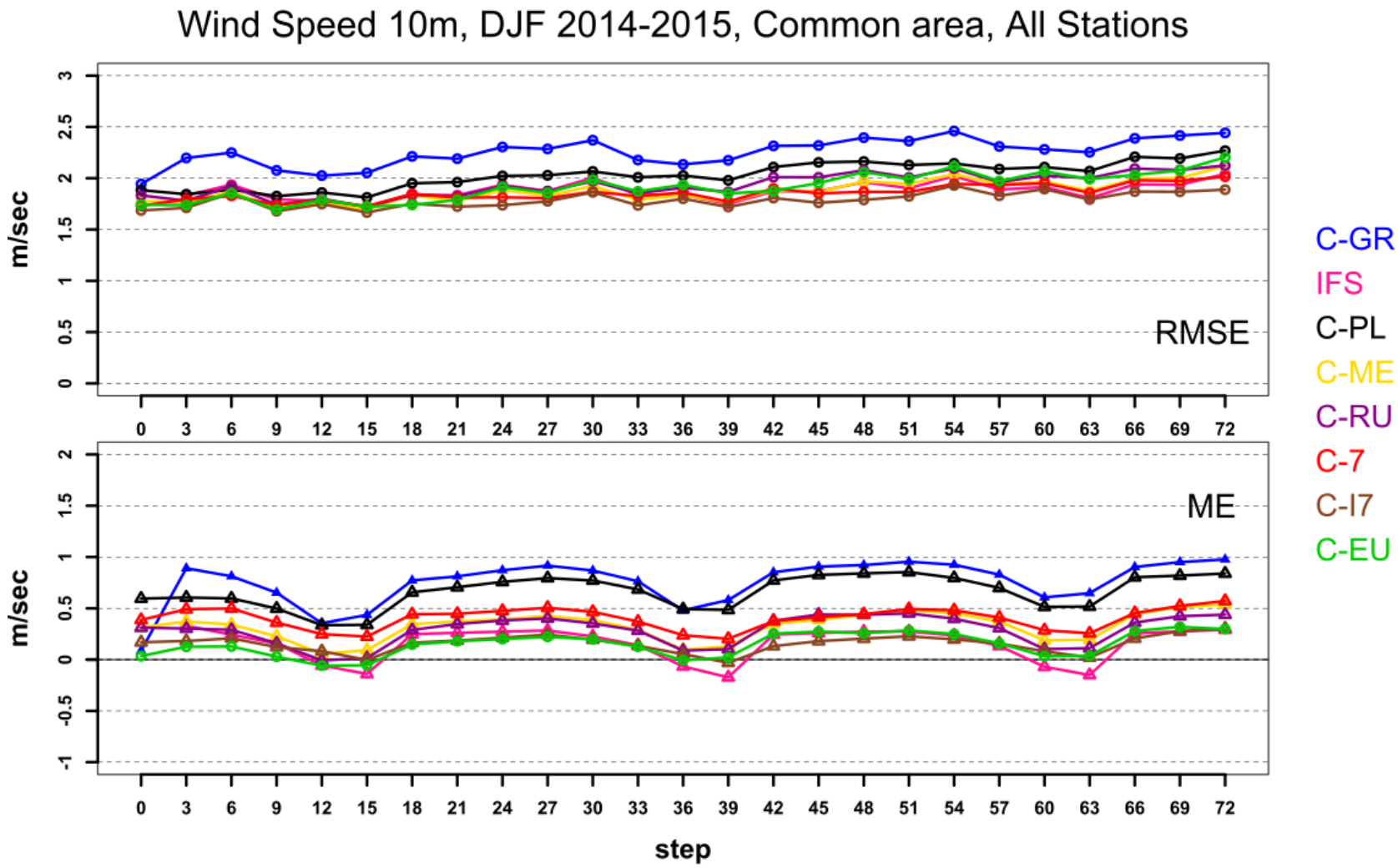
Different error behaviour
MSLP DJF 2014/2015



Common error behaviour
Mean scaled RMSE for MSLP



Different error behaviour
WS 10m DJF 2014/2015



Summary – I:
elements with quality not depending on the driving model

- **Total cloud cover:**
  - *Clear dependence of BIAS on the introduction of minimal diffusion coefficient*
  - *It is not clear whether it is a real BIAS!!!*
  - *But signals resulting from the modification of minimum diffusion coefficient (verification for fields in the free atmosphere) are not strictly positive.*
- **Temperature 2m:**
  - *Clear diurnal cycle of BIAS during summer month with higher values during night and lower values durning day with amplitudes depending on local model configuration (SMA yes/no, …, What is cheaper: SMA or postprocessing?)*
  - *In general negative BIAS during winter with a diurnal cycle similar to summer but with lower amplitude*
  - *SON and MAM are between JJA and DJF*
- **Dew point temperature 2m:**
  - *During winter, spring and autumn nearly similar behaviour of BIAS for all model versions concerning diurnal cycle with lowest amplitudes in COSMO-EU*
  - *During summer months no systematic differences concerning BIAS - but SMA does a very good job as can be seen from RMSE!*

Summary – II:

elements with quality depending on the driving model to a certain degree

- **Mean surface level pressure:**
  - *Clear dependence of RMSE on model configuration (driving model)*
  - *No uniform behaviour of BIAS except for summer month where all models are loosing mass with increasing forecast times*
  - *All models (also IFS) show a maximum of RMSE during summer at late afternoon. The origin of this error is probably the driving model with its specific problems in the middle troposphere.*
- **Wind speed 10m:**
  - *In general overestimation with positive BIAS and well formed diurnal cycle with relatively low amplitude and minimal values during late afternoon*
  - *Behaviour of RMSE is similar to MSLP – but not so strictly depending on the driving model*
- **Precipitation:**
  - *Summer: Overestimation for occurences of low precipitation amounts during day especially for 06 - 12 UTC, high precipitation amounts are in general predicted with lower frequency than observed – except for some models for 06 – 12 UTC*
  - *Winter: Overestimation for occurences of low precipitation during the whole day, for higher precipitation amounts frequency bias is slightly greater than 1 with worse quality compared to low precipitation amounts, but verification against SYNOP observations???*
  - *Model rank of forecast quality for winter show as favourites the IFS-driven models at least for day three*

Summary – III:
Long term trends

- **Cloud cover:**
  - *No clear trend can be seen except for the BIAS depending on the introduction of minimal difusion coefficient. SYNOP vs. satellite information?*
- **T2m and Tdew 2m:**
  - *Remarkable influence of modification for the diagnostics of T2m*
- **Wind 10m:**
  - *Remarkable influence of SSO scheme*
- **Precipitation:**
  - *No clear trend when verifying against SYNOP observations*
  - *Small but positive trend for medium and high precipitation amounts when verifiying against high resolution networks*
  - *Same for verifying against information derived from radar observations*
- **DWD specific:**
  - *Use of ICON boudary conditions lead to a jump in forecast quality!*

- **But in general:** $\delta = \Sigma \varepsilon$

- **Recommended actions in order to get a deeper insight to the verification results:**
  - ***Check the current configuration for each model version***
  - ***Check the complete history (at least for the last three years) of model changes***
  - ***Common permanent activity for WG5 and WGx***

- **View a lot of verification results at**
  - ***http://www.cosmo-model.org/content/tasks/verification.priv/commonPerCountry/summary.html***

Thank you for your attention!