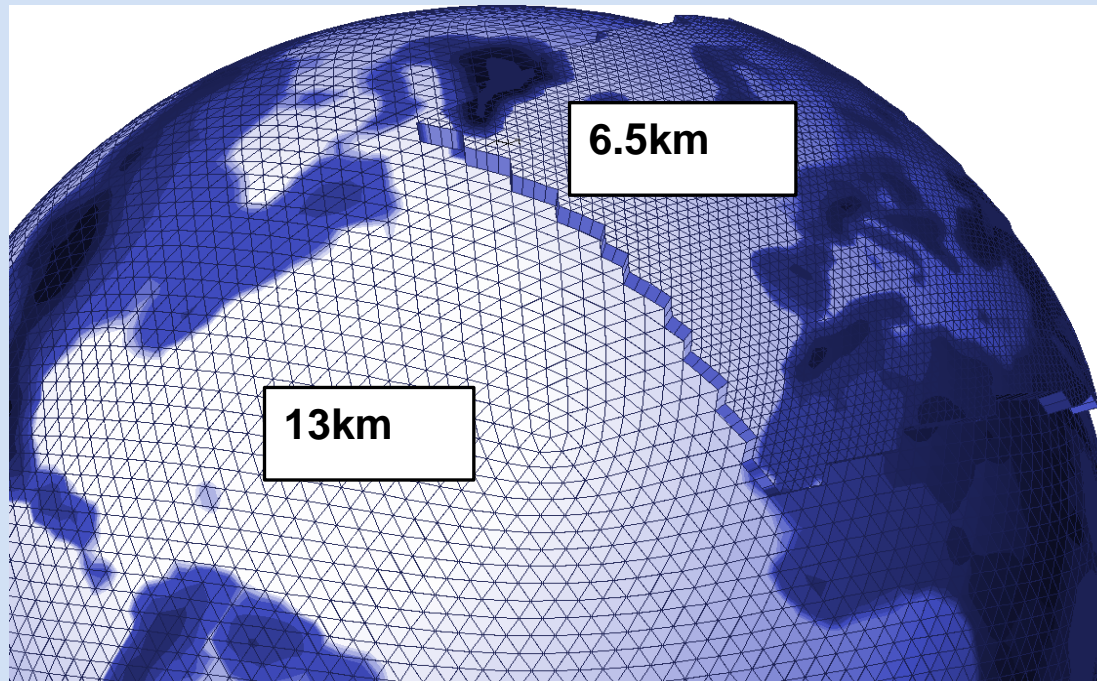


# Verification of ICON / ICON-EU



COSMO GM Jerusalem, September 2017  
WG 5, M. Buchhold, DWD

## Background

- ICON-LAM will be the upcoming COSMO consortium model
- An first version of ICON-LAM is already available
- ICON-EU has replaced COSMO-EU at DWD in 2016. ICON-EPS will be operational in Q4 2017
- Consortium members are (probably) interested in the quality of the model

## Aim of the presentation

- ➔ to show verification results of ICON / ICON-EU in comparison with IFS / COSMO-DE
- ➔ to show the capabilities of the new feedback file based verification system (Rfdbk)

## Content

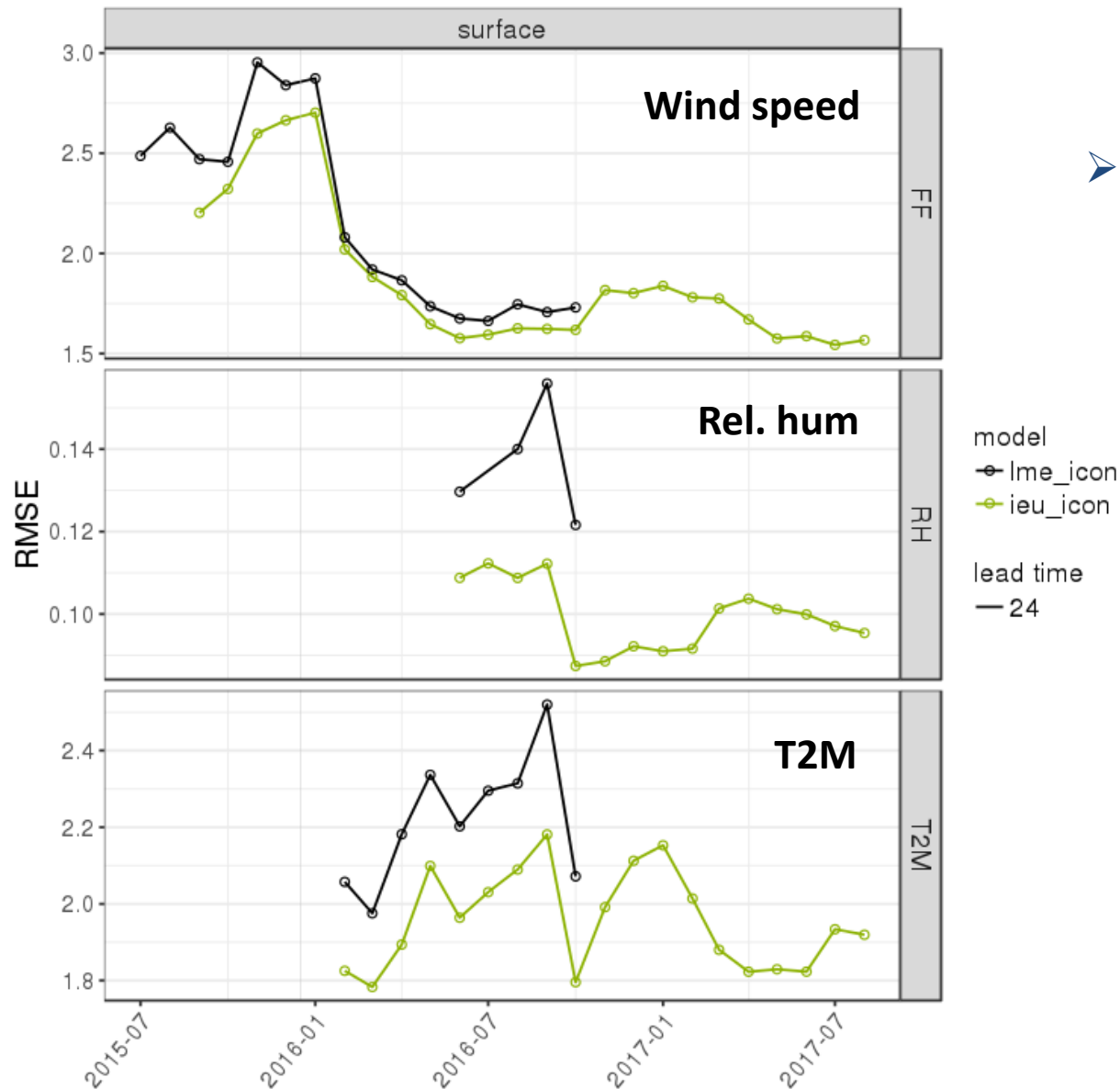
- Verification results for February and July 2017
    - Differences between ICON-EU and ICON
    - ICON compared to IFS
    - ICON-EU compared to COSMO-DE
  - ICON-EPS vs EC-EPS
- } for the ICON-EU area
- for COSMO-DE domain

## A quick look back

### Replacement of COSMO-EU by ICON-EU

# ICON-EU vs. COSMO-EU

Time series of monthly mean RMSE of 00 UTC+24 h forecasts



➤ Clear improvements by  
ICON-EU

**Are there differences in forecast quality between  
ICON-EU and ICON?**

**And if so, where?**

# ICON-EU vs ICON

00 UTC runs, continuous verification, SYNOP, Feb 2017

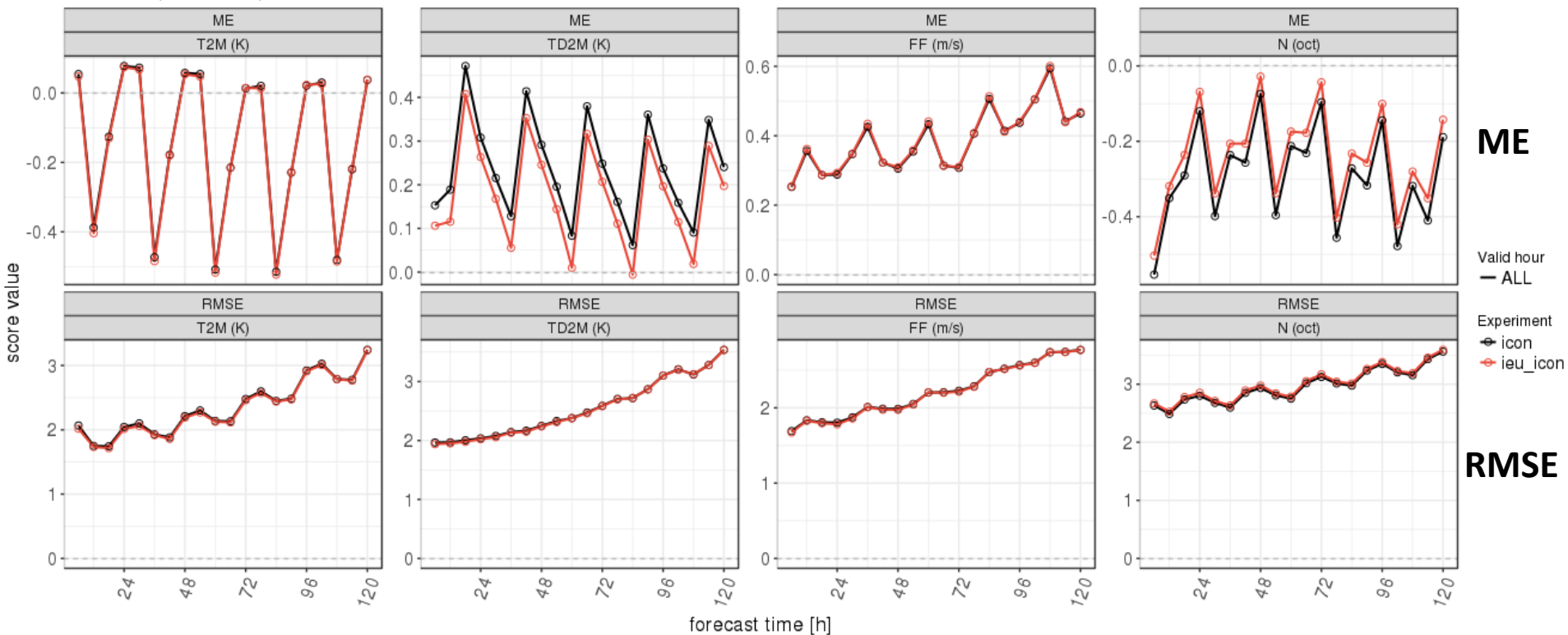
**T2M**

**TD2M**

**wind speed**

**total cloud cover**

2017/02/01-00UTC - 2017/02/28-18UTC  
INI: 00 UTC, DOM: ALL, STAT: ALL



# ICON-EU vs ICON

00 UTC runs, continuous verification, SYNOP, July 2017

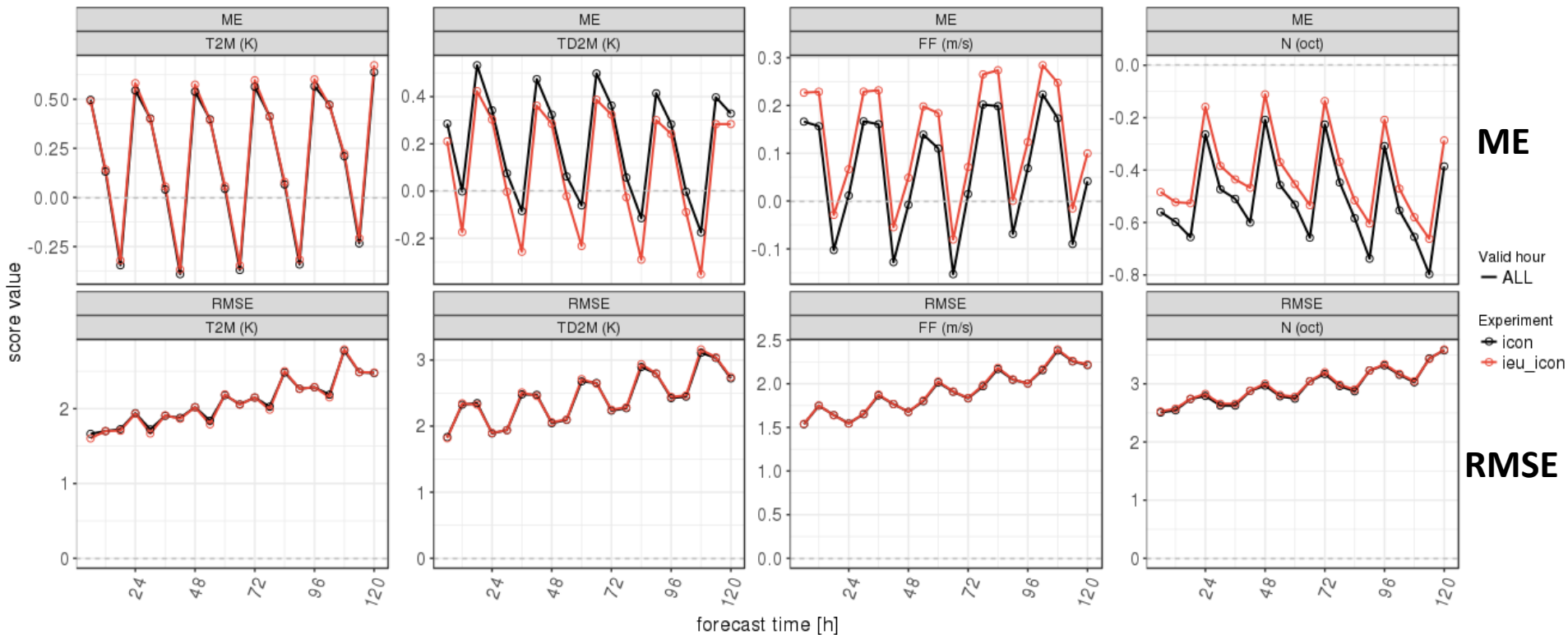
**T2M**

**TD2M**

**wind speed**

**total cloud cover**

2017/07/01-00UTC - 2017/07/31-18UTC  
INI: 00 UTC, DOM: ALL, STAT: ALL



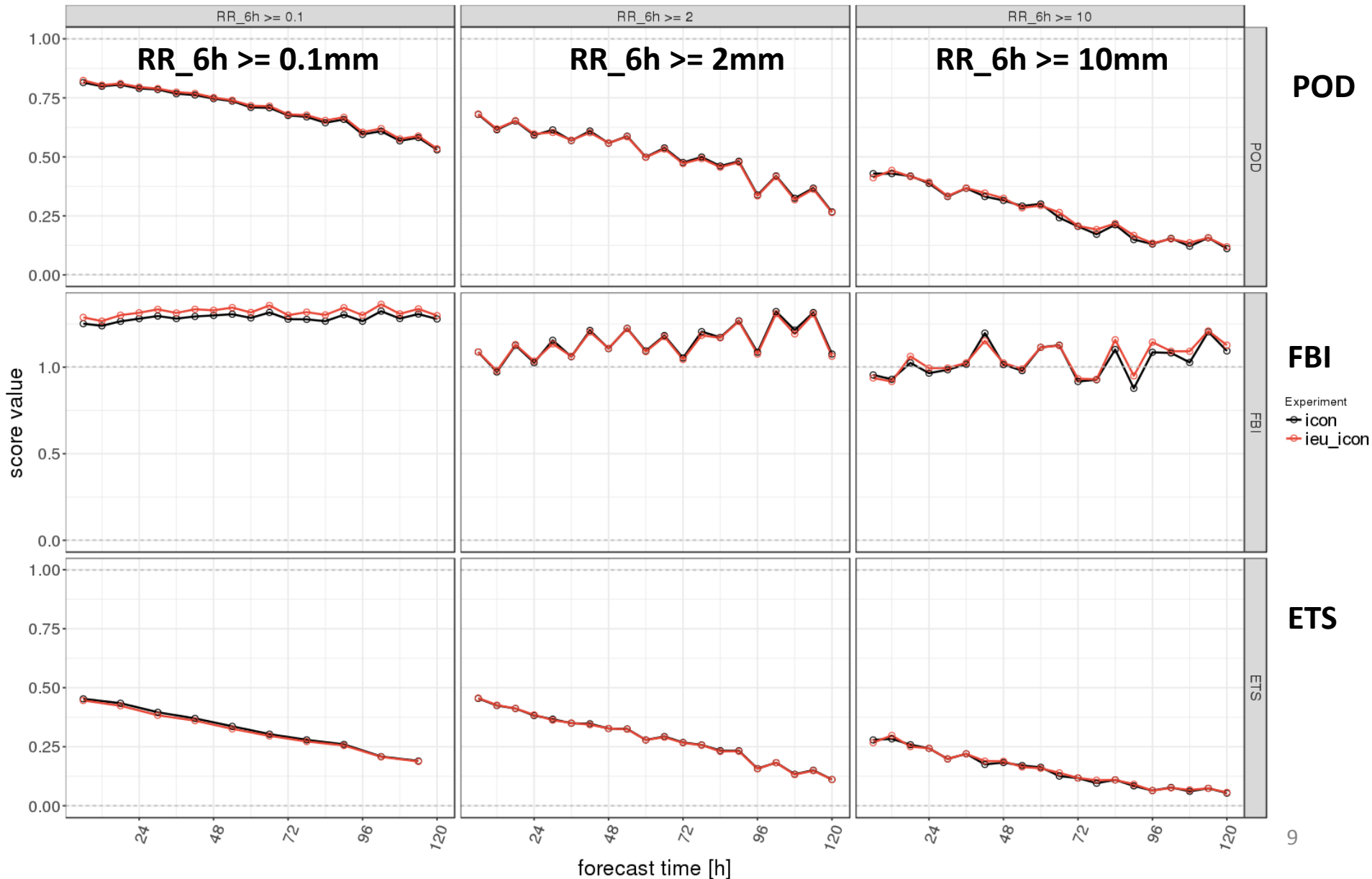


# ICON-EU vs ICON

## All runs, categorical verification, SYNOP, Feb 2017

2017.02.01-00UTC - 2017.02.28-18UTC

VAL: ALL UTC, INI: ALL, STAT: ALL, DOM: ALL

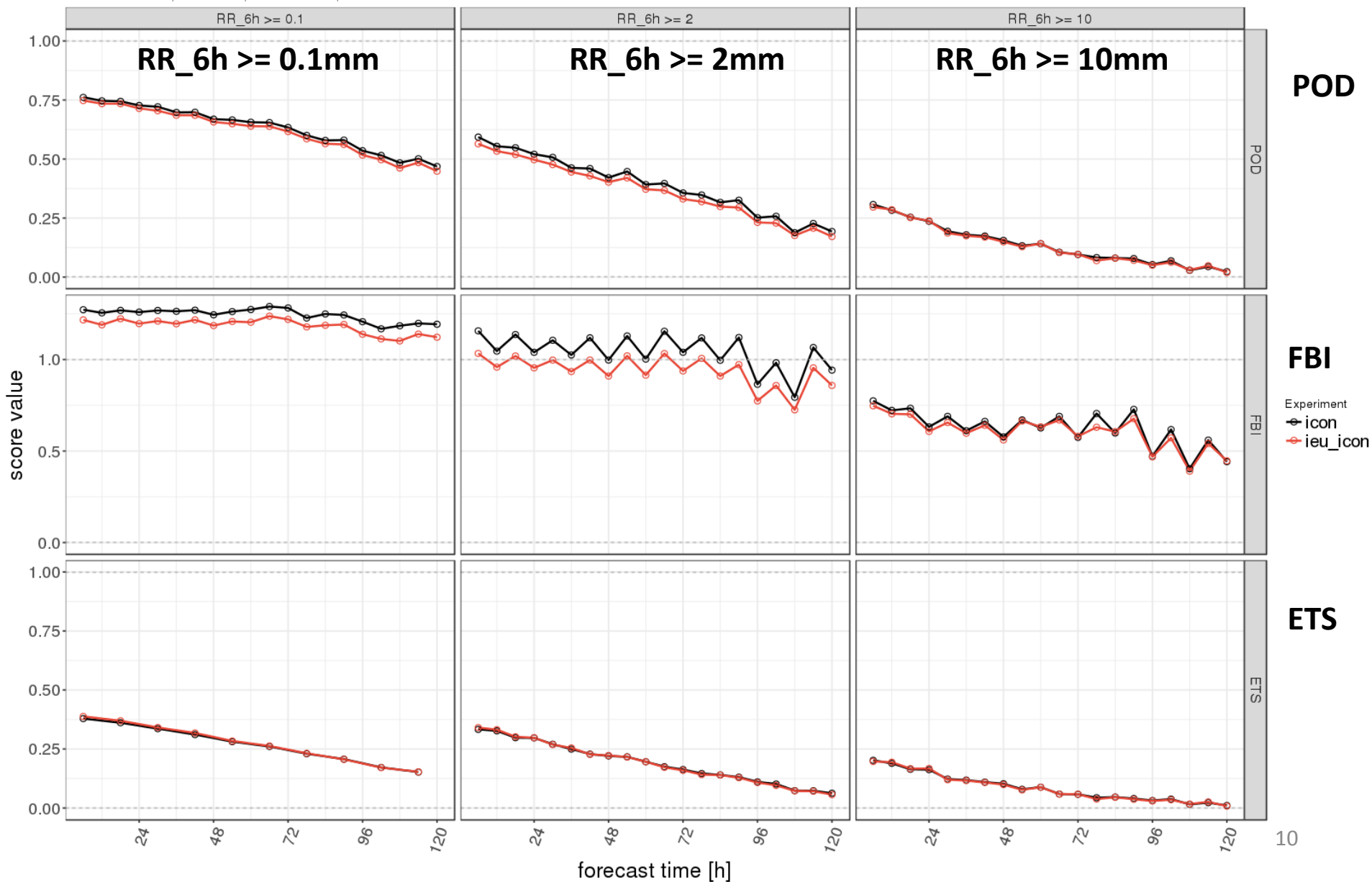


# ICON-EU vs ICON

## All runs, categorical verification, SYNOP, Jul 2017

2017.07.01-00UTC - 2017.07.31-18UTC

VAL: ALL UTC, INI: ALL, STAT: ALL, DOM: ALL

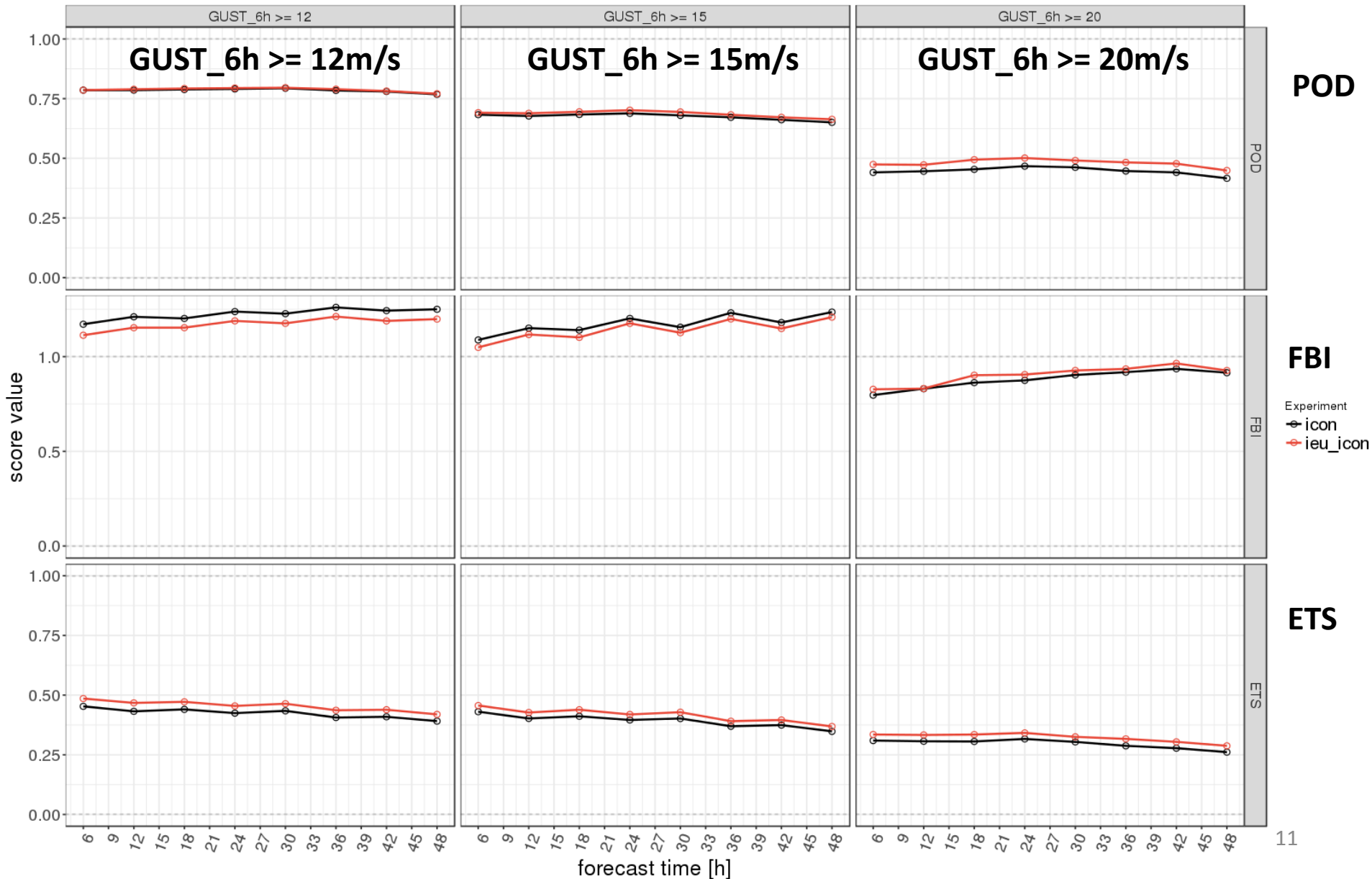


# ICON-EU vs ICON

## All runs, categorical verification, SYNOP, Feb 2017

2017.02.01-00UTC - 2017.02.28-18UTC

VAL: ALL UTC, INI: ALL, STAT: ALL, DOM: ALL

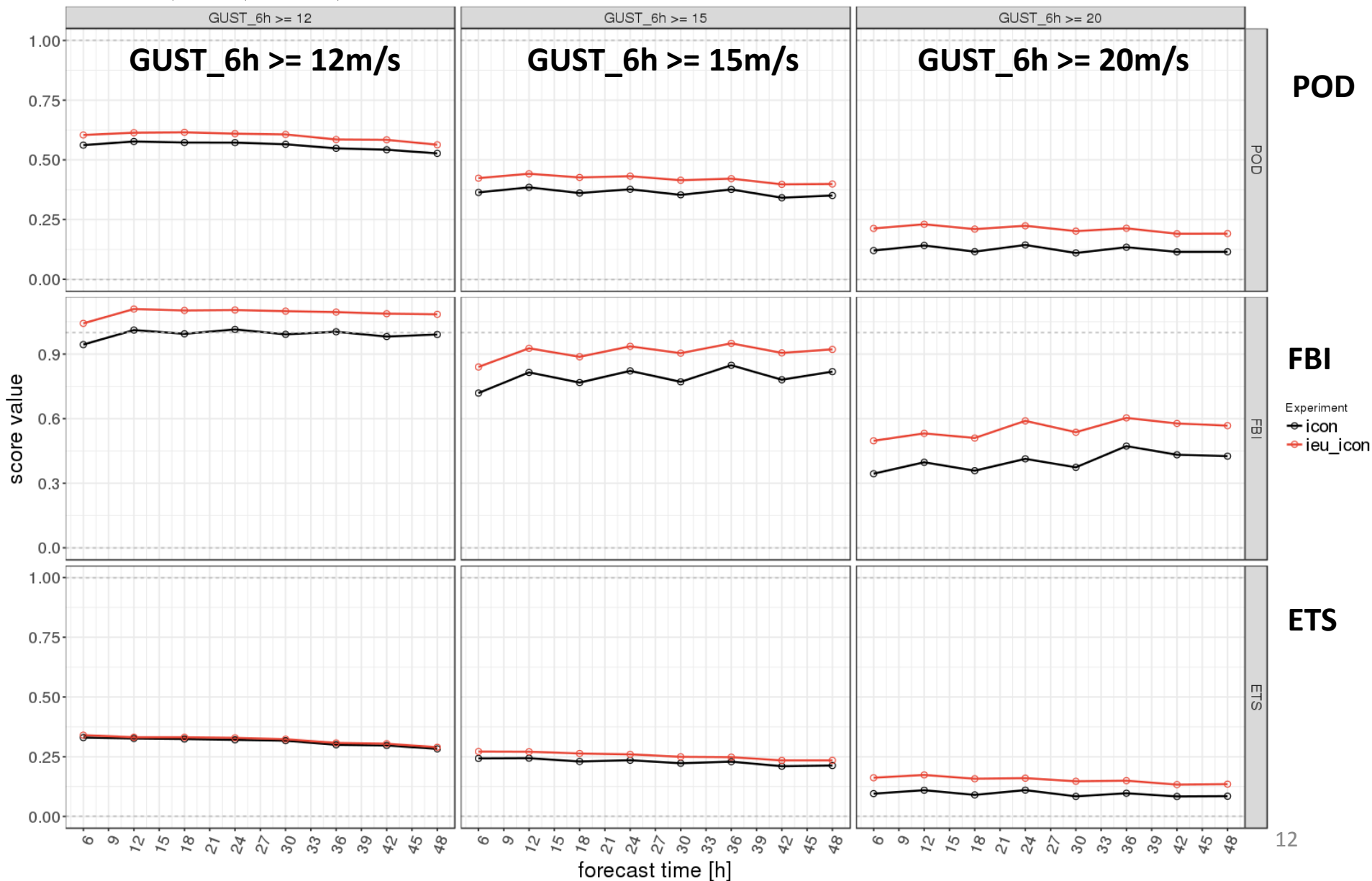


# ICON-EU vs ICON

## All runs, categorical verification, SYNOP, July 2017

2017.07.01-00UTC - 2017.07.31-18UTC

VAL: ALL UTC, INI: ALL, STAT: ALL, DOM: ALL



# ICON-EU vs ICON

## Results

- Almost equal quality with respect to the continuous variables
- Small differences in precipitation verification but no real difference in quality.  
This may be due to the point-by-point verification
- ICON-EU shows significant advantages in the gust forecasts, especially in July

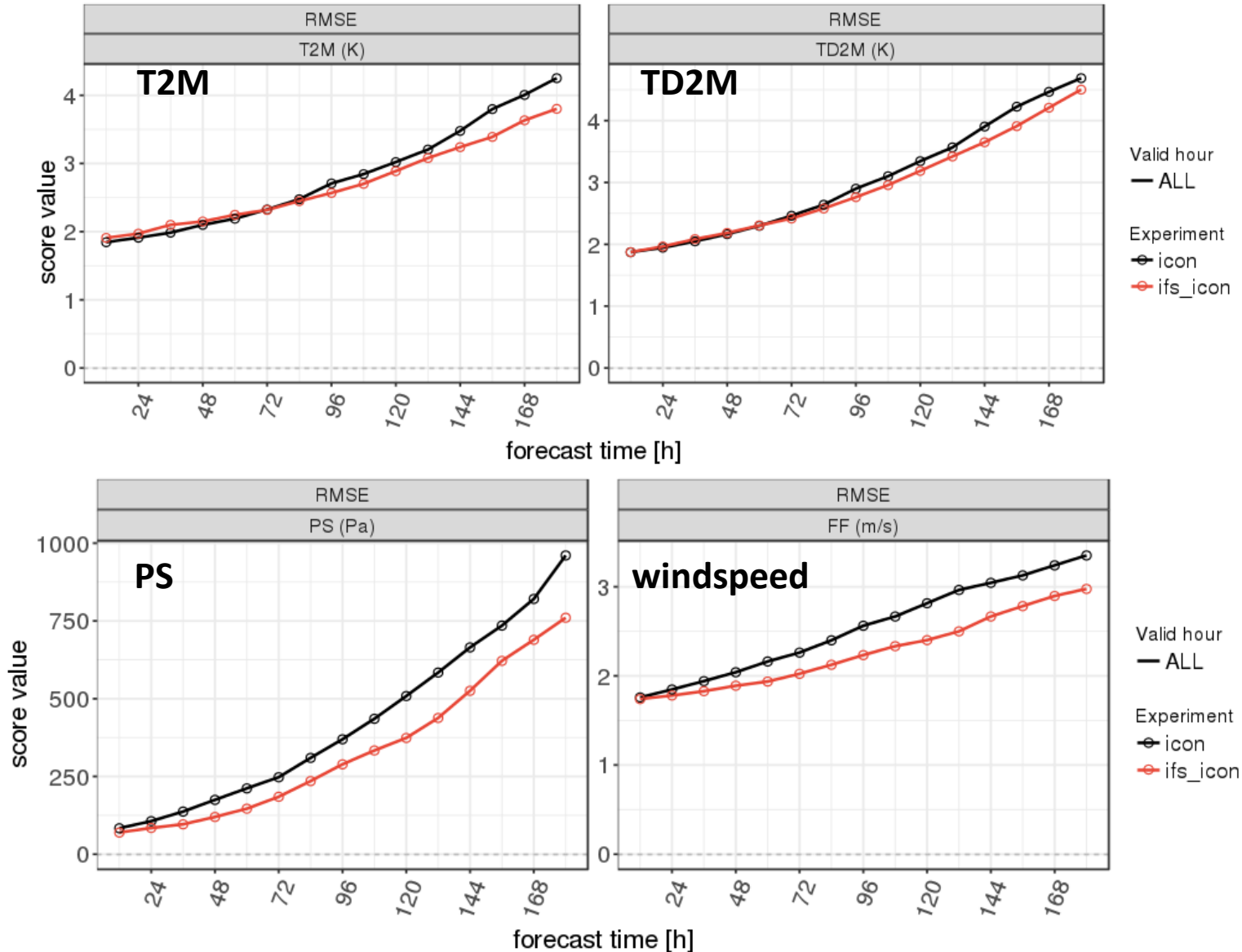


## How good is ICON compared to the IFS?

# ICON vs IFS

## RMSE, all runs, continuous verification, SYNOP, Feb 2017

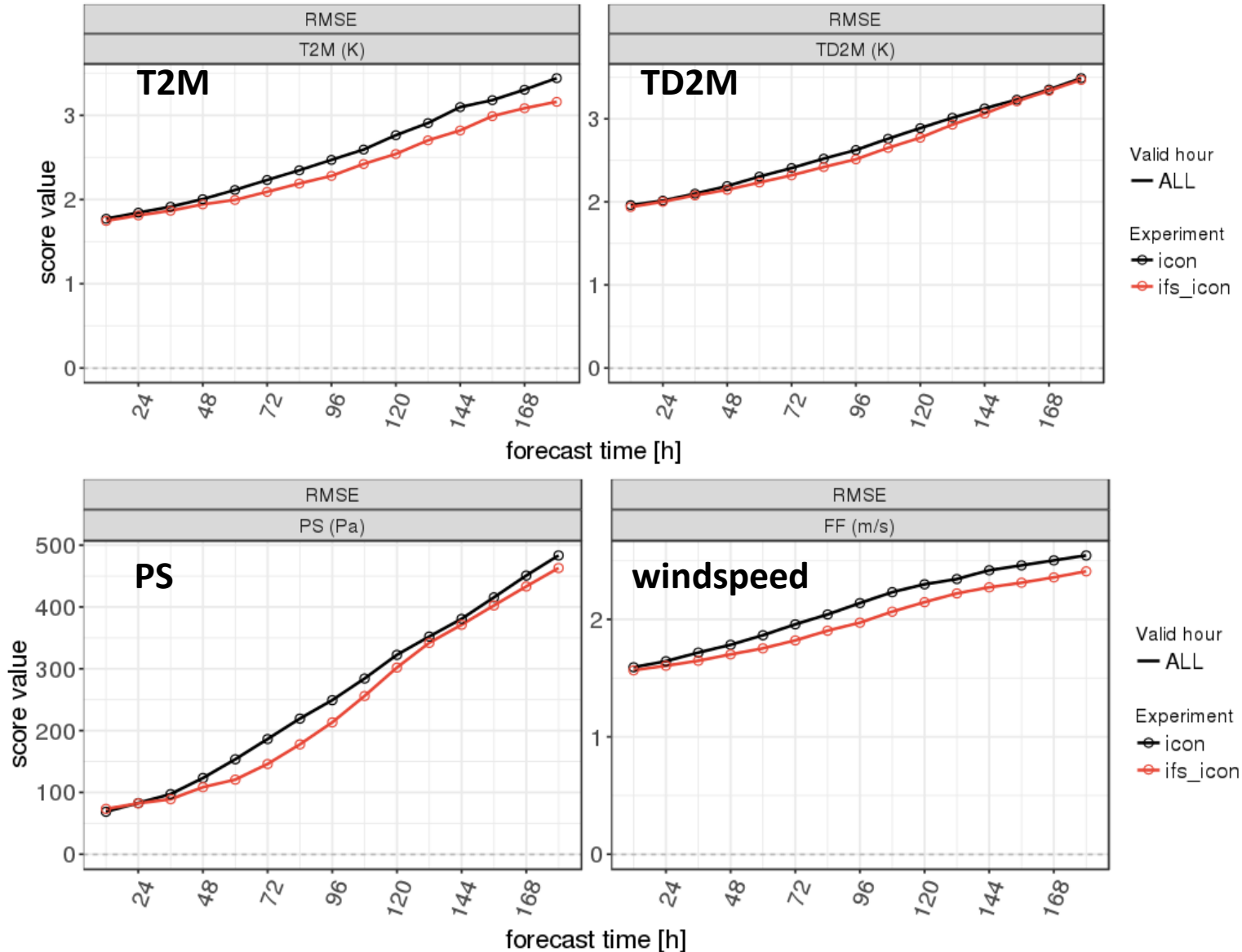
2017/02/01-00UTC - 2017/02/28-12UTC  
INI: ALL UTC, DOM: CEU, STAT: ALL



# ICON vs IFS

## RMSE, all runs, continuous verification, SYNOP, Jul 2017

2017/07/01-00UTC - 2017/07/31-12UTC  
INI: ALL UTC, DOM: CEU, STAT: ALL



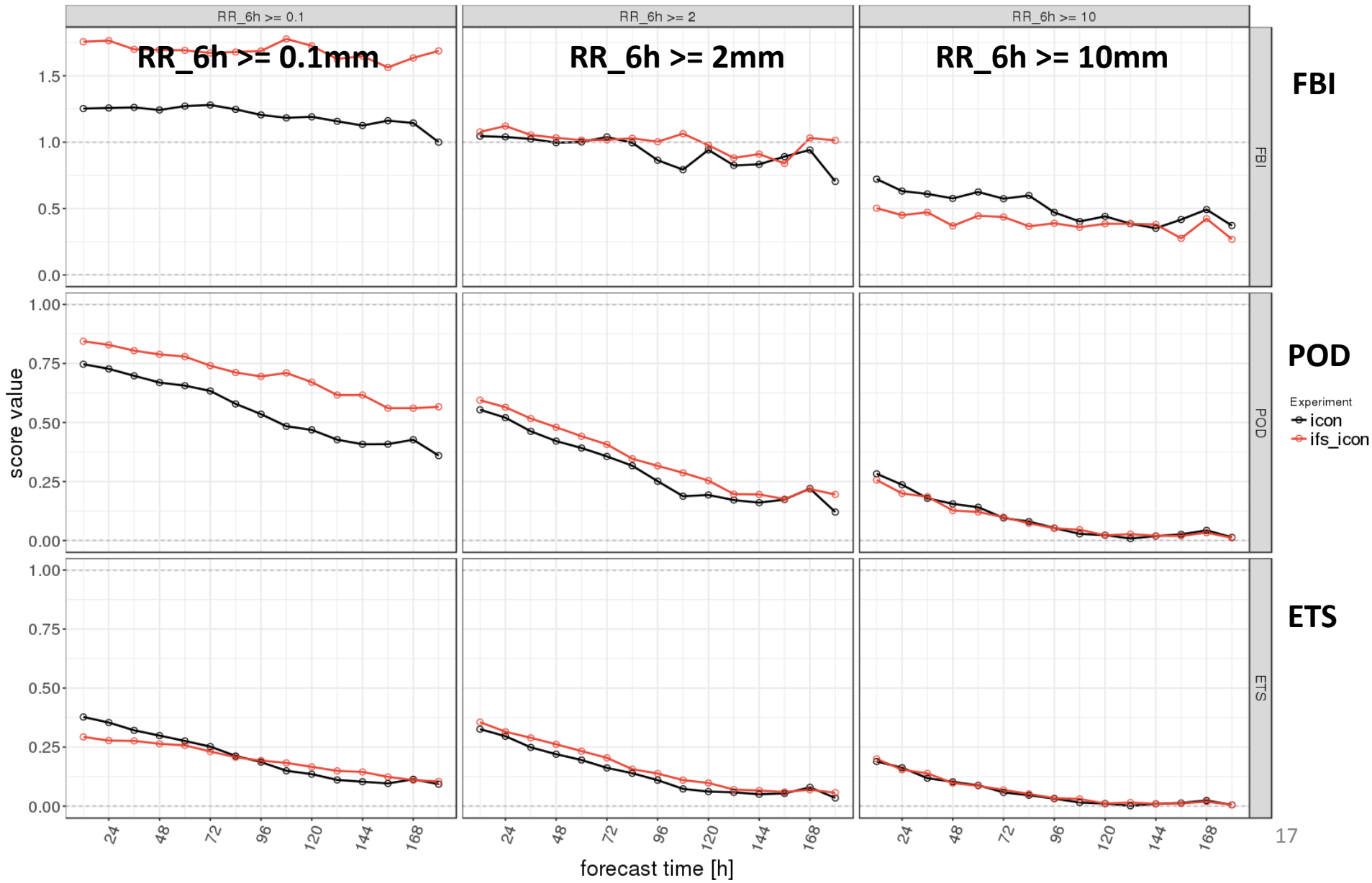


# ICON vs IFS

## 00 and 12 UTC runs, categorical verification, SYNOP Jul 2017

2017.07.01-00UTC - 2017.07.31-12UTC

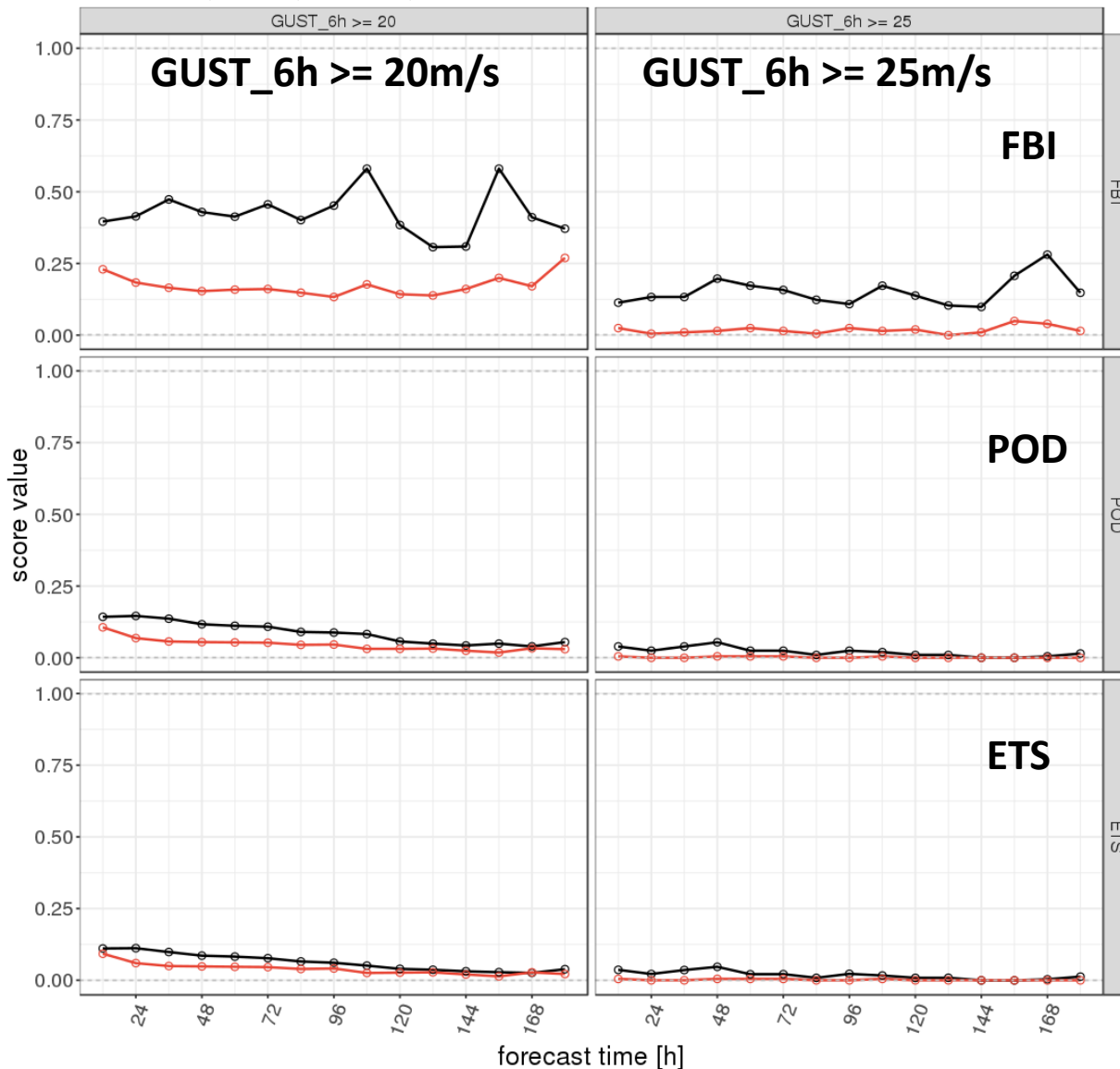
VAL: ALL UTC, INI: ALL, STAT: ALL, DOM: CEU



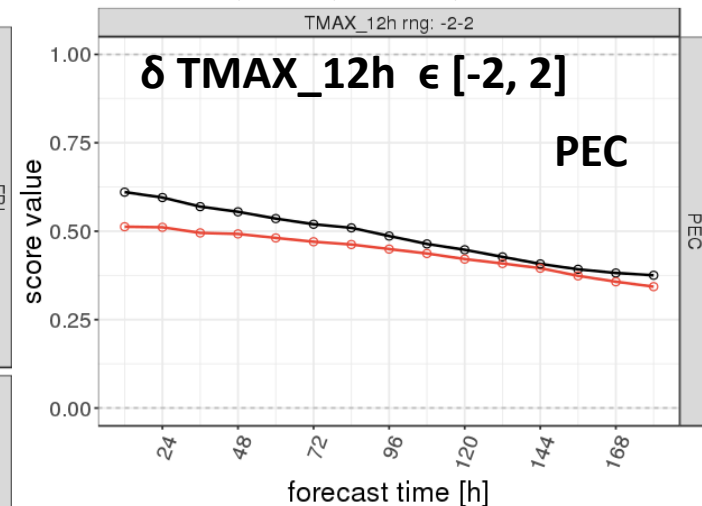
# ICON vs IFS

00 and 12 UTC runs, categorical verification, SYNOP Jul 2017

2017.07.01-00UTC - 2017.07.31-12UTC  
VAL: ALL UTC, INI: ALL, STAT: ALL, DOM: CEU



2017.07.01-00UTC - 2017.07.31-12UTC  
VAL: ALL UTC, INI: ALL, STAT: ALL, DOM: NH



# ICON vs IFS

## SYNOP verification results

- **Continuous verification**  
RMSE T2M, TD2M, PS,FF: **advantage IFS**  
Small RMSE differences in T2M, TD2M up to 3 days
- **Categorical verification.**  
RR  $\geq$  2 mm/6h: **slight advantage IFS**  
RR  $\geq$  10 mm/6h: **slight advantage ICON**
- Gusts: **Clear advantages ICON** for all threshold
- TMAX: **Advantage ICON**



TEMP verif.

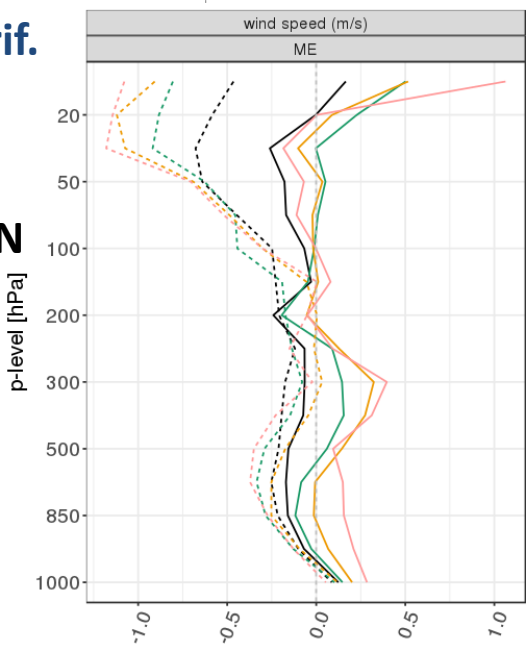
Feb2017

all runs

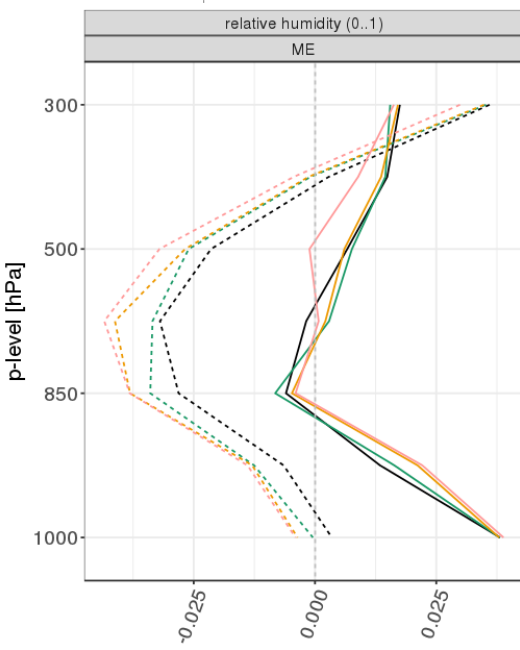
— ICON  
- - IFS

ME

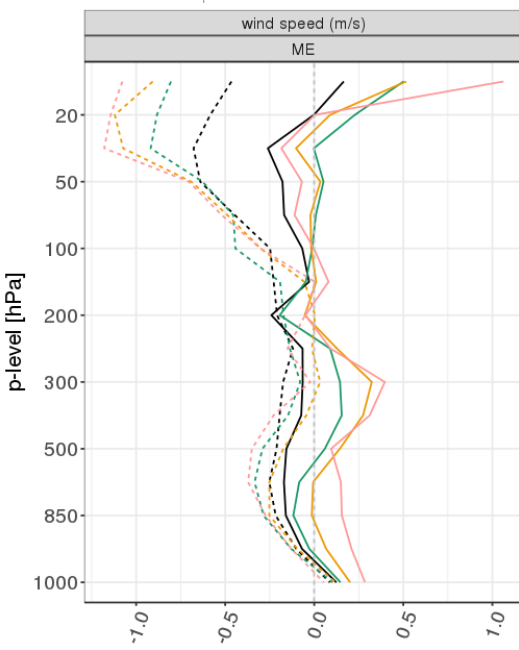
**T**  
2017/02/01 - 2017/02/28  
INI: ALL UTC, DOM: CEU



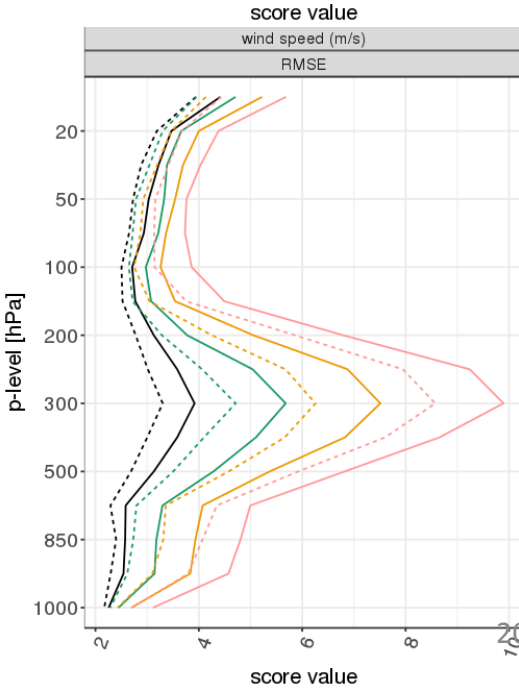
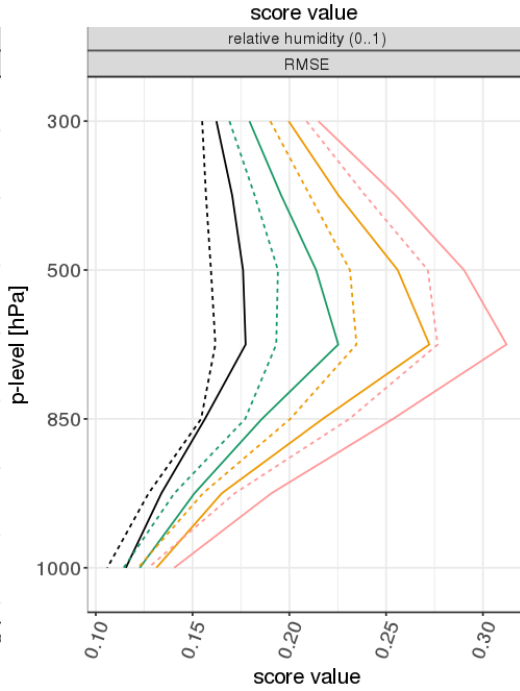
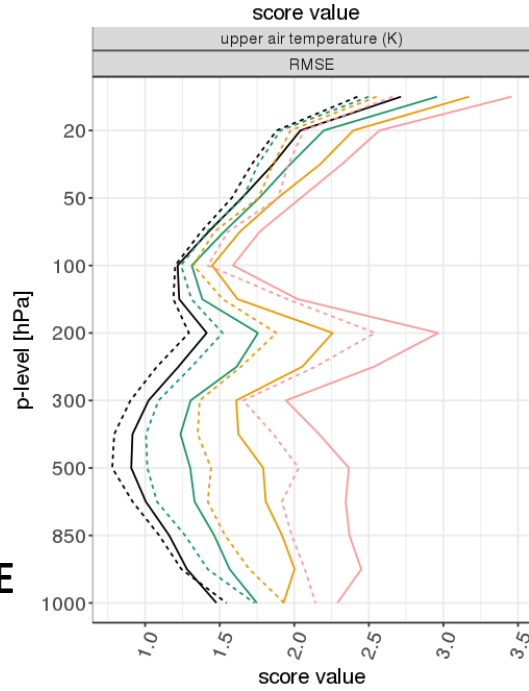
**RH**  
2017/02/01 - 2017/02/28  
INI: ALL UTC, DOM: CEU



**FF**  
2017/02/01 - 2017/02/28  
INI: ALL UTC, DOM: CEU



RMSE



TEMP verif.

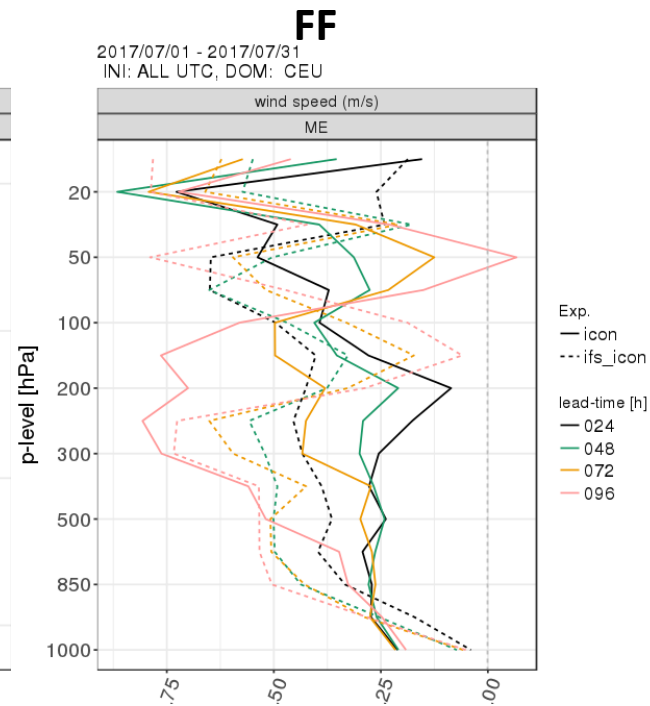
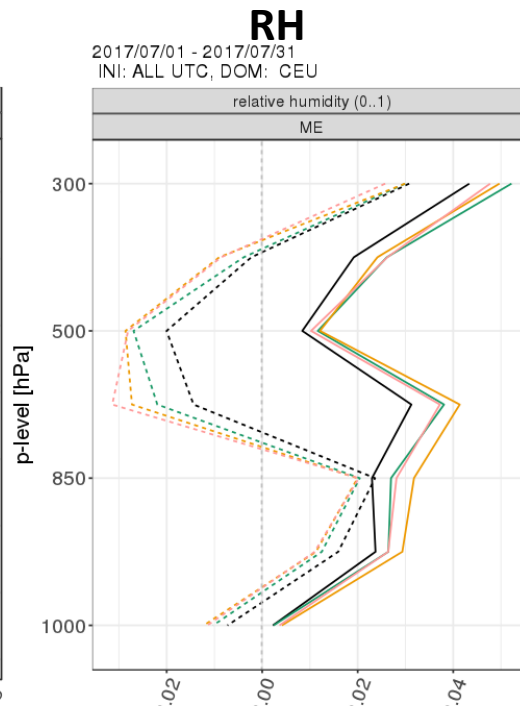
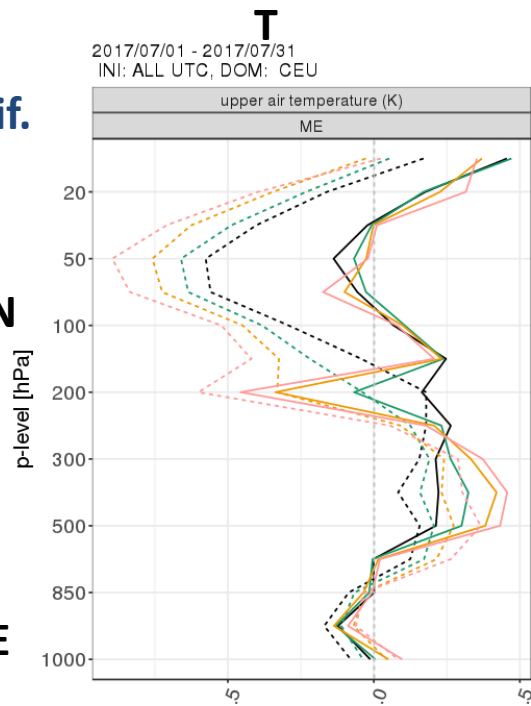
Jul 2017

all runs

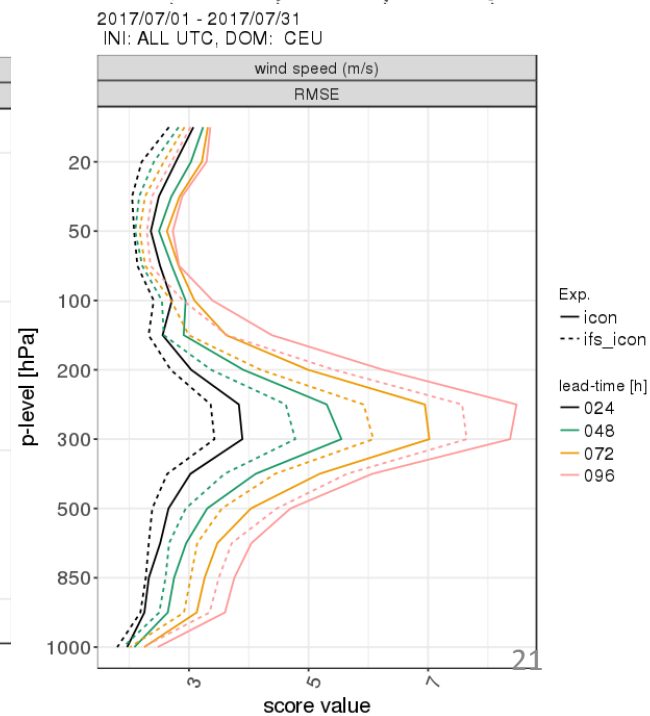
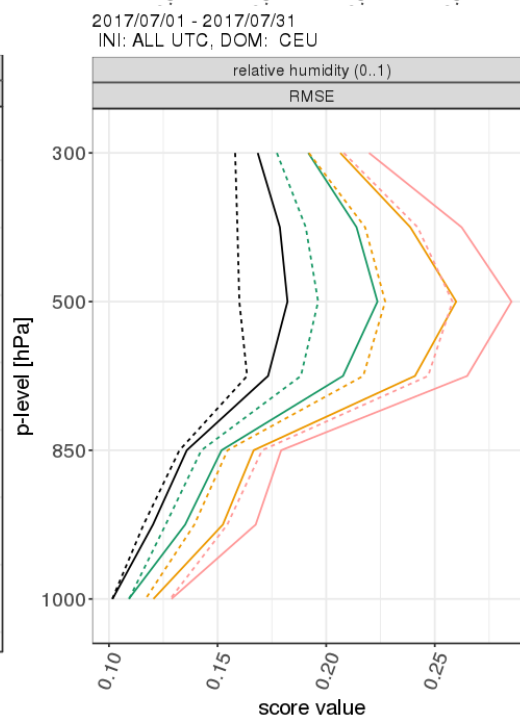
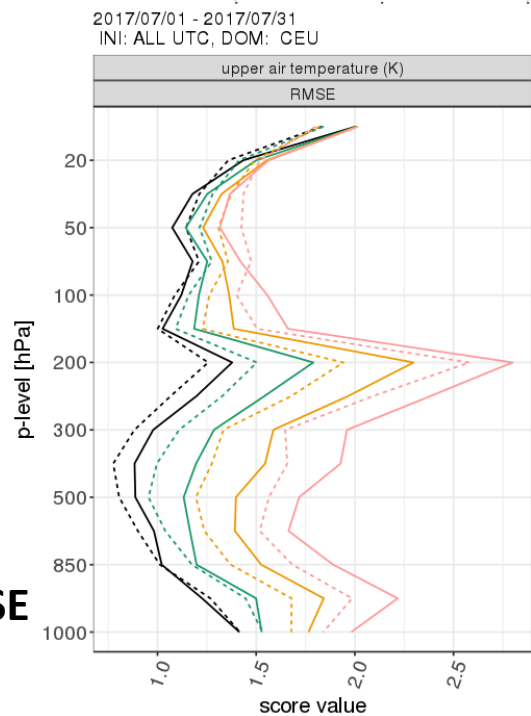
— ICON

- - - IFS

ME



RMSE



# ICON vs IFS

## TEMP verification results

- ICON shows slightly larger error growth
  - larger RMSE of T, RH, Wind
- probable cause: sub-optimal initial conditions
- advantage IFS



# Comparison of ICON-EU with COSMO-DE

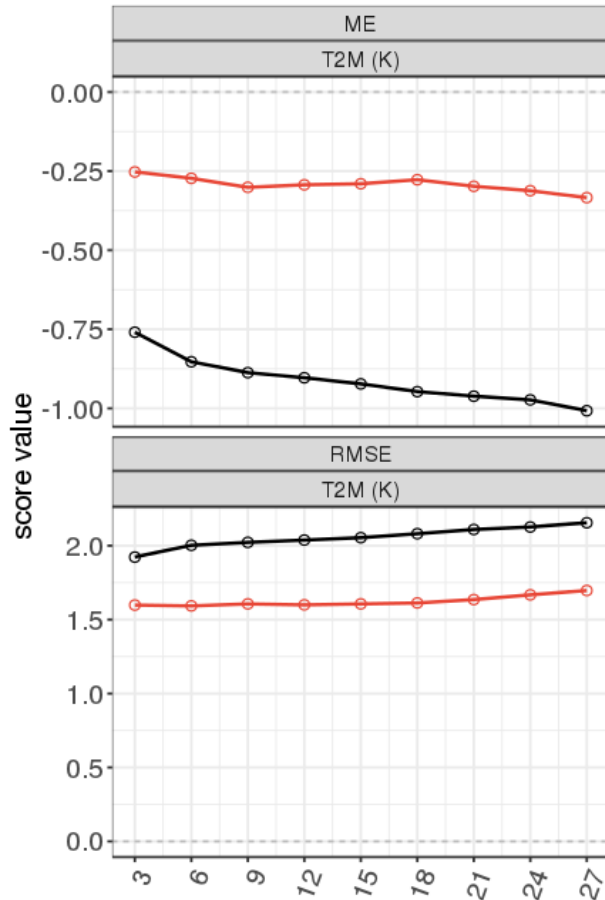
*despite different model resolution*

# ICON-EU vs COSMO-DE

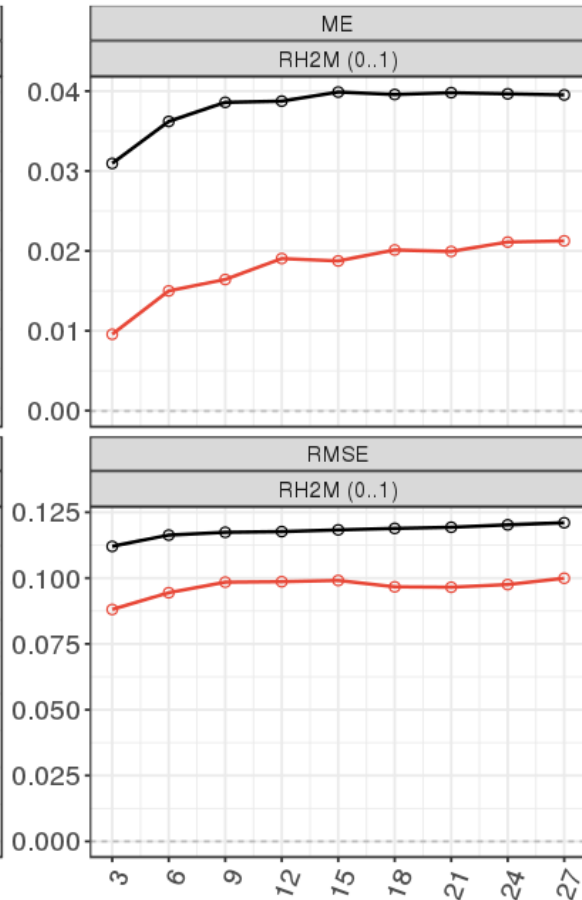
All runs, continues verification, SYNOP Feb 2017

## T2M

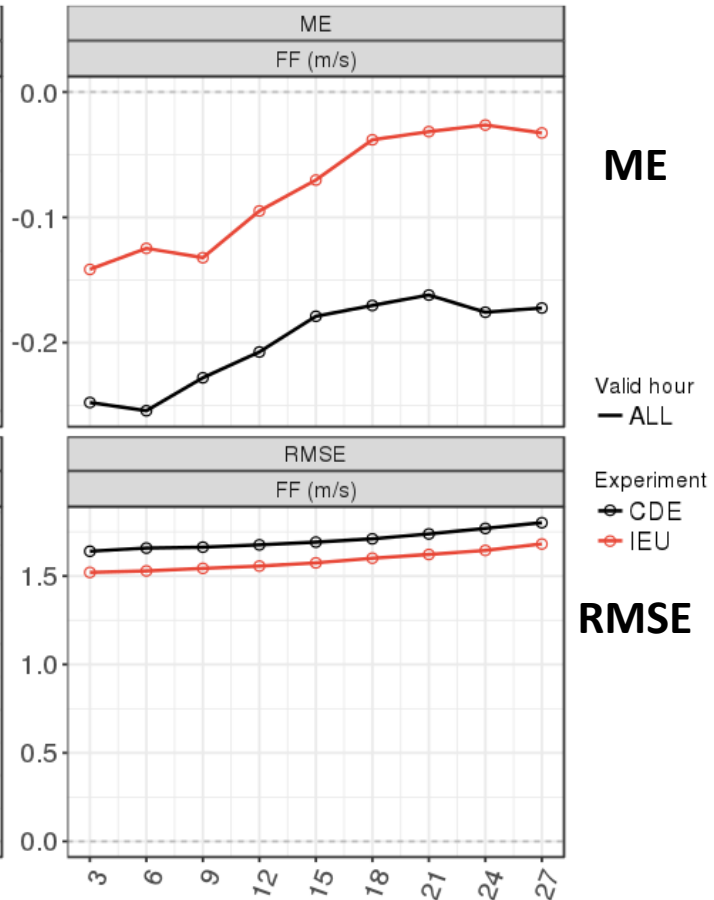
2017/02/01-00UTC - 2017/02/28-18UTC  
INI: ALL UTC, DOM: CDE, STAT: ALL



## RH2M



## FF10M



ME

Valid hour  
— ALL

Experiment  
● CDE  
● IEU

RMSE

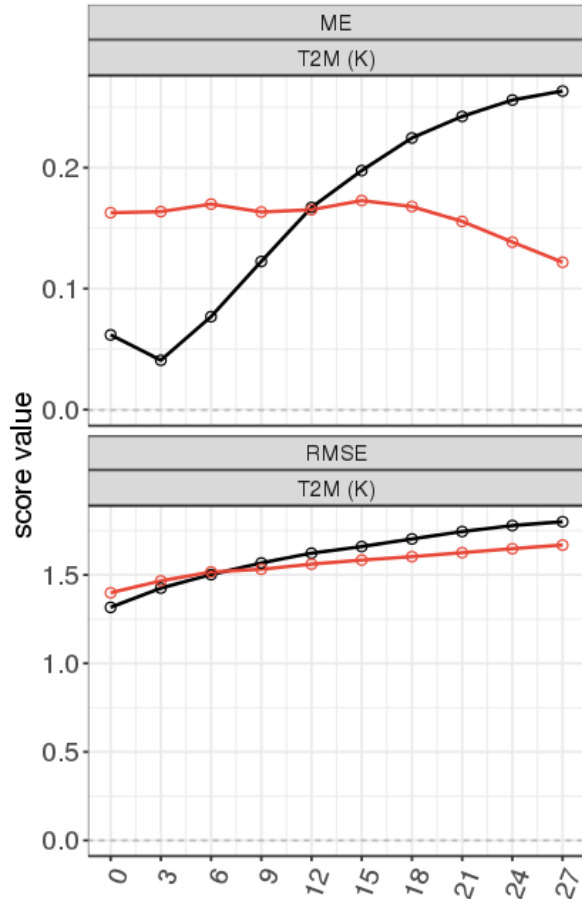


# ICON-EU vs COSMO-DE

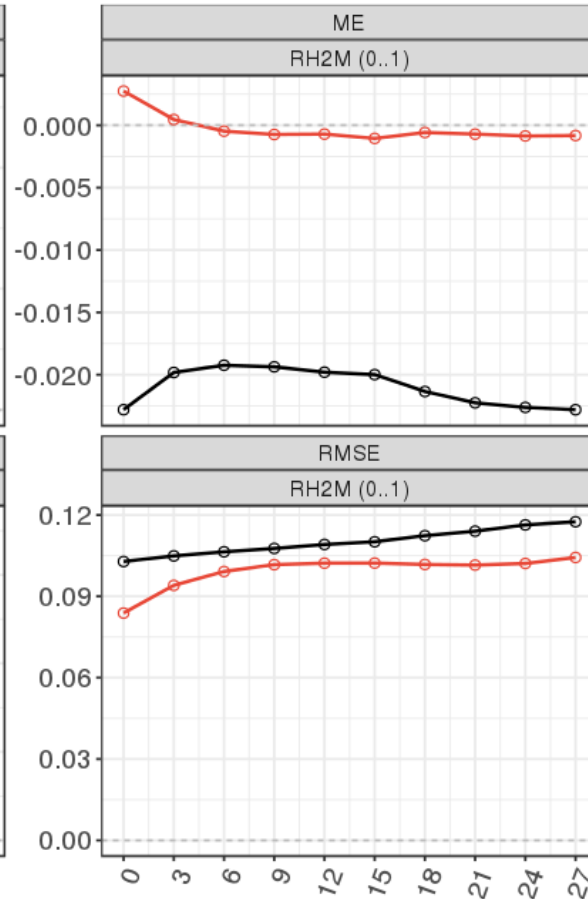
All runs, continues verification, SYNOP July 2017

## T2M

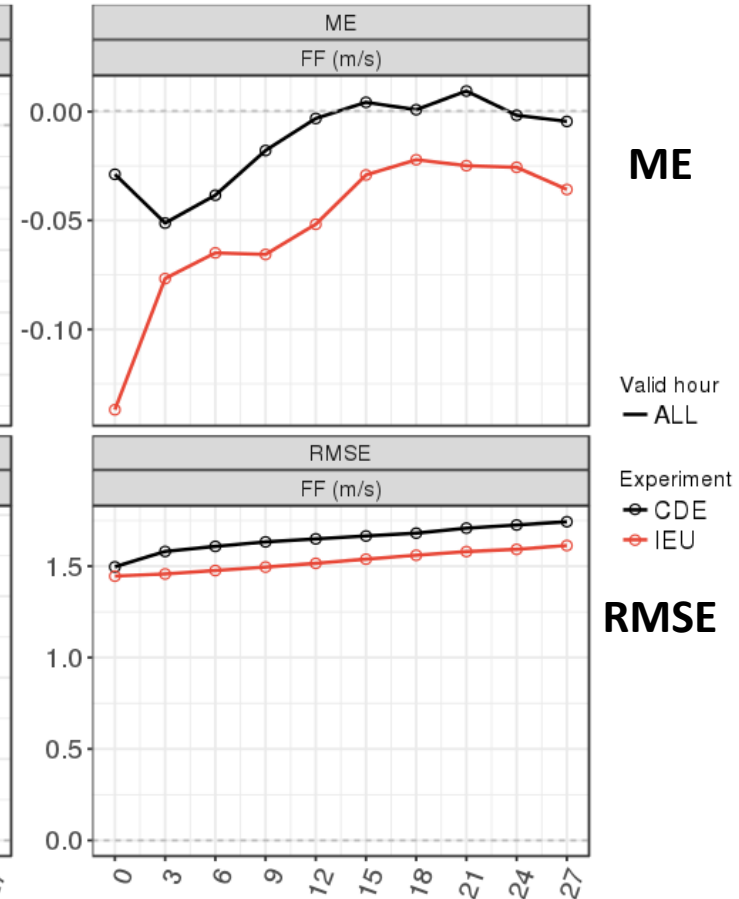
2017/07/01-00UTC - 2017/07/31-21UTC  
INI: ALL UTC, DOM: CDE, STAT: ALL



## RH2M

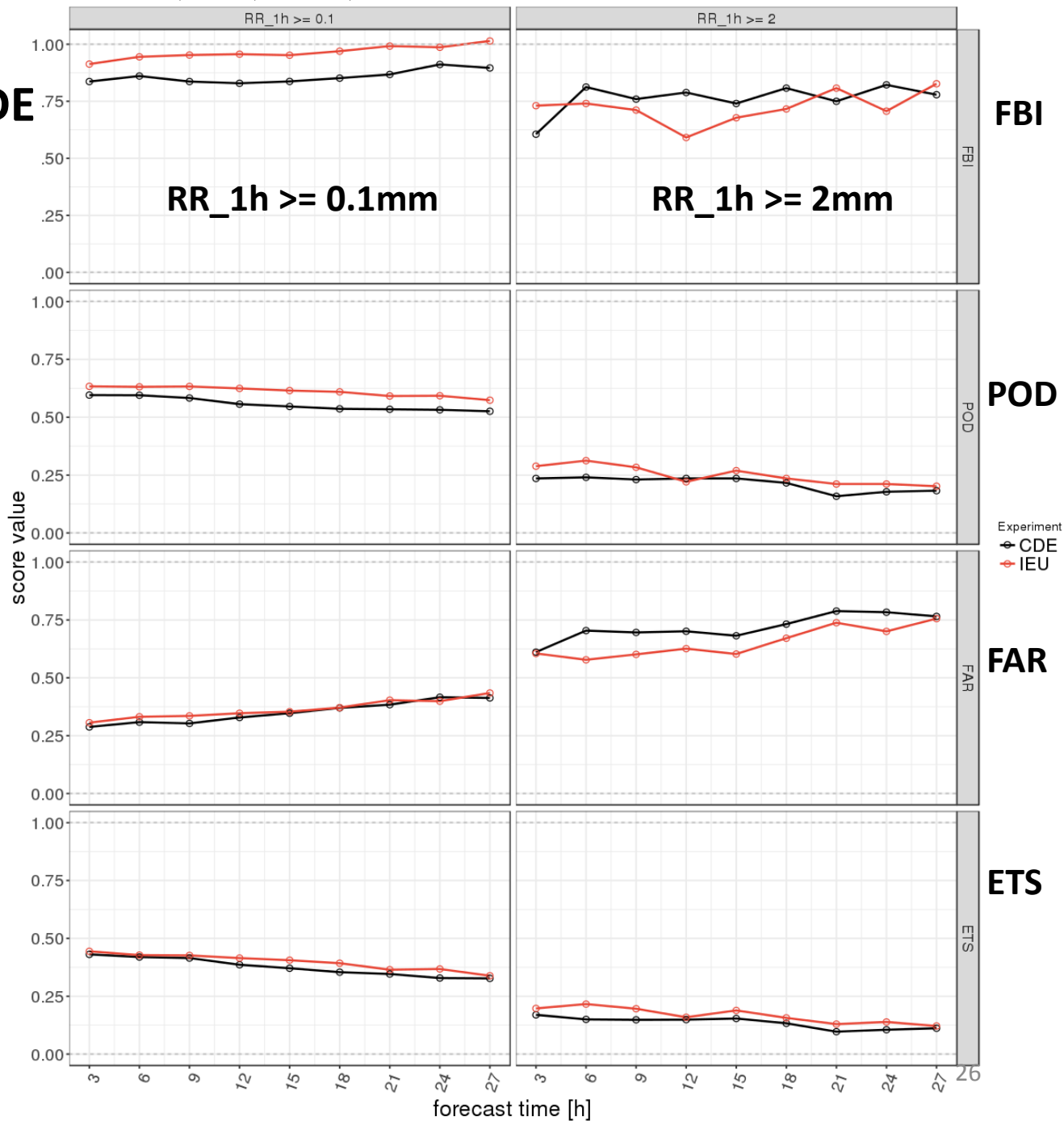


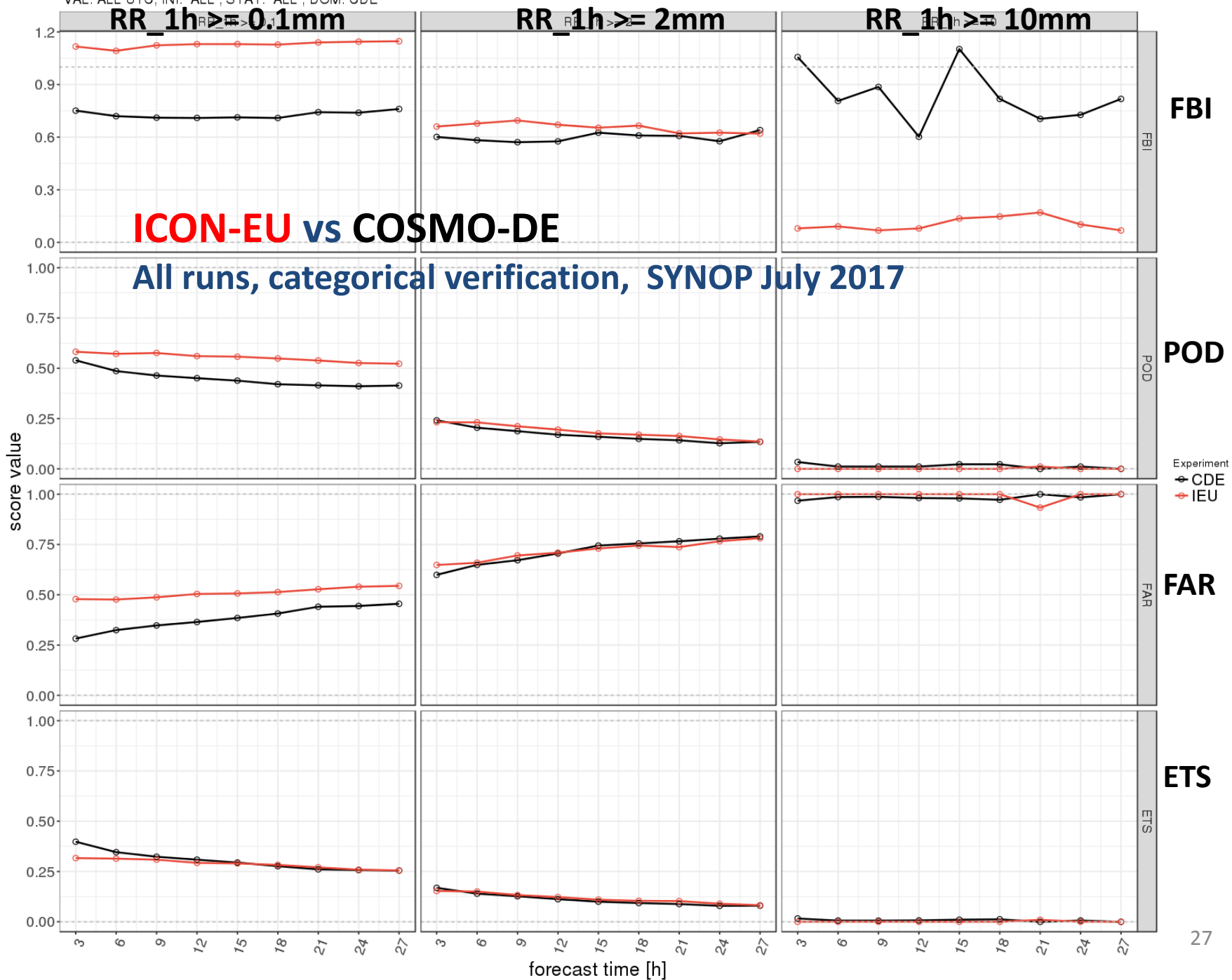
## FF10M



# ICON-EU vs COSMO-DE

all runs  
categorical verification  
SYNOP Feb 2017



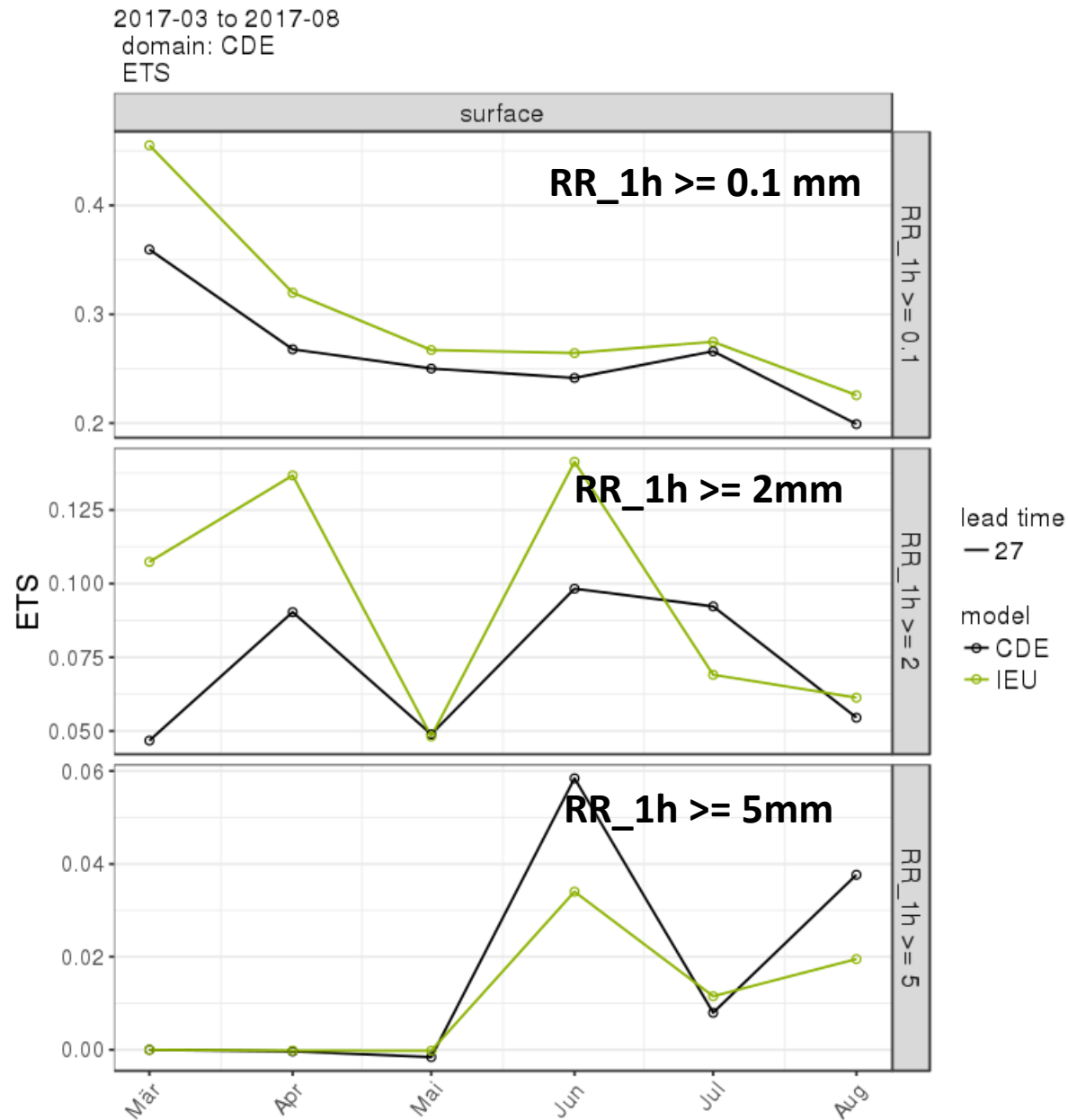


# ICON-EU vs COSMO-DE

12 UTC runs + 27h

Categorical verification RR\_1h

Time series ETS



2017.02.01-00UTC - 2017.02.28-18UTC  
 V: ALL, I: ALL, S: ALL, D: CDE

**GUST\_1h >= 15m/s**

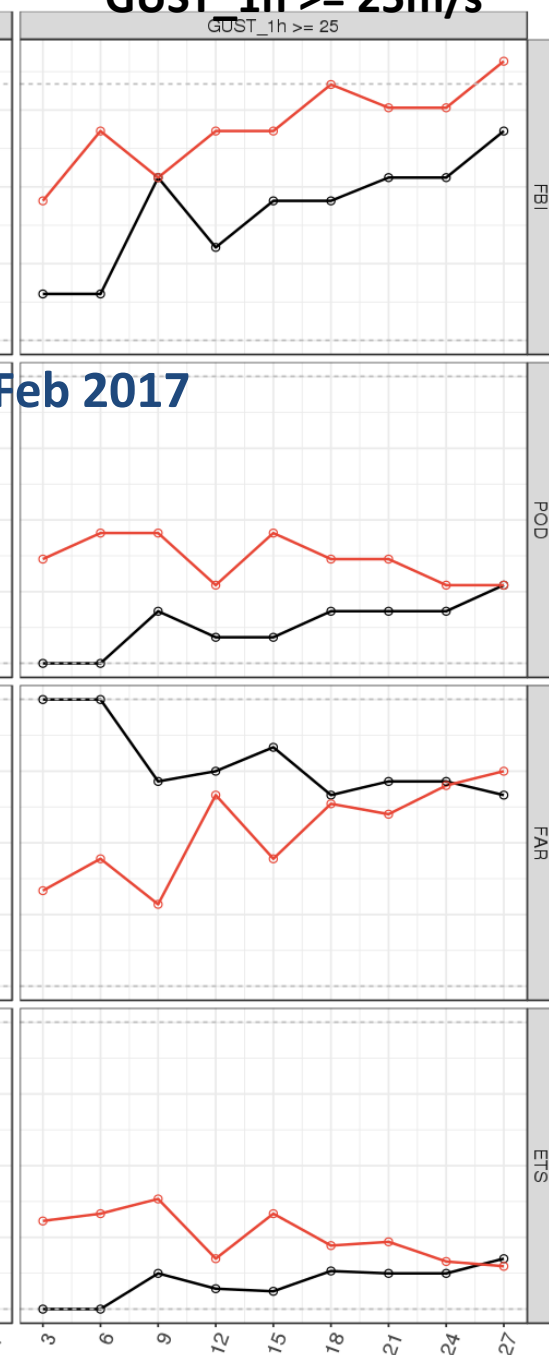
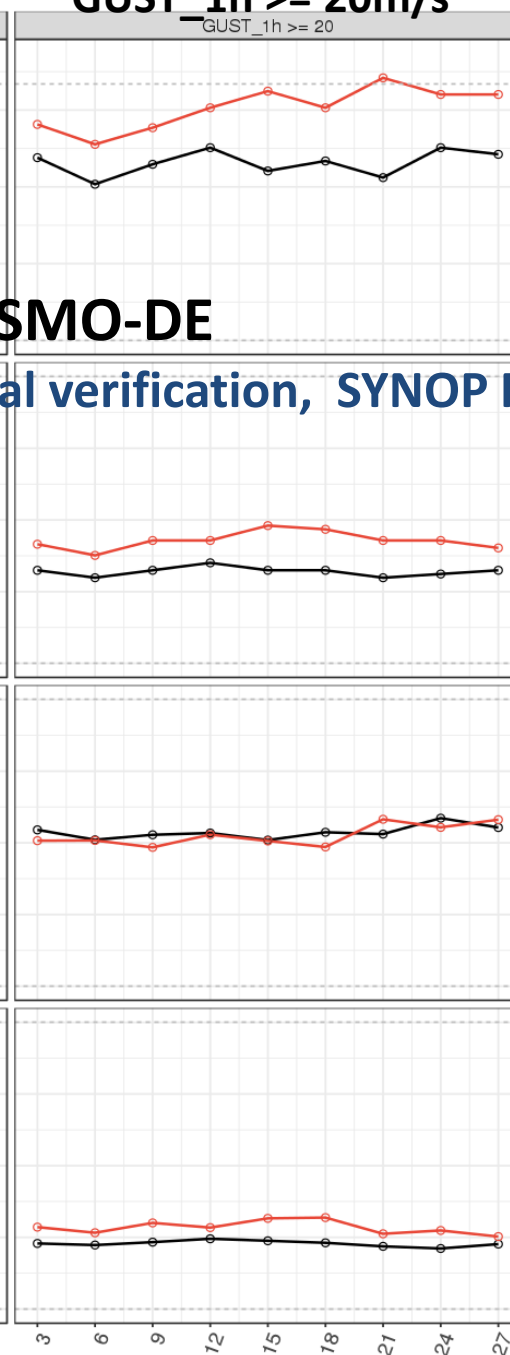
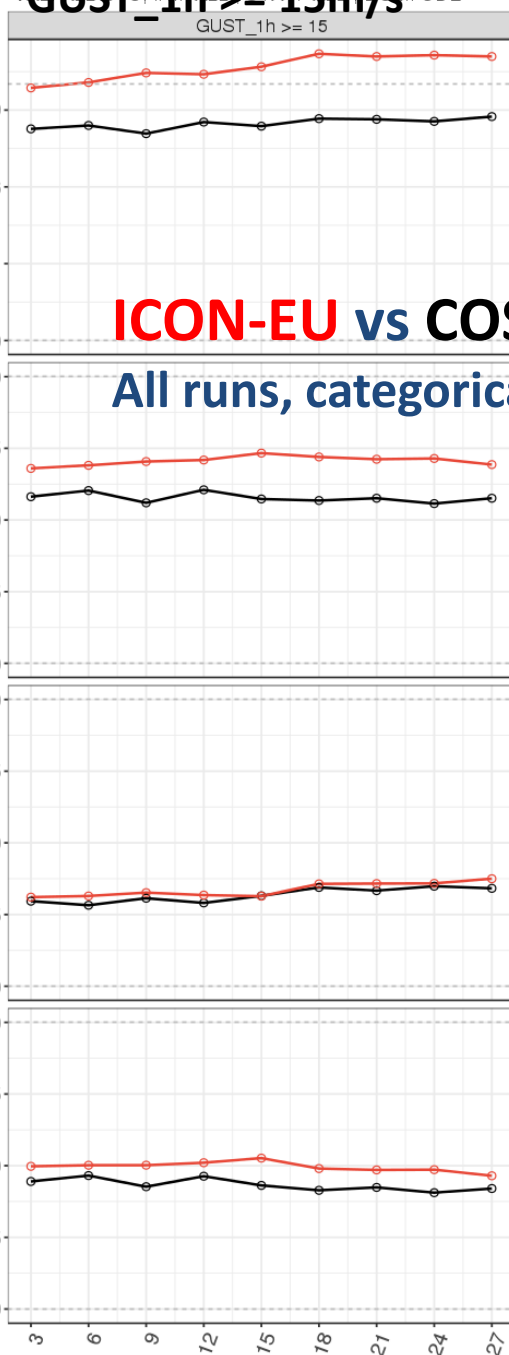
**GUST\_1h >= 20m/s**

**GUST\_1h >= 25m/s**

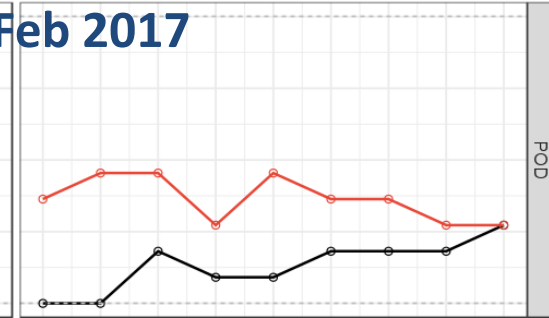
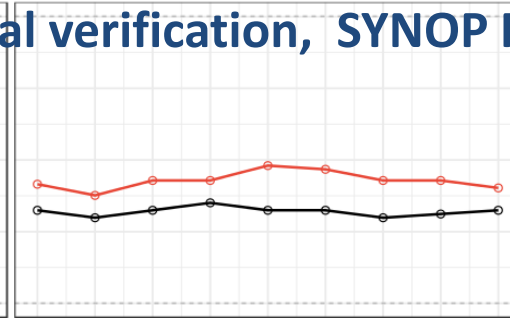
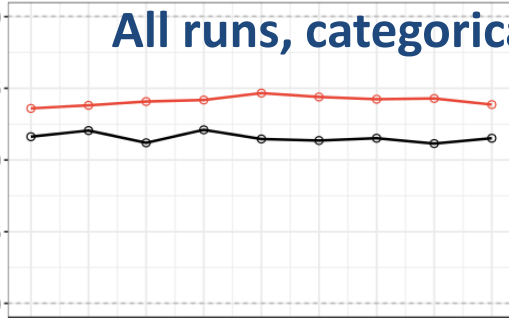
**ICON-EU vs COSMO-DE**

**All runs, categorical verification, SYNOP Feb 2017**

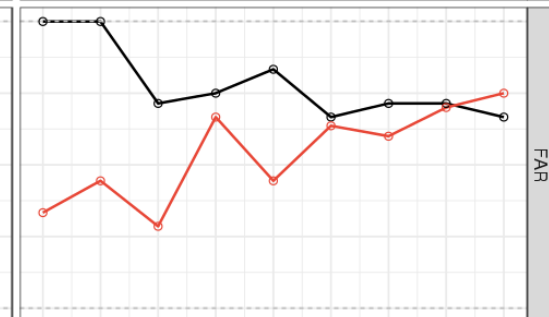
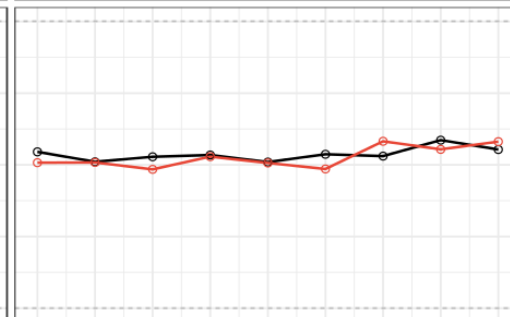
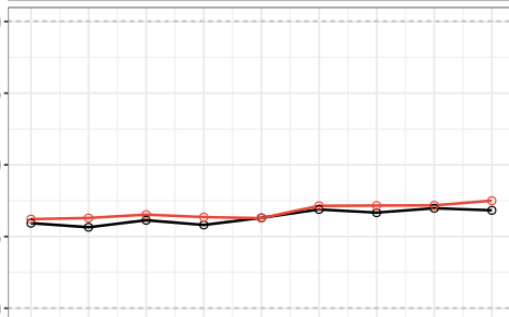
score value



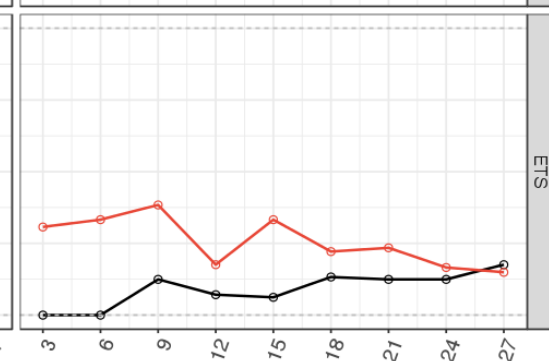
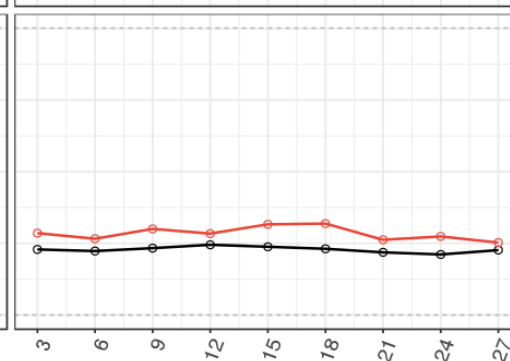
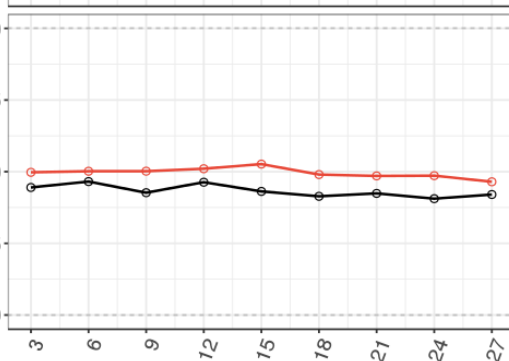
**FBI**



**POD**



**FAR**



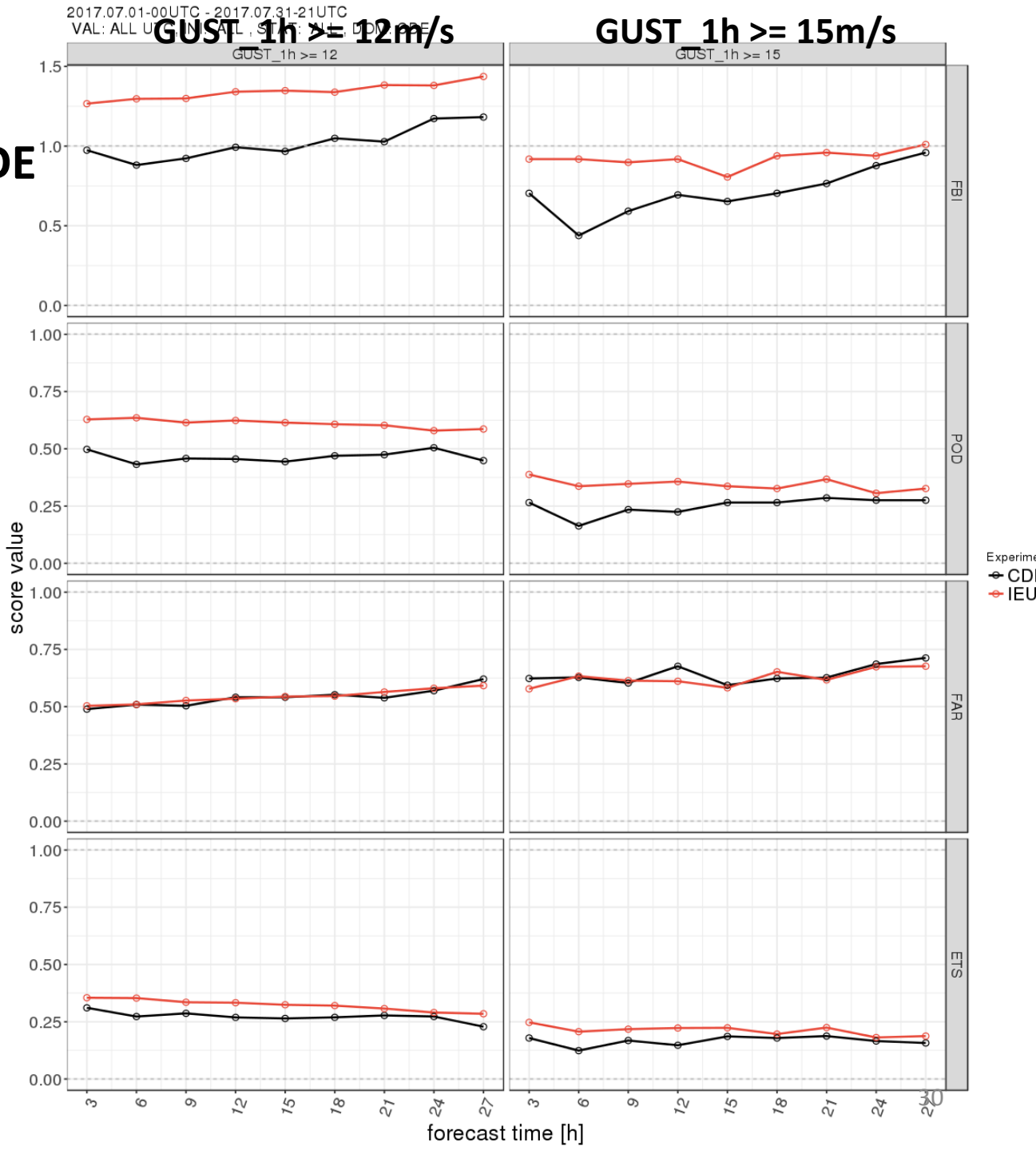
**ETS**

# ICON-EU vs COSMO-DE

All runs

categorical verification

SYNOP July 2017

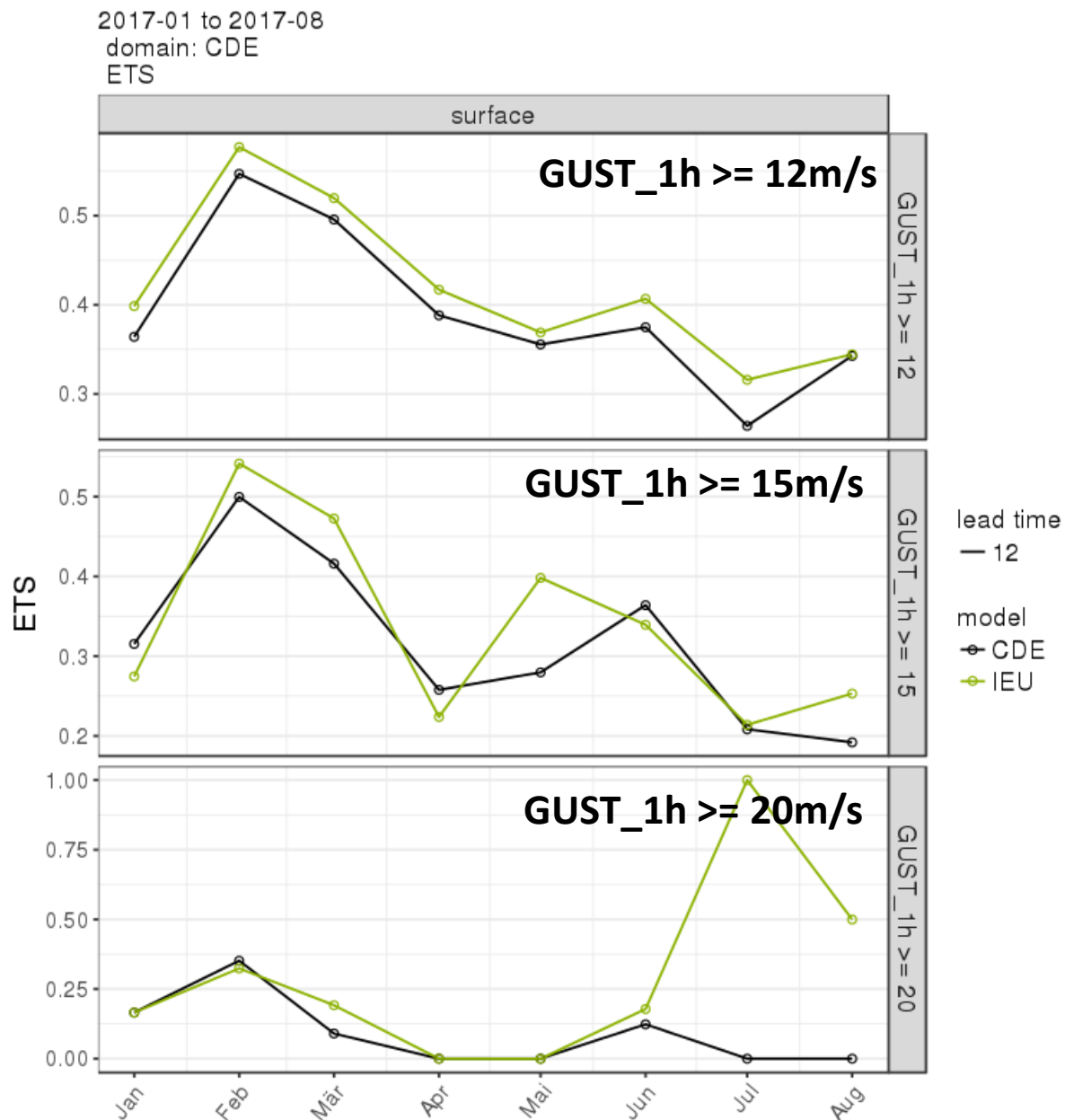


# ICON-EU vs COSMO-DE

00 UTC runs + 12h

Categorical verification GUST\_1h

Time series ETS



## ICON-EU vs COSMO-DE

### SYNOP verification results

- Continues verification
  - ICON-EU has consistently smaller errors (ME, RMSE) in T2M, RH2m, FF10M forecasts
- Categorical verification
  - Precipitation: ICON-EU shows better results at low thresholds, COSMO better at high thresholds in Summer.
  - Gusts: ICON-EU shows consistently better scores, even at high thresholds in Winter and Summer

Note: Comparison by point verification is not fair at significantly different model resolutions (7km vs. 2.8km)





## Summary

ICON / ICON-EU show good overall results compared to IFS and COSMO-DE.

Especially in the case of the ground-level variables, it is partly as good or better IFS

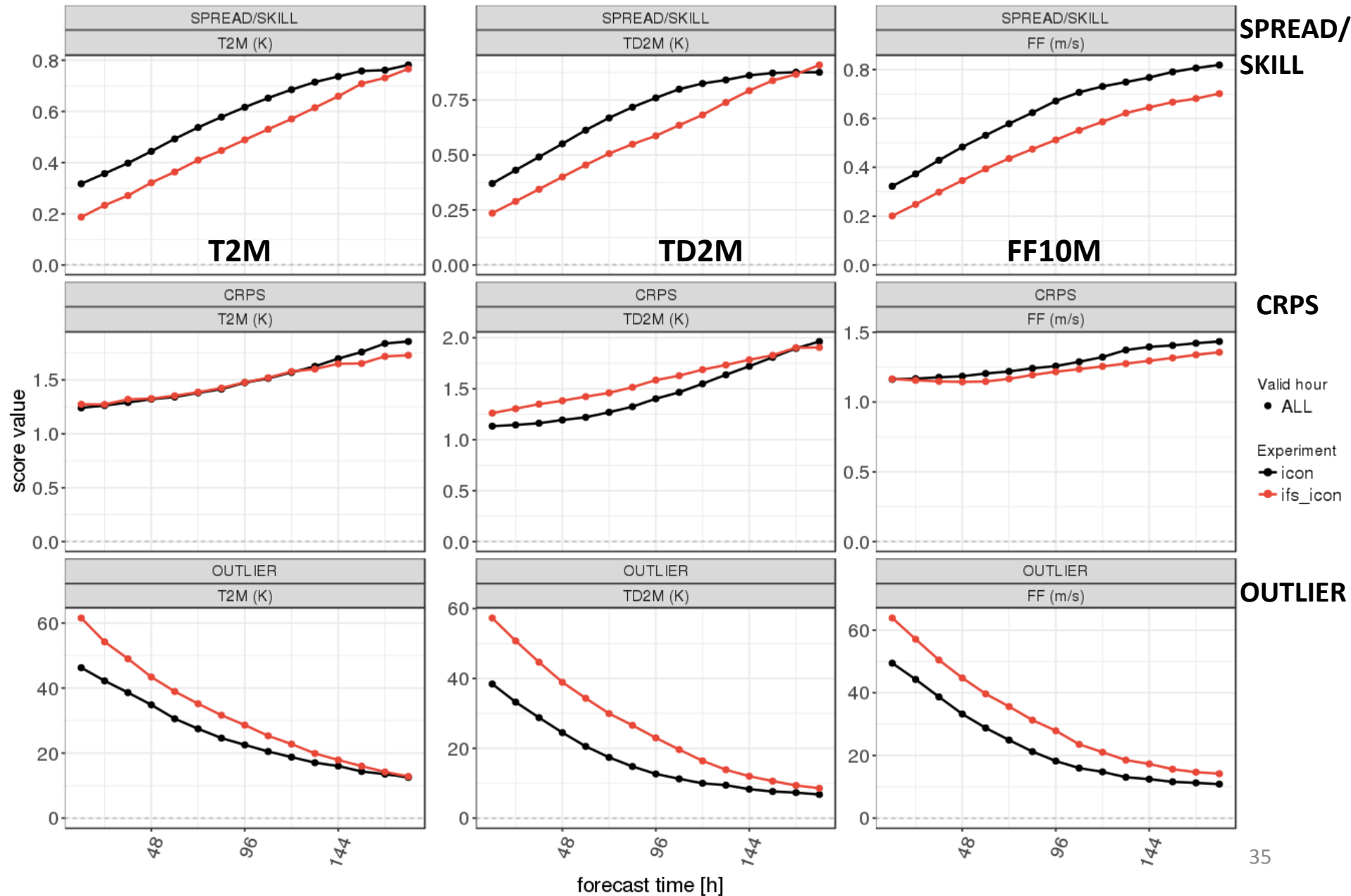
The larger errors in the upper air can be hopefully reduced by enhancement the data assimilation

- **Tests with ICON-LAM as a replacement for COSMO can be started as soon as possible in the consortium**

## **Some complementary verification results of ICON-EPS compared to EC-EPS**

# ICON-EPS vs EC-EPS All runs, continues verification, SYNOP Feb 2017

2017/02/08-00UTC - 2017/02/28-12UTC  
INI: ALL UTC, DOM: CEU, STAT: ALL



# ICON-EPS vs EC-EPS All runs, continues verification, SYNOP July 2017

2017/07/01-00UTC - 2017/07/31-00UTC

INI: ALL UTC, DOM: CEU, STAT: ALL

