

# **I. Advances in Rfdbk**

# **II. Rfdbk for the COSMO Test Suite at ECMWF**

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# What is Rfdbk (not)

## Package allowing to work with Feedback File content in R

- Load file content (partially, parallel)
- Basic verification scores (det. & EPS) implemented
- Some convenience functions like data adjustment, re-labeling, binning etc.

## Rfdbk exploits functionality of R data.table format

- Handle huge data tables efficiently
- Concise syntax allowing to apply functions on sub-categories
- Straight forward to build a verification upon

## Rfdbk is no verification package

- However, it helps producing results in a view lines of R code

## Rfdbk Package

- No recent modifications
- More efficient implementation of loading radar information is planned (so far loading filtered data is not possible)

## Rfdbk based verification

- Verification is now done for the full set of observations, as initially planned (especially most SYNOP observations were not contained in the beginning)
- Additionally aircraft measurements are used for verification & monitoring
- Verification of „hindcast“ mode made possible
- Cross model verification (e.g. COSMO vs. ICON)
- DIY verification allows DWD users to conveniently start their own verification job
- Many enhancements of the graphic, interactive representation of results

## 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

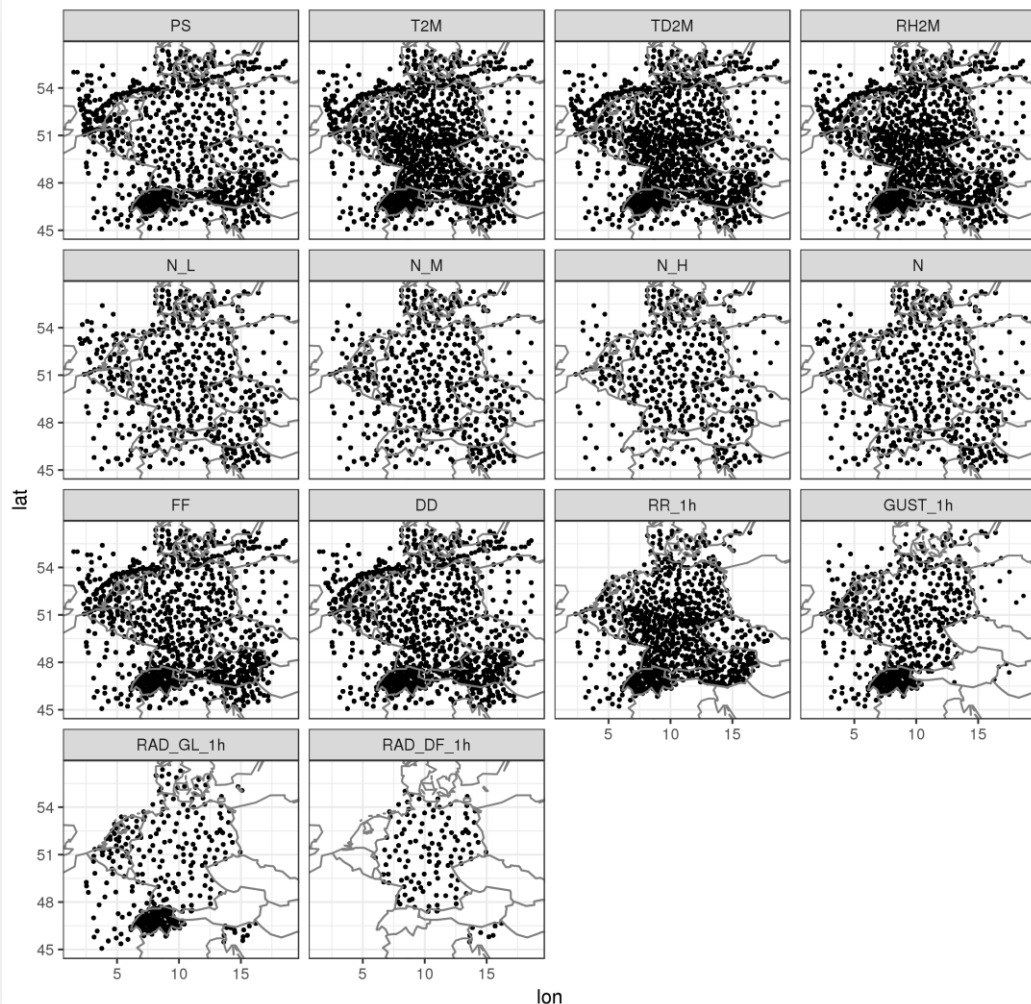
## Visualization

- Lead-time
- Time series
- Station based

## Aggregation

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

01UTC observations

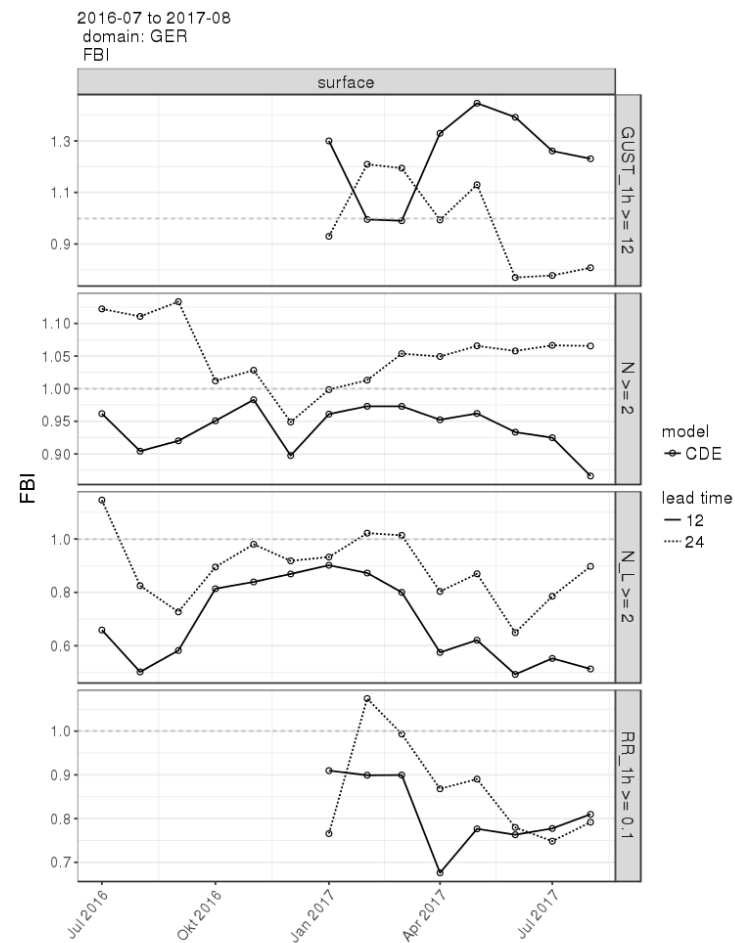
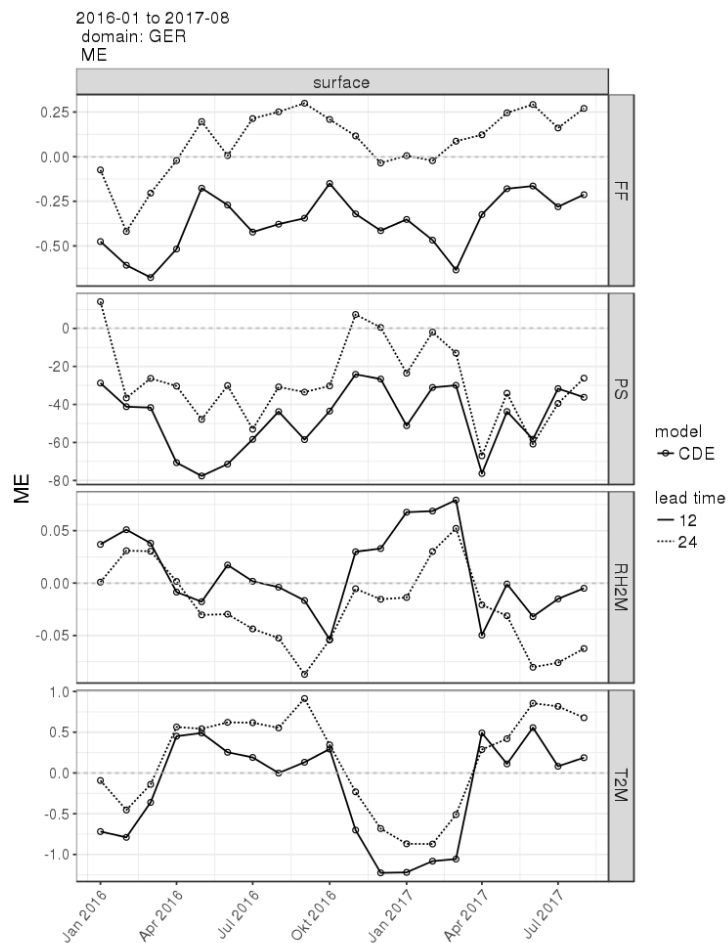


## COSMO-DE surface observations

Example 2018-08-15

Additionally 3,6,12 hourly  
sums/maxima of RR and Gusts are  
available

## COSMO-DE 00 UTC monthly biases since 2016-01

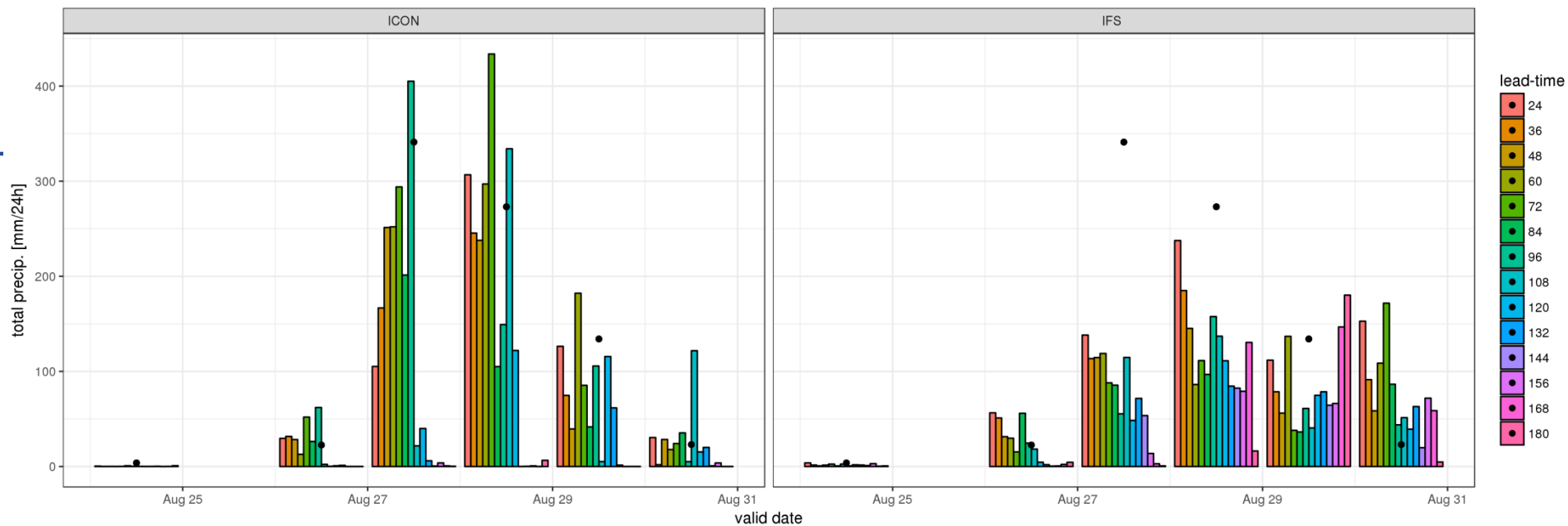


## After ~2 years in use

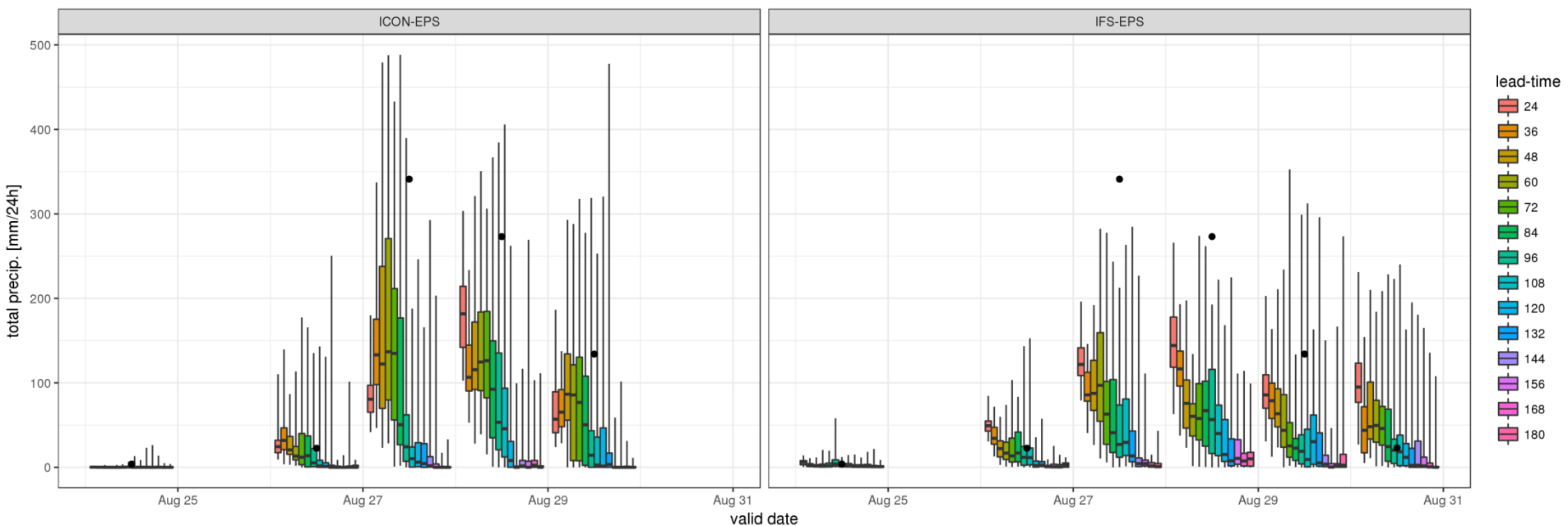
- Feedback files have become a cornerstone in verification at DWD
- Rfdbk has shown to be a stable interface for R
- The verification built on Rfdbk is extensive with rather little amount of code
- The concise code allows a quick implementation of new features
- Users (at DWD) can start their own verification task conveniently via app
- The combination of feedback files and R allowed for many verification tasks aside of the routine verification...



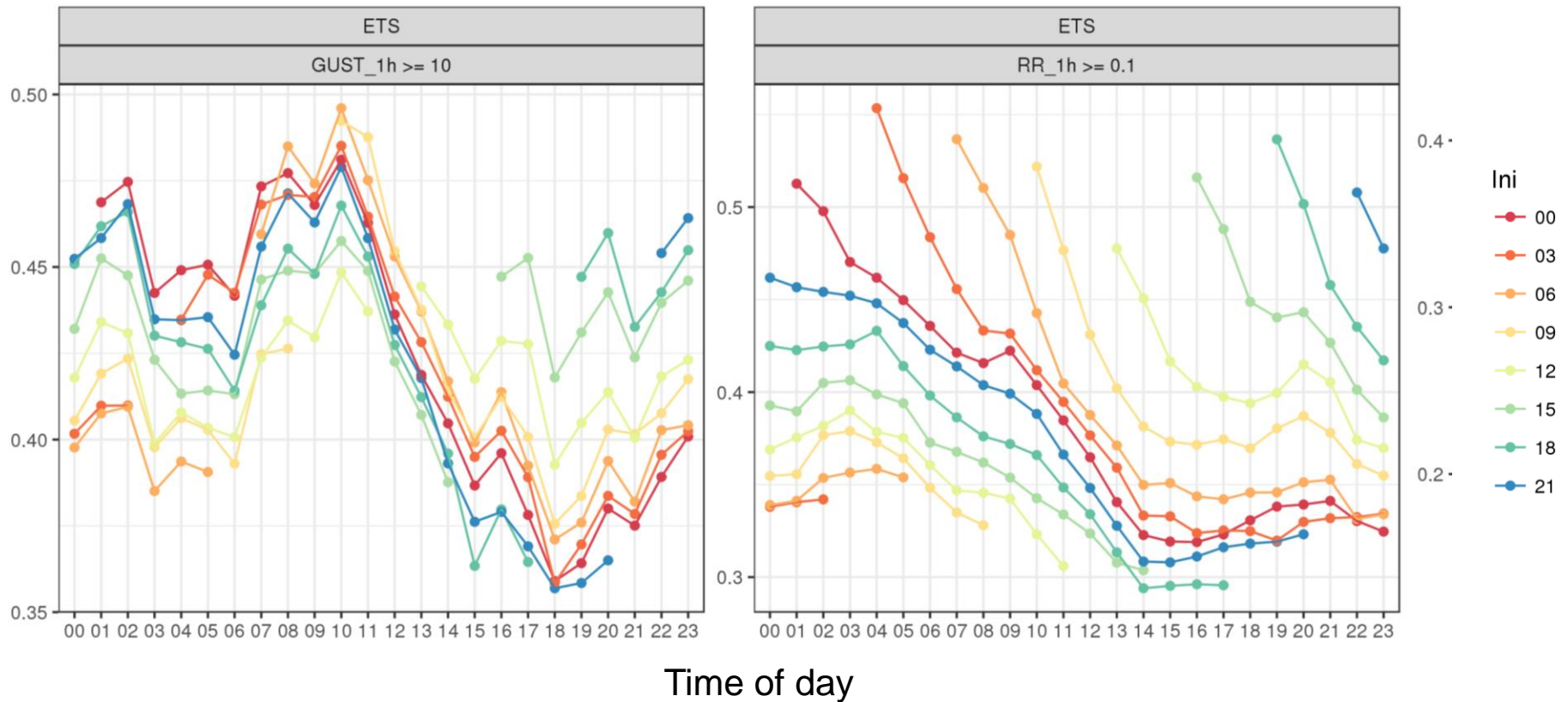
24h total precipitation forecasts (12 UTC - 12 UTC) for HOUSTON (id: 72243)



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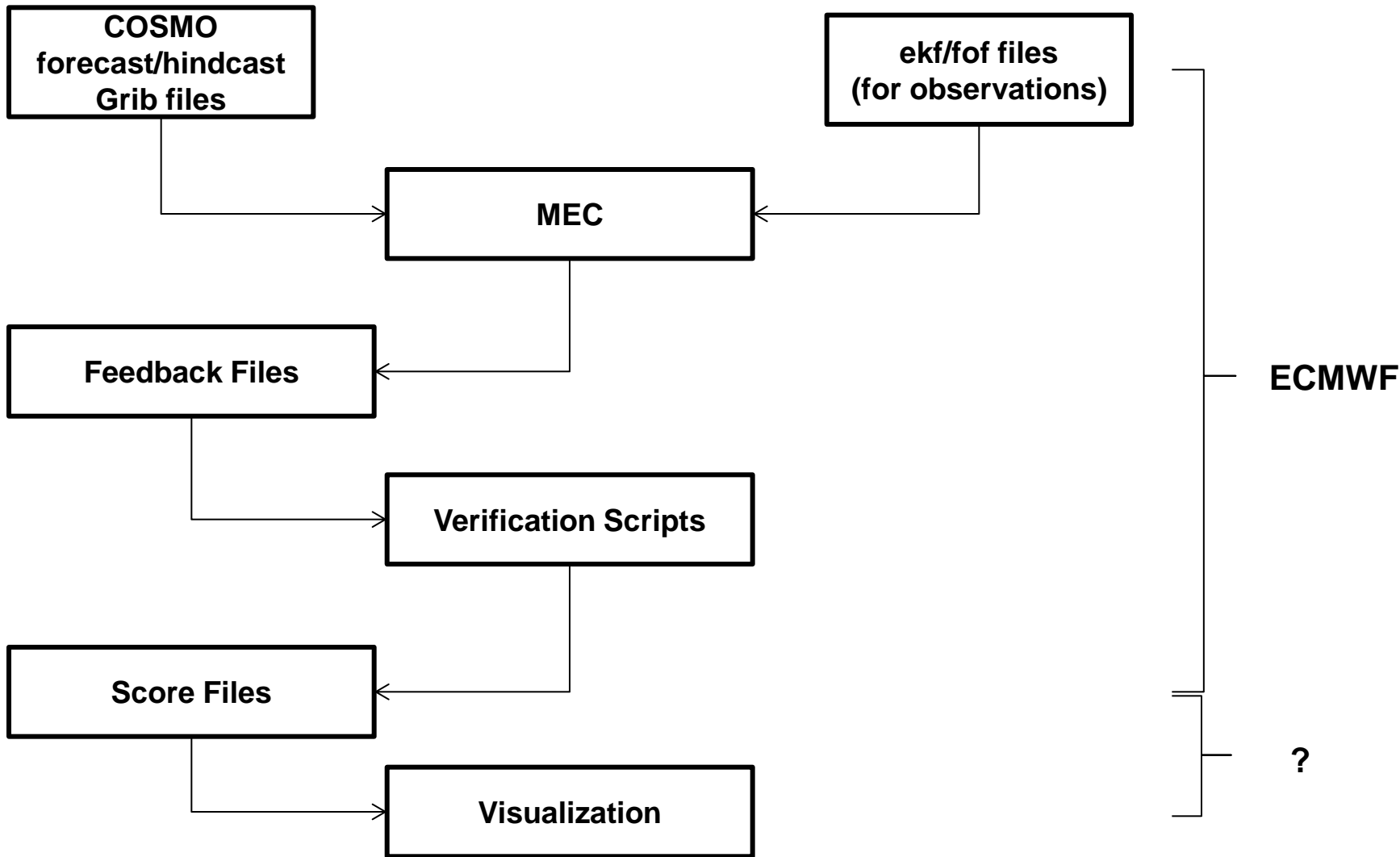


## COSMO-DE verification for Germany 2017/03 – 2017/08



## **II. Rfdbk for the COSMO Test Suite at ECMWF**

# Workflow



# 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?

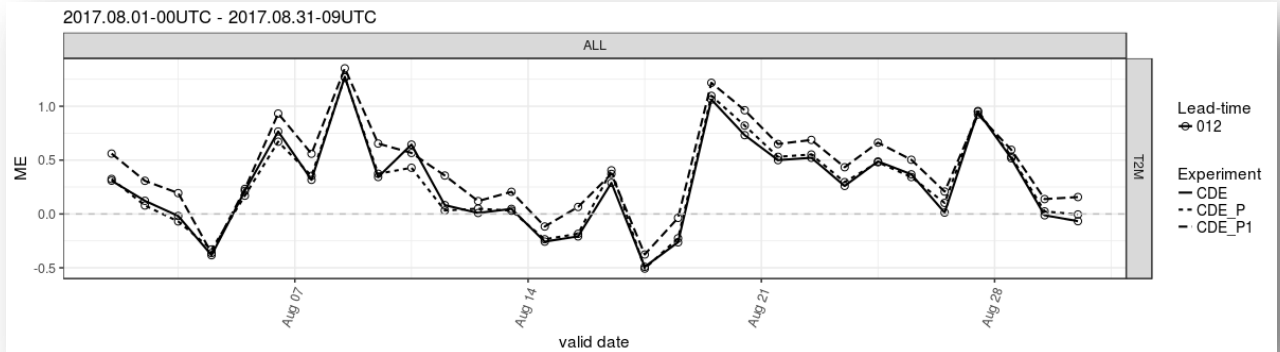
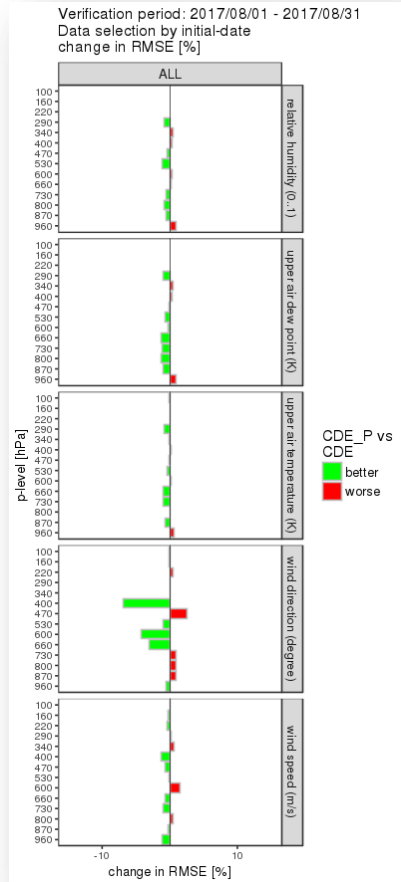
# Requirements (Common Plots)

## 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

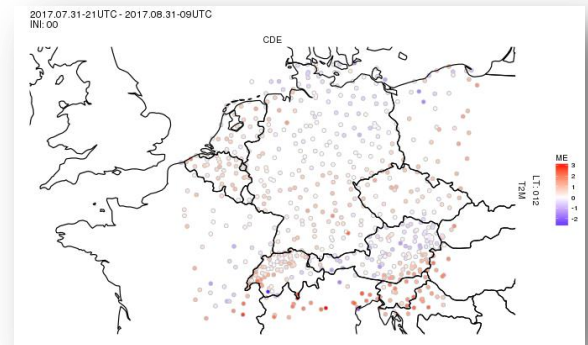
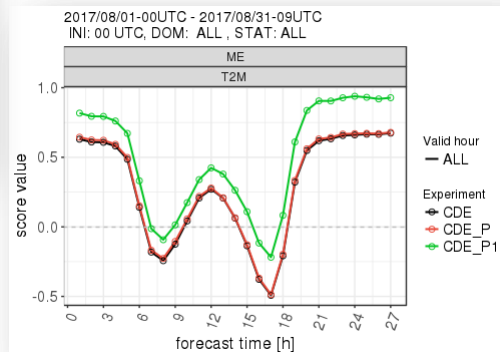
## Scenario B (centralized production of feedback files)

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



Scores by lead-time  
Scores by valid date  
Scores by station  
Score cards  
Difference plots

All interactive accessible via browser



## In case DWD verification approach is adopted

- Runs fast
- Data adjustment between experiments
- Hindacst mode implemented
- Score cards and difference plots available
- Raw scores are exportable
- Manageable 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