Effect of MEC methods on verification

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Background

- Model Equivalent Calculator (MEC) is the basic tool to produce feedback files.
- MEC provides 2 methods („MEC“, „GMESTAT“) that can be altered via namelist.
- Methods differ in observation operators.
- Main difference can be attributed to the smoothing of forecast input:
  - MEC: basically nearest neighboring grid point
  - GMESTAT: weighted 3 nearest neighboring grid points

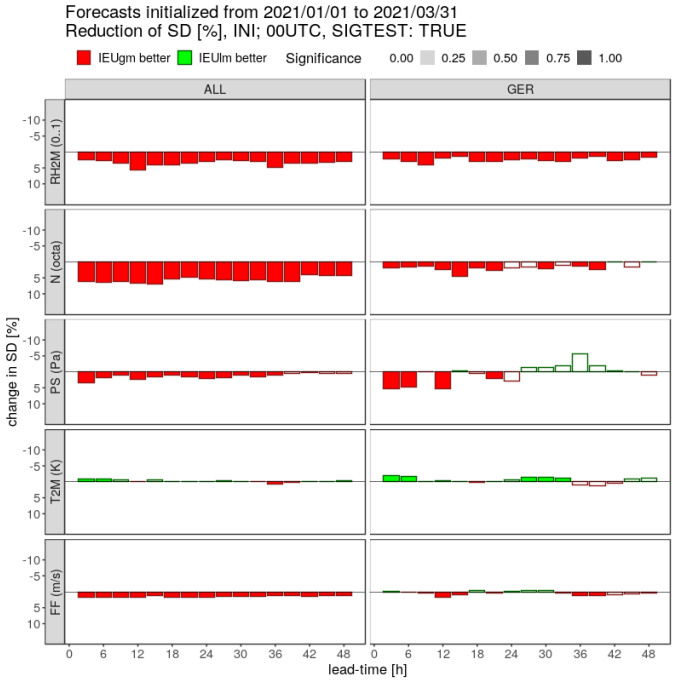
- Scores like RMSE/SD reward smoother input fields

- To quantify this, a comparison of both methods based on ICON-EU nest feedback files is shown:
  a) GMESTAT: ICON-EU feedback files filled with observations from DWD data base
  b) MEC: ICON-EU feedback files filled with observations from PP-CARMA (mars archive)

- Verification should show differences in scores due to differing MEC methods.
- Some additional differences will be due to differences in observations.
- A 3hrly verification was done for JFM 2021 for 48h forecast using Rfdbk/FFV.

Scorecards

Standard Deviation SD



IEUlm – local MEC mode
IEUgm – global MEC mode

Rel. Humidity

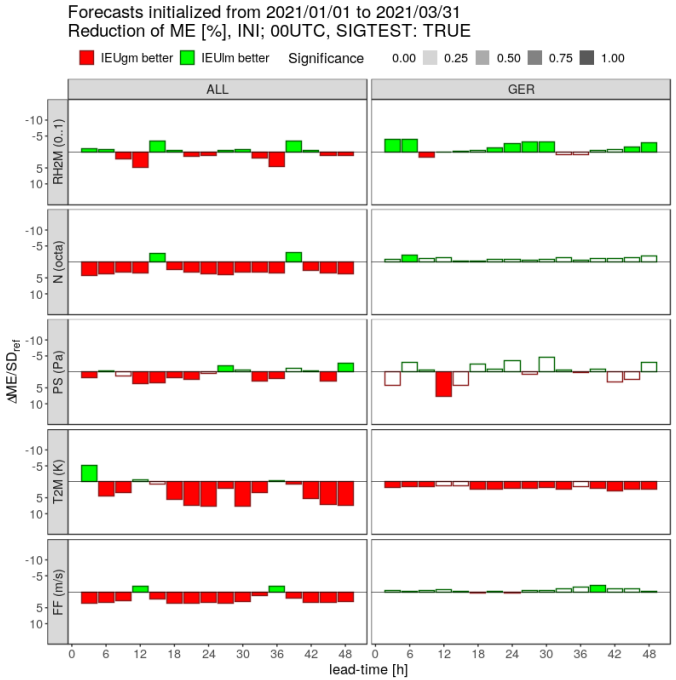
Total Cloud Cover

Surface Pressure

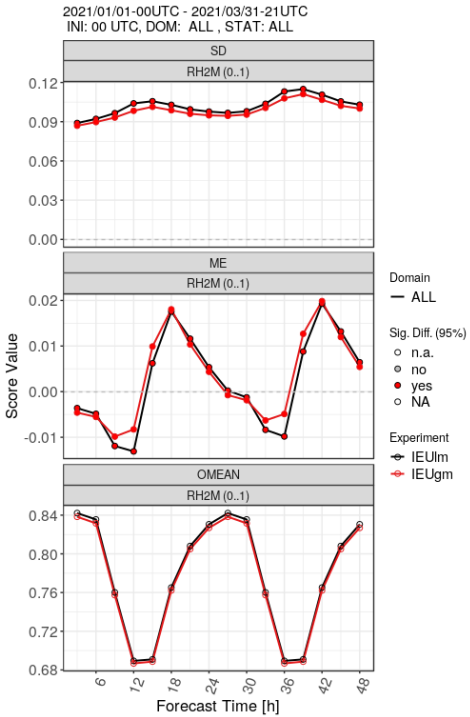
2m Temperature

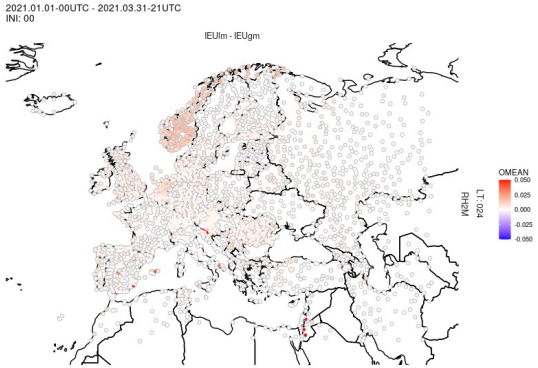
Wind Speed

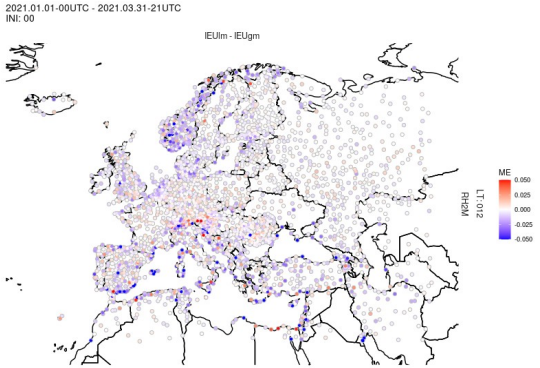
BIAS (ME)

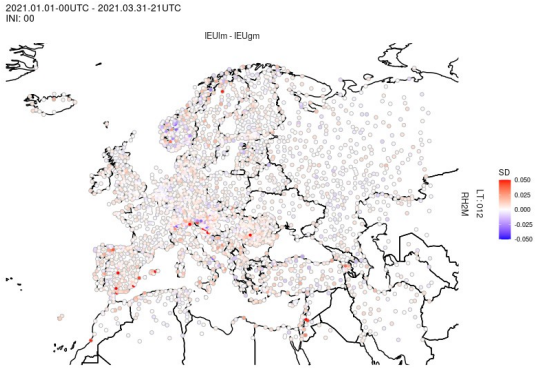


Relative Humidity



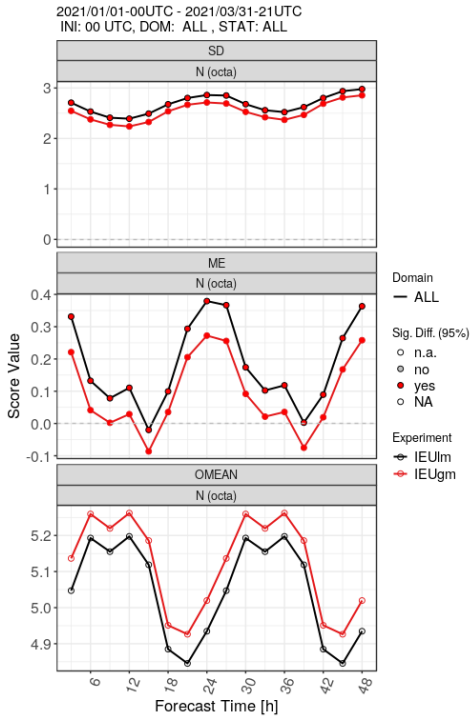


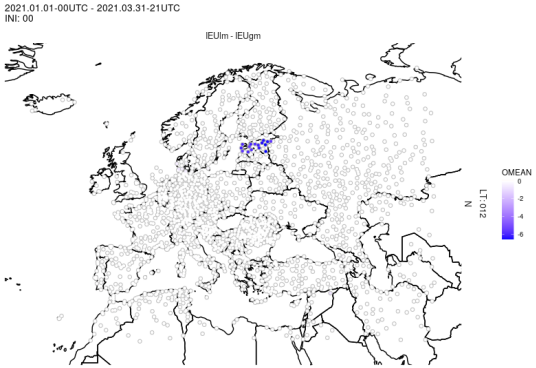


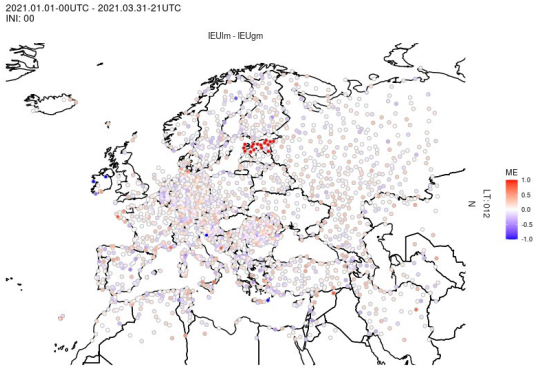


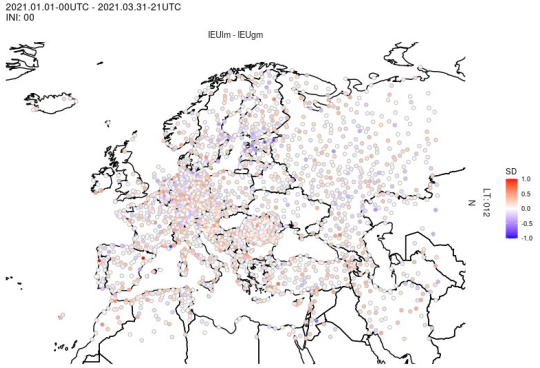
- Observations slightly more humid
- Costal stations less humid with LM version
- No clear spatio-temporal SD pattern
- SD biased towards global MEC mode

Total Cloud Cover



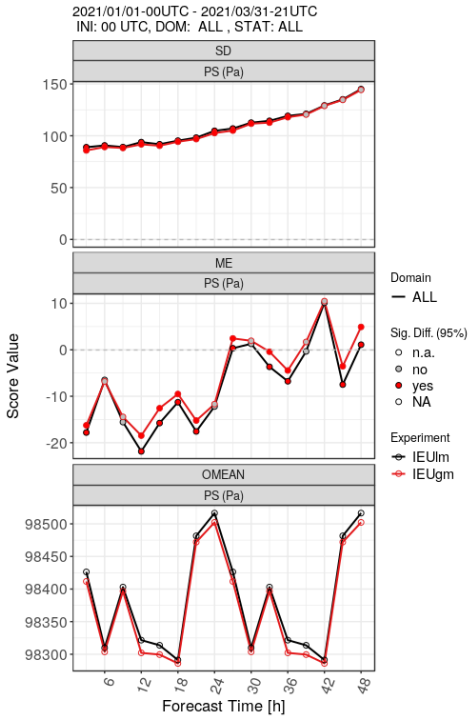


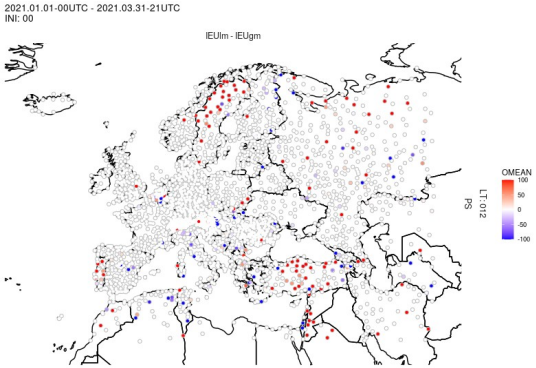


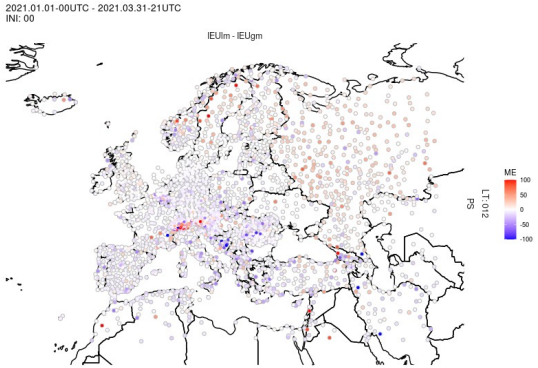


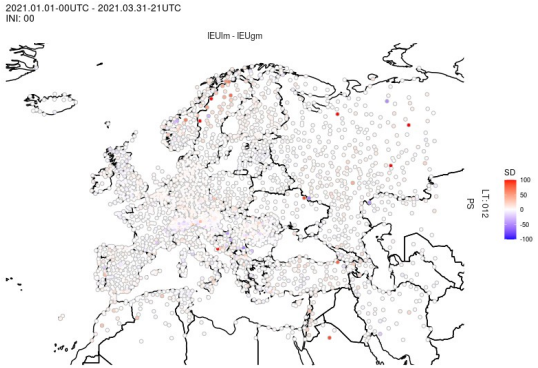
- Some Baltic stations reporting always 0 (mars data)
- SD rewards smoother N forecasts (~5%)
- No obvious spatio-temporal dependency
- SD biased towards global MEC mode

Surface Pressure



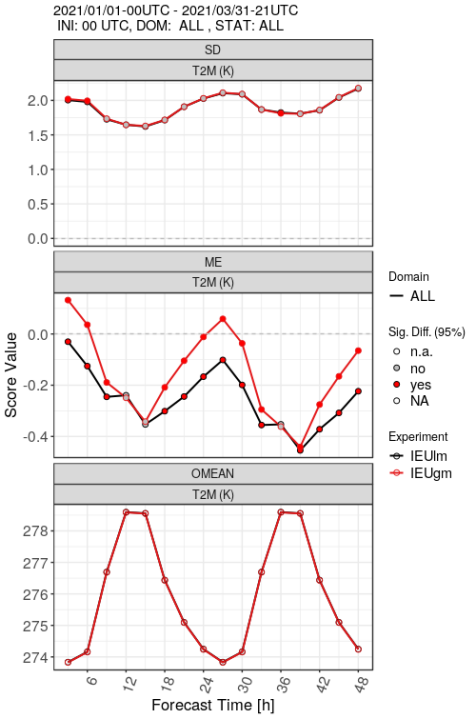


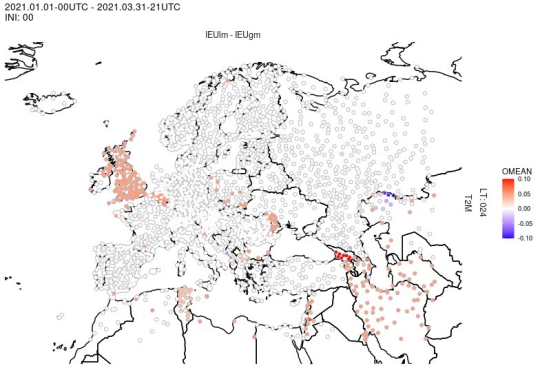


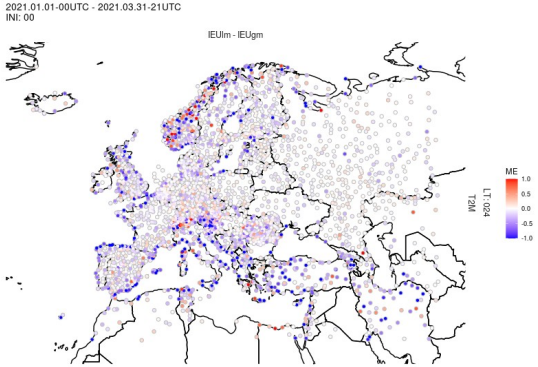


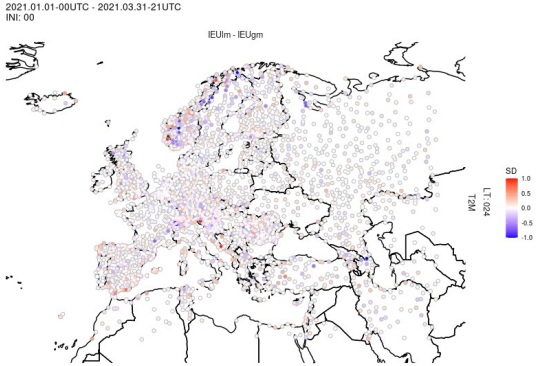
- Some differences in station reports
- Effect of complex terrain visible in bias
- SD shows no obvious spatial dependency
- Differences become less relevant with growing error
- SD biased towards global MEC mode

2m Temperature



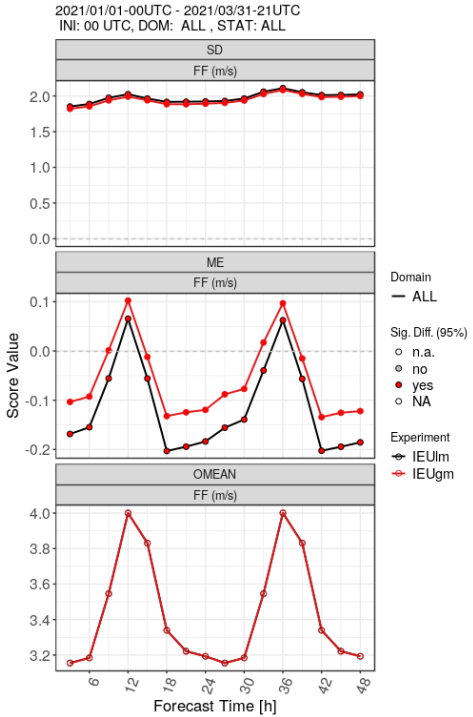


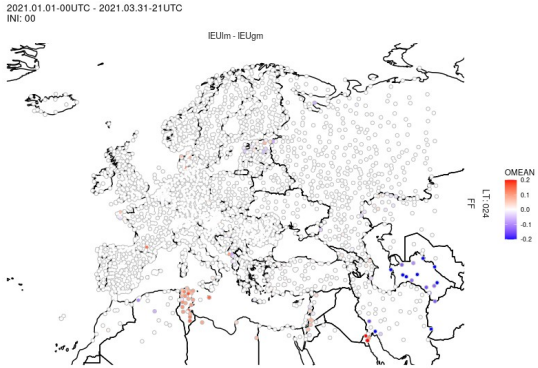


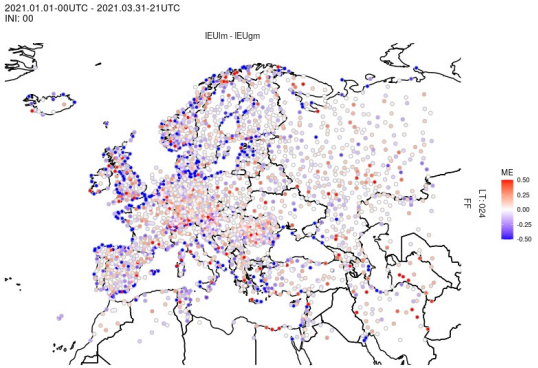


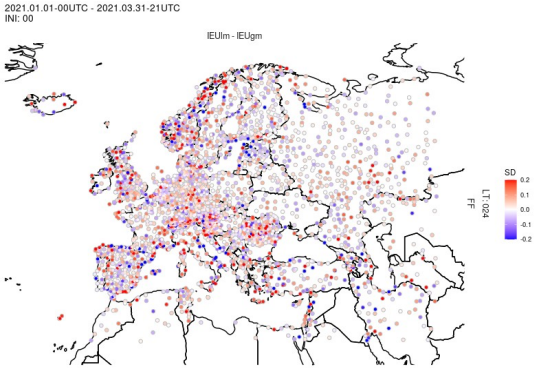
- Constant temperature offset between some observations (mars warmer)
- Local MEC is colder at coastal stations at night
- No clear spatio-temporal pattern in SD observable
- SD not strongly affected

Wind Speed



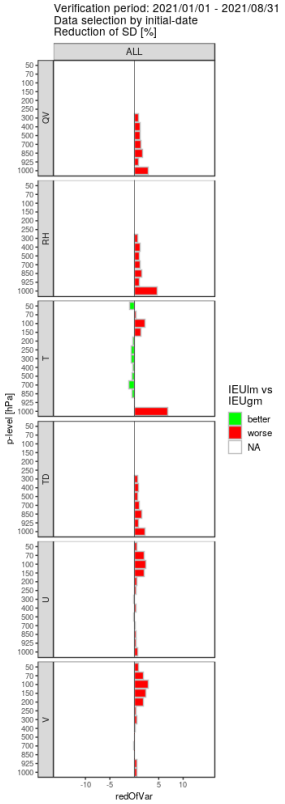






- Some observations differ
- Local MEC has weaker winds at coastal stations
- No clear spatio-temporal pattern in SD observable
- SD biased towards global MEC mode

Upper Air TEMP Verification



Spec. Humidity

Rel. Humidity

Temperature

Dew Point Temp.

U Wind Speed

V Wind Speed

- SD rewards smoother input of global MEC method
- SD for T & RH is stronger influenced near ground
- SD for wind seem more influenced at higher levels
- Bias (not shown) is not much different

Conclusions

- The MEC methods differ in way of interpolating to observations with resulting different outcomes in verification.
- The smoother „GMESTAT“ method seems to be beneficial for SD in many surface variables and also upper air.
- But not all variables (e.g. T2M & PS) are affected equally strong.
- A fair comparisons of models should happen on the same spatial scale.
- With these results, the DWD routine verification of ICON-D2 (MEC) vs. ICON-EU (GMESTAT) is expected to be especially unfair towards ICON-D2 due to additional spatial averaging of the already coarser ICON-EU.
- Sidenote: It would be good to have a blacklist for some obviously wrong reporting stations in the CARMA observation data.

For the sake of a fairer verification, it would be good to modify GMESTAT method to nearest neighbor and use the same observation operators.
This work is ongoing at DWD.