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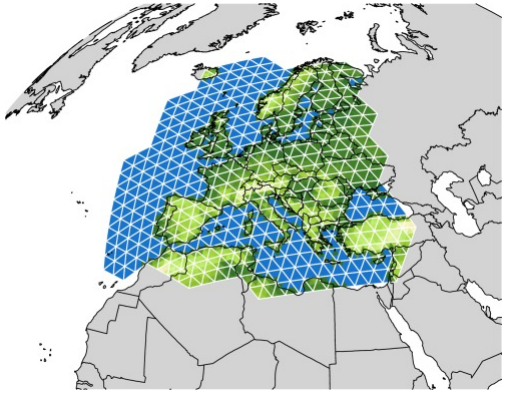
Wetter und Klima aus einer Hand

Recent / ongoing activities in ICON-NWP development





Günther Zängl

on behalf of the DWD ICON development team

WGNE Meeting, 10/11/2022

Resolution upgrade

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- Enhance EPS resolution from 40/20 km to 26/13 km while keeping the deterministic configuration at 13/6.5 km
- Increase number of vertical levels from 90 to 120 (60 to 74 in EU-nest) in DET and EPS, placing the majority of the additional levels in the stratosphere
- This will be combined with using higher-resolved orography data (3´ instead of 30´´) and model-DA coupling for surface friction (see part 2 of this talk)
- The higher EPS resolution turns out to have a slight beneficial impact on the deterministic analyses due to the higher resolution of the ensemble B-matrix
- Subsequent slides: Verification results for autumn/winter period (Oct 15 – Dec 31 2020); relative changes w.r.t. operational configuration
- Will become operational on 23 November 2022

Scorecard DET radiosonde verification

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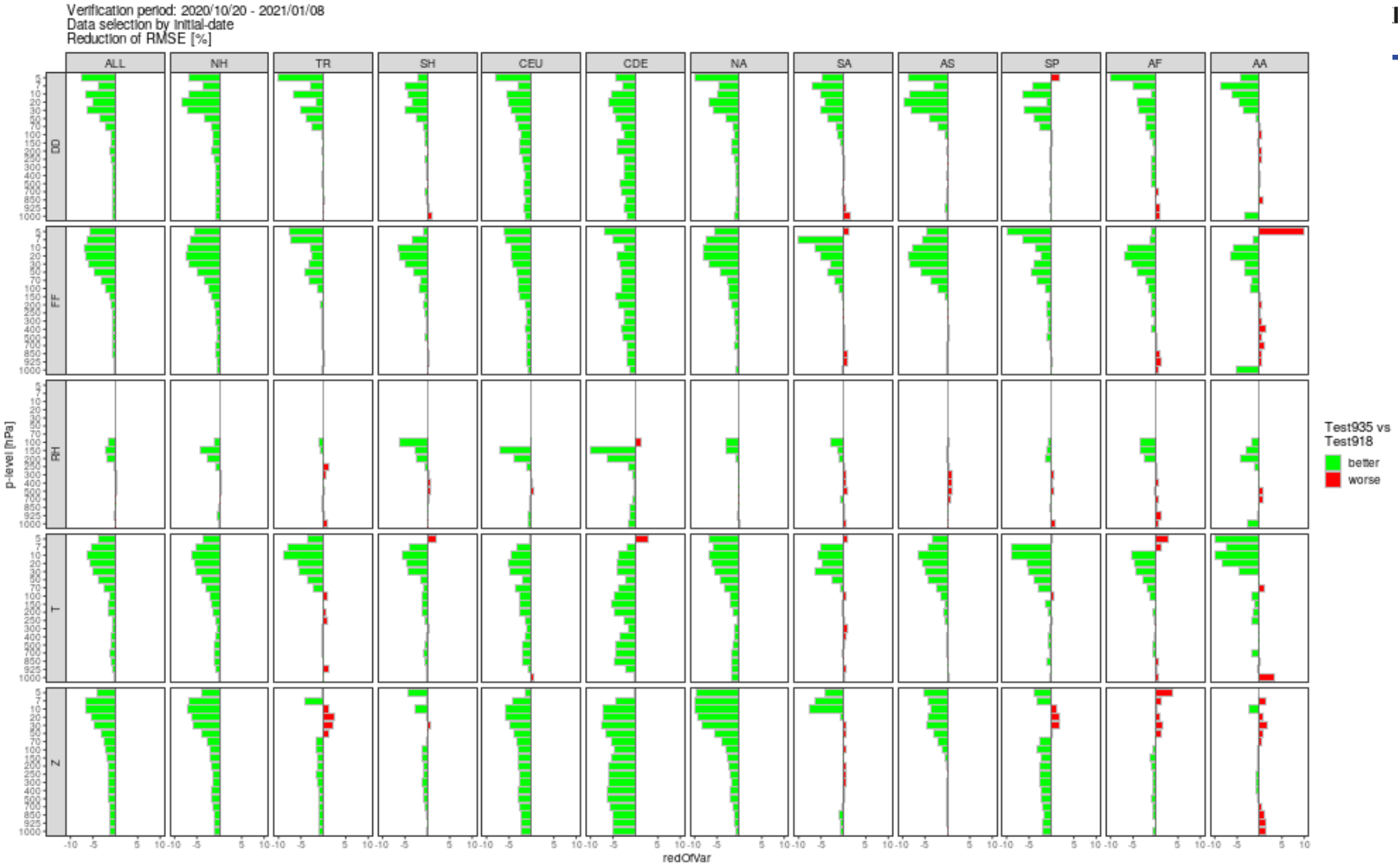

Relative change of RMSE (scale: 10%)

Scorecard EPS radiosonde verification

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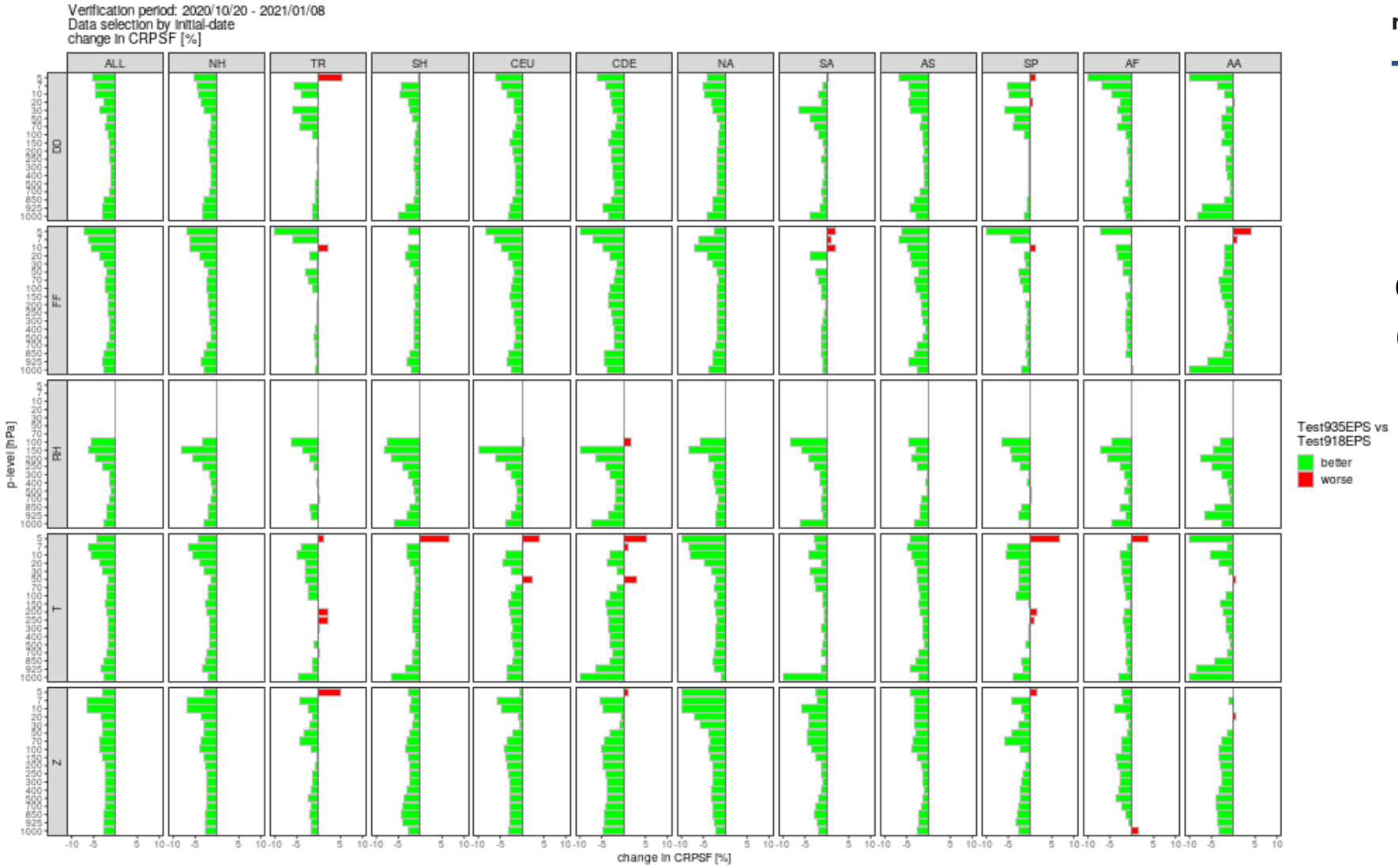

Relative change of CRPS (scale: 10%)

Model-DA coupling

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- **Near-surface model biases are strongly affected by uncertain physical properties of vegetation and soil (e.g. stomata resistance, heat conductivity) as well as model tuning parameters**
- **Physical properties are usually derived from external parameter data (land-cover and soil-type classification, ...), which may not cover the full heterogeneity that exists in nature**
- **This typically leads to ambivalent results when trying to tune parameters (better in some regions, worse in others)**
- **At DWD, we developed a methodology to use information from data assimilation (DA) to adaptively optimize uncertain parameters (internally referred to as model-DA coupling)**

Special acknowledgements to Harald Anlauf and Christine Sgoff for related work in data assimilation

See presentation given at the Systematic Error Workshop for more details

Methodology

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DWD

- Forecast variables targeted for adaptive optimization: T2M, RH2M, FF10M
- Time-filtered data assimilation increments for temperature, humidity and wind speed at the lowest model level are used as proxies for the model bias / predictors for adaptive optimization (filtering time scale 2.5 days)
- This obviously requires assimilation of T2M, RH2M and FF10M data

Remarks

- The adaptive optimization of T2M was put into operations together with the assimilation of T2M (previous attempts of T2M assimilation were not successful)
- In regions where FF10M observations are blacklisted for assimilation, the adaptive tuning of surface friction needs to be turned off as well

Methodology

Model parameters selected for adaptive optimization

- **T2M/RH2M: stomata resistance of plants, minimum evaporation resistance of bare soil, LAI and root depth (transitional seasons only)**
- **T2M diurnal amplitude: soil heat capacity, heat conductivities of soil and skin layer, (under testing) near-surface profiles of minimum vertical diffusion coefficient**
- **T2M in the presence of snow cover: snow albedo**
- **FF10M: vegetation roughness length, SSO blocking tendency at lowest model level**

Results

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- T2M assimilation and the related elements of model-DA coupling were operationalized in May 2022
- Adaptive surface friction will follow in late November 2022 in combination with new (higher resolution) raw data for orography and a resolution upgrade (40 → 26 km for EPS, 90 → 120 levels for DET and EPS)

- To demonstrate the isolated effect of model-DA coupling on forecast skill, an experiment for autumn 2020 was repeated without coupling
- In addition, results for the preparatory (parallel routine) phases for the above-mentioned upgrade steps will be shown

Scorecard for SYNOP verification, T2M assimilation and related coupling

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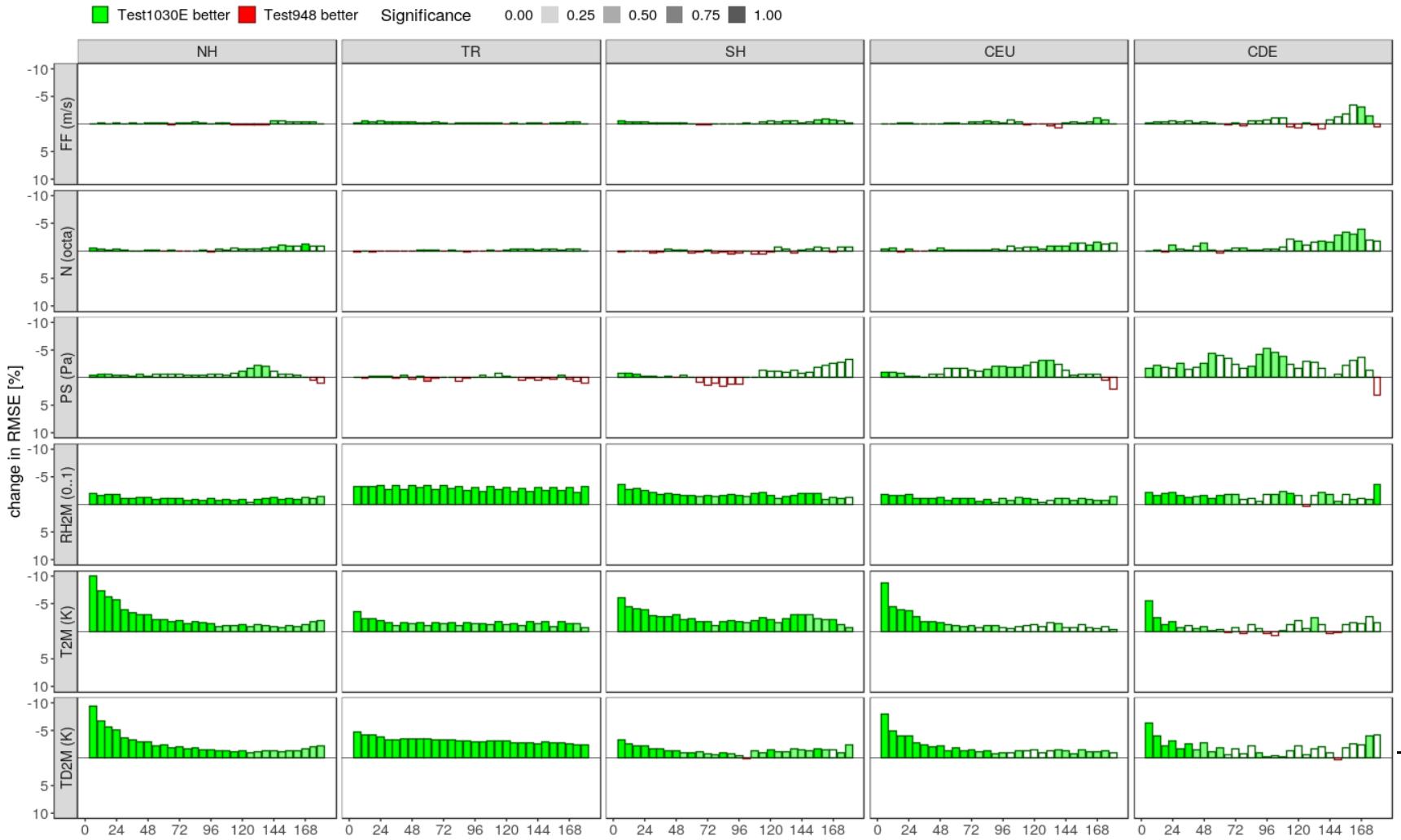

wind speed

cloud cover

surface pressure

2m humidity

2m temperature

2m dewpoint

Scorecard for SYNOP verification, adaptive surface friction and orography+resolution upgrade

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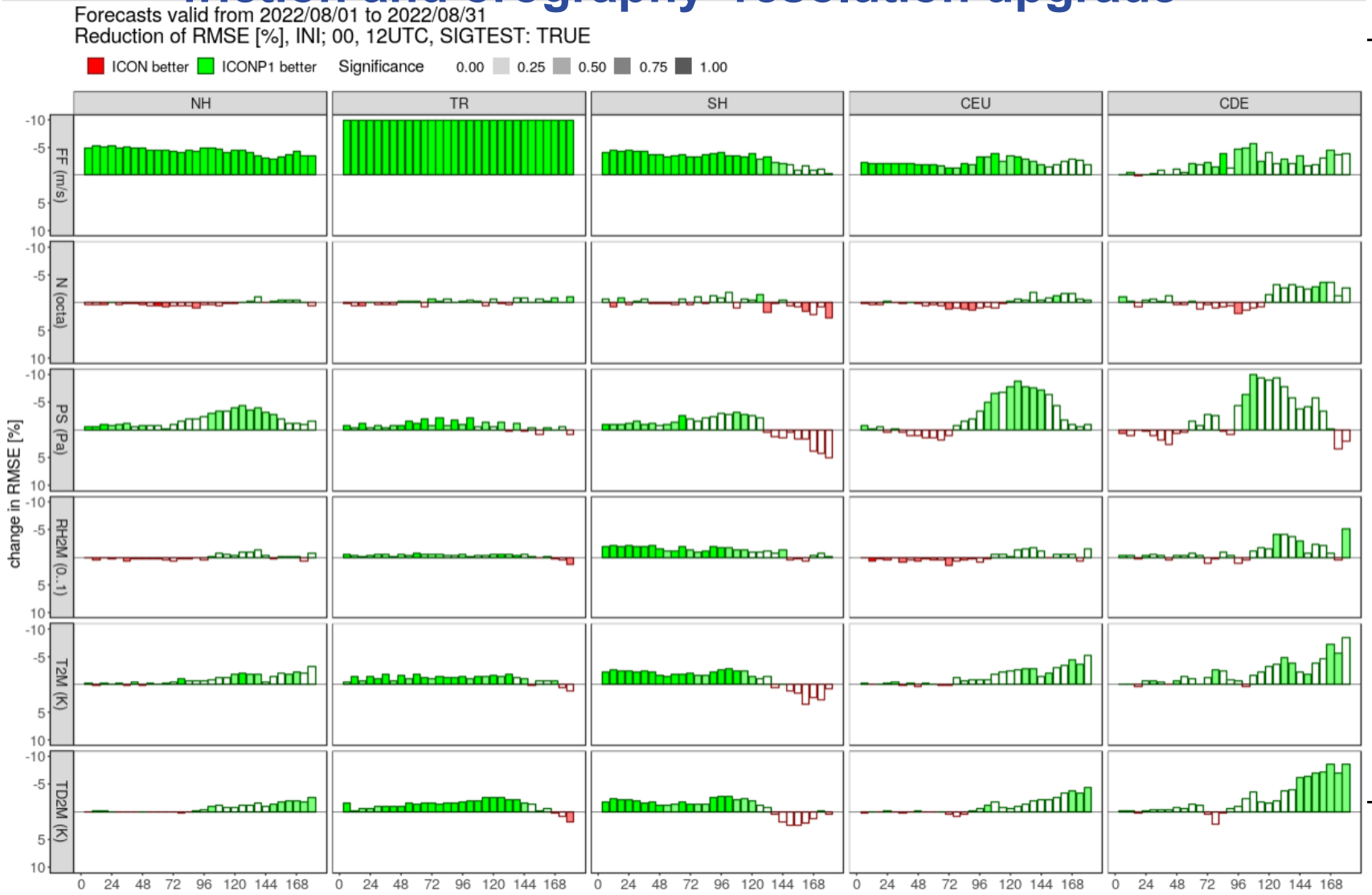

wind speed

cloud cover

surface pressure

2m humidity

2m temperature

2m dewpoint

Scorecard for SYNOP verification, benefit from full model-DA coupling when starting from same analyses

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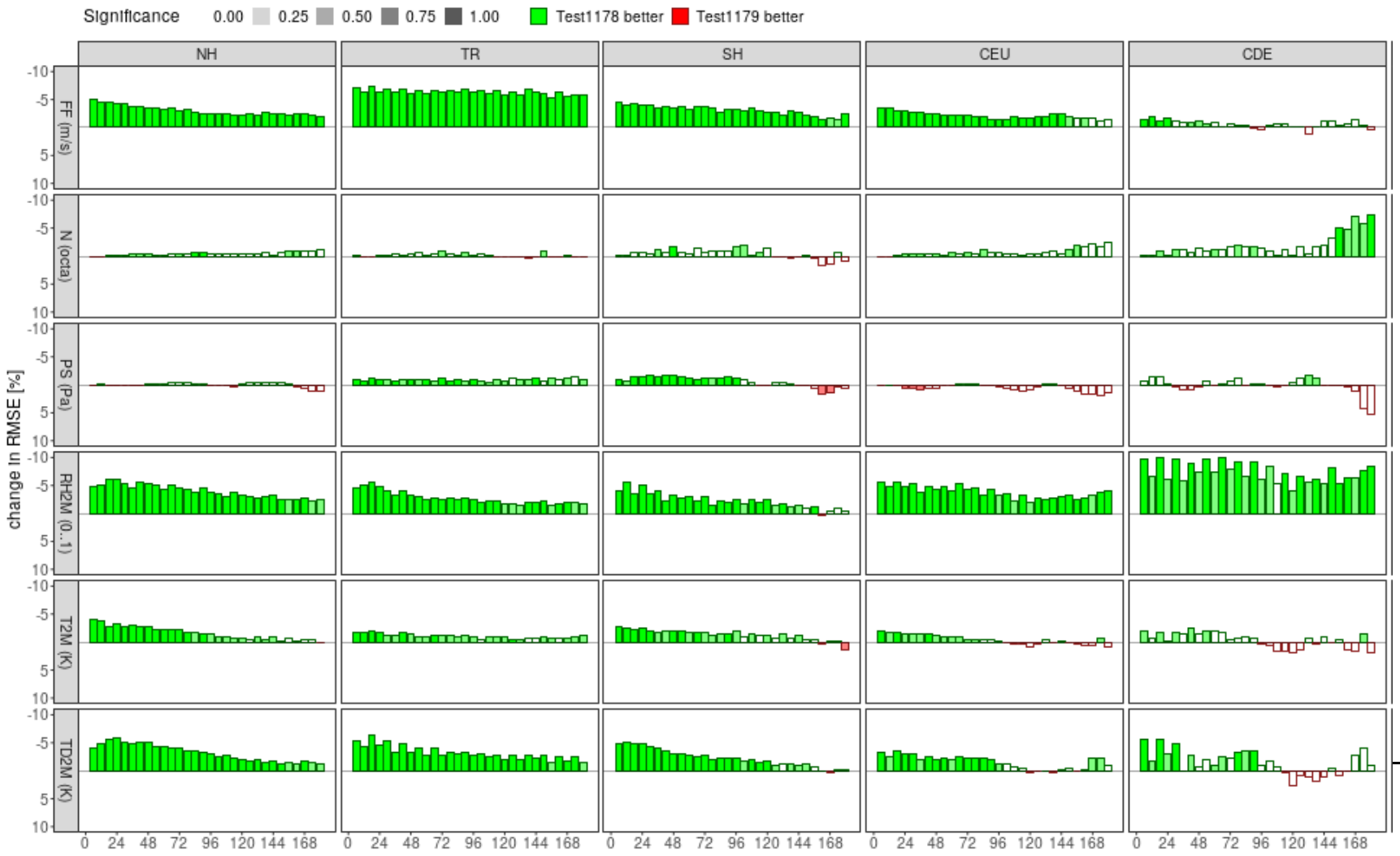

wind speed

cloud cover

surface pressure

2m humidity

2m temperature

2m dewpoint

Radiosonde verification, NH, Europe, North America, Asia

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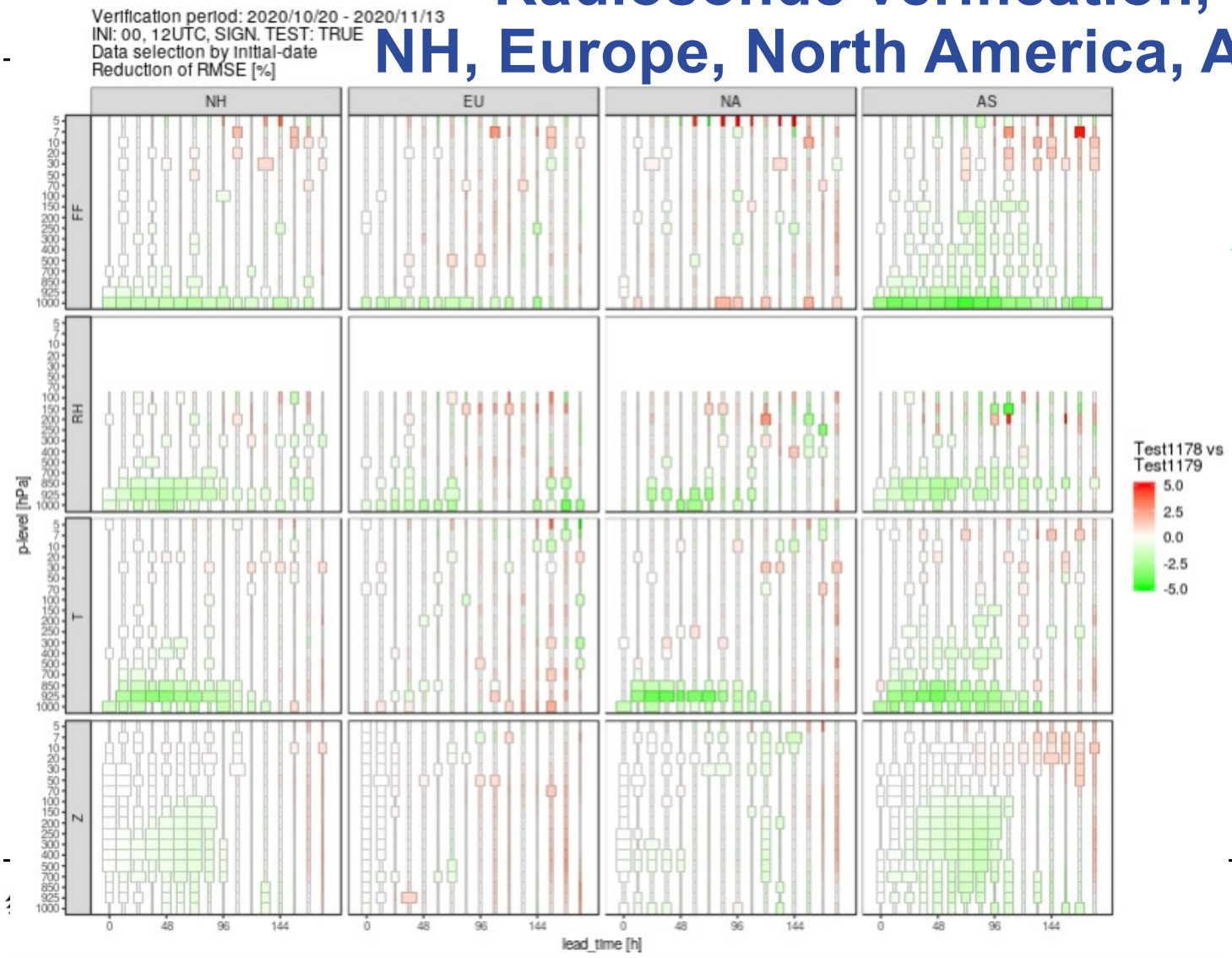

filled boxes: significant at 95% level

The score improvements in the lower troposphere give confidence that the model-DA coupling corrects true biases, not representativity errors of surface stations