



Operational Verification at DWD Comparison ICON-EU vs. COSMO-EU

Ulrich Pflüger
Deutscher Wetterdienst

→ Synop verification

- Time Series of Percentage Difference of RMSE (WD_{10m} , WS_{10m} , T_{2m})
- Time series of monthly means of ME and RMSE(WD_{10m} , WS_{10m} , T_{2m})
- Spatial and day/night variation of ME and Δ RMSE of T_{2m} (May 2016)
- Monthly FBI and ETS of rr_24h for different thresholds for day 1, 2 and 3

→ Upper-air verification



- Time Series of Percentage Difference of RMSE (Geop., Rel.Hum., Temp., WD, WS)
- Profiles of ME, RMSE (Temp., WS)
- Time Series (09/2015 – 08/2016) of Daily Δ RMSE (Geop., Rel.Hum., Temp., WD, WS)

Percentage Difference of RMSE (PD_{RMSE} in [%])

$$PD_{RMSE} = \frac{(RMSE_{COSMO-EU} - RMSE_{ICON-EU}) * 100}{(RMSE_{COSMO-EU} + RMSE_{ICON-EU}) * 0.5}$$

Model names in some figures

ieu_icon	=	ICON-EU
lme_icon	=	COSMO-EU

	+	ICON-EU	better
	-	ICON-EU	worse



Time Series of Percentage Difference of RMSE

03/16

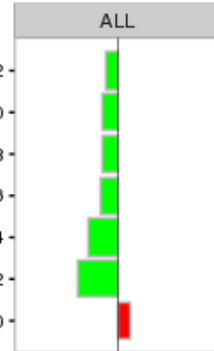
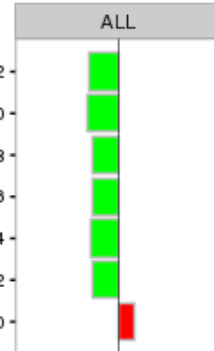
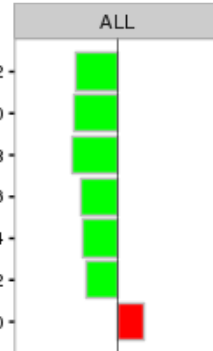
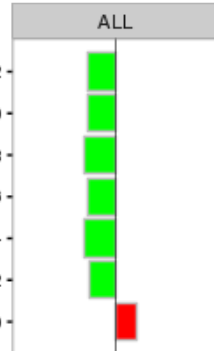
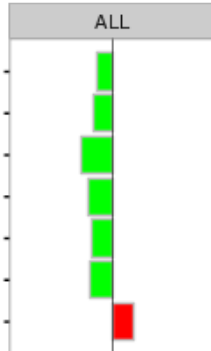
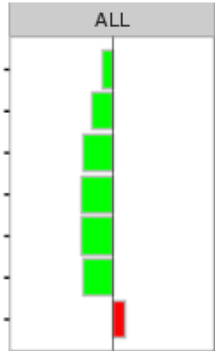
04/16

05/16

06/16

07/16

08/16



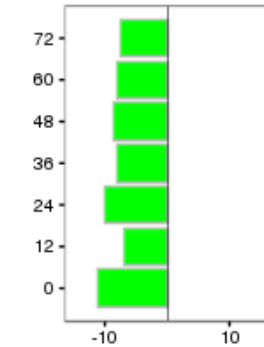
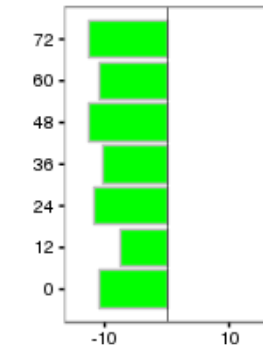
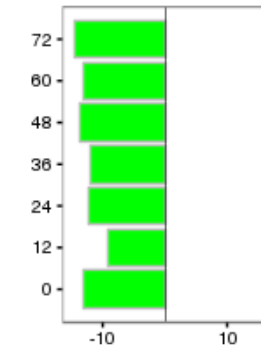
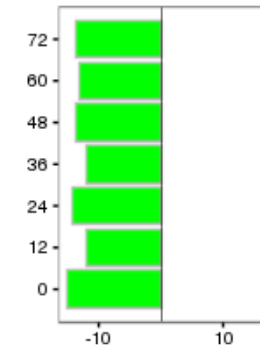
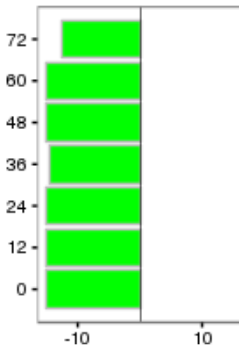
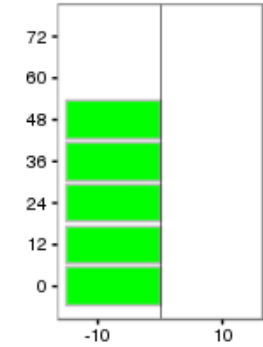
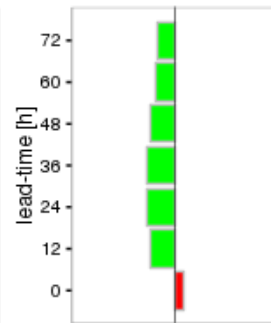
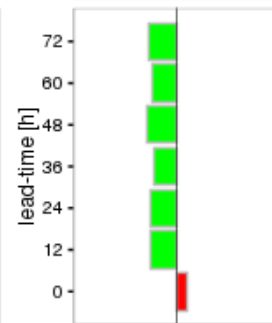
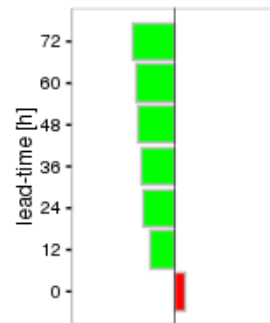
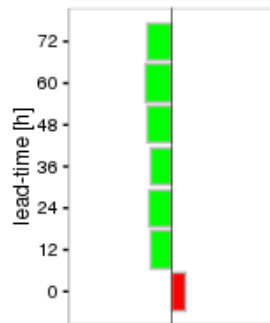
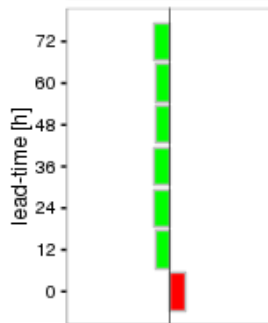
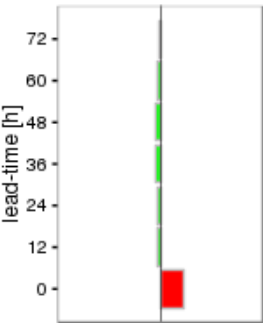
DD_10M

ICON-EU



FF_10M

T_2M



Percentage difference RMSE [%]

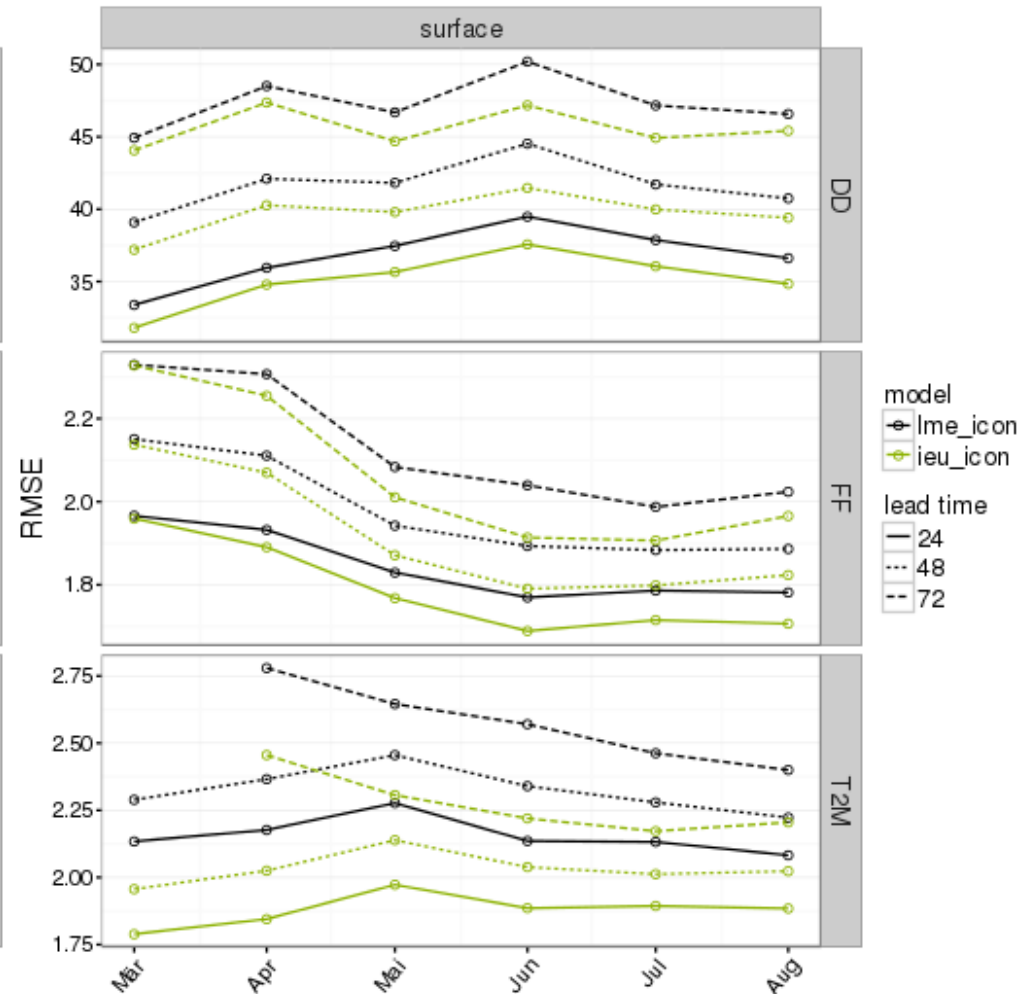
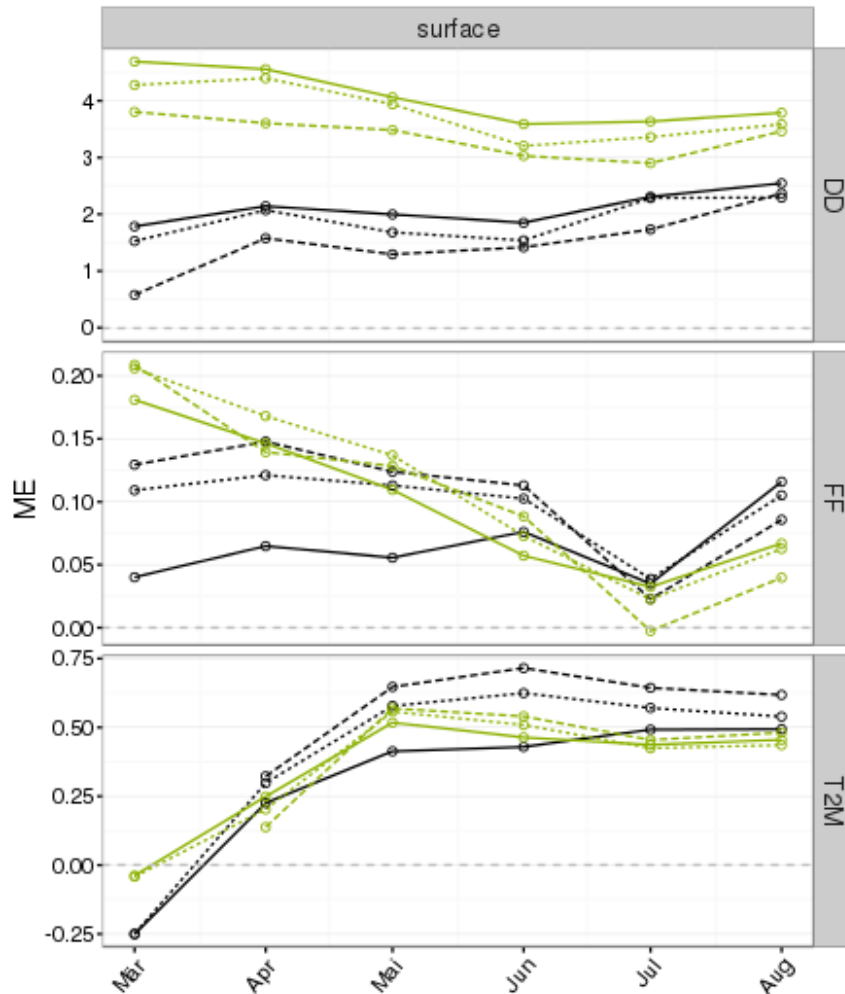


Time series of monthly means of ME and RMSE of DD_10m, FF_10m and T_2m

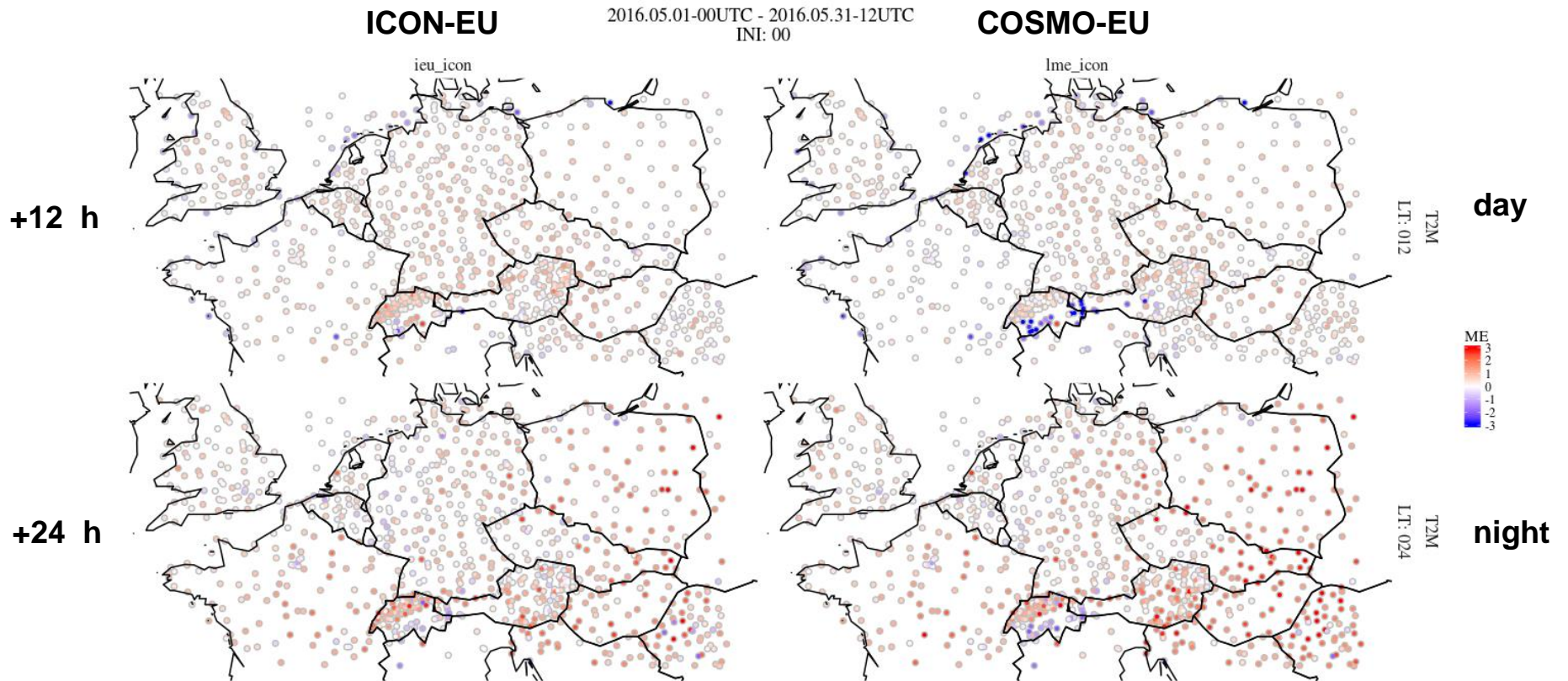


2016-03 to 2016-08
domain: ALL
ME

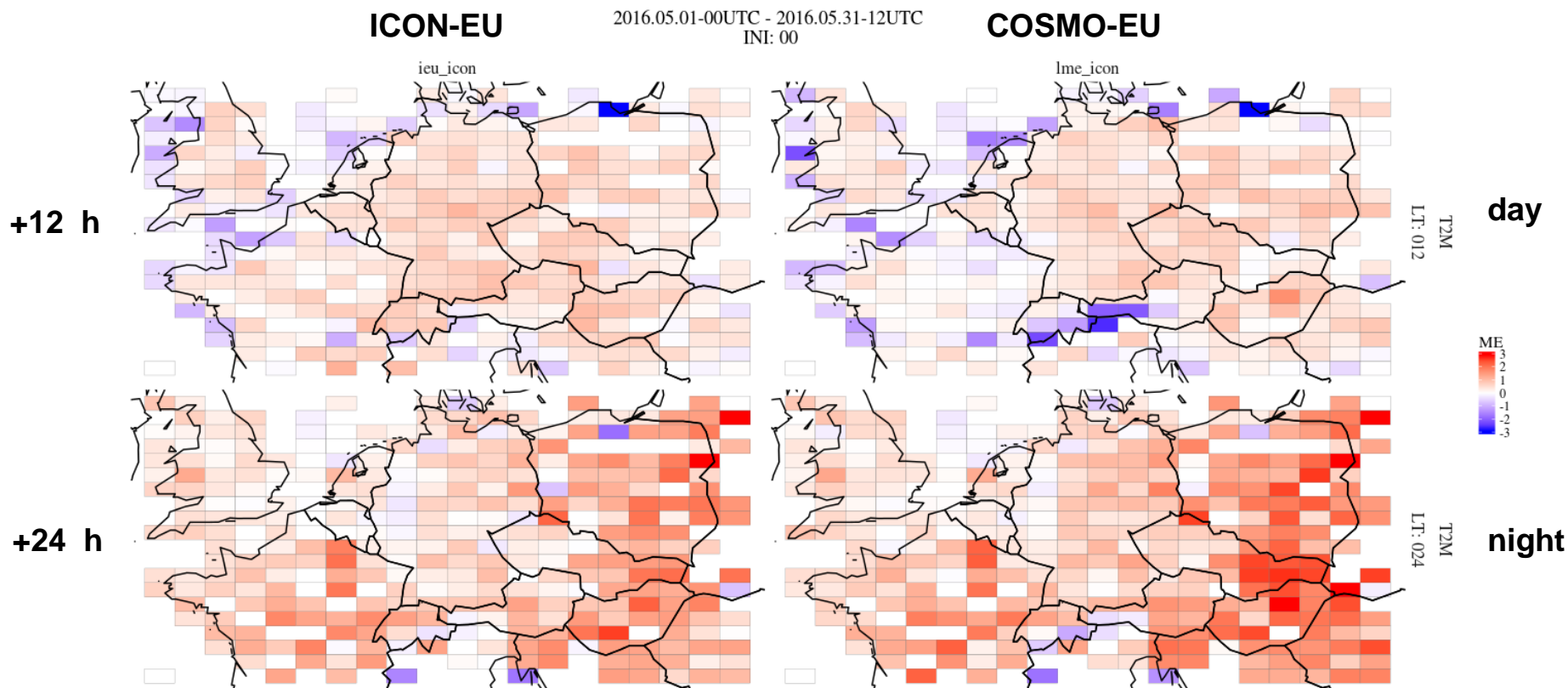
2016-03 to 2016-08
domain: ALL
RMSE



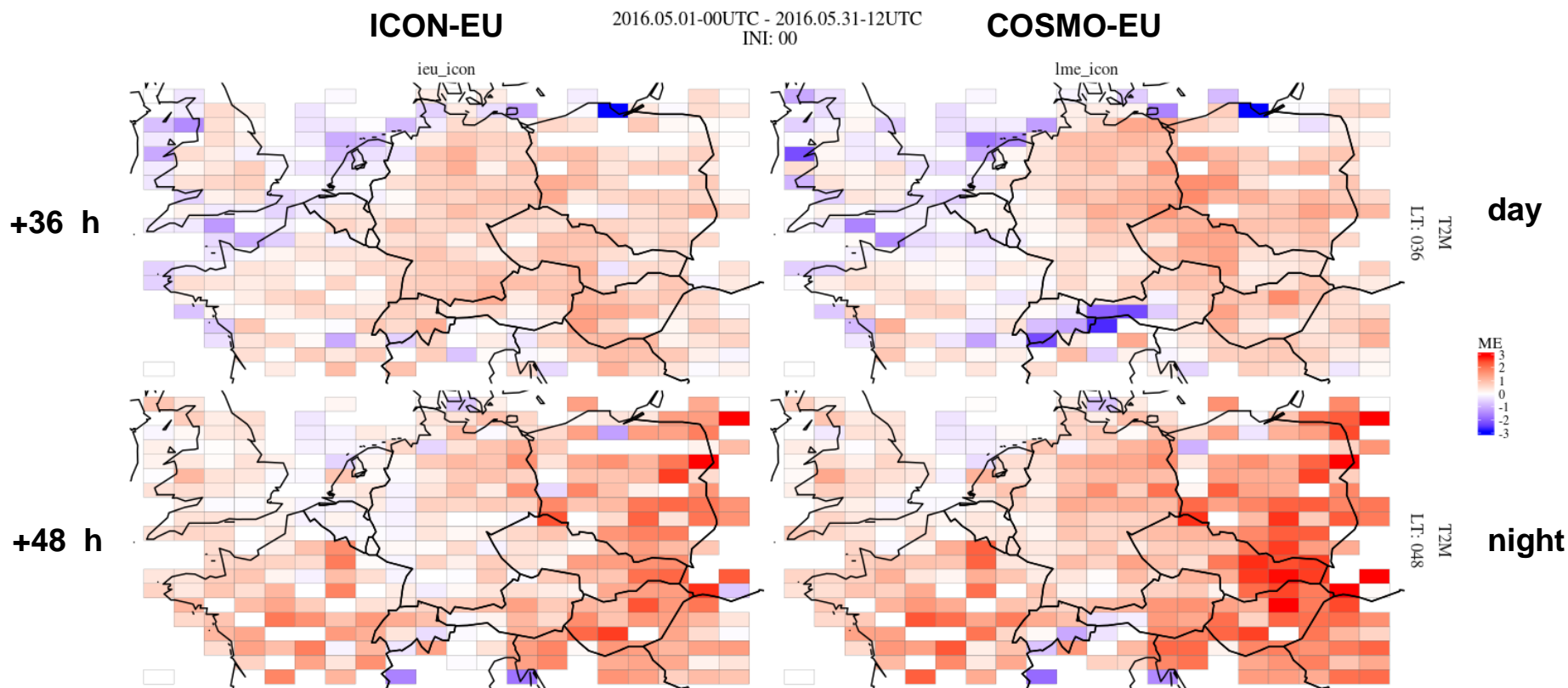
Spatial and day/night variation of ME of T_{2m} (May 2016)



Spatial and day/night variation of ME of T_{2m} (May 2016)



Spatial and day/night variation of ME of T_{2m} (May 2016)



Spatial and day/night variation of Δ RMSE of T_{2m} (May 2016)

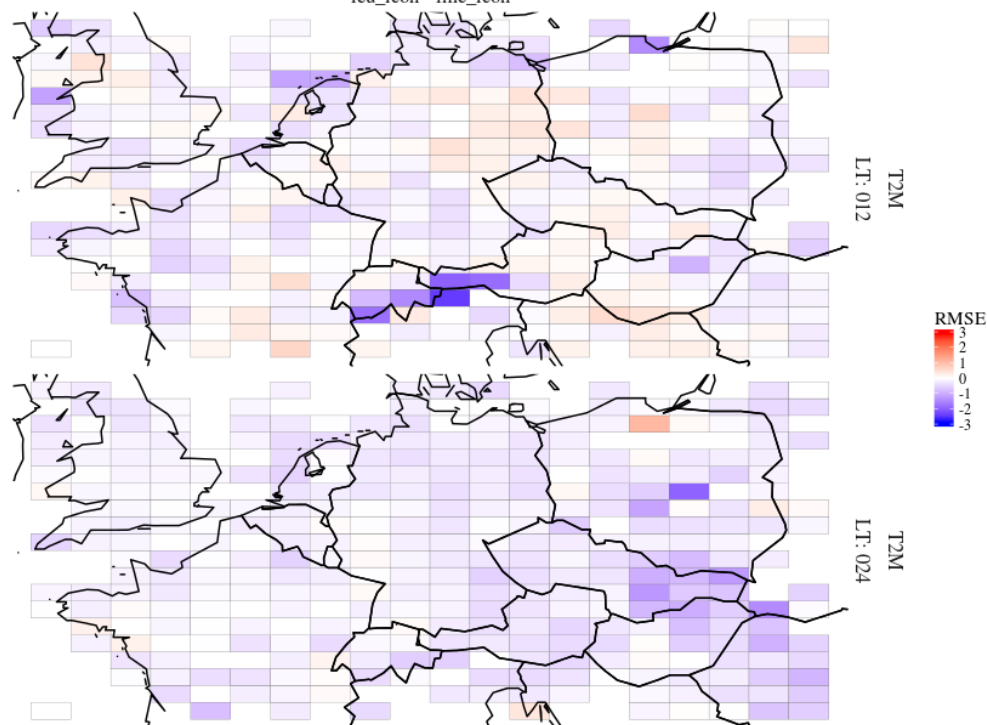


Δ RMSE (ICON-EU – COSMO-EU)

2016.05.01-00UTC - 2016.05.31-12UTC
INI: 00

ieu_icon - lme_icon

+ 12 h



day

+ 24 h

night



Spatial and day/night variation of Δ RMSE of T_{2m} (May 2016)

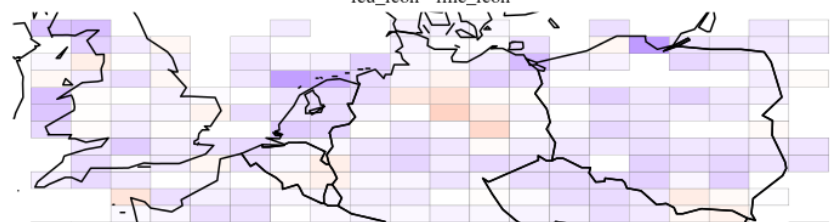


Δ RMSE (ICON-EU – COSMO-EU)

2016.05.01-00UTC - 2016.05.31-12UTC
INI: 00

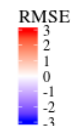
ieu_icon - lme_icon

+ 36 h

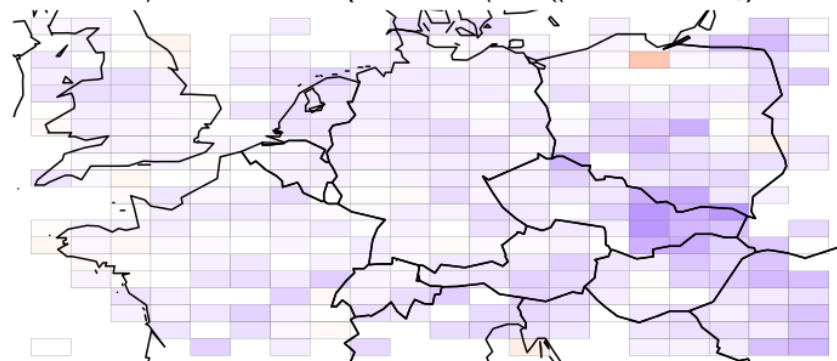


T2M
LT: 036

day



+ 48 h



T2M
LT: 048

night



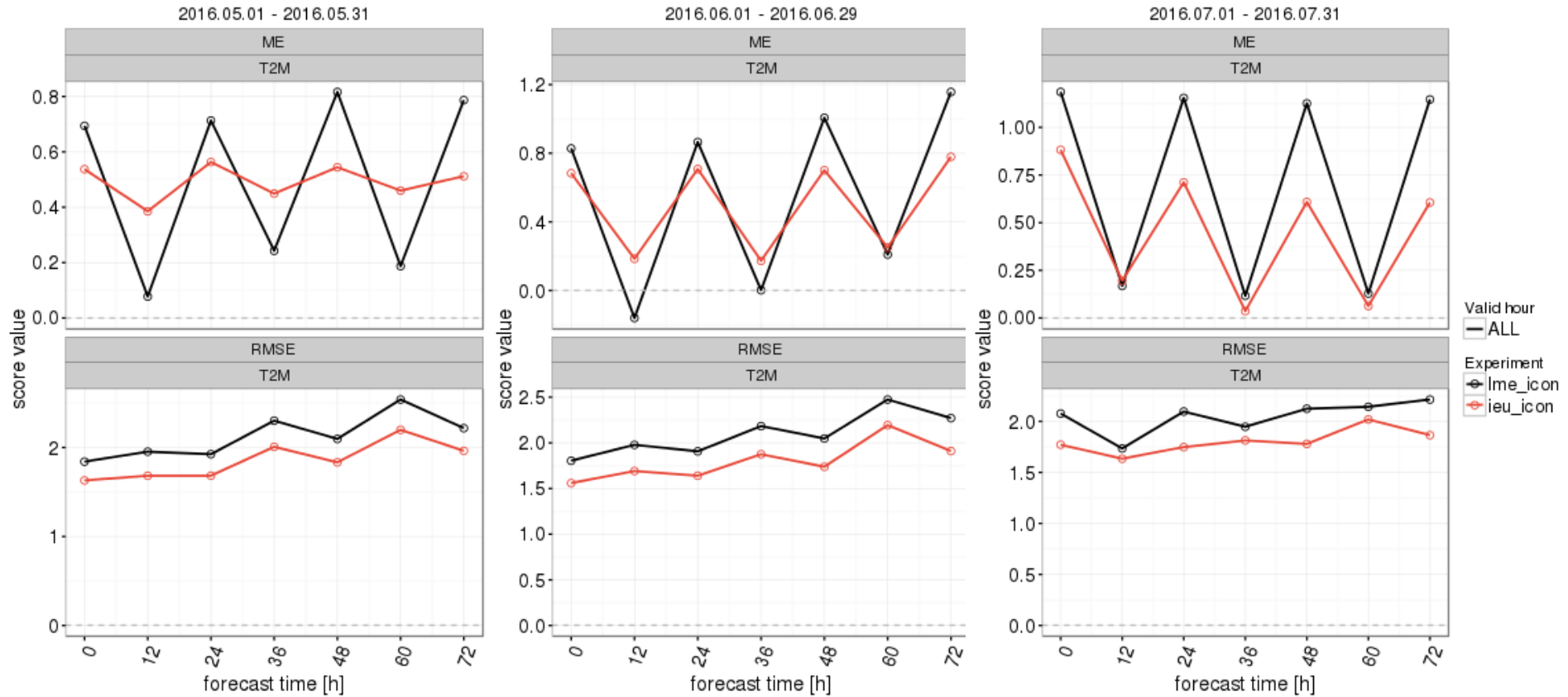
Monthly mean of ME and RMSE of T_{2m} (CDE-Domain)



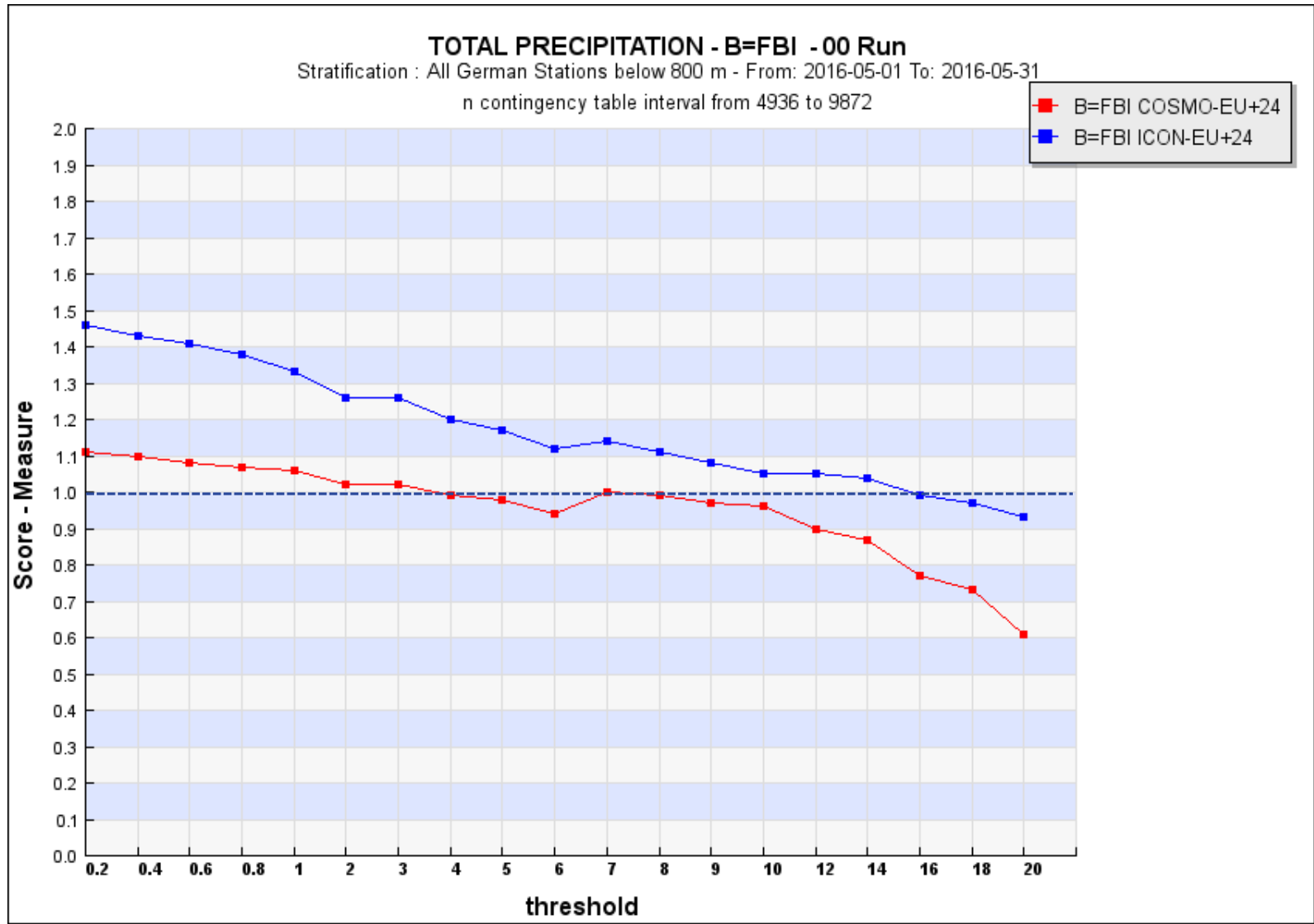
05/16

06/16

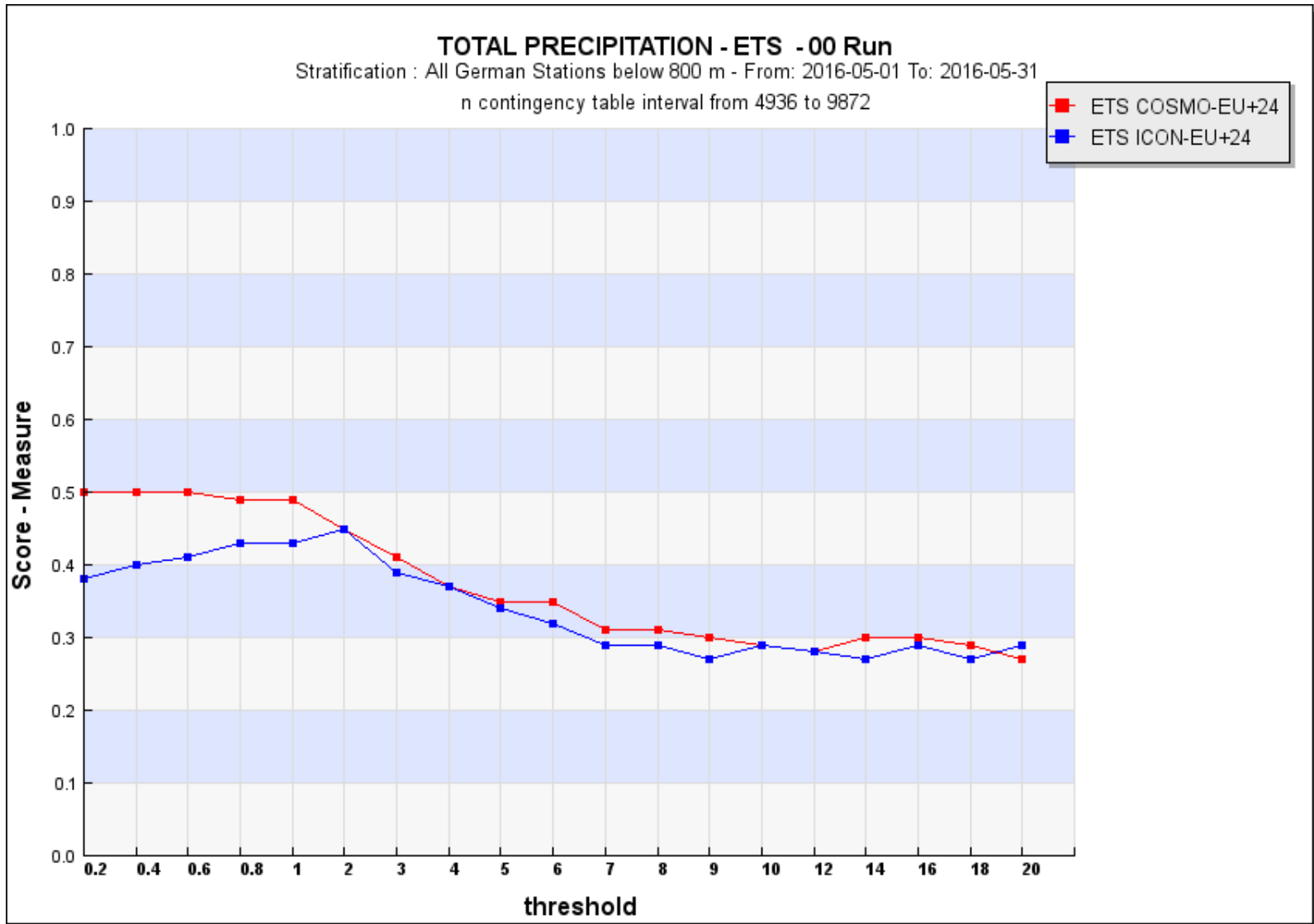
07/16



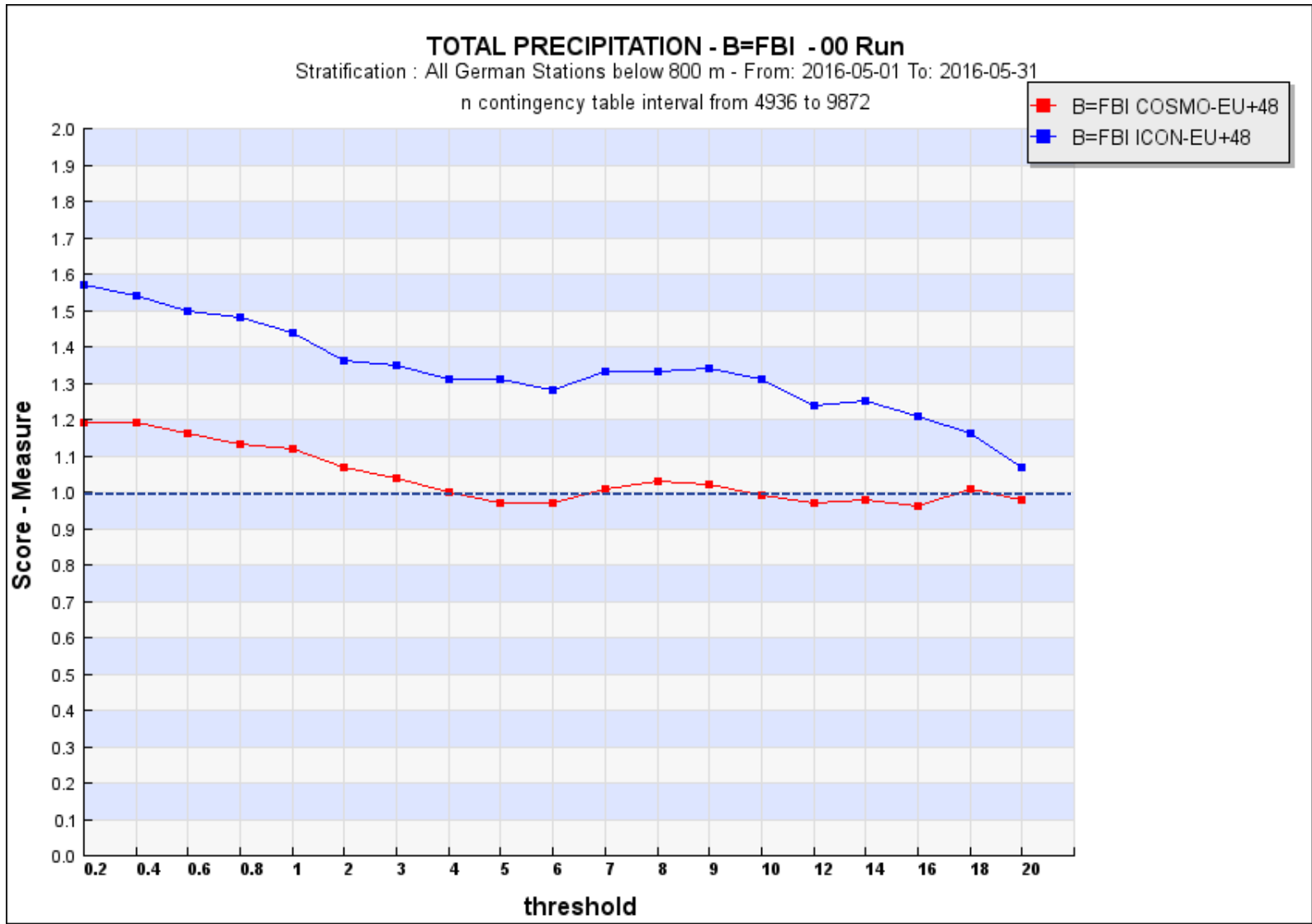
Monthly FBI of rr_24h for different thresholds for day 1



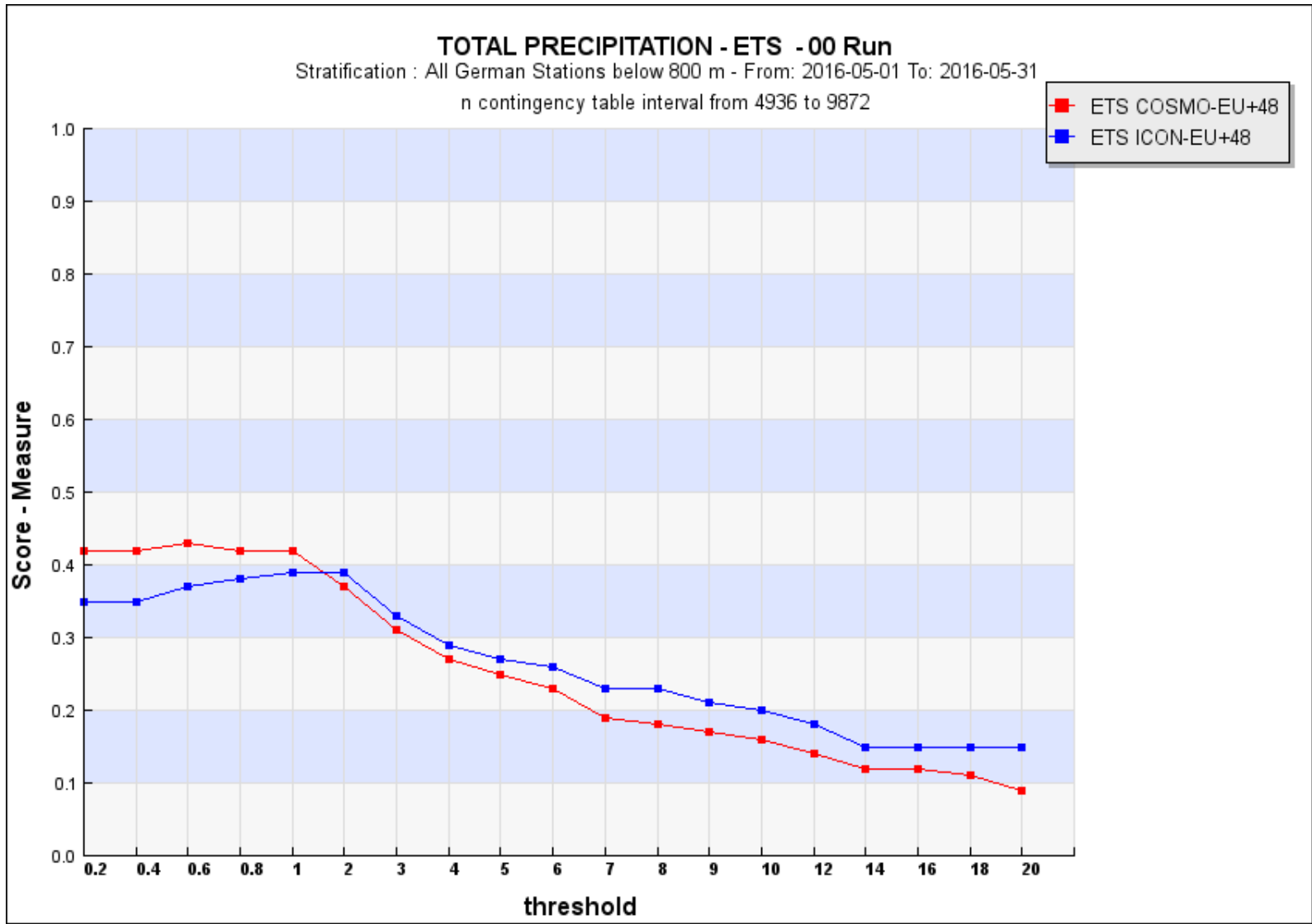
Monthly ETS of rr_24h for different thresholds for day 1



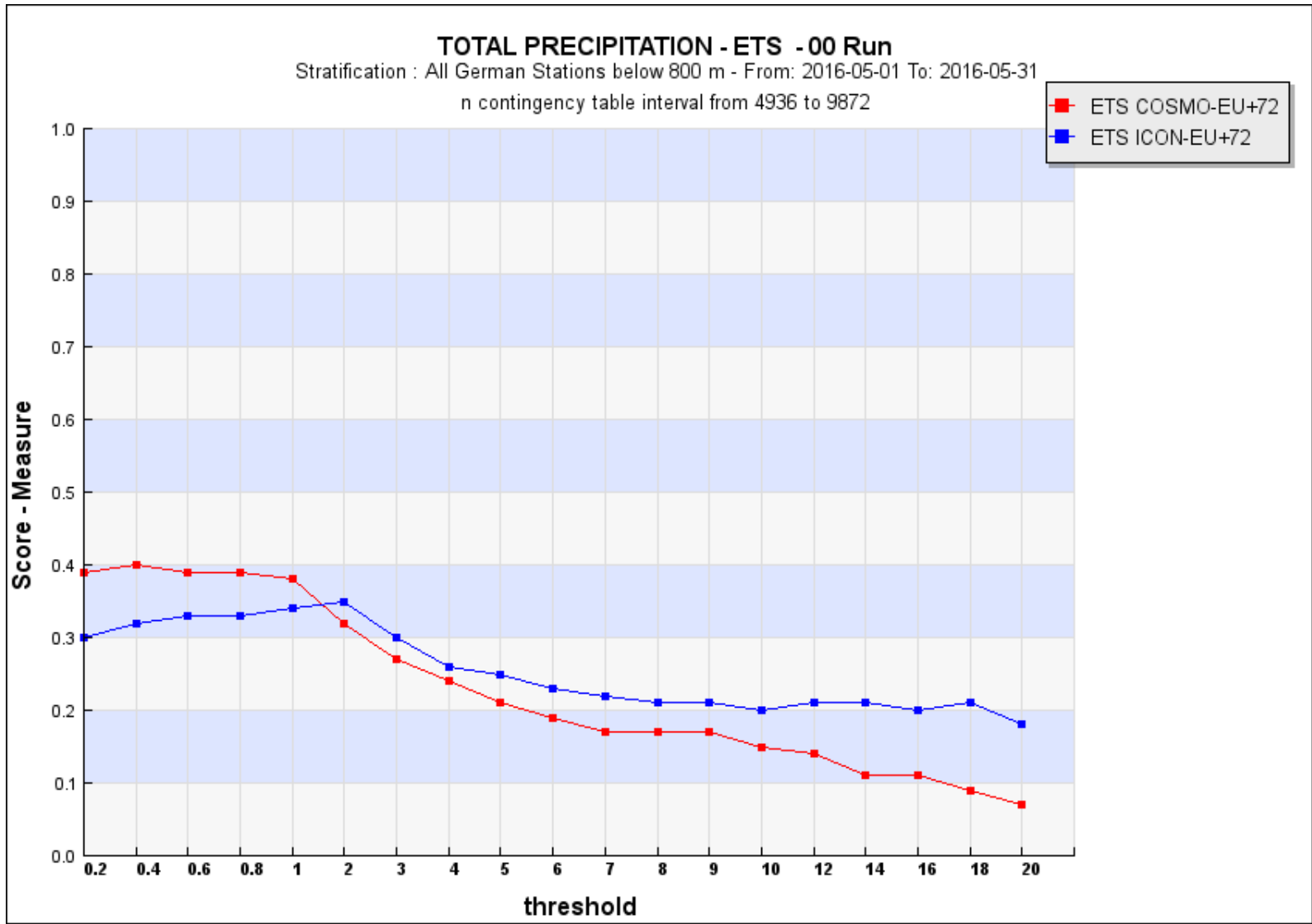
Monthly FBI of rr_24h for different thresholds for day 2



Monthly ETS of rr_24h for different thresholds for day 2



Monthly ETS of rr_24h for different thresholds for day 3



Monthly FBI of rr_24h for different thresholds for day 1, 2 and 3



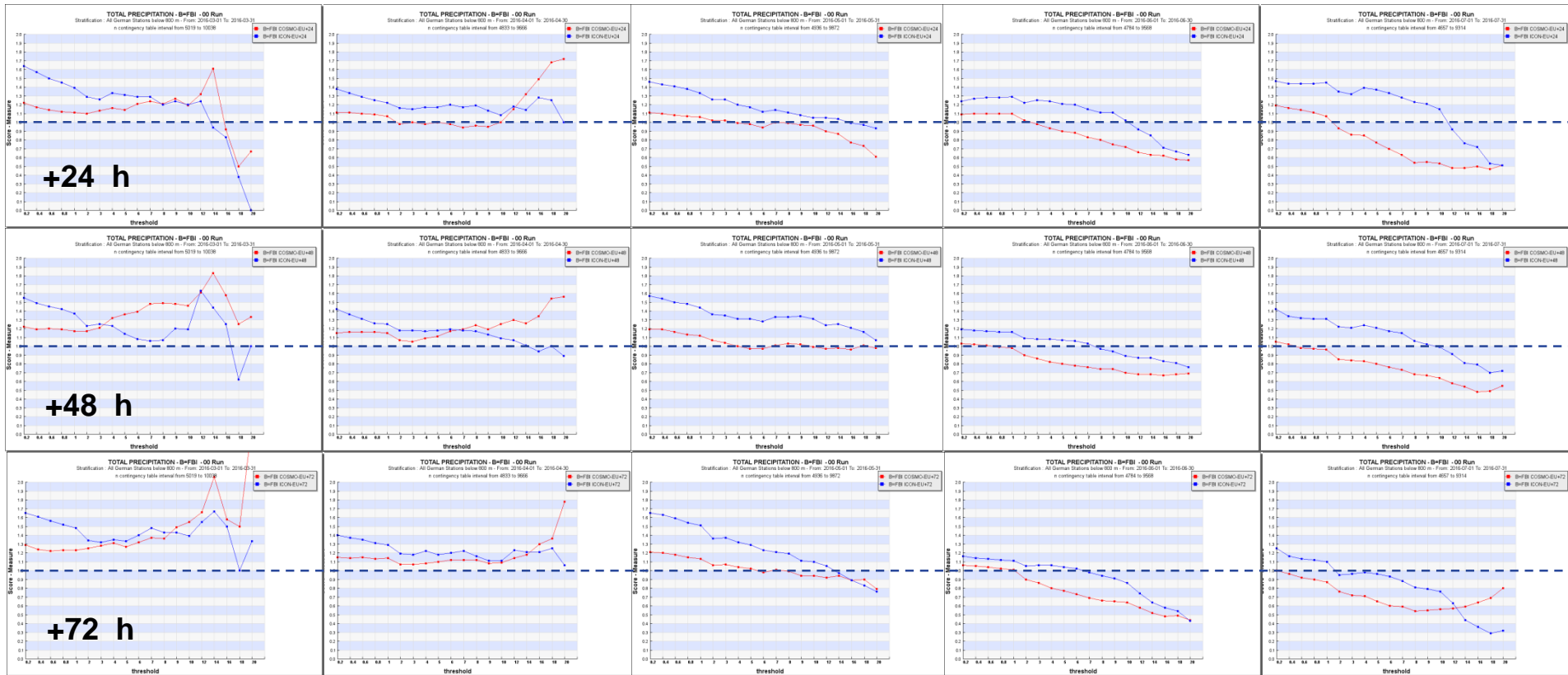
03/16

04/16

05/16

06/16

07/16



Monthly ETS of rr_24h for different thresholds for day 1, 2 and 3



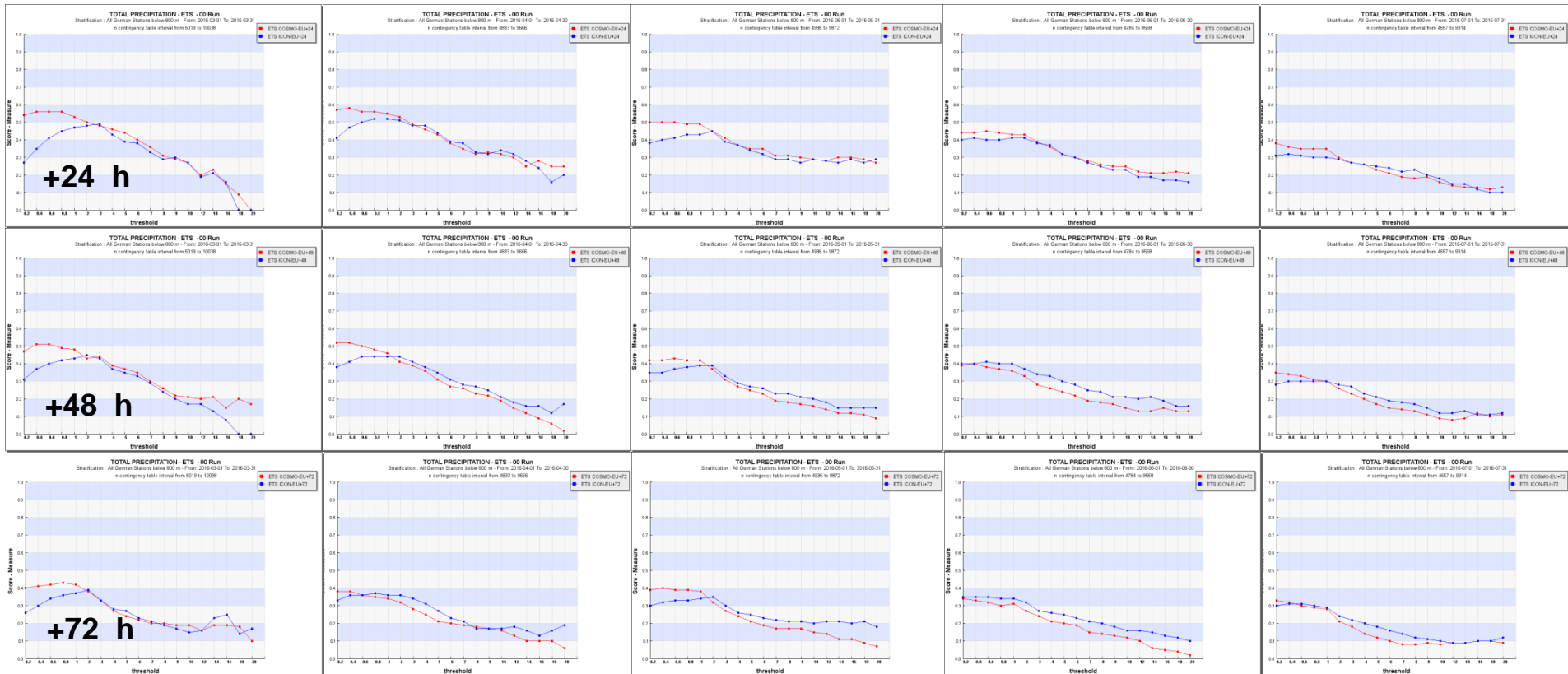
03/16

04/16

05/16

06/16

07/16



Monthly ETS of rr_24h for different thresholds for day 1, 2 and 3



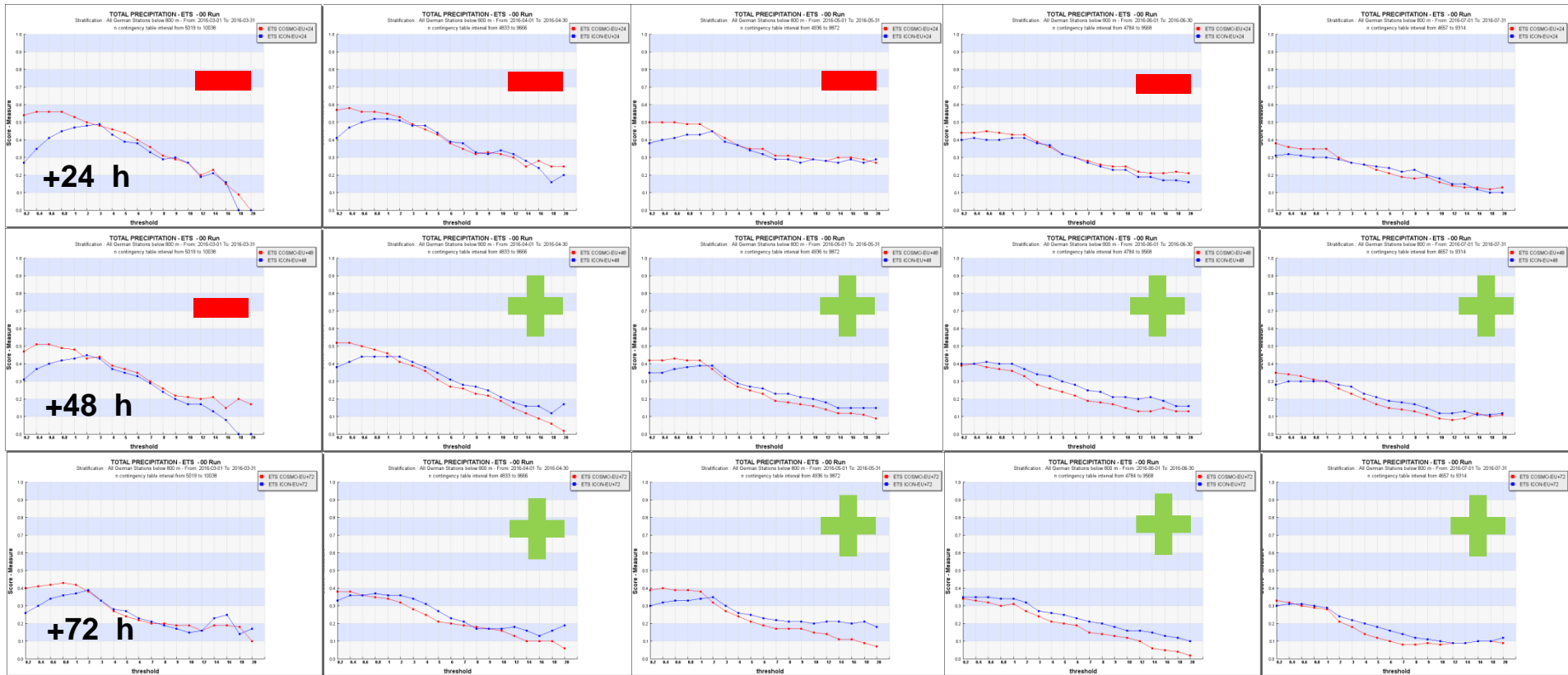
03/16

04/16

05/16

06/16

07/16





Time Series of Percentage Difference of RMSE

All common radiosondes

All runs (00 and 12 UTC)

All lead times

03/16

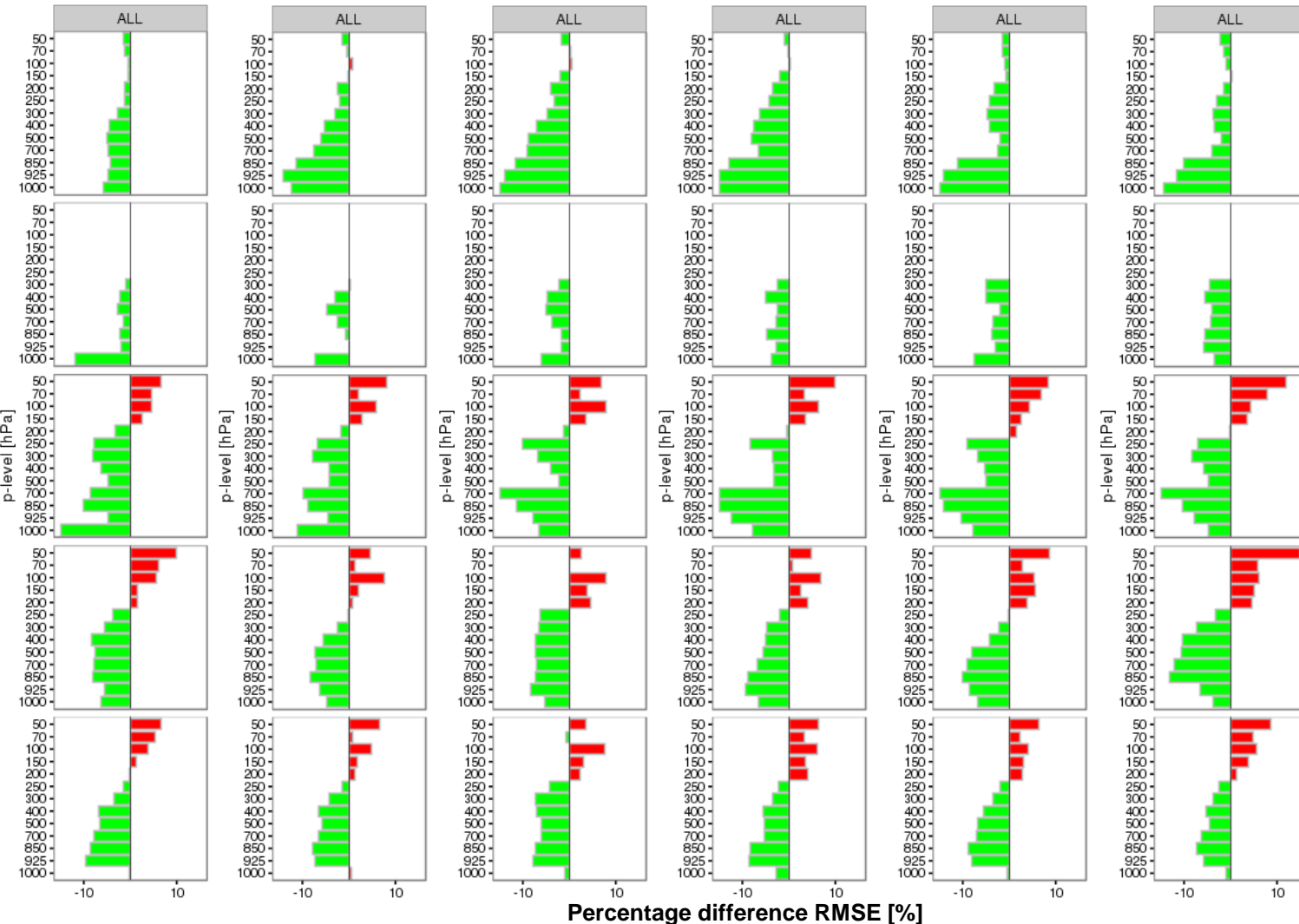
04/16

05/16

06/16

07/16

08/16



Geop.

ICON-EU



Rel. H.

Temp.

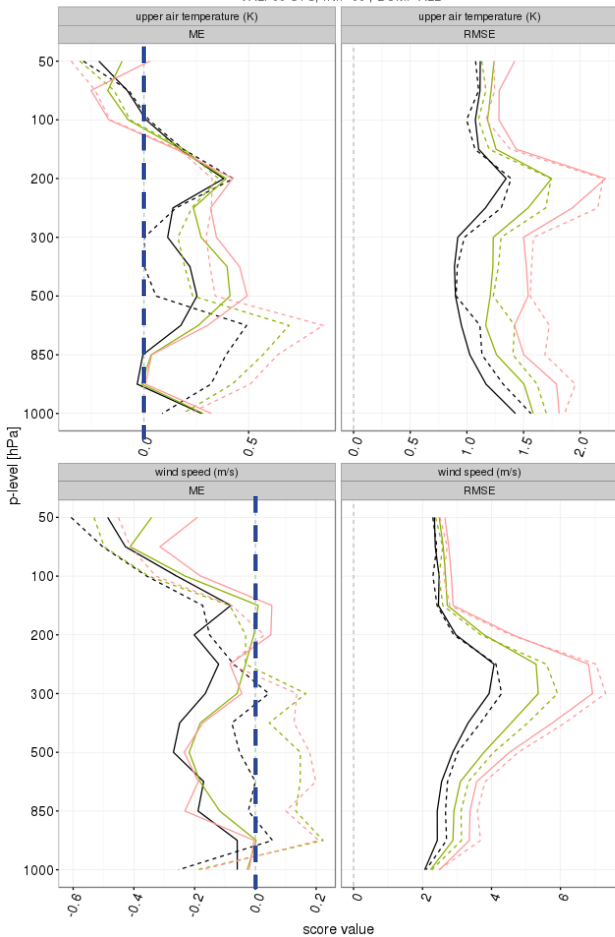
Wind Direction

Wind Speed



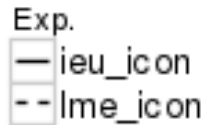
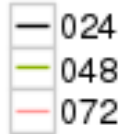
ME **05/16** **RMSE**

2016/05/01 - 2016/05/31
VAL: 00 UTC, INI: 00, DOM: ALL



TEMPERATURE

lead-time [h]



WIND SPEED

above 200 hPa:

- Raleigh damping at the model top of COSMO-EU causes smoother wind and temperature fields
- gravity waves are damped in COSMO-EU
- =>less variance => smaller RMSE

Monthly Upper-air Verification



05/16

ME

RMSE

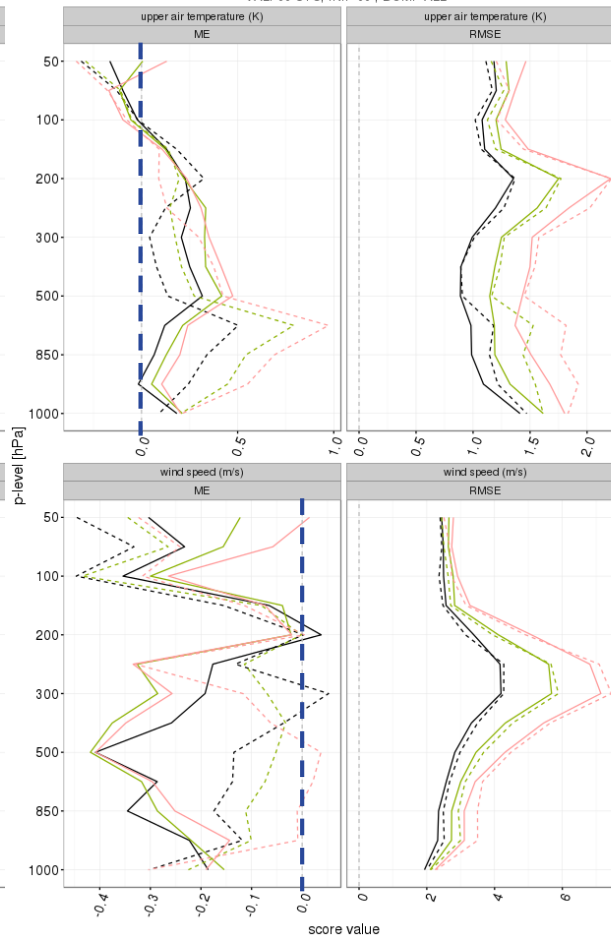
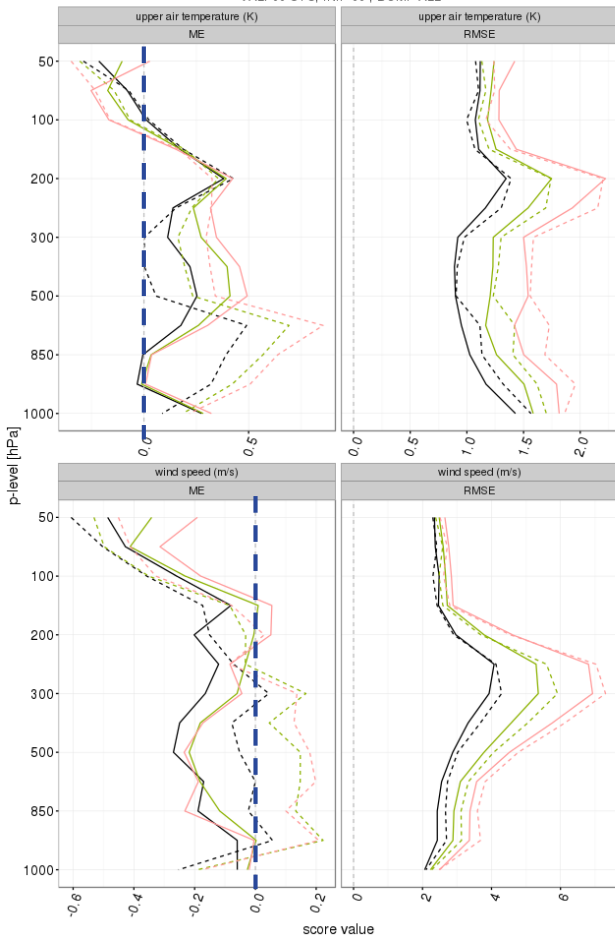
2016/05/01 - 2016/05/31
VAL: 00 UTC, INI: 00, DOM: ALL

06/16

ME

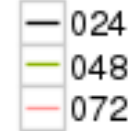
RMSE

2016/06/01 - 2016/06/29
VAL: 00 UTC, INI: 00, DOM: ALL

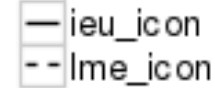


TEMPERATURE

lead-time [h]



Exp.



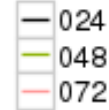
WIND SPEED



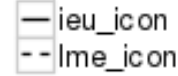
Monthly Upper-air Verification



lead-time [h]



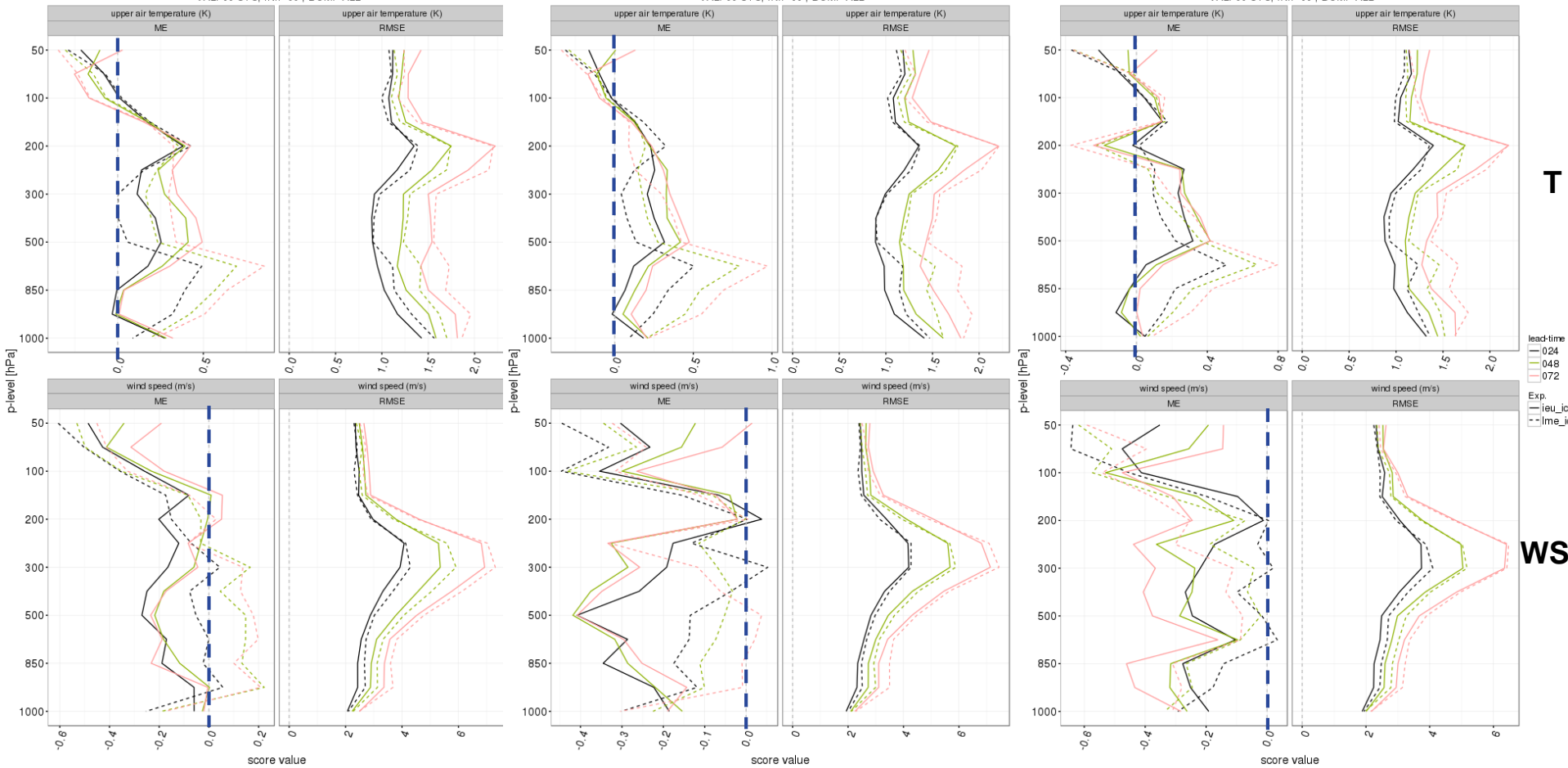
Exp.



ME RMSE
05/16
2016/05/01 - 2016/05/31
VAL: 00 UTC, INI: 00, DOM: ALL

ME RMSE
06/16
2016/06/01 - 2016/06/29
VAL: 00 UTC, INI: 00, DOM: ALL

ME RMSE
07/16
2016/07/01 - 2016/07/31
VAL: 00 UTC, INI: 00, DOM: ALL



T

WS

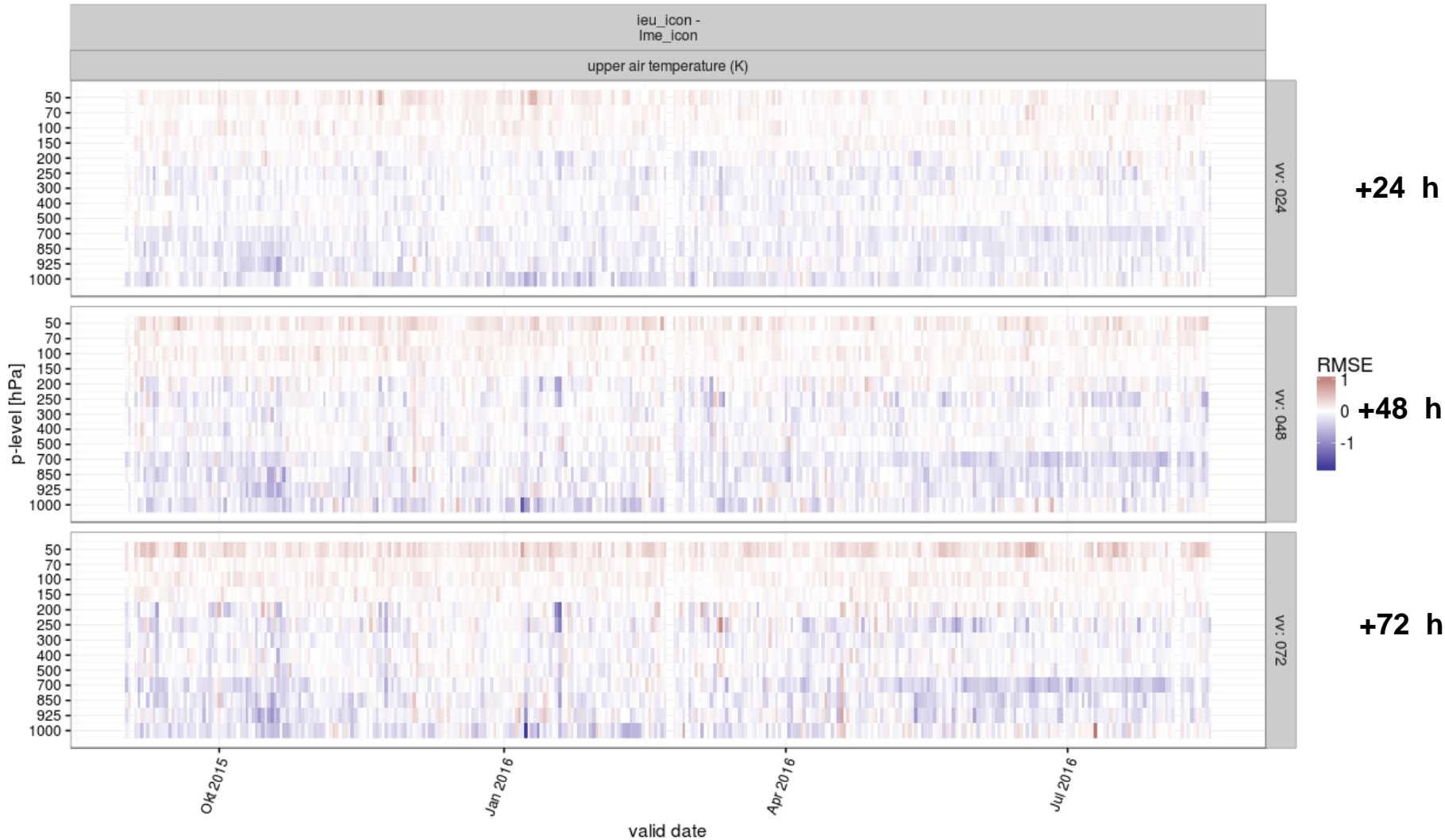


Δ RMSE, temperature ICON-EU – COSMO-EU

Daily time Series 09/2015 – 08/2016, All Radiosondes



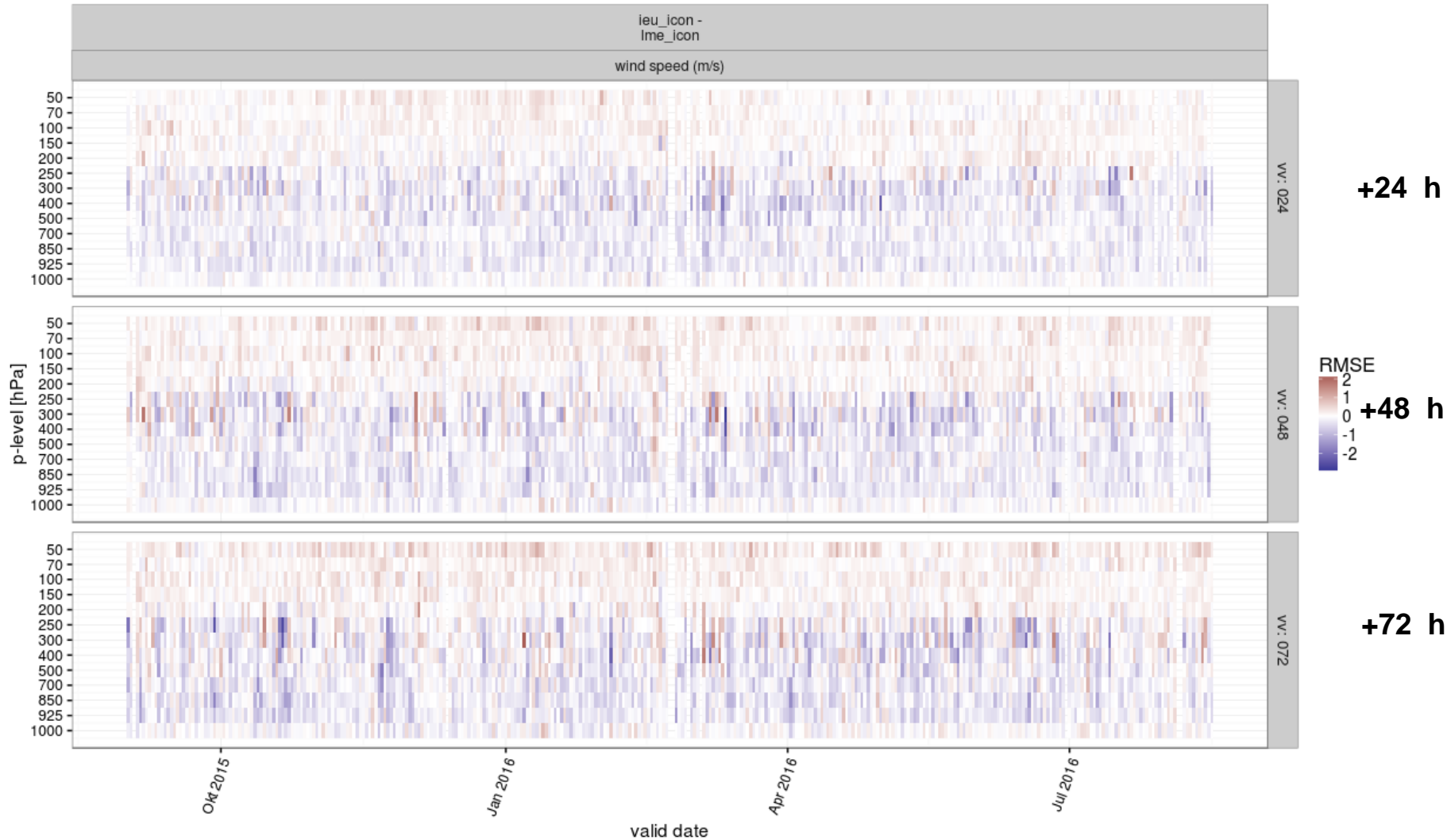
2015/09/01 - 2016/08/16
VAL: 00 UTC, INI: 00 , DOM: ALL



Δ RMSE, wind speed, ICON-EU – COSMO-EU Daily time Series 09/2015 – 08/2016, All Radiosondes



2015/09/01 - 2016/08/16
VAL: 00 UTC, INI: 00 , DOM: ALL

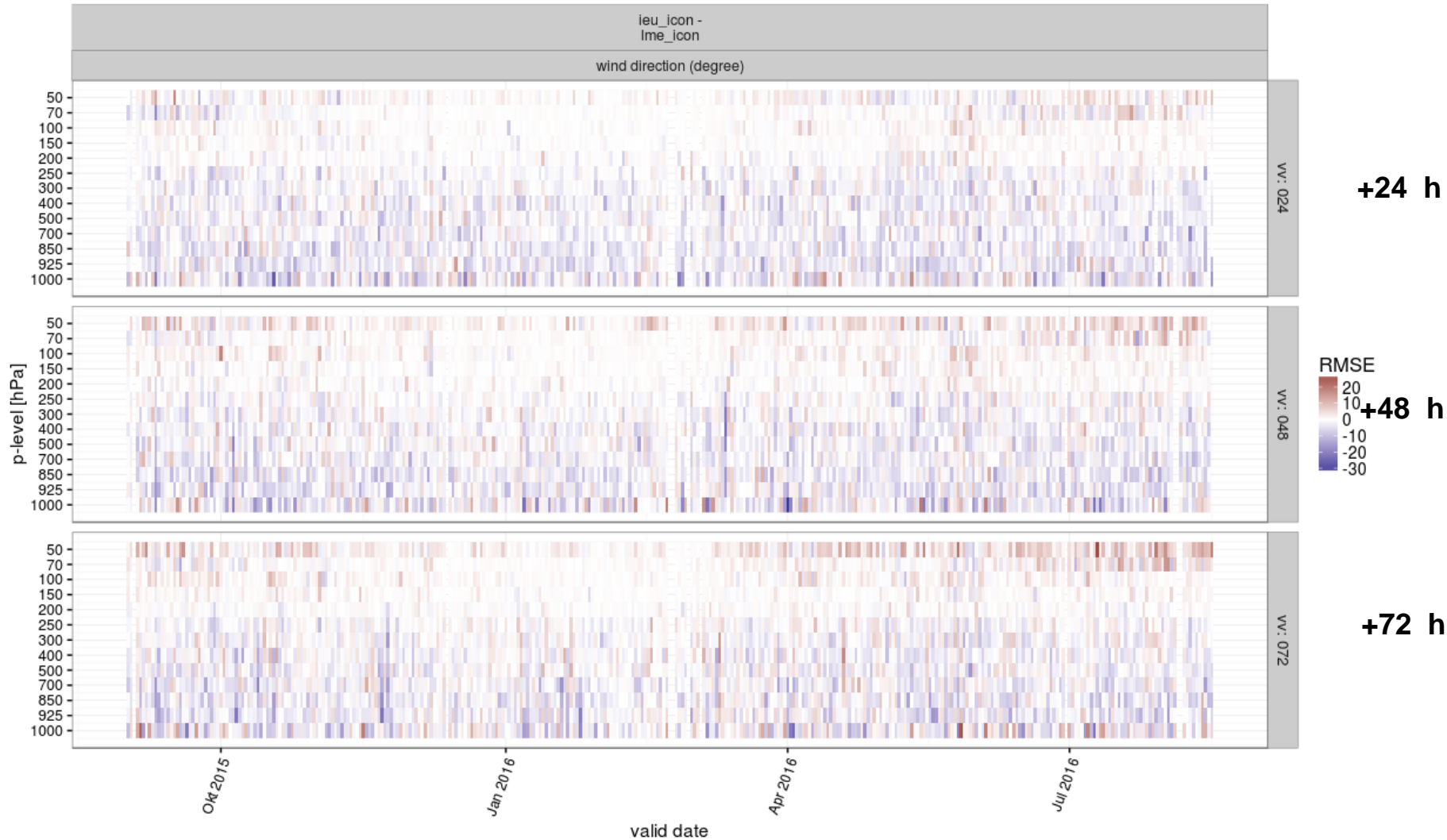


Δ RMSE, wind direction, ICON-EU – COSMO-EU

Daily time Series 09/2015 – 08/2016, All Radiosondes



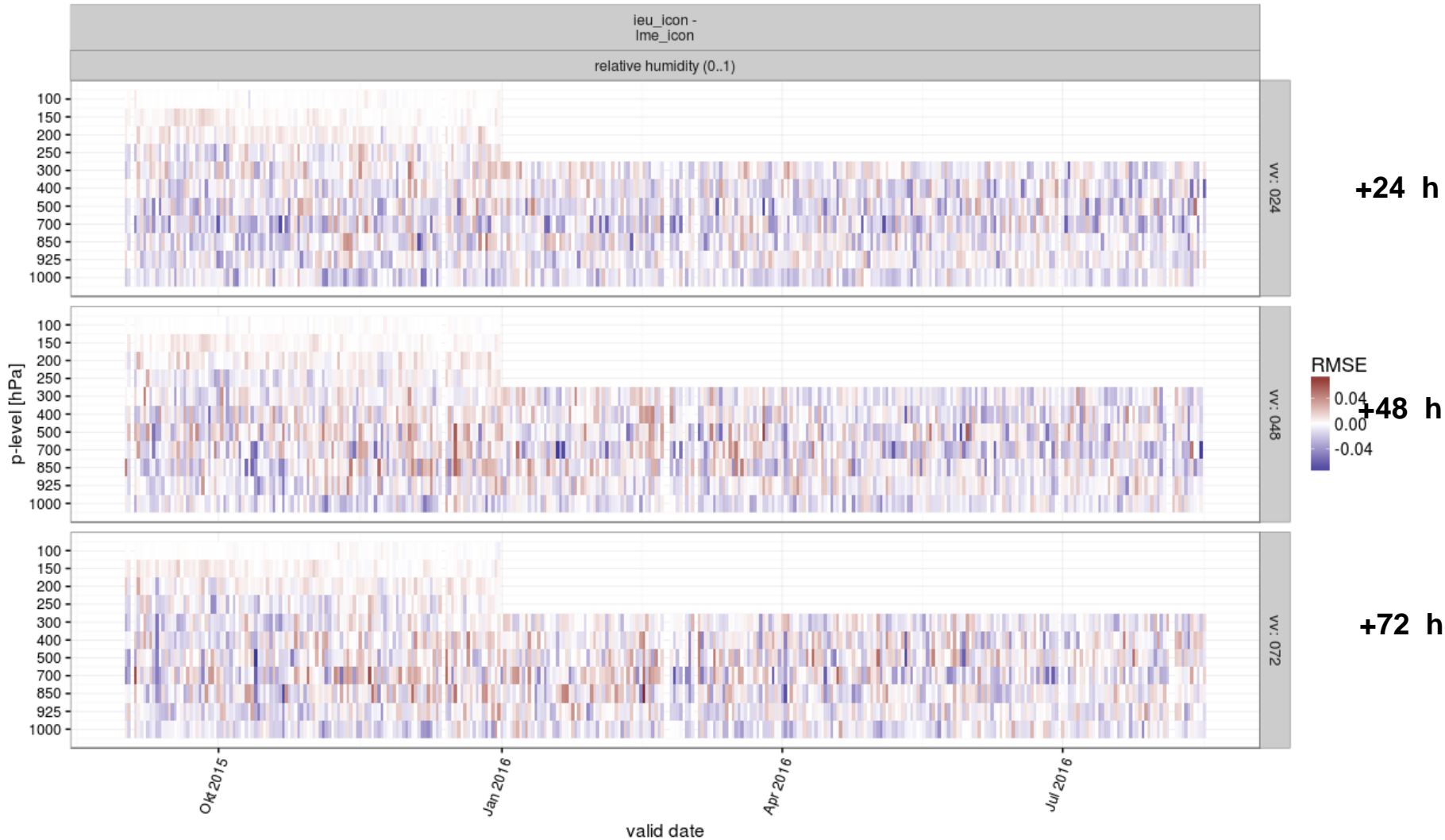
2015/09/01 - 2016/08/16
VAL: 00 UTC, INI: 00 , DOM: ALL



Δ RMSE, rel. Humidity, ICON-EU – COSMO-EU Daily time Series 09/2015 – 08/2016, All Radiosondes



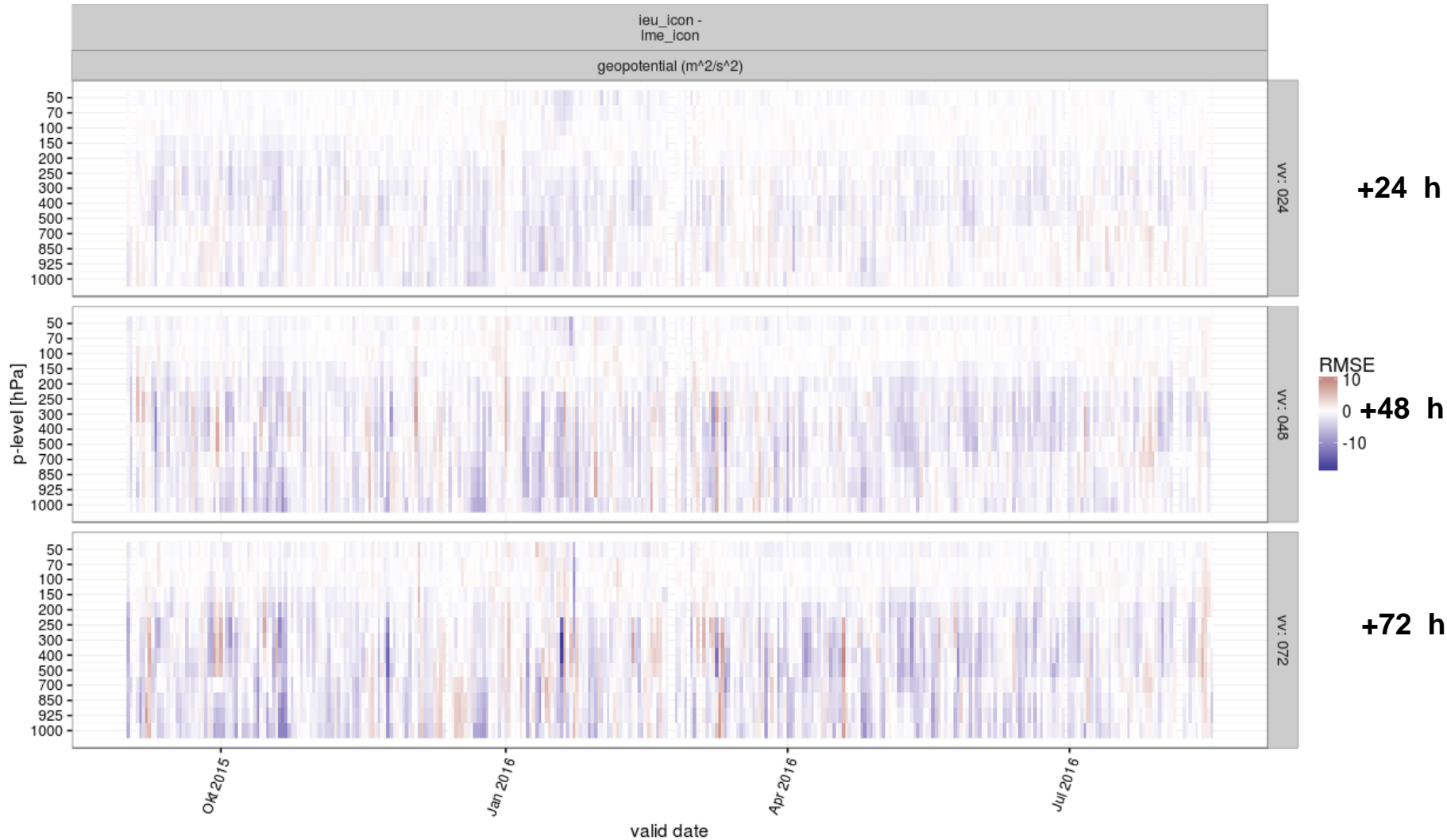
2015/09/01 - 2016/08/16
VAL: 00 UTC, INI: 00 , DOM: ALL



Δ RMSE, geopotential, ICON-EU – COSMO-EU Daily time Series 09/2015 – 08/2016, All Radiosondes



2015/09/01 - 2016/08/16
VAL: 00 UTC, INI: 00 , DOM: ALL



Summary Synop Verification

→ ME:

- WD_{10m} positive in both models, decreasing with lead time, Range: ICON-EU(3-5°), COSMO-EU (1-3°)
- WS_{10m} positive in both models, less increase with lead time in ICON-EU
- T_{2m} positive in both models (except 03/16), less increase with lead time in ICON-EU

→ RMSE:

- ICON-EU smaller for $Wind_{10m}$ and clearly smaller for T_{2m} (gain of more than a day in forecast quality)

→ Precipitation:

- $FBI_{ICON-EU} > FBI_{COSMO-EU}$, especially for thresholds ≤ 1 mm due to convective drizzle
- $ETS_{COSMO-EU}$ better than $ETS_{ICON-EU}$ for day 1, 2 and 3 and thresholds ≤ 1 mm due to conv. drizzle
- $ETS_{ICON-EU}$ slightly worse than $ETS_{COSMO-EU}$ for day 1 and thresholds > 1 mm
- $ETS_{ICON-EU}$ better than $ETS_{COSMO-EU}$ for day 2/3 and thresholds > 1 mm

Summary Upper-air Verification

→ BIAS (ICON-EU):

- **Temp.:** below 500 hPa less than in COSMO-EU, except 1000 hPa, 500 – 200 hPa mostly greater than in COSMO-EU
- **Wind Speed:** below 200 hPa stronger negative

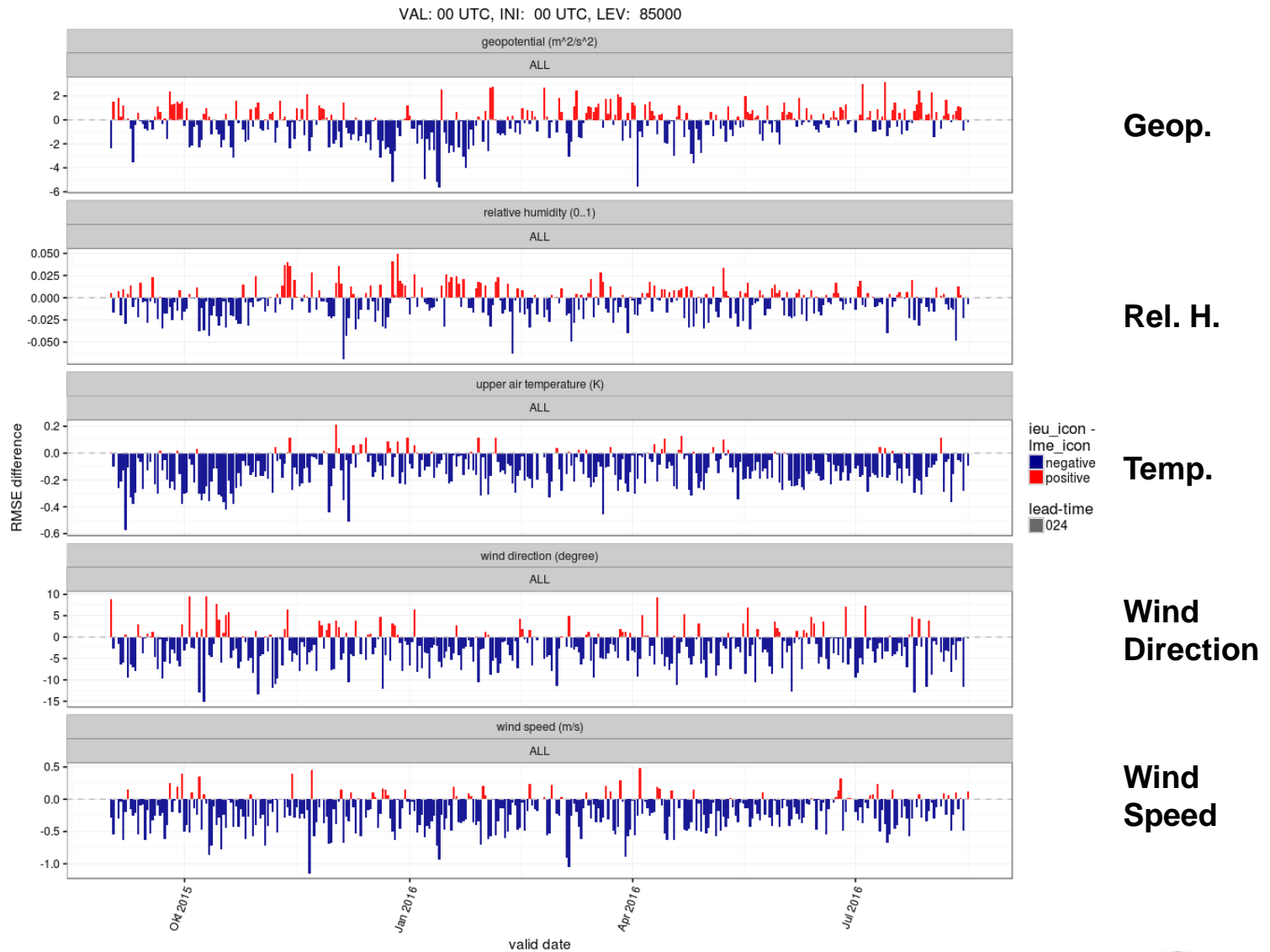
→ RMSE (ICON-EU, all parameters):

- **below 200 hPa:** smaller than in COSMO-EU with more or less daily exceptions
- **200 hPa and above:** greater than in COSMO-EU due to Raleigh damping in COSMO-EU



Thank you
for your attention

Time Series RMSE difference, 850 hPa, 24 h forecast



Time Series RMSE difference, 850,700,500 hPa, 24, 48,72 h forecast



+00 h

+24 h

+48 h

+72 h



500 hPa

700 hPa

850 hPa

