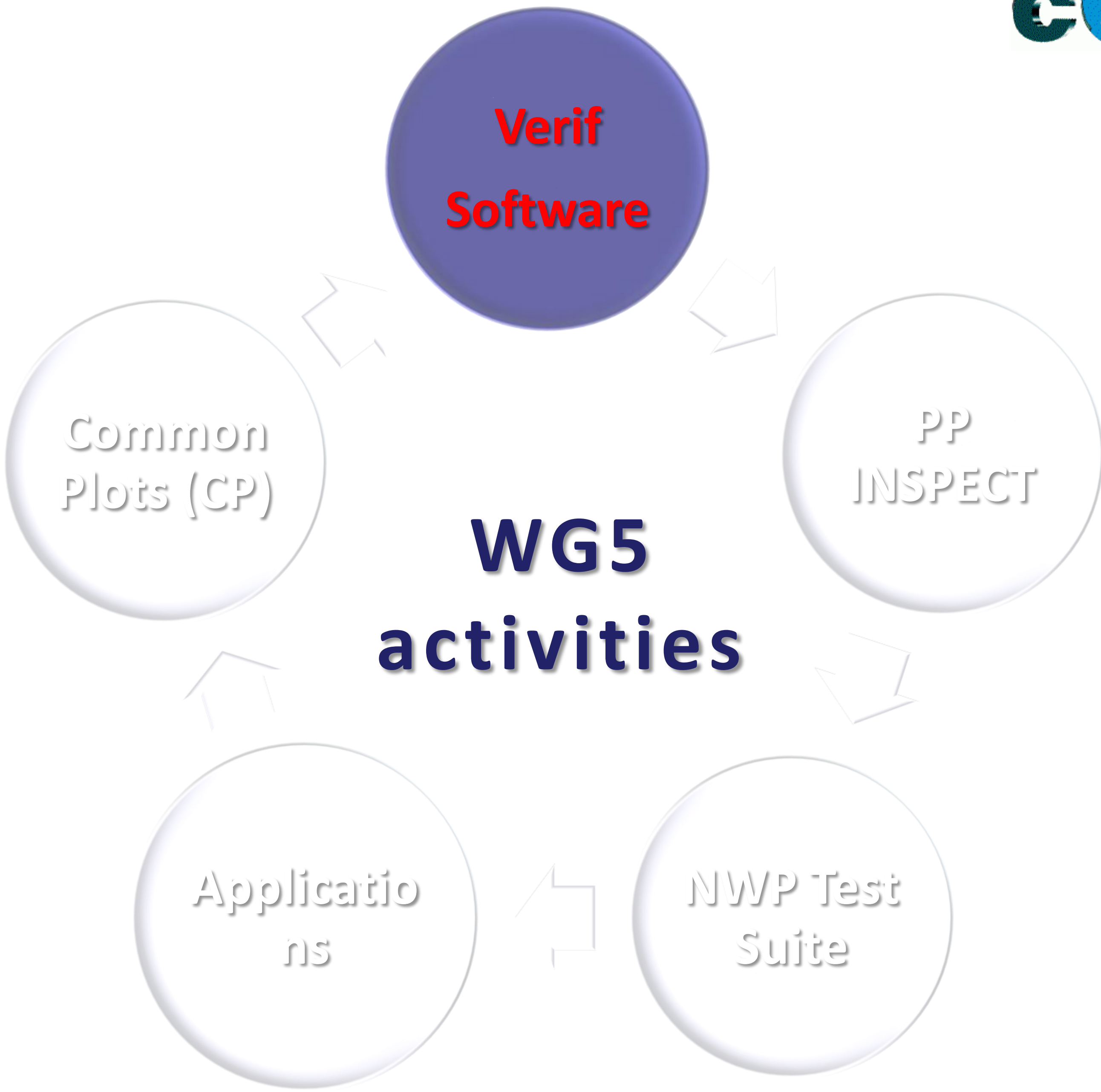
Verification and Case studies

Overview of activities

Flora Gofa


Verif
Software
Common
Plots (CP)
PP
INSPECT
WG5
activities
Applicatio
ns
NWP Test
Suite

VERSUS: Common Verification Software

- **Maintenance phase** since Sep. 2016 - renewed
- Use as **Common Verification Software** (CVS) for the production of the CP
- VERSUS installation on ecgate is used as part of the NWP test suite execution for the testing of each new COSMO version

COMET has initiated procedure to finance **further developments** in VERSUS:

a) Overall improvement of performances for EPS verification

b) Hindcast mode

c) Output data export of daily cycle / time series statistics txt files and better representation of Confidence Interval

d) Possible upgrade of libraries/OS

These activities once approved should start in the first quarter of 2018

VAST 2.0 beta improvements

(VERSUS Additional Stistical Tehniques – Neighborhod methods)

This version contains the following updates:

- Possibility to verify precipitation, total cloud cover and wind speed starting from TXT files. (Only precipitation with LIBSIM preprocessing at the moment)
- Possibility to verify boxes containing more than one timestep (3D boxes versus previous 2D boxes)
- Possibility to specify if the R version is older than 3.0 or not (from this version on some functions have changed so code was rearranged)
- Updated user manual

Available in WG5 repository on COSMO web page

CONSORTIUM FOR SMALL SCALE MODELING

Naima Vela, ARPA-PT

I. Advances in Rfdbk

II. Rfdbk for the COSMO Test Suite at ECMWF

Felix Fundel

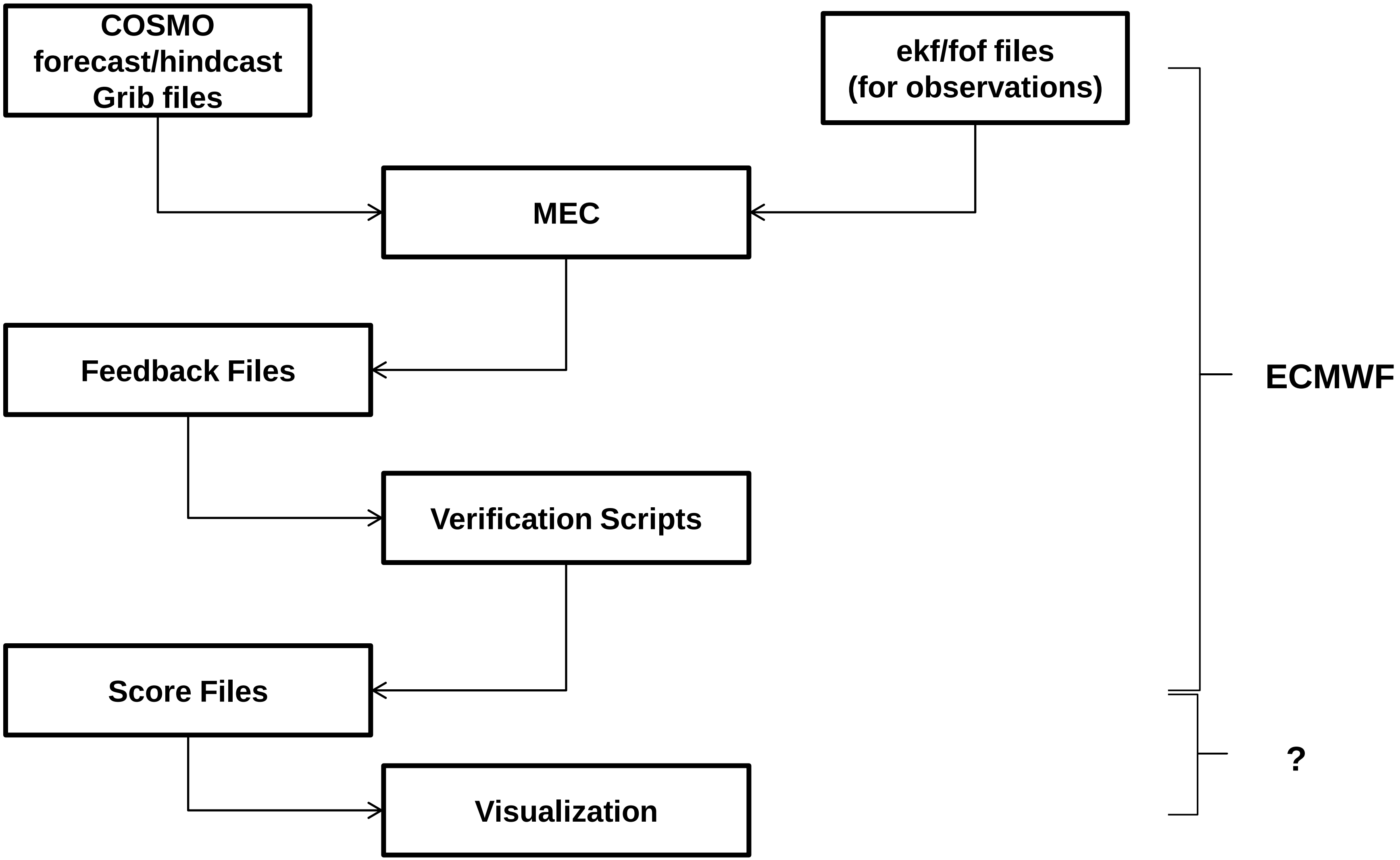
Deutscher Wetterdienst

FE 15 – Predictability & Verification

Tel.:+49 (69) 8062 2422

Email: Felix.Fundel@dwd.de

Workflow


COSMO forecast/hindcast Grib files
ekf/fof files (for observations)
MEC
Feedback Files
Verification Scripts
Score Files
Visualization
ECMWF
?

Status at DWD

Models

- 3 ICON global deterministic routines
- 3 ICON EU Nest deterministic routines
- 2 ICON global EPS
- 2 ICON EU Nest EPS
- 3 COSMO-DE deterministic routines
- 3 COSMO-DE-EPS ensemble routines
- IFS deterministic
- IFS EPS

\+ Experiments

Observation systems

- SYNOP
- TEMP (radiosondes)
- SATOB (AMV)
- GPSRO (radio occultations)
- SCATT (scatterometer)
- AIREP (aircraft)
- PILOT (wind profiler)

Methods

- Deterministic: continuous and categorical
- EPS: ensemble and probabilistic

Visualization

- Lead-time
- Time series
- Station based

Aggregation

- Sub-domains
- Height bins or levels
- Lead-time to time of day conversion („hindcast mode“)

Requirements (Common Plots)

Deutscher Wetterdienst
Wetter und Klima aus einer Hand

Scenario A (decentralized production of feedback files)

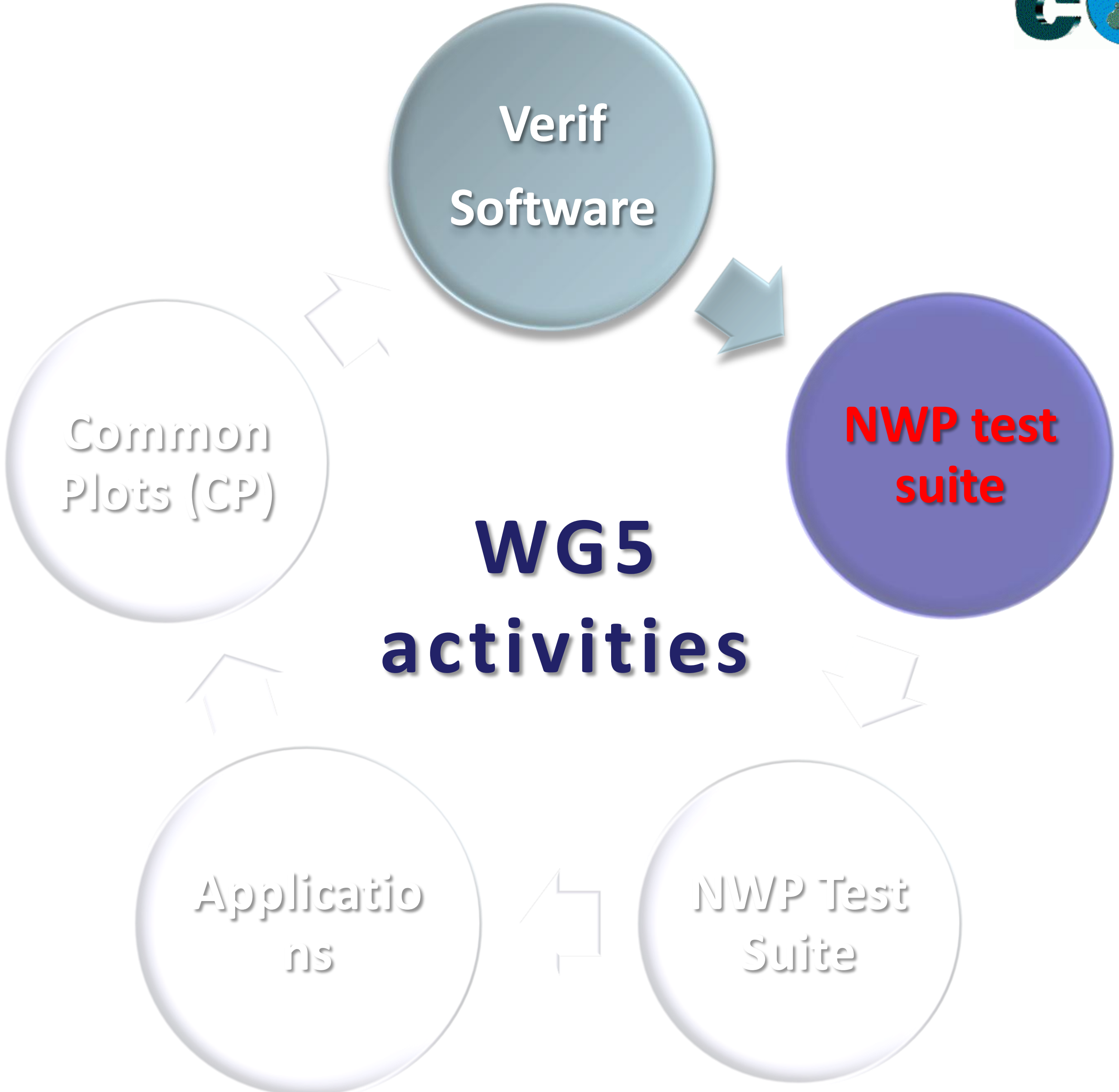
- MEC
  - Installation at each center individually
  - Requires larger support effort from DWD

- Observations need to be provided
  - Feedback files with observations (ekf, fof) for the common domain would have to be provided to the participating centers on a continuous basis
  - Maybe files from the DWD COSMO routine are suitable

- Verification suite setup
  - Verification should be performed centralized
  - Each participating center would have to send its feedback files
  - R, Rfdbk and a shiny-server installation would have to be installed at the responsible center
  - Verification scripts and visualization applications would have to be adapted

Scenario B (centralized production of feedback files)

Individual runs (>5Gb per run (deterministic, 27h)) would have to be transferred to and collected at the site in charge. Probably not feasible.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NWP test
suite
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Plots (CP)

NWP Meteorological Test Suite
Review of possible changes in the current setup

Recommendations (text from document circulated to the STC)

A. It is recommended that for the next round of the NWP Test Suite (at least for one month, January or July) numerical experiments will be performed in both the forecast and the hindcast modes. In order to prepare these experiments, additional human resources should be allocated to set up the model and the verification software, and to perform the execution of the suite in two modes (forecast and hindcast). These will cover (i) adaptation of hindcast run output for VERSUS, and (ii) verification of two model versions (operational and test versions) for both resolution for one month. An estimate for the setup of the additional experiments will be provided by A. Montani shortly. An evaluation of the relative value of the two set-ups will be performed by the SMC and a final recommendation will be given to the STC.

B. Based on the outcome of **A**, a Priority Task should be proposed aimed at building a **new platform for the hindcast-based NWP Test Suite, followed by the generation of Feedback Files with MEC and the evaluation of the performance using Rfdbk software.** The details and implications of the new PT (meteorological approach, selection of test cases, computer resources, human resources, support of DWD experts as to the installation of MEC and the adaptation of Rfdbk, etc.) will be discussed during the COSMO GM in Jerusalem at the parallel session dedicated to the NWP Test Suite changes. It is expected that the duration of a PT will be approximately 6 months; the target start date of a PT is January 2018. Then, the resulting new test-suite platform can become available in the second half of 2018.

Benefits (if DWD verification is adopted for NWP Test suite)

- Runs fast
- Hindcast mode implemented
- Score cards and difference plots available
- Raw scores are exportable
- Managable code (all R), relatively easy to implement new features, e.g. scores or visualization
- In case of open shiny server, all results are accessible to entire COSMO community

Requirements (COSMO Test Suite)

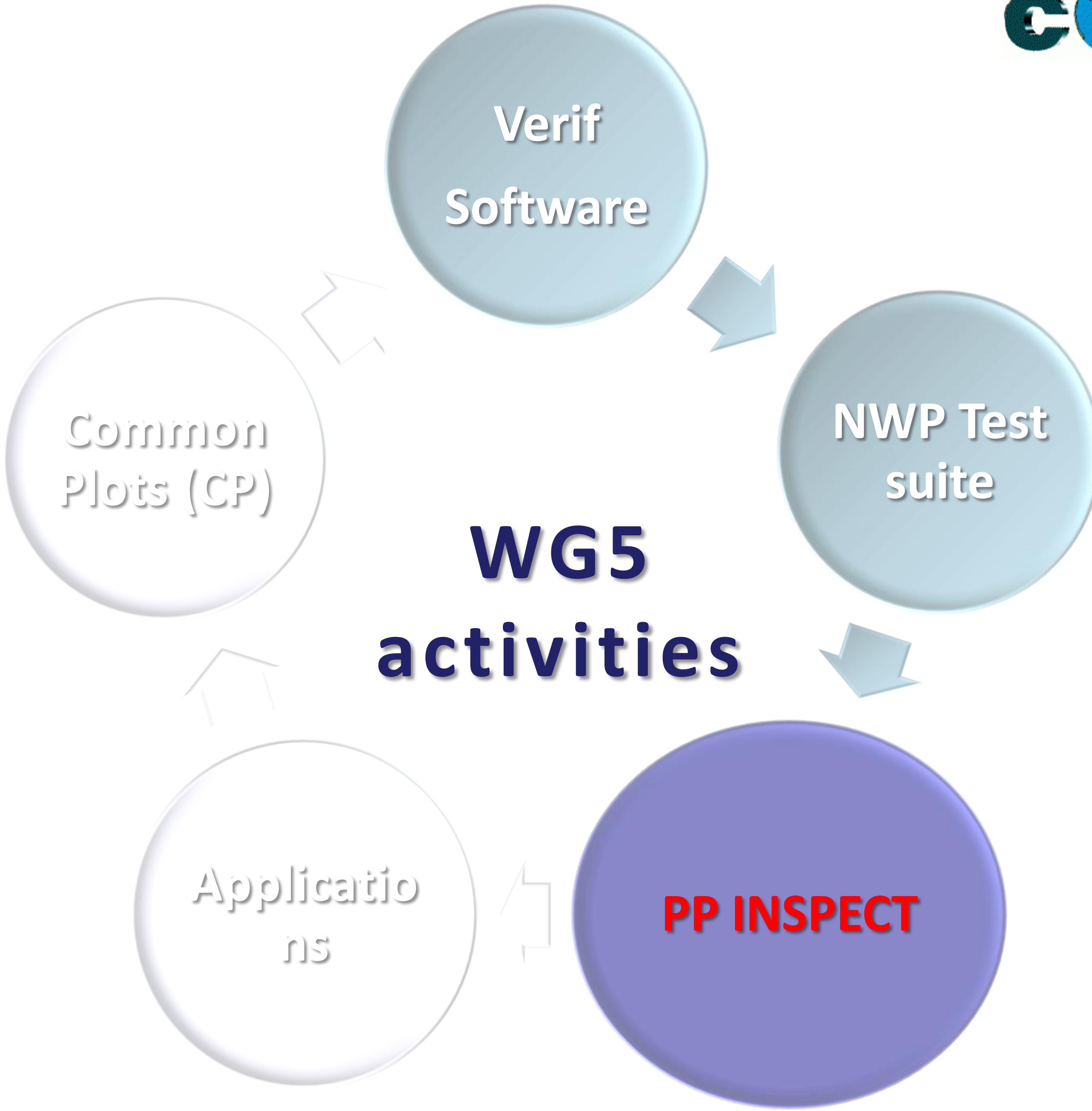
- MEC (EPS and det. version) needs to be installed at ECMWF
  - Already running with IFS forecasts
  - Some modifications to run with the COSMO model (0.1 FTE)

- Observations need to be provided
  - Feedback files with observations (ekf, fof) could be provided for the COSMO test suite periods (0.1 FTE)

- Rfdbk needs to be installed
  - R with most of the required packages is available as module on ecgate
  - Rfdbk installation was successful with user dwo

- Verification scripts using Rfdbk have to be provided and maintained
  - First (DWD verification) scripts are on ecgate, no complications expected (0.1 FTE)
  - For R code development Rstudio is available on ecgate

- Visualization of score files produced at ECMWF
  - Open shiny-server installation would be required to mimic DWD visualization (0.1 FTE)
  - Maybe COMSO server would be an option?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Software
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suite
PP INSPECT
Applicatio
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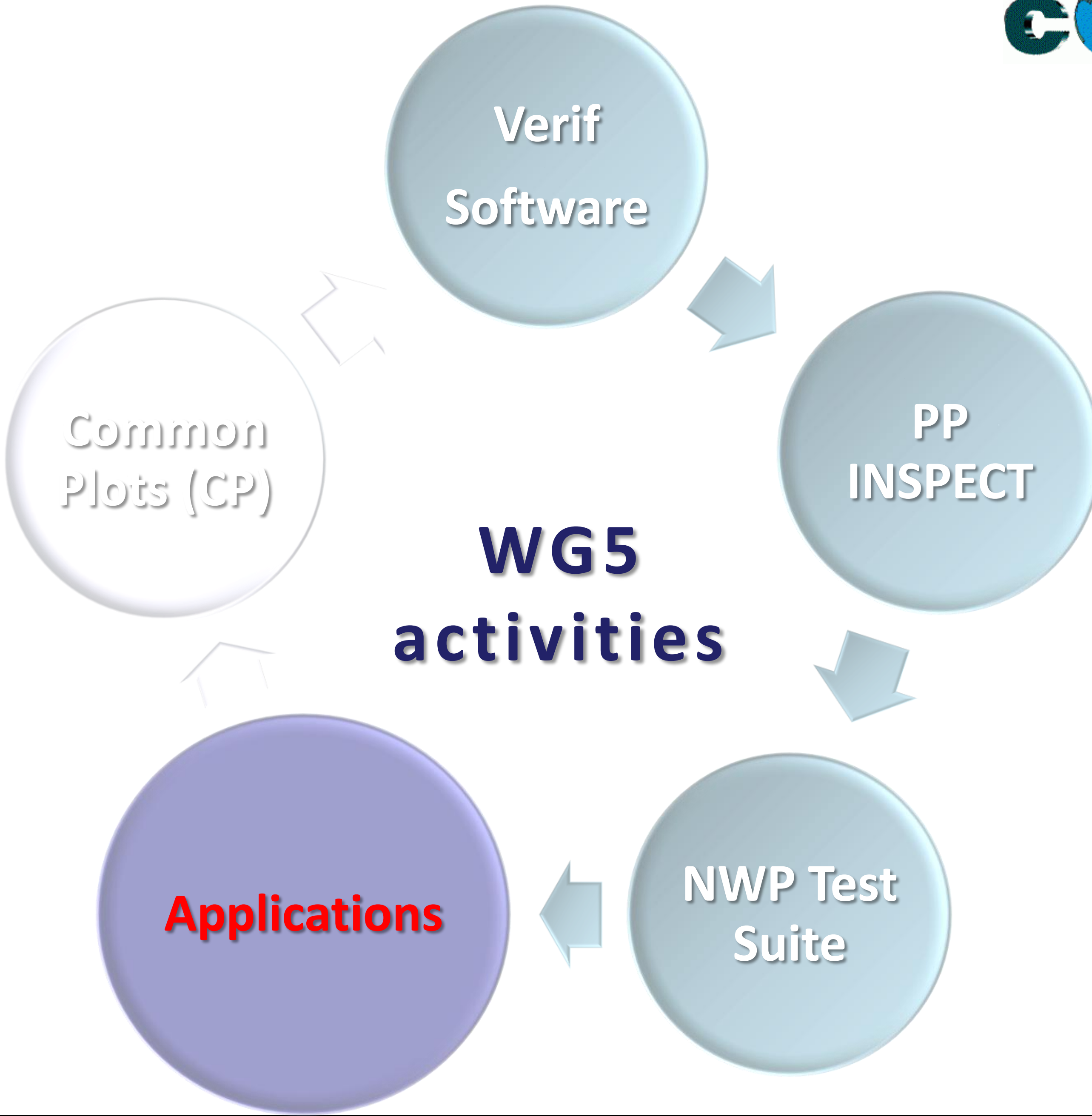
Common
Plots (CP)
WG5
activities

PP- INSPECT: INtercomparison of SPatial vErification methods for COSMO Terrain

PL: A. Bundel, F.Gofa

- PP INSPECT is extended until the end of 2017
- Extension was necessary due to delays in Task 4 on the application of spatial verification methods to ensembles and Task 5 on the Guidelines for using spatial methods
- Close cooperation with international community through MesoVICT (2nd meeting was held in Bologna)

Presentation to follow by A.Boundel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NWP Test Suite
Applications
Common Plots (CP)
WG5 activities

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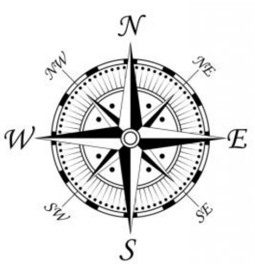
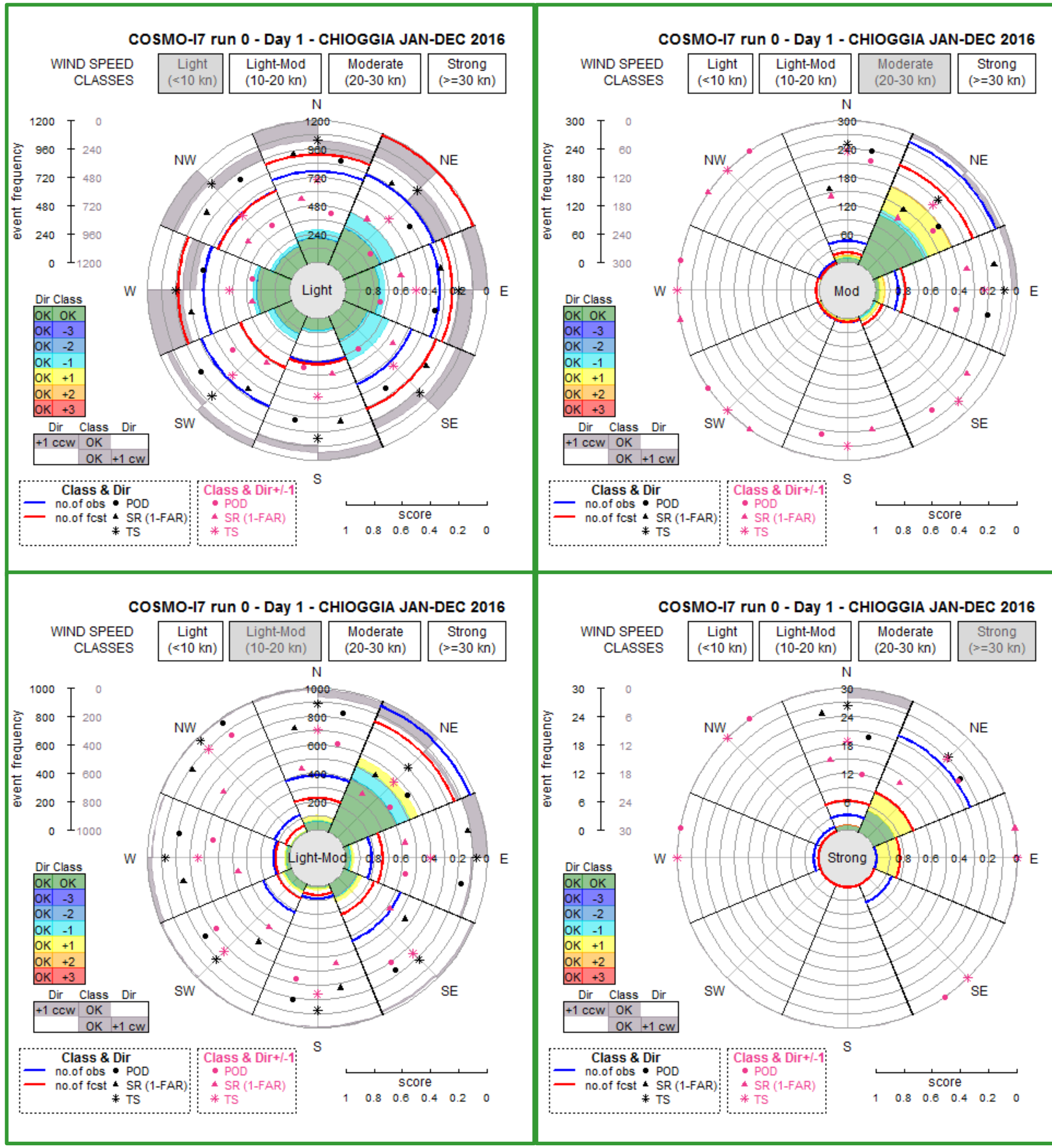
CONSORTIUM FOR SMALL SCALE



The “Performance – Rose”

A novel diagram in which scores and type of errors of wind forecast are summarized according to directions



For each station, 10m-wind observations (hourly or 3/6-hourly or other time aggregations) and corresponding data predicted by model are categorized in octants for wind direction and in classes for wind speed.

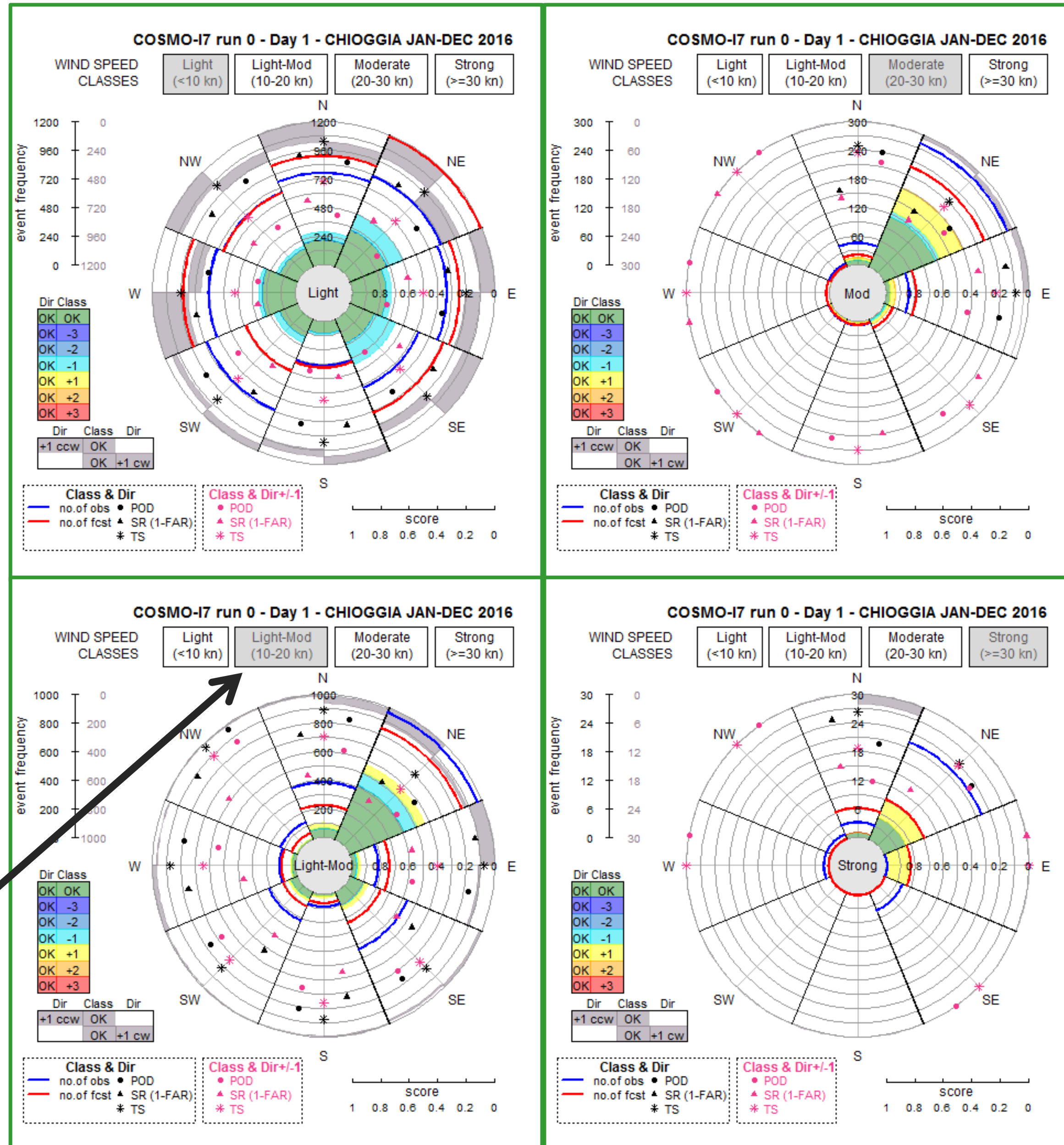
Light: ws<10 knots

Light-Moderate: 10≤ ws < 20 Knots

Moderate: 20≤ ws < 30 Knots

Strong: ≥30 Knots

For each class a separate plot is done

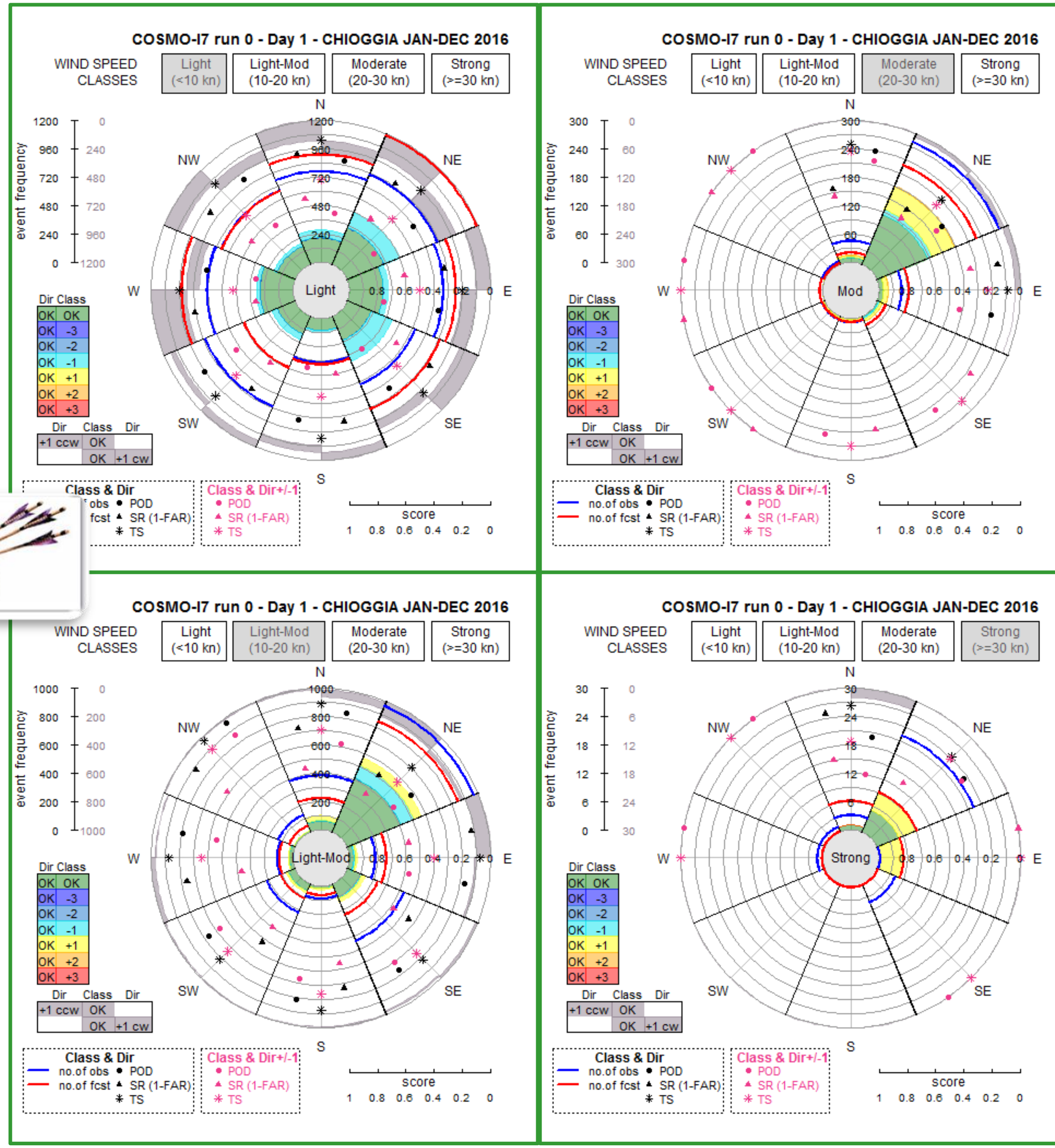


Verification scores are plotted as symbols:

- The colors represent the two types of event
  - **Black:** Correct speed class and direction
  - **Purle:** Correct speed but with a tolerance in direction (1 octants)
- Perfect score 1 is in the innermost ring

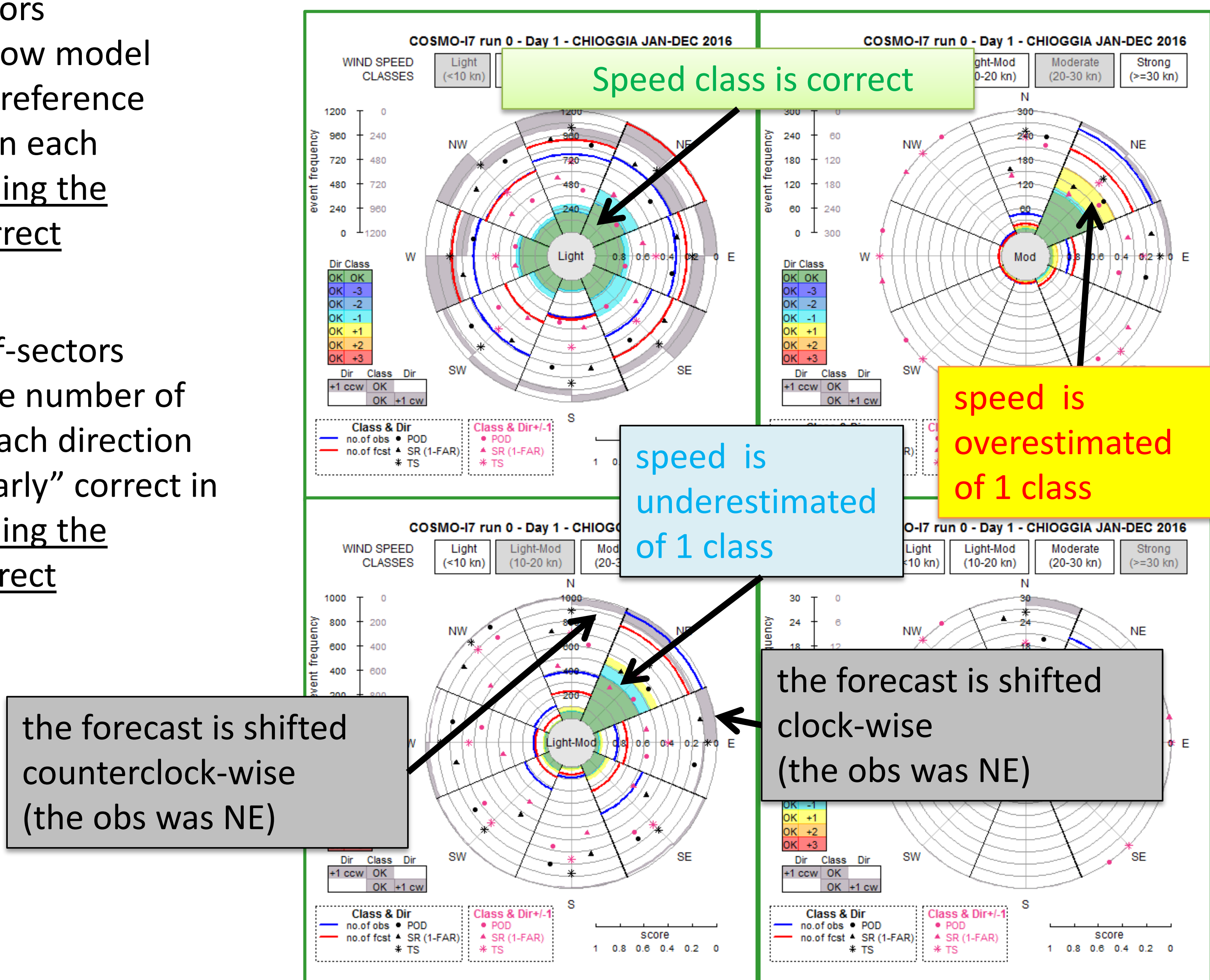
- Red line represents the number of forecast in the specific class
- Blue line represent the number of observations in the specific class

Scores improve in the case of tolerance in direction, especially for light wind



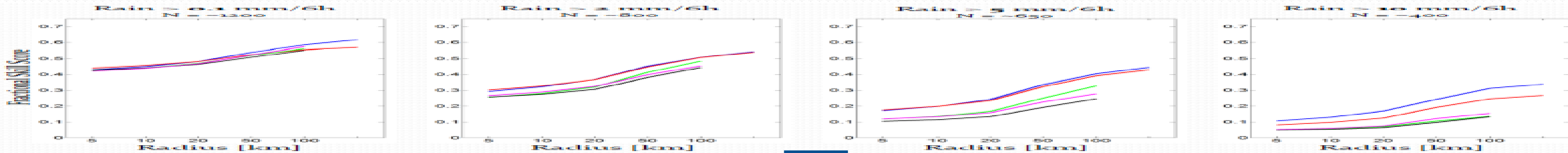
Colored sectors represents how model predicts the reference speed class in each direction, being the direction correct

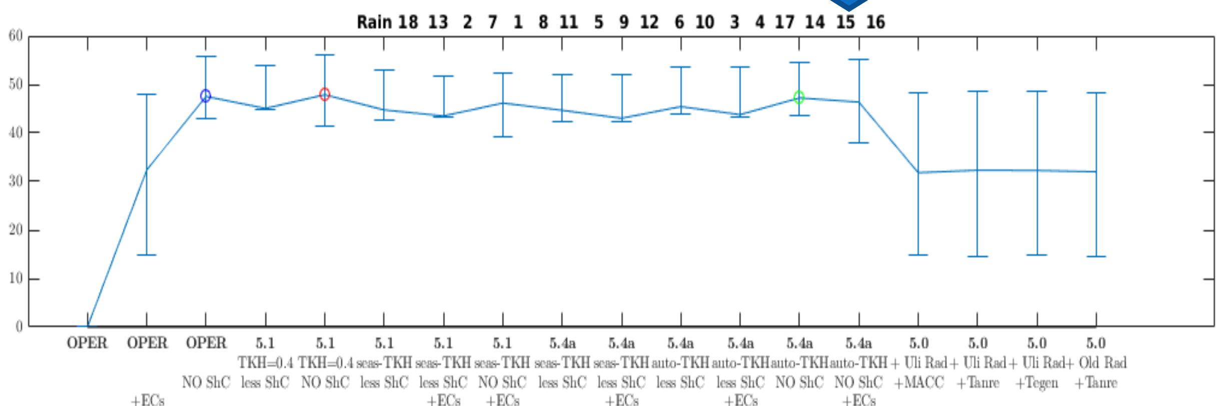
The gray half-sectors represent the number of forecast in each direction that are "nearly" correct in direction, being the intensity correct

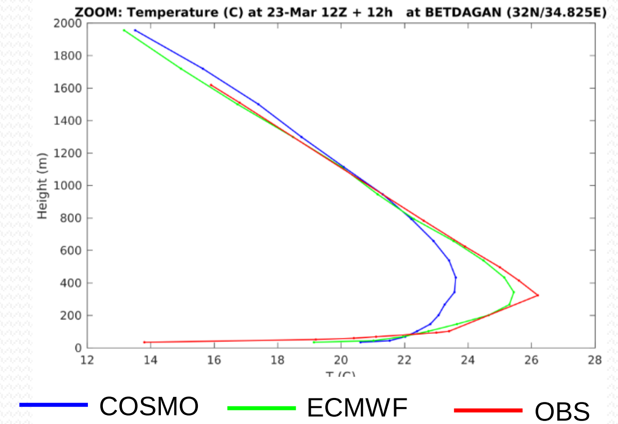


Research Verification

precipitation







	Rainy	Dry winter	Summer
COSMO version	5.1	5.4	5.1
lconv	FALSE	TRUE	TRUE
thick_sc	-	100mb	250mb
entr_sc	-	0.001	0.0003
pat_len	500	AUTO	500
tkhmin	0.4	AUTO	0.4

Research Verification

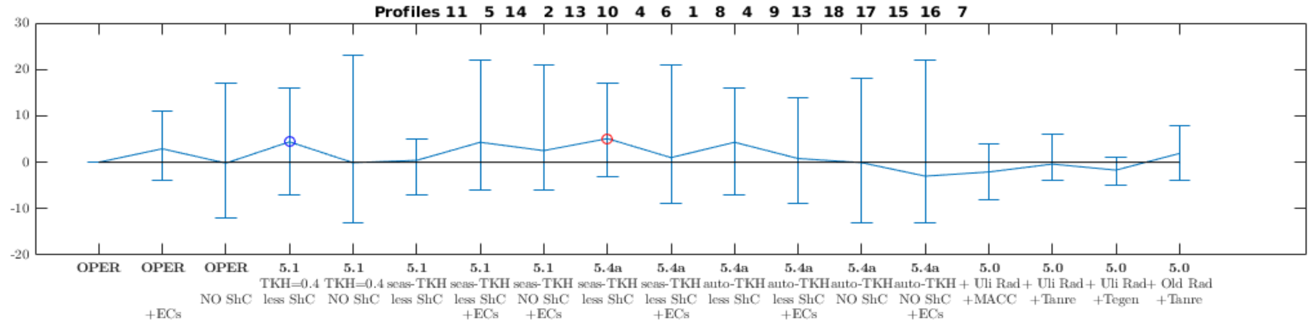
CONSORTIUM FOR SMALL SCALE MODELING

IMS

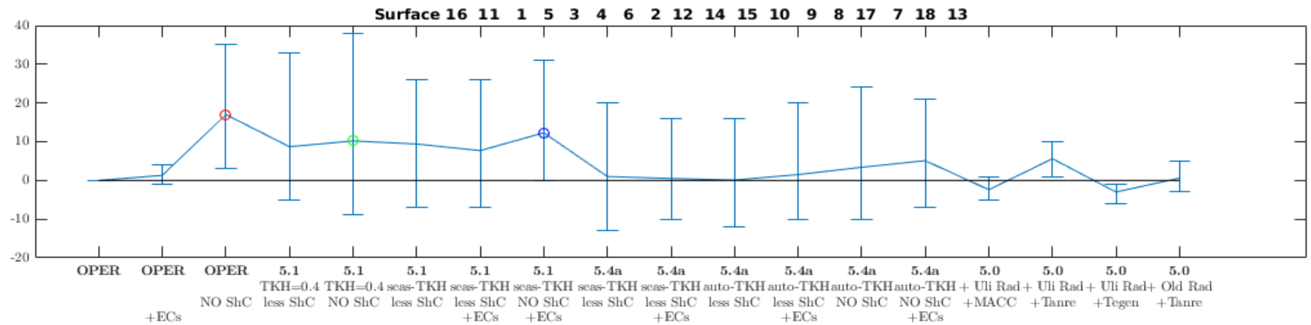
COSMO

Tuning

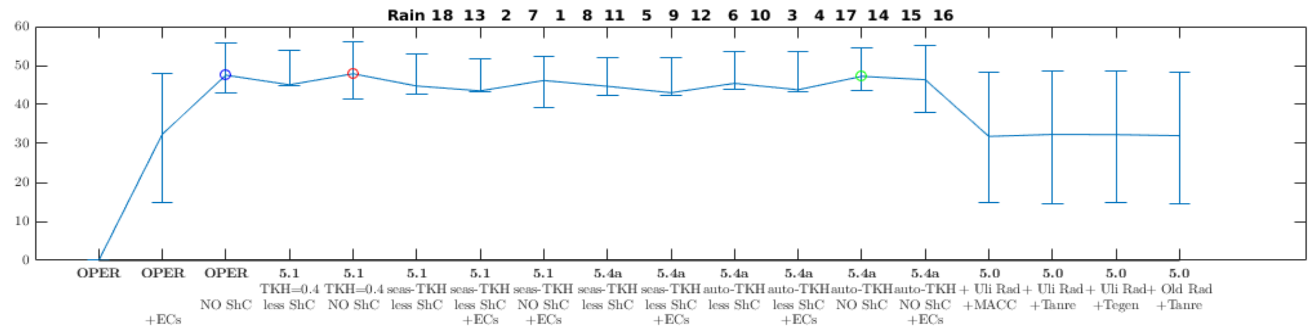
Upper Air



Ground



Precipitation



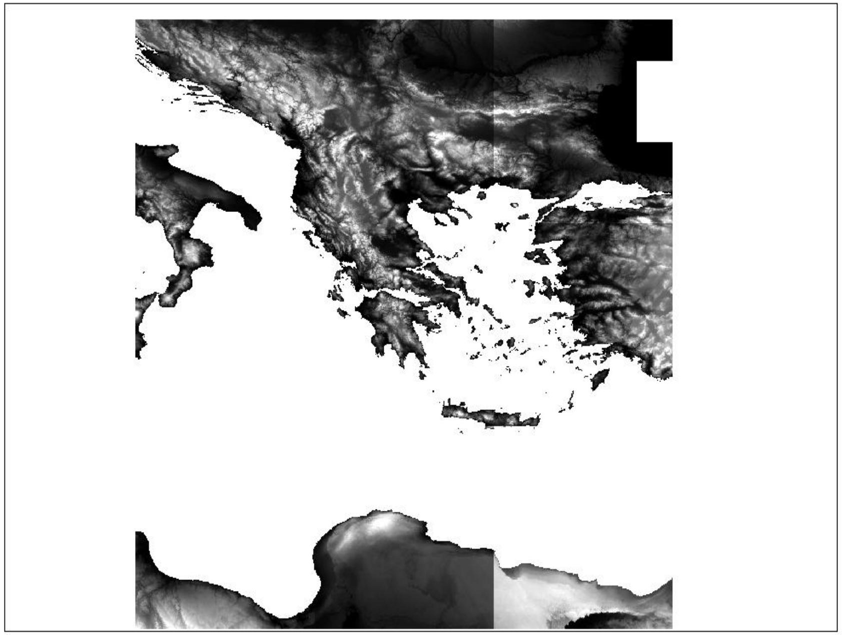
Observation precipitation analysis driven by climatological data

The precipitation data series of monthly values of 160 stations for 35 years are correlated with geophysical parameters (elevation height, slope, orientation, % sea-land, distance from coast line, etc.) that correspond to the latititude-longitude position of each station

The analysis procedure is performed in two stages:

- A: Calculation of geophysical parameters from the digital surface model DEM originating from NASA (SRTM) 90 x 90m (http://srtm.csi.cgiar.org)
- B: Application of a multiple linear regression analysis to correlate the mean monthly values to the geophysical parameters.

Shuttle Radar Topography Mission



F. Gofa, et a;)

ΕΘΝΙΚΗ ΜΕΤΕΩΡΟΛΟΓΙΚΗ ΥΠΗΡΕΣΙΑ
HELLENIC NATIONAL METEOROLOGICAL SERVICE

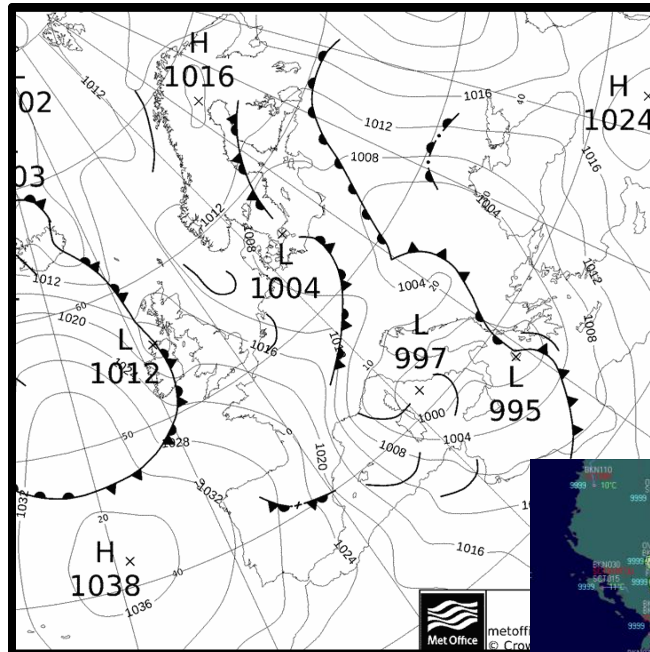
Test case: 07 February 2013

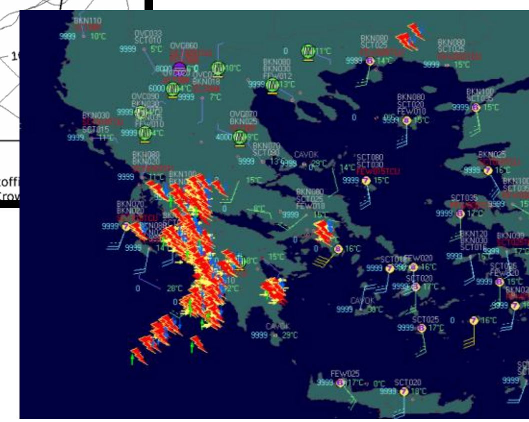
ΕΘΝΙΚΗ ΜΕΤΕΩΡΟΛΟΓΙΚΗ ΥΠΗΡΕΣΙΑ
HELLENIC NATIONAL METEOROLOGICAL SERVICE

- On February 7 2013, intense convective activity and several tornadoes developed mainly along western Greece.

- Observations from 220 surface stations were available as 24h accumulations

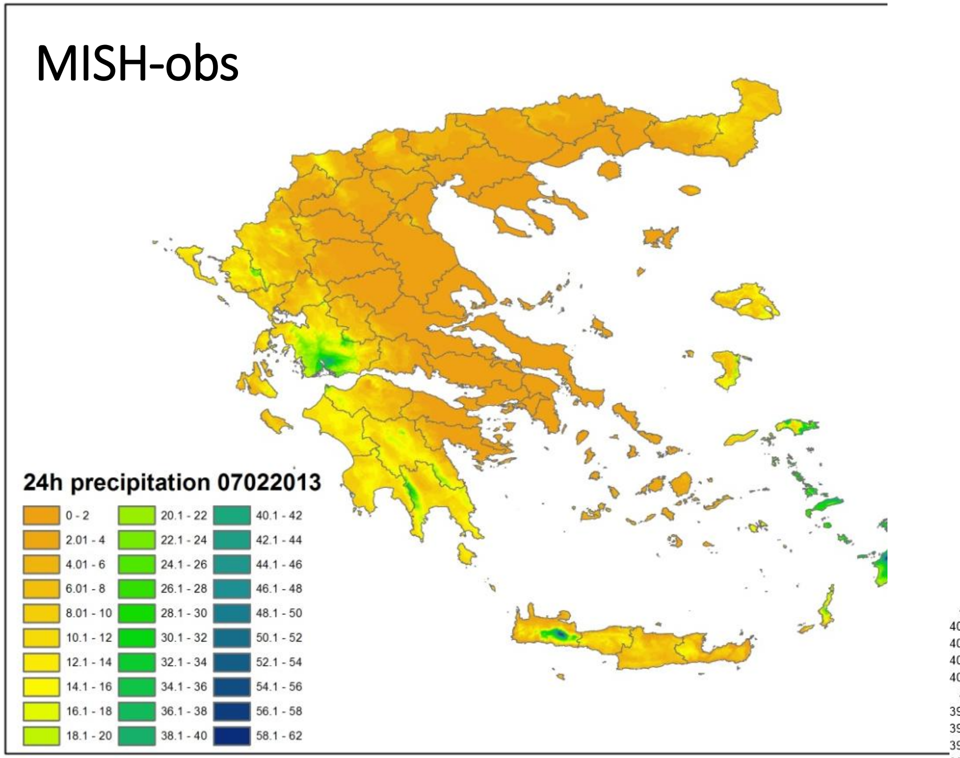
- The point observations was attempted to be interpolated spatially using MISH method on a ~1km grid.

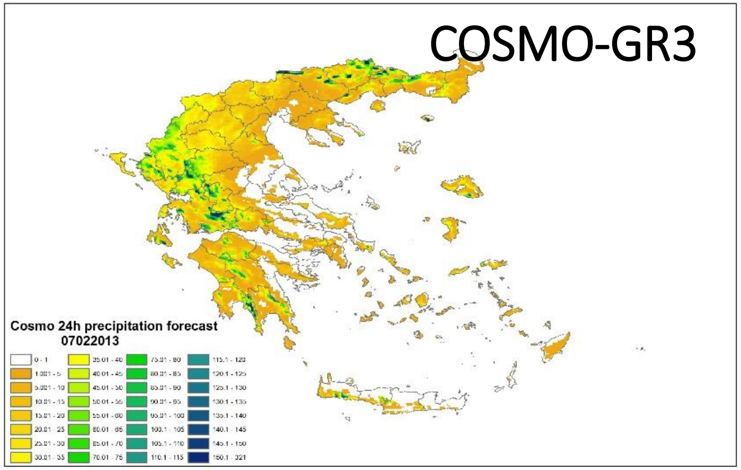


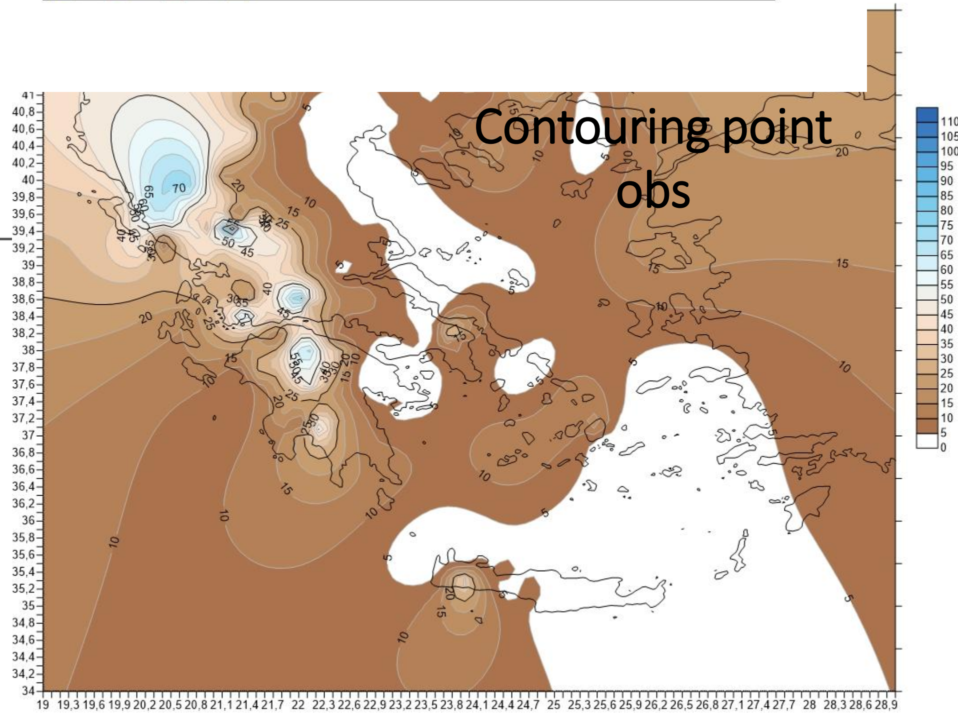


- The interpolation is based on the correlations with the geophysical parameters that resulted from the spatial analysis of the climatological data for February (first stage of MISH simulation)

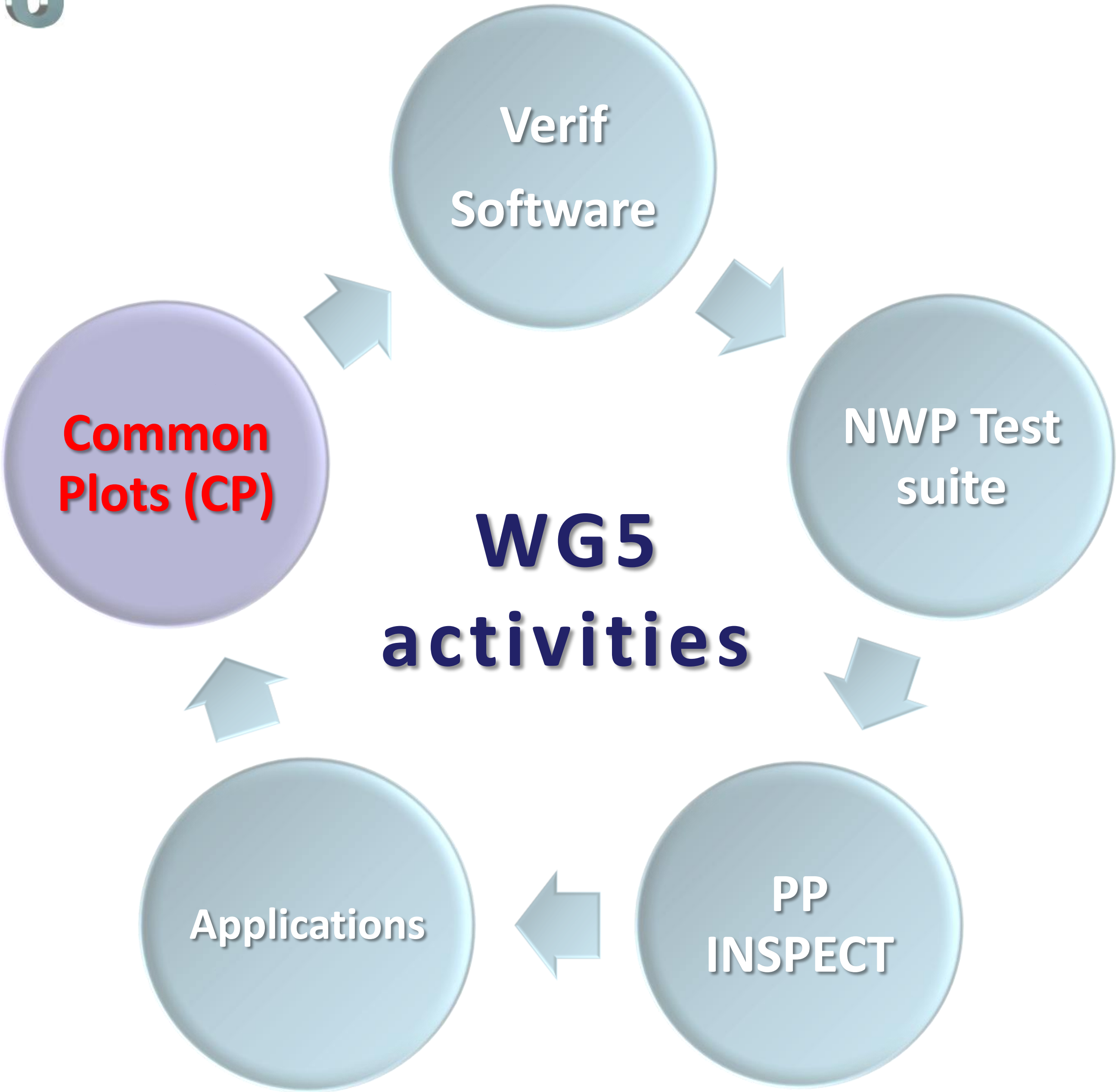
07.02.2013 Observation spatial analysis from MISH







07.02.2013


Verif
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activities

Common Plot Reports

Presentation of Verification Overview (A. Kirsanov)

Contributions: 2016-2017 (SPRT)

4	Common Plot Activity		
4.1	0.2	Reporting	
Assigned	FTEs	Name	Detail
Ru	0.2	Kirsanov	Report Production
4.2	0.45	Score Production	
Assigned	FTEs	Name	Detail
Ge	0.05	Pflueger	Score Production
Sw	0.05	Lapillonne	Score Production
It	0.05	Vocino	Score Production
It	0.05	Tesini	Score Production
Gr	0.05	Gofa	Score Production-COSMOGR
Gr	0.05	Boucouvala	Score Production-ECMWF
Po	0.05	Linkowska	Score Production
Ro	0.05	Dumitrache	Score Production-ICON
Ru	0.05	Kirsanov	Score Production
5	Documentation		

4.1 Reporting

0.2FTEs , A. Kirsanov

Graphics preparation, report writing, web page feeding

4.2 Score Production

0.05 FTEs per participating service/model

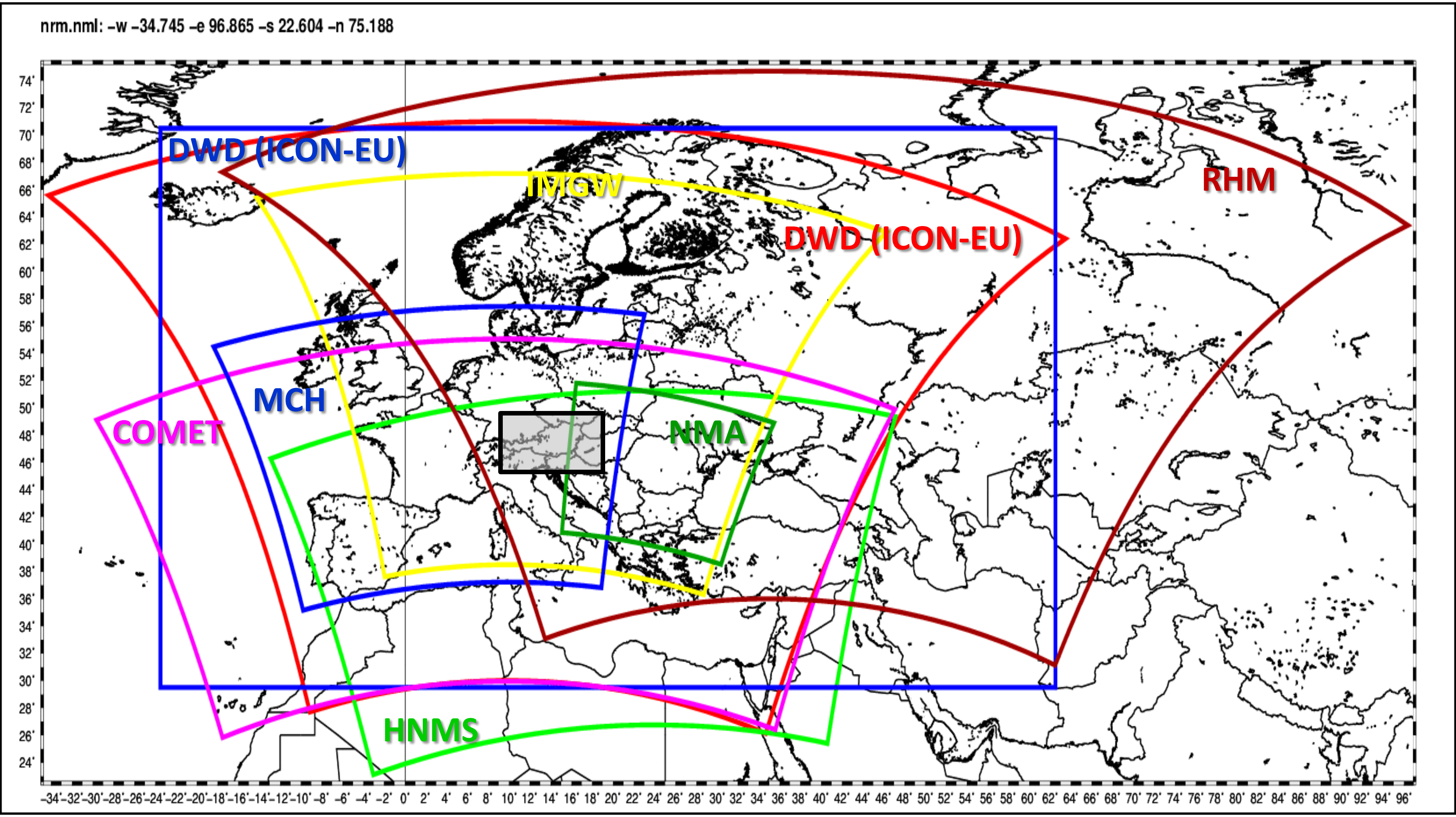
+0.05 FTEs for ICON, IFS global

Common Plot Reports 2017-2018

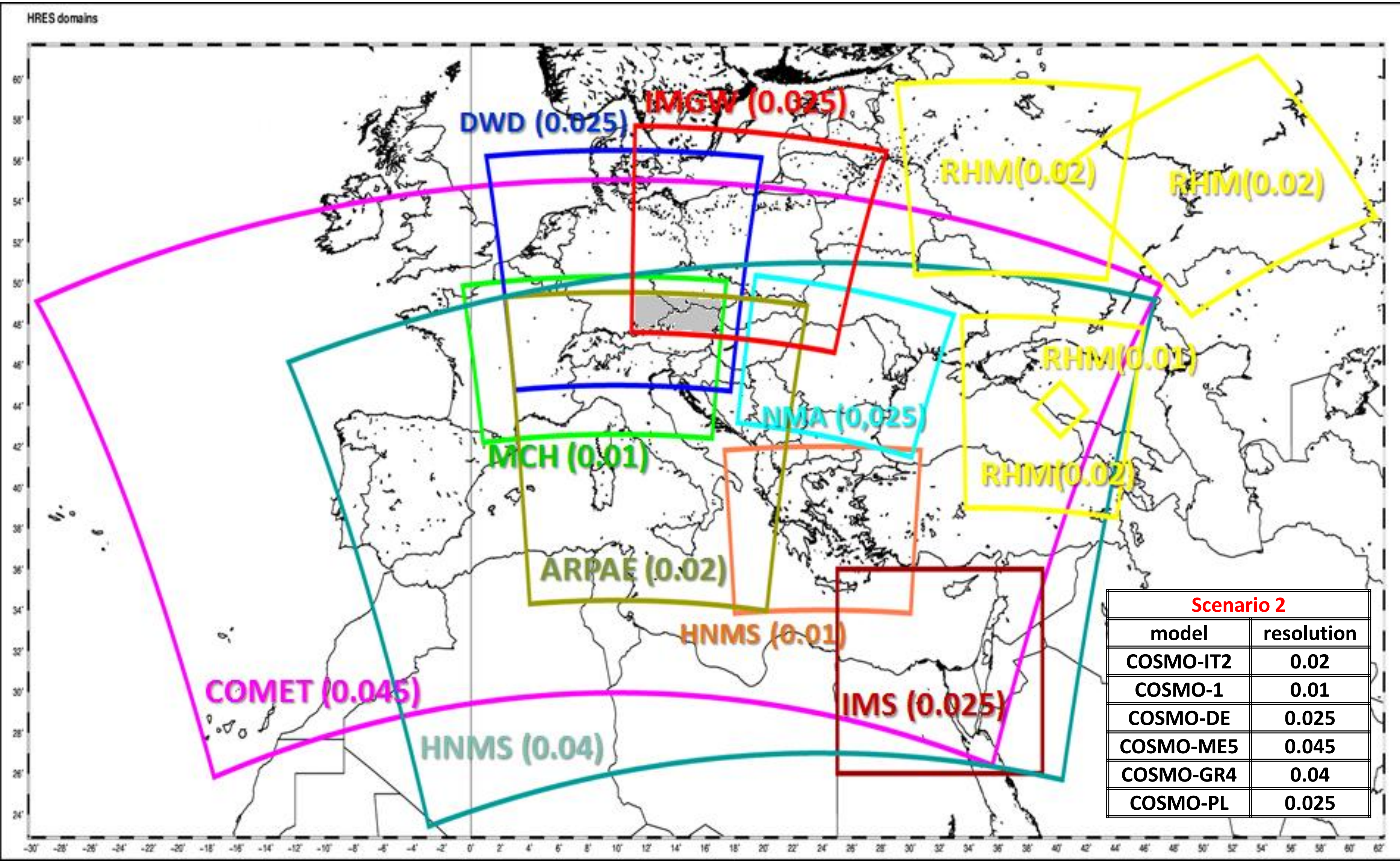
Presentation of Verification Overview (D. Boucouvala, HNMS)

- Keep the coarser resolution comparison (~5-7km) for one year (trend since 2011)
- Add high res model comparison on two “semi-common” areas: different climatology
- Keep 12UTC run despite for coarser resolution comparisons
- Extremal dependence scores – SEDI for 6h and 24h precipitation
- Add LCC on top of TCC, also categorical scores with thresholds
- Add wind gust categorical scores
- Add wind performance rose diagrams(Tesini) for selected graphs

operational coarse res models

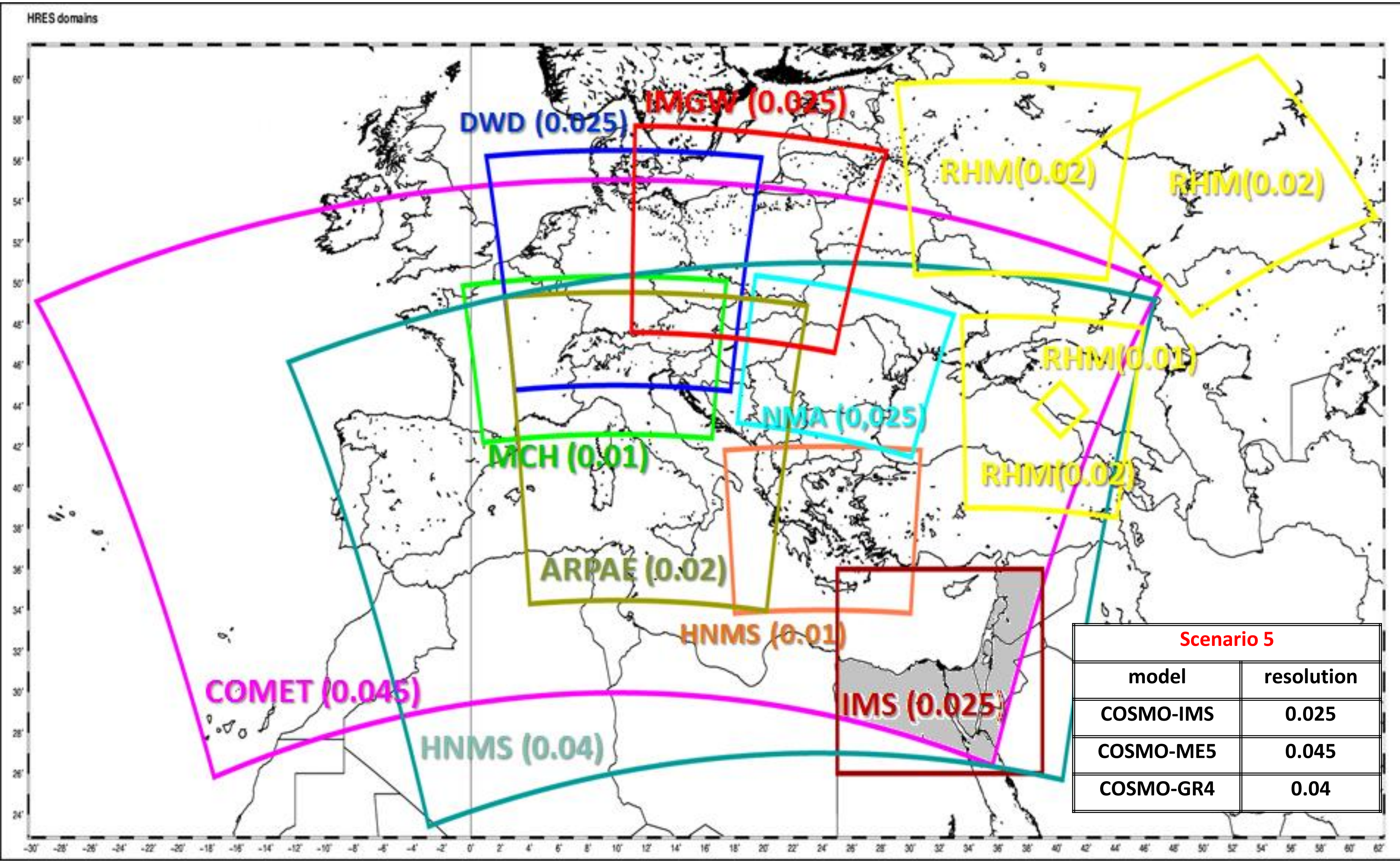


CP HRES scenario 2



Scenario 2	
model	resolution
COSMO-IT2	0.02
COSMO-1	0.01
COSMO-DE	0.025
COSMO-ME5	0.045
COSMO-GR4	0.04
COSMO-PL	0.025

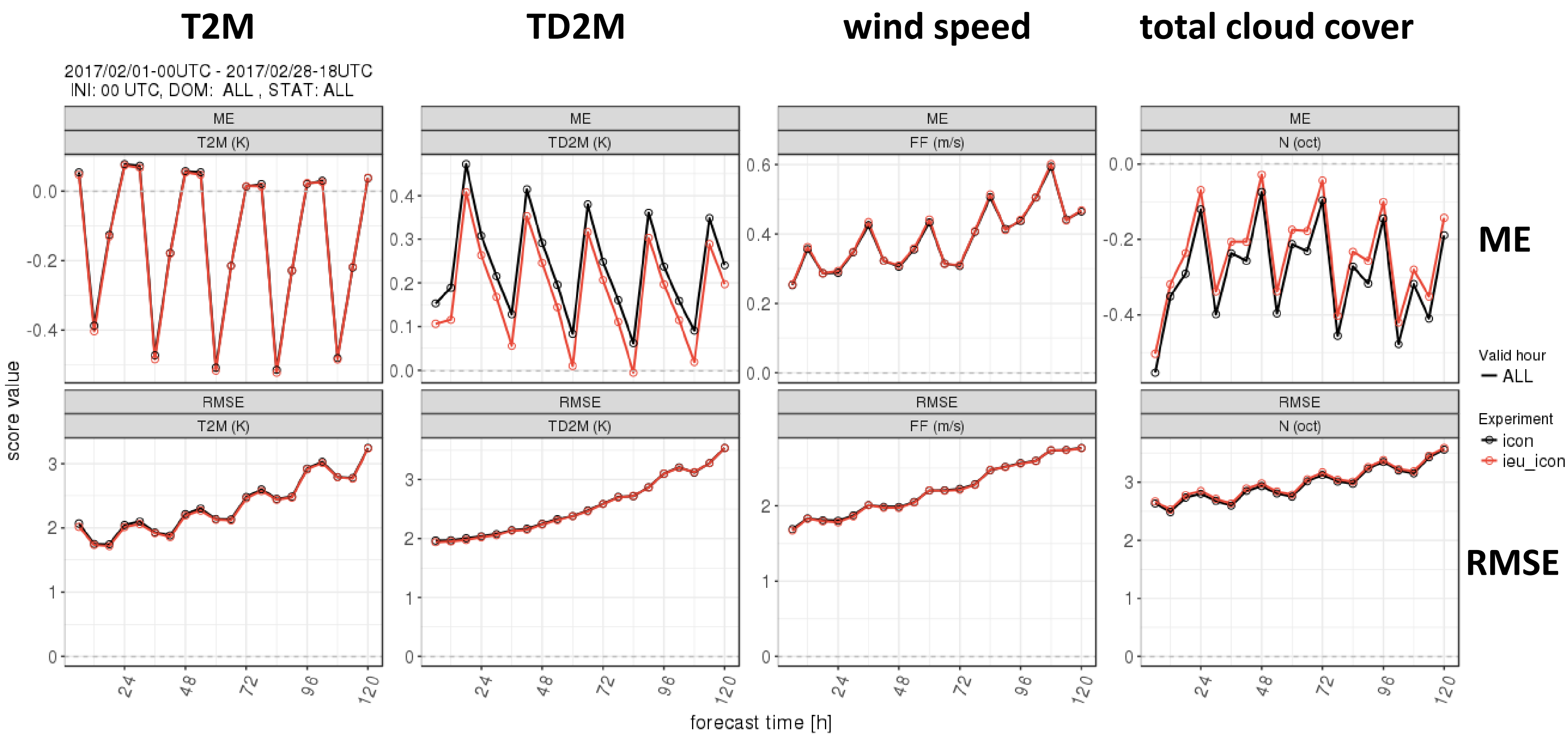
CP HRES scenario 5



Scenario 5	
model	resolution
COSMO-IMS	0.025
COSMO-ME5	0.045
COSMO-GR4	0.04

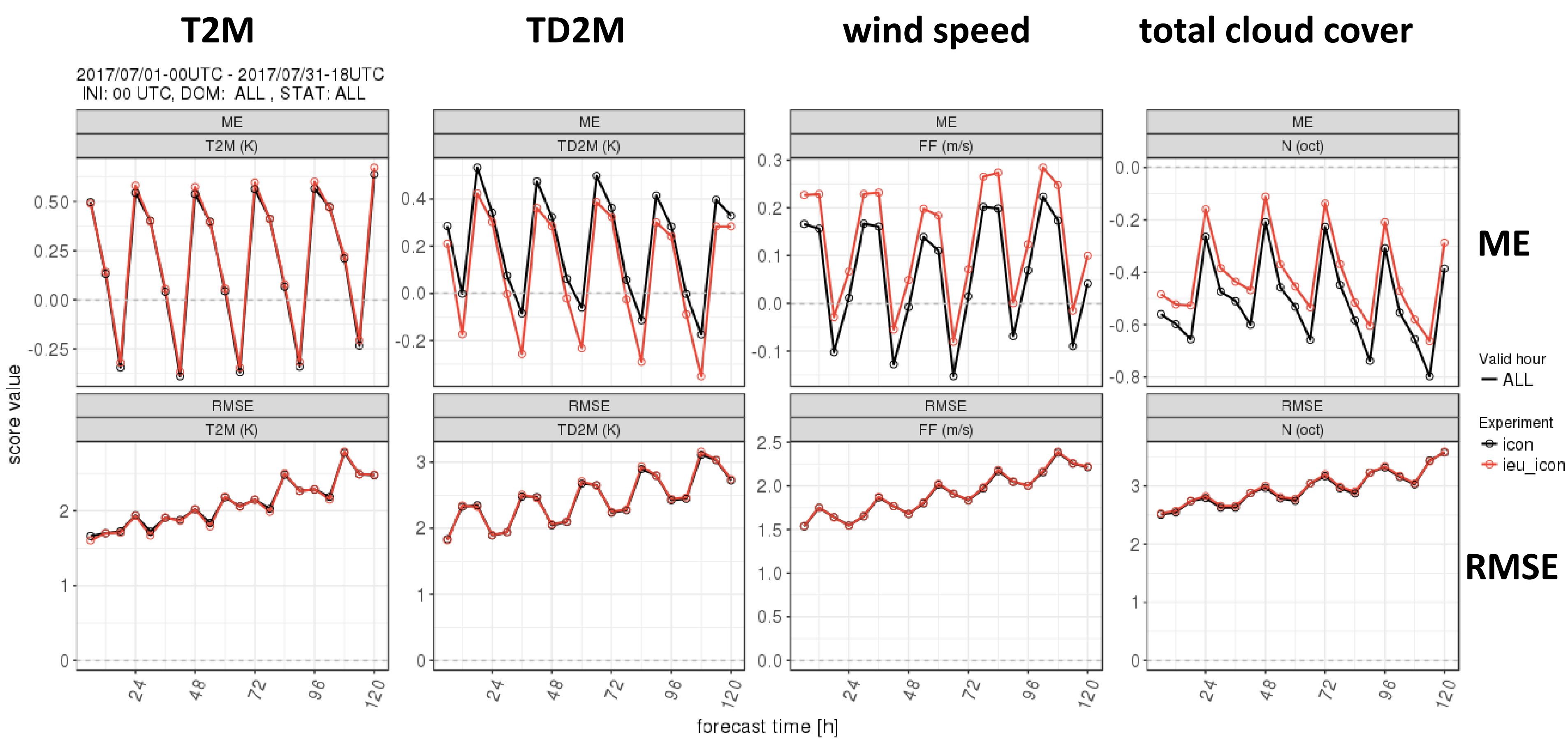
ICON-EU vs ICON

00 UTC runs, continuous verification, SYNOP, Feb 2017



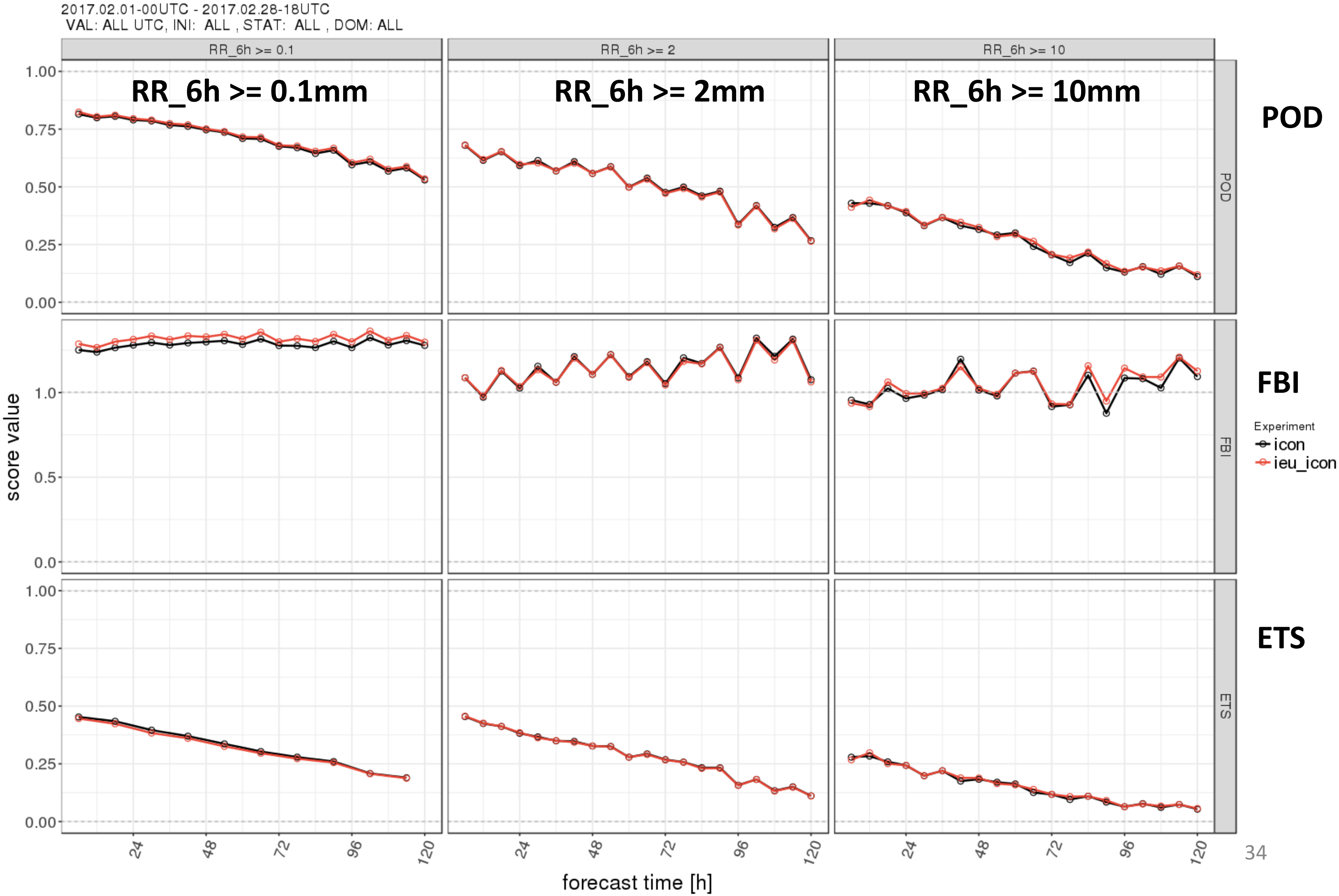
ICON-EU vs ICON

00 UTC runs, continuous verification, SYNOP, July 2017



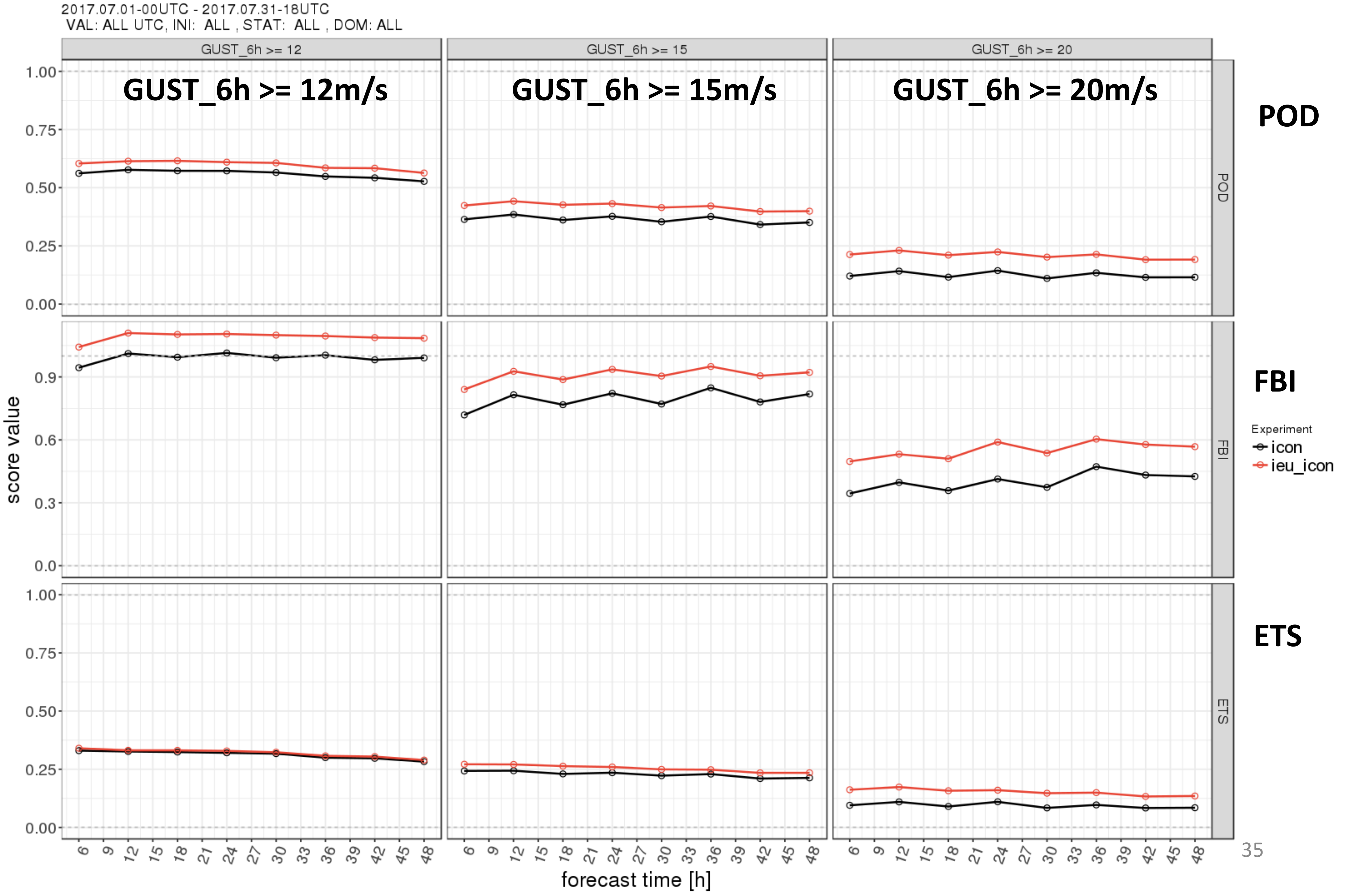
ICON-EU vs ICON

All runs, categorical verification, SYNOP, Feb 2017



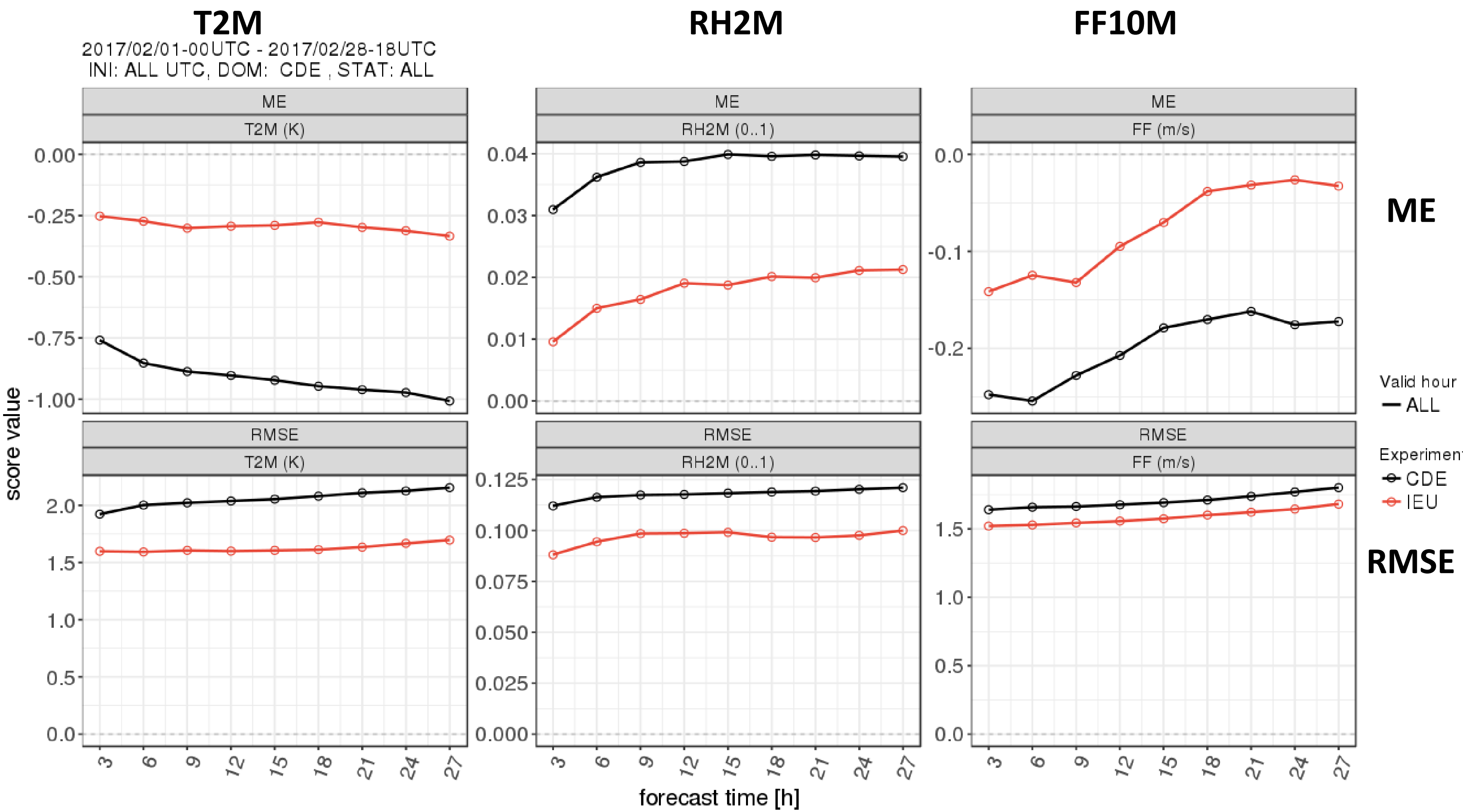
ICON-EU vs ICON

All runs, categorical verification, SYNOP, July 2017



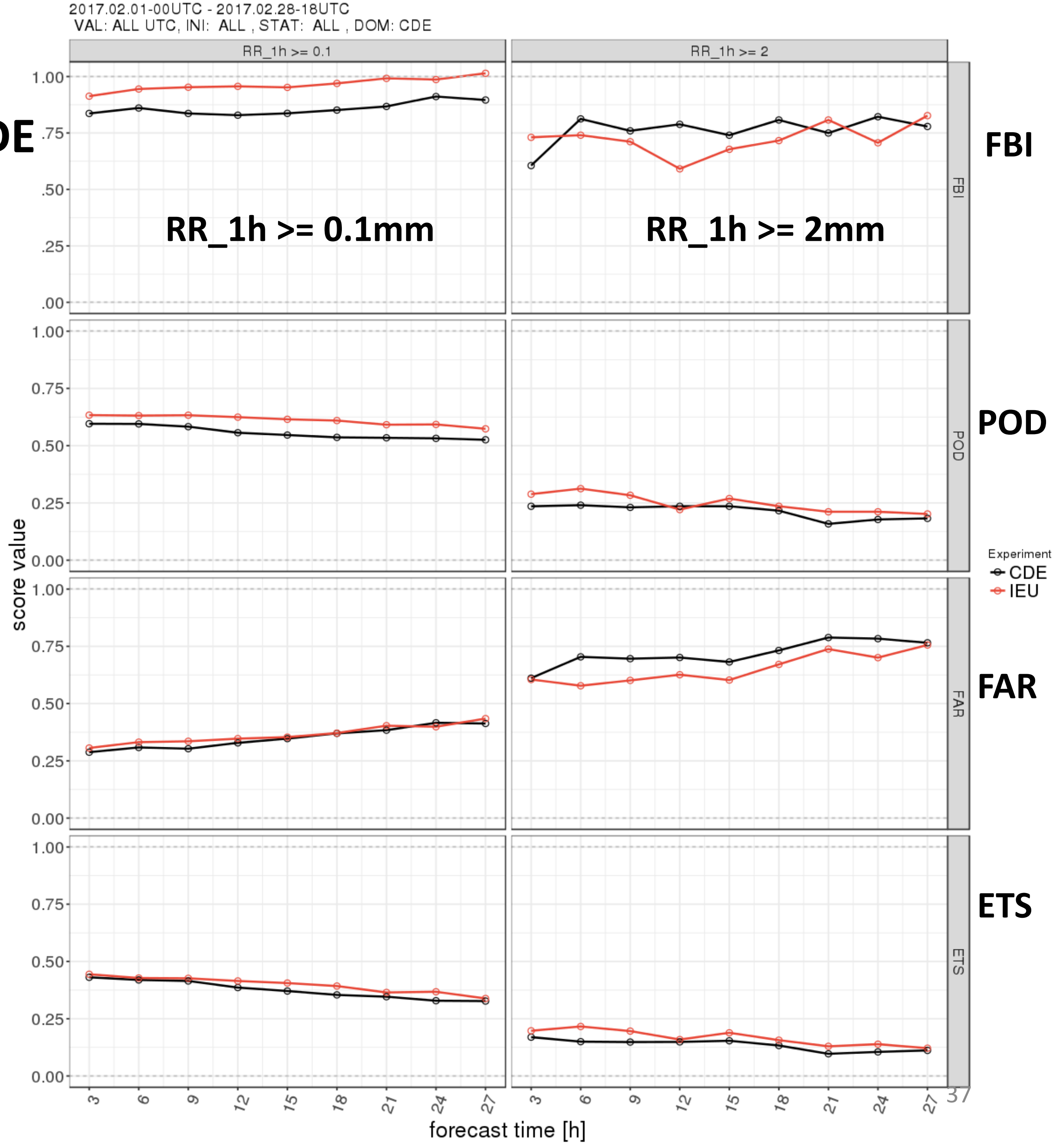
ICON-EU vs COSMO-DE

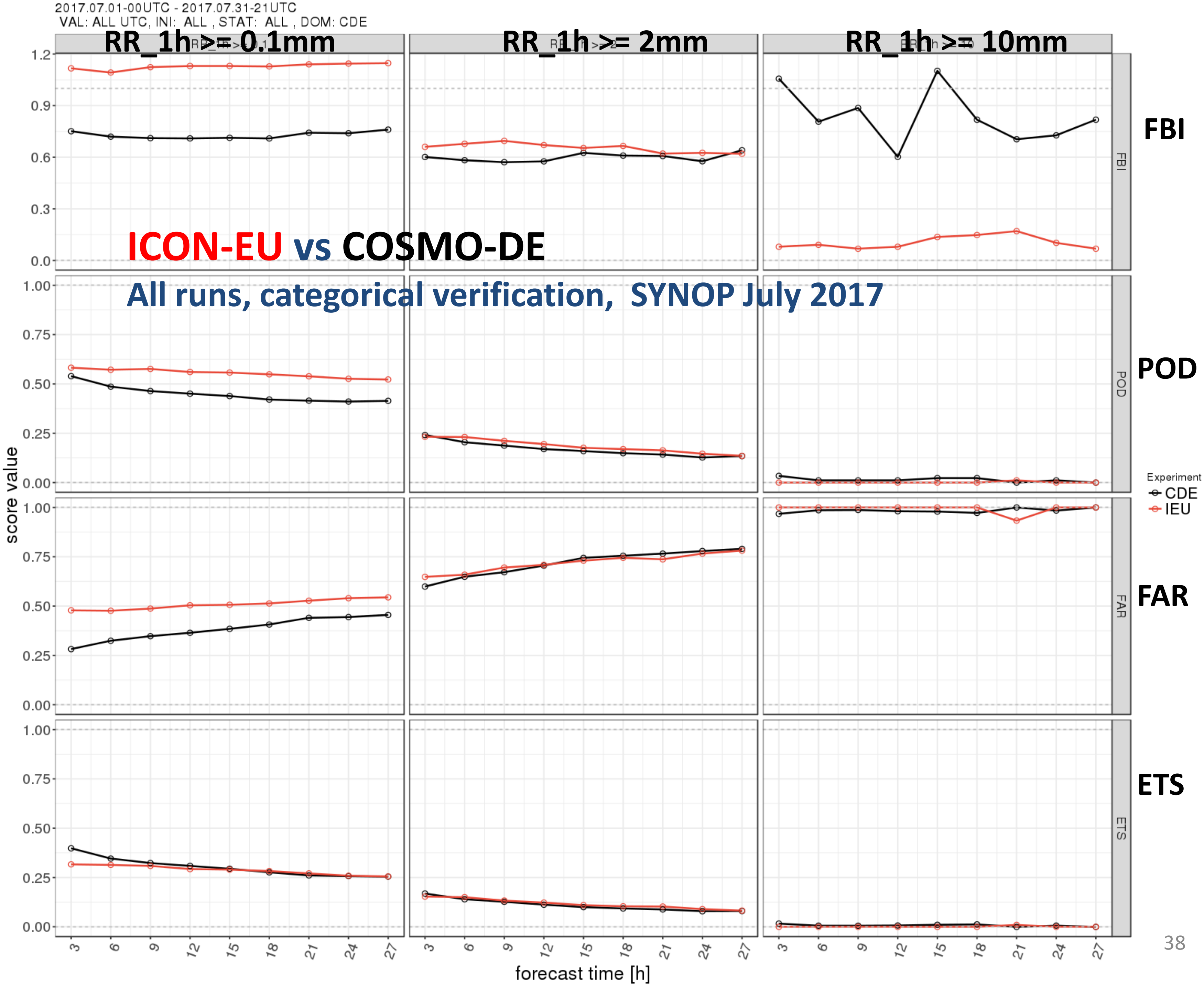
All runs, continues verification, SYNOP Feb 2017

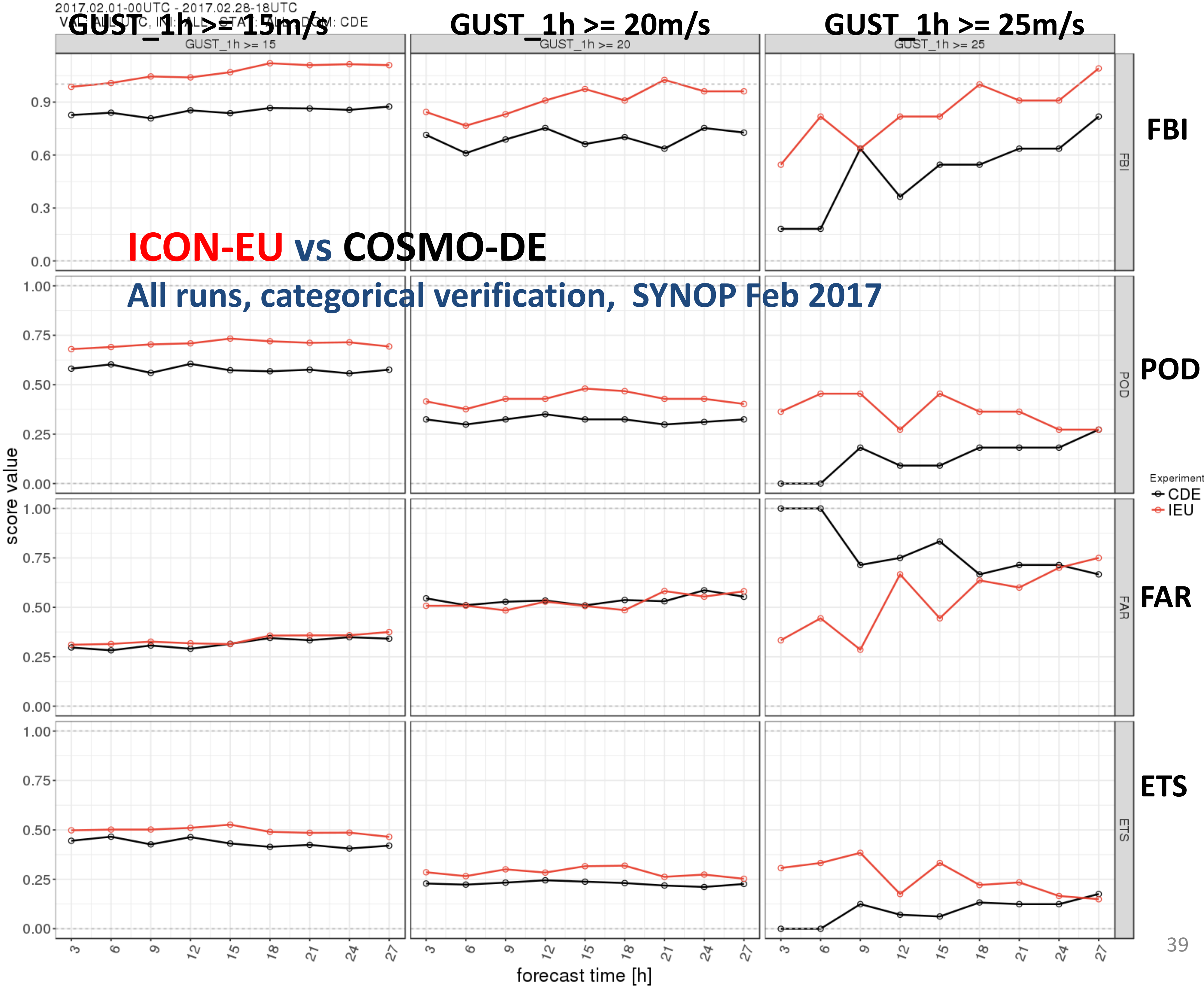


ICON-EU vs COSMO-DE

all runs
categorical verification
SYNOP Feb 2017




2017.07.01-00UTC - 2017.07.31-21UTC
VAL: ALL UTC, INI: ALL , STAT: ALL , DOM: CDE
RR_1h >= 0.1mm
RR_1h >= 2mm
RR_1h >= 10mm
ICON-EU vs COSMO-DE
All runs, categorical verification, SYNOP July 2017
FBI
POD
FAR
ETS
score value
forecast time [h]
Experiment
CDE
IEU



2017.02.01-00UTC - 2017.02.28-18UTC
GUST_1h >= 15m/s
GUST_1h >= 20m/s
GUST_1h >= 25m/s
GUST_1h >= 15
GUST_1h >= 20
GUST_1h >= 25
ICON-EU vs COSMO-DE
All runs, categorical verification, SYNOP Feb 2017
FBI
POD
FAR
ETS
score value
forecast time [h]
Experiment
CDE
IEU

WG5 Contributing Scientists

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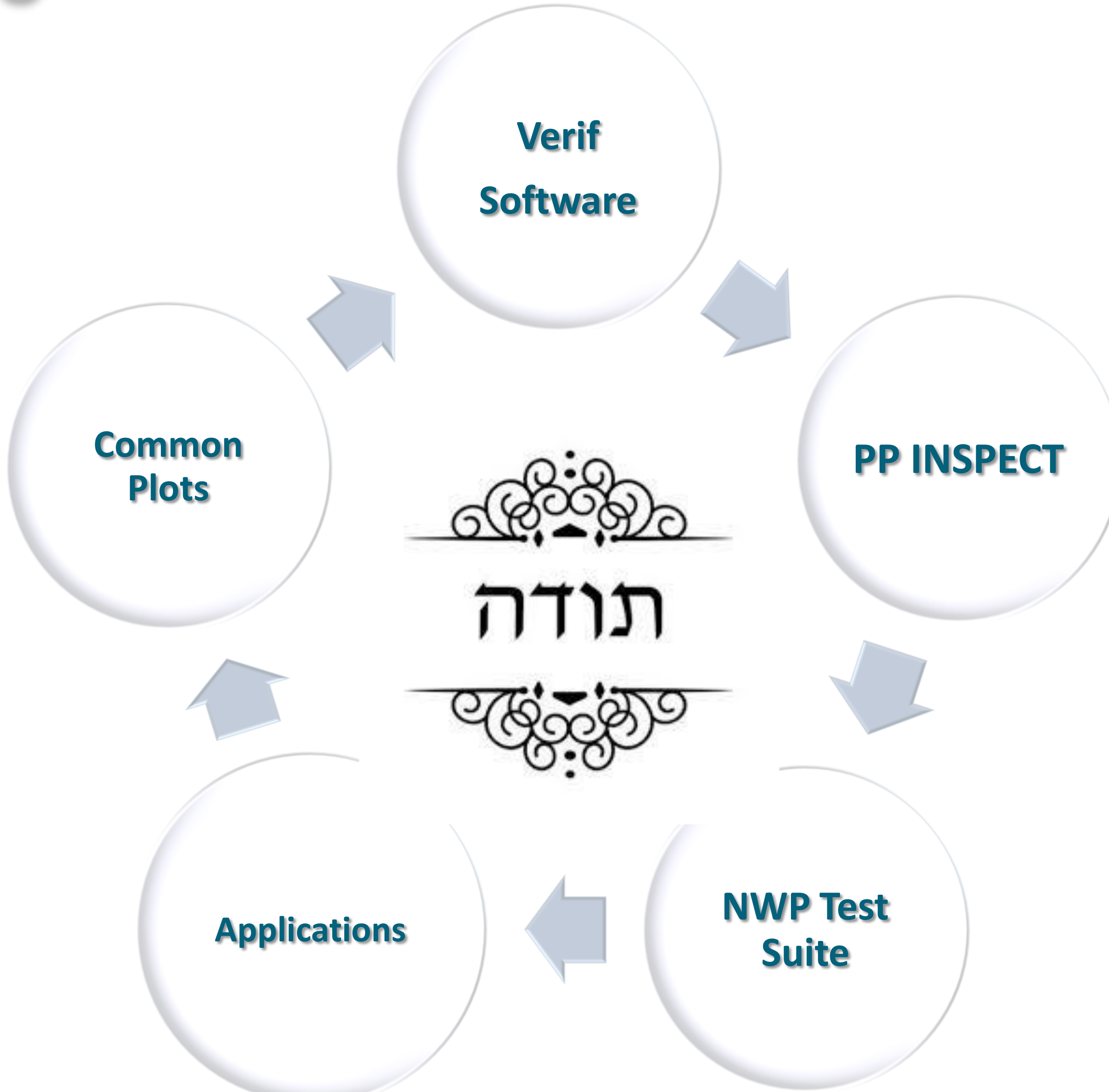
Roberto Bove, COMET
Anastasia Bundel, RHM
Rodica Dumitrache, NMA
Felix Fundel, DWD
Flora Gofa, HNMS
Amalia Iriza, NMA
Pirmin Kaufmann, MCH
Alexander Kirsanov, RHM
Xavier Lapillonne, MCH
Joanna Linkowska, IMGW
Elena Oberto, ARPA-PT
Ulrich Pflüger, DWD
Maria Stefania Tesini, ARPAE
Naima Vela, ARPA-PT
Antonio Vocino, COMET
Yftach Ziv, IMS



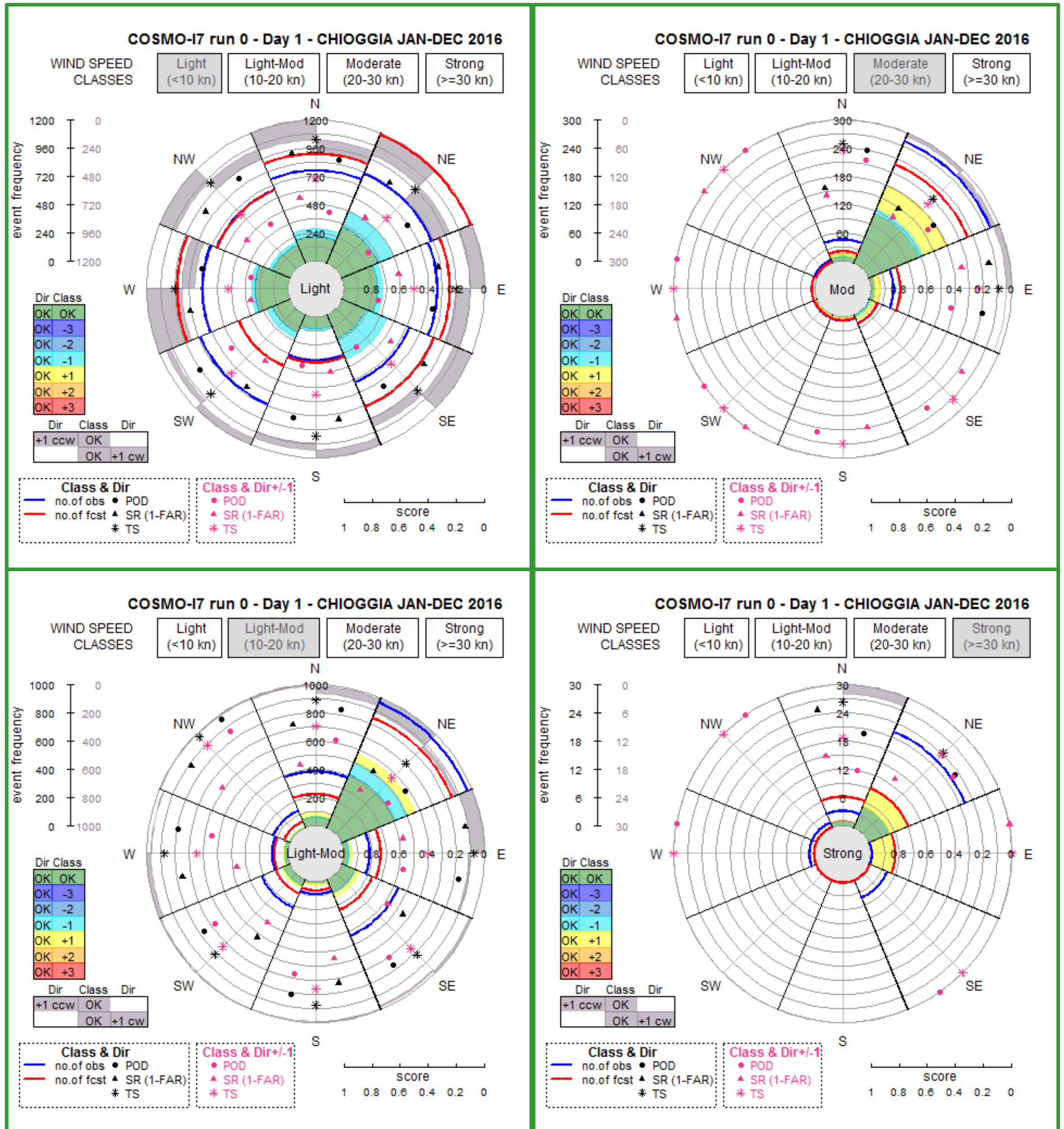
Verification of hourly 10-m wind predicted by COSMO-I7 00 UTC run for the station "Chioggia" near Venice. The statistics refer to 1 year (JAN-DEC 2016) of hourly data from 1 to 24 h of forecast (DAY 1) and corresponding observations.

Underestimation of the intensity ,with correct direction predicted, is more evident for "Light" and "Light-moderate" classes (see cyan sectors).

In case of "Moderate" winds predicted the number of cases of underestimation is very small, while the number of overestimated events is significant (see yellow sectors).

This information is important for the forecasters as they can be confident about the low risk of missing critical events.

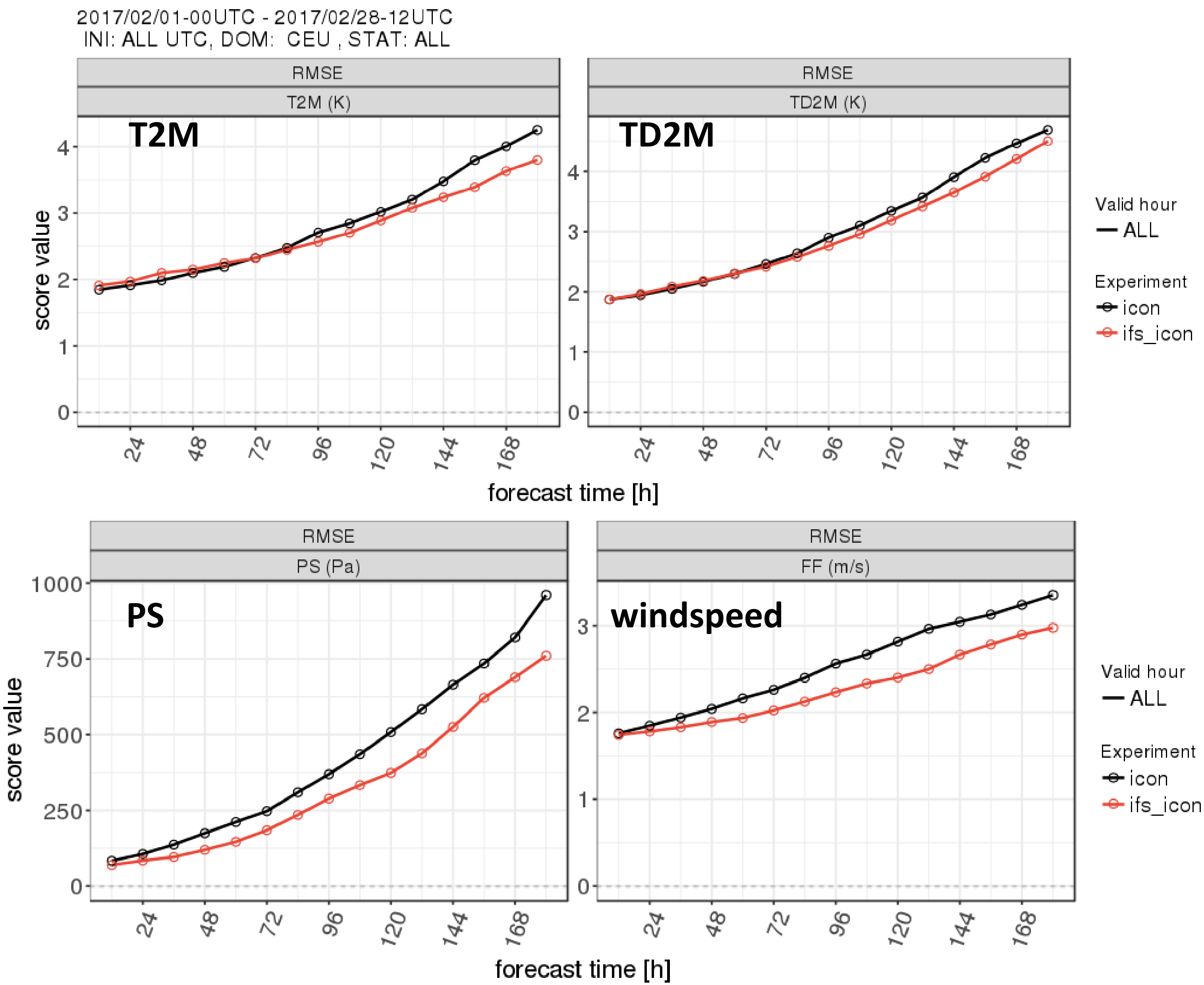
Unfortunately the performance-rose relative to "Strong" wind shows that the scores relative to this type of event are very low. In addition to cases of overestimations, the most frequent error is the complete missing of the event (predicted in lower wind classes with very different direction and therefore not visible in the performance-roses).



How good is ICON compared to the IFS?

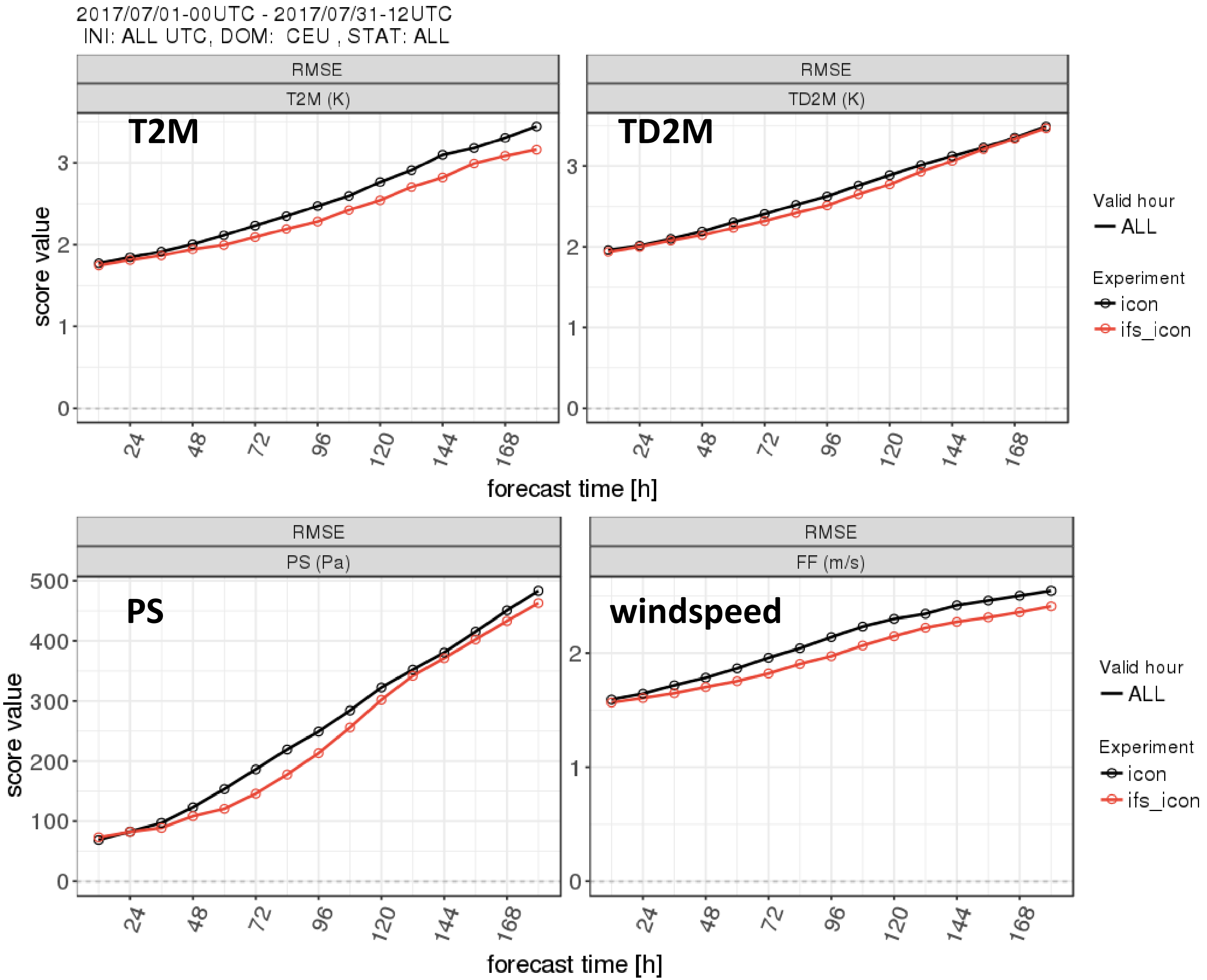
ICON vs IFS

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



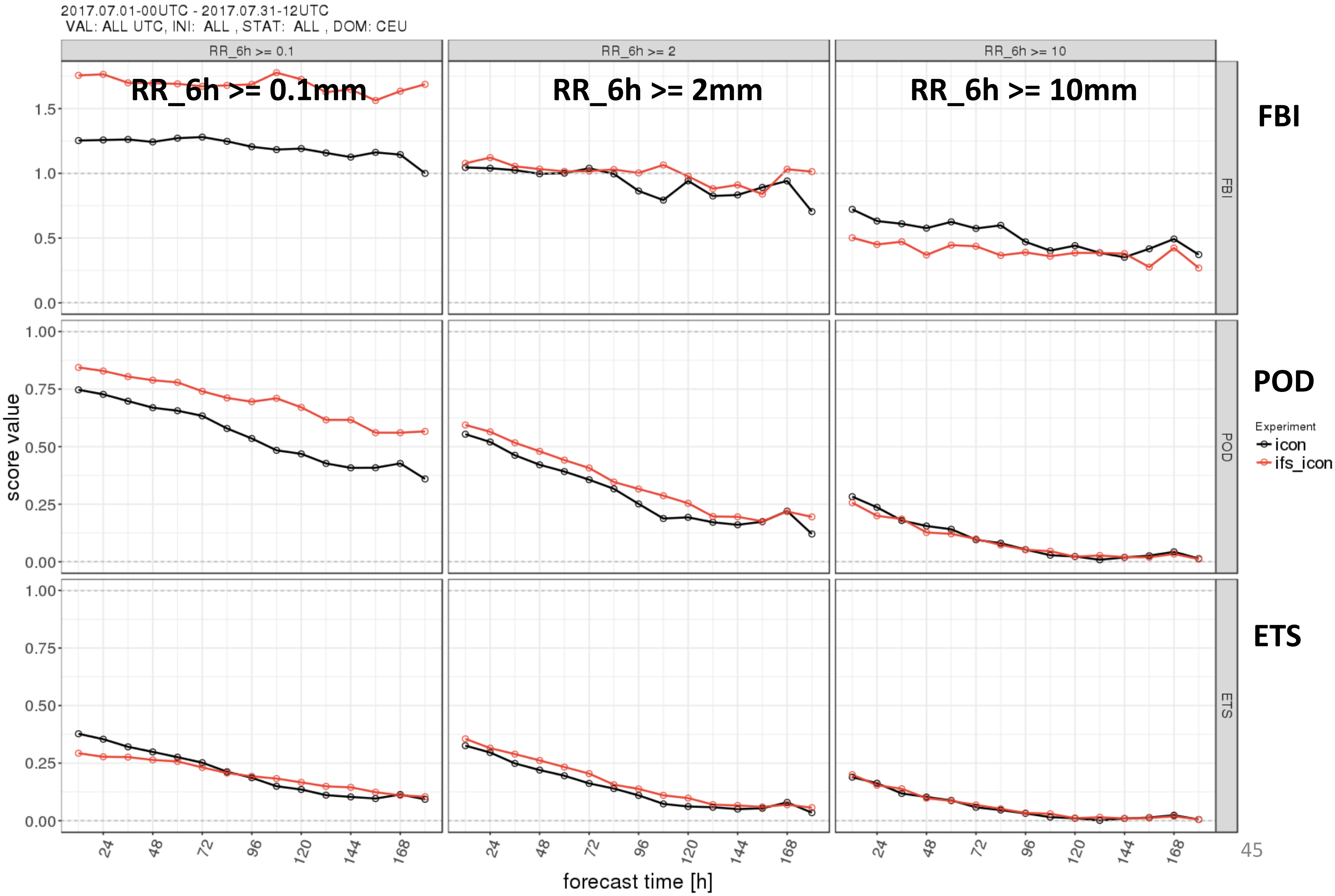
ICON vs IFS

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



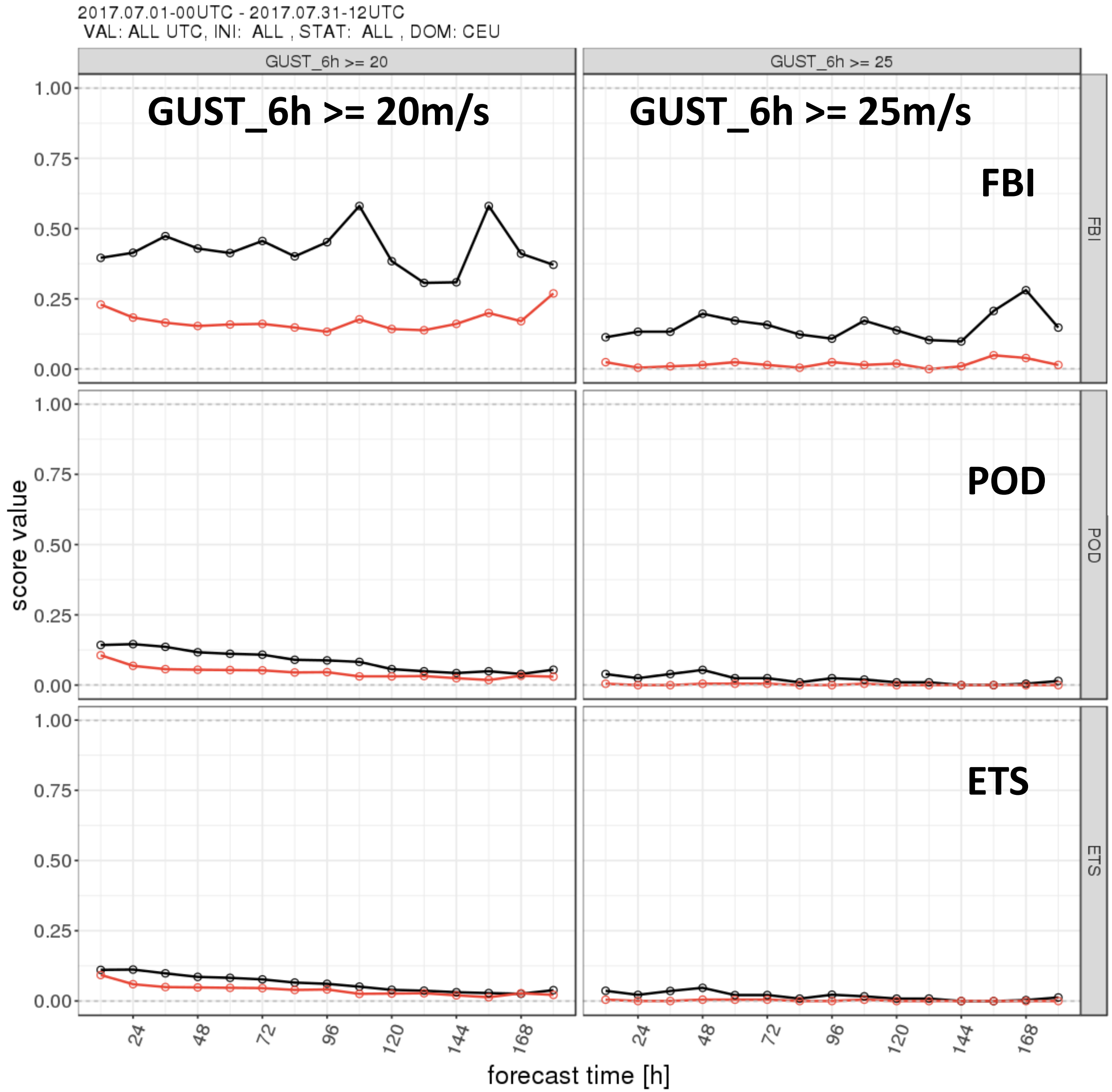
ICON vs IFS

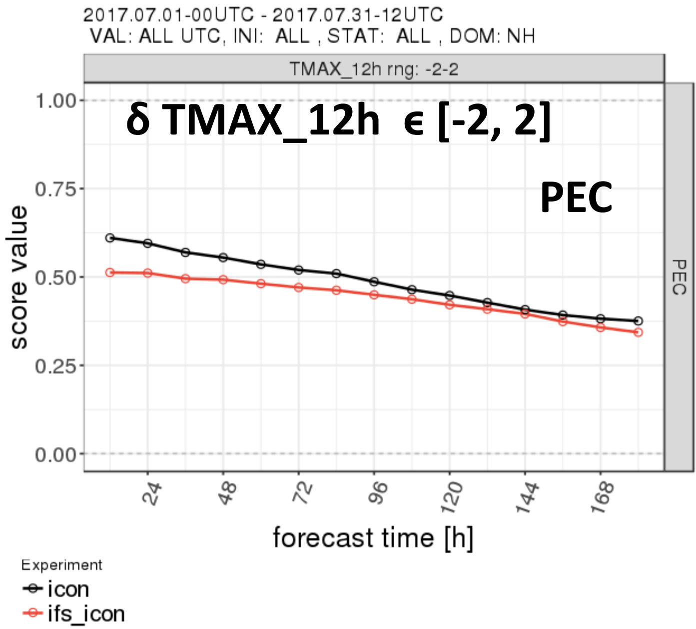
00 and 12 UTC runs, categorical verification, SYNOP Jul 2017



ICON vs IFS

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





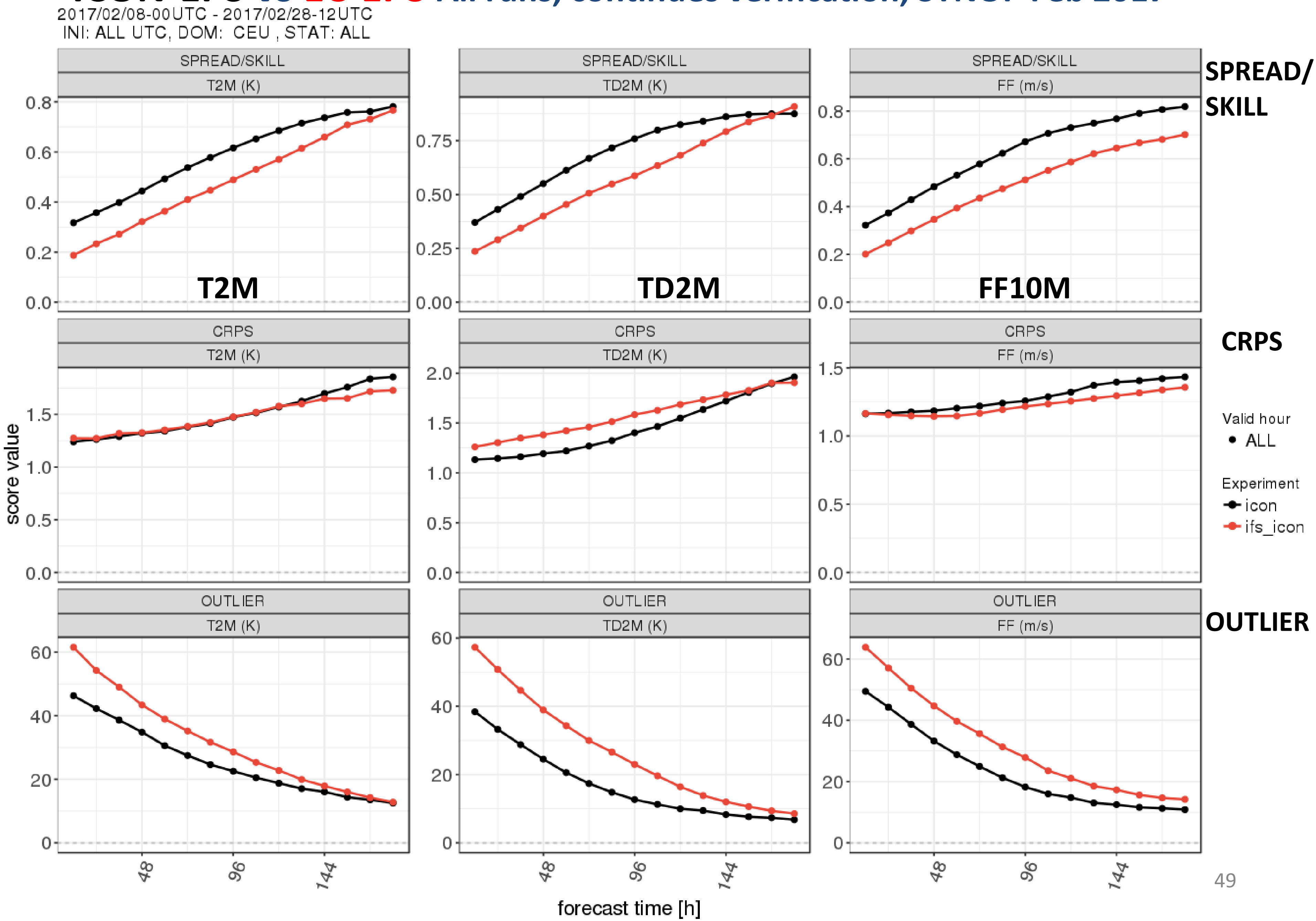
ICON vs IFS

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 >= 2 mm/6h: slight advantage IFS
  RR >= 10 mm/6h: slight advantage ICON
- Gusts: Clear advantages ICON for all threshold
- TMAX: Advantage ICON

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

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



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