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Swiss Confederation

Federal Department of Home Affairs FDHA
Federal Office of Meteorology and Climatology MeteoSwiss

KENDA Activities at MeteoSwiss

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MeteoSwiss, Switzerland

COSMO General Meeting, 3.9.2018, St. Petersburg, Russia

Outline

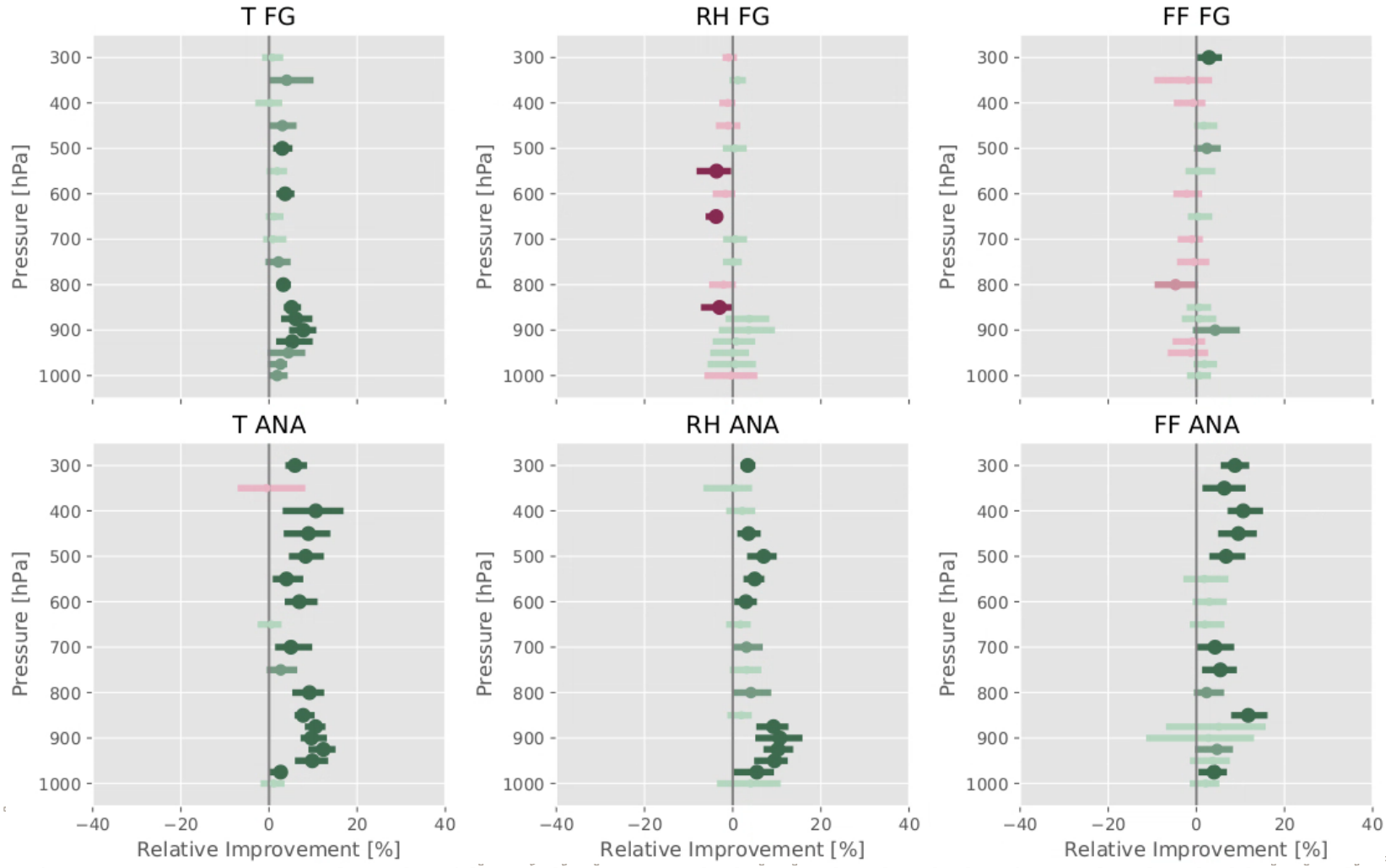
- KENDA Tests with Additive Covariance Inflation (ACI)
- KENDA Tests with COSMO in single precision (SP)
  - 1h COSMO forecast 20% to 30% faster
  - good results for atmosphere (& COSMO-E forecasts), but problems within the soil for both temperature and moisture
- Assimilation of temperature and humidity profiles from Raman Lidar at Payerne
  - encouraging results for convection case
  - small impact for low stratus case

Tests with ACI

- Additive Inflation settings and external data (from global model) provided by DWD
- Parallel Suites running from
  - 2018-01-01 to 2018-02-05 (Winter period)
  - 2018-06-02 to 2018-07-02 (Summer period)
- Using same LBCs and Observations as operational

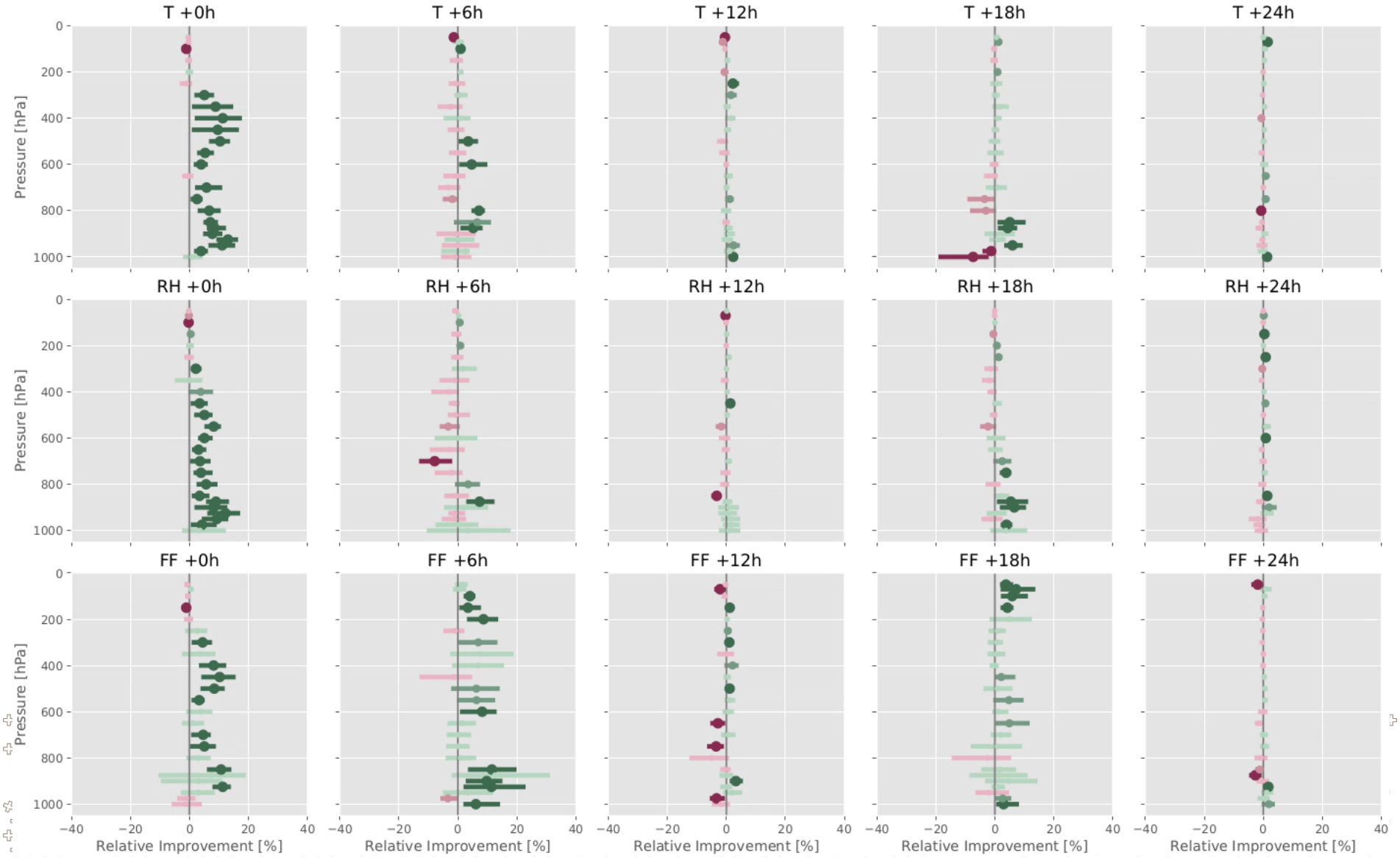
Tests with ACI (Winter Period)

Percentage Improvement of **KENDA det member** **RMSE** compared to OPR



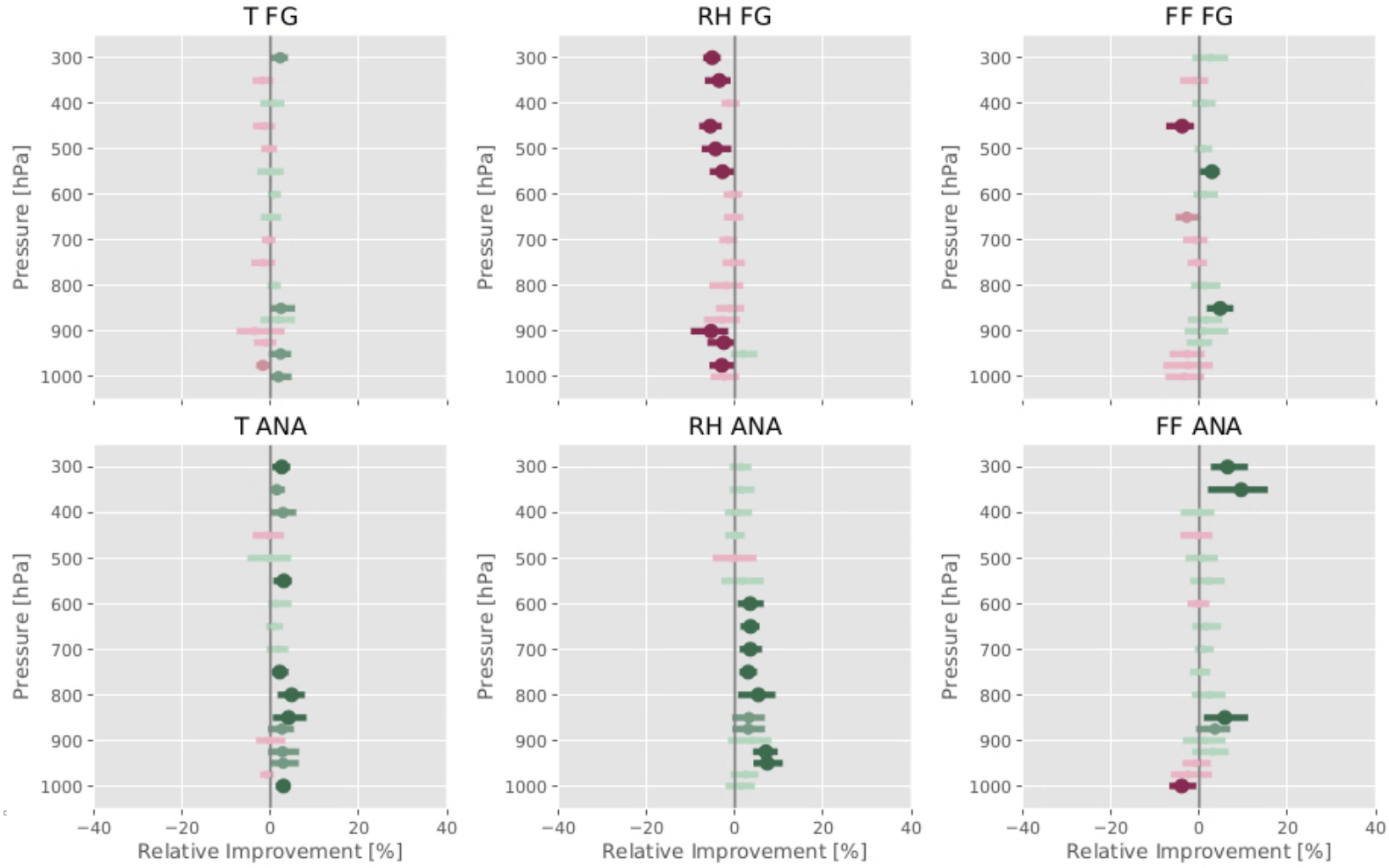
Tests with ACI (Winter Period)

Percentage Improvement of **COSMO-E CTRL** **RMSE** compared to OPR



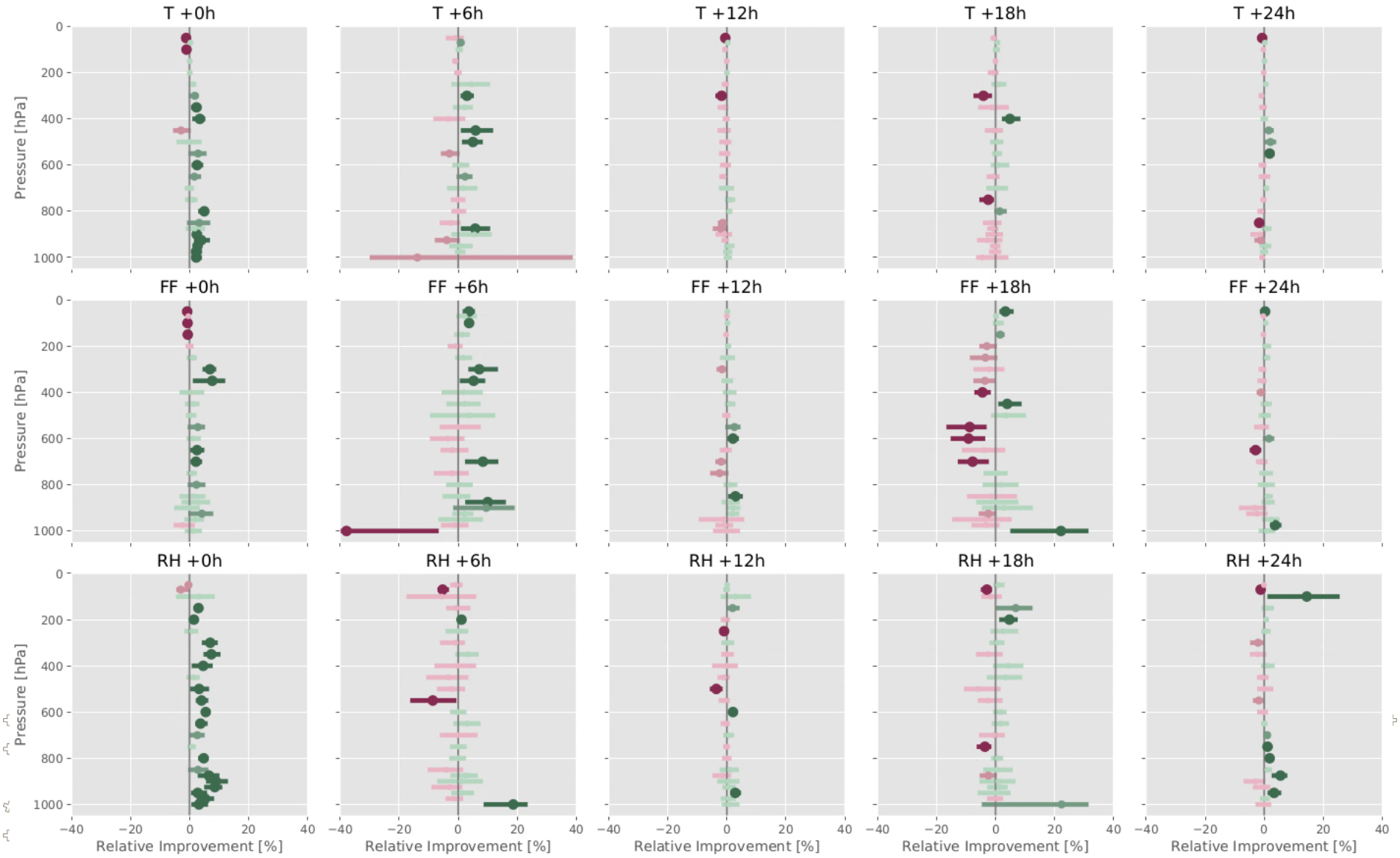
Tests with ACI (Summer Period)

Percentage Improvement of **KENDA det member** **RMSE** compared to OPR



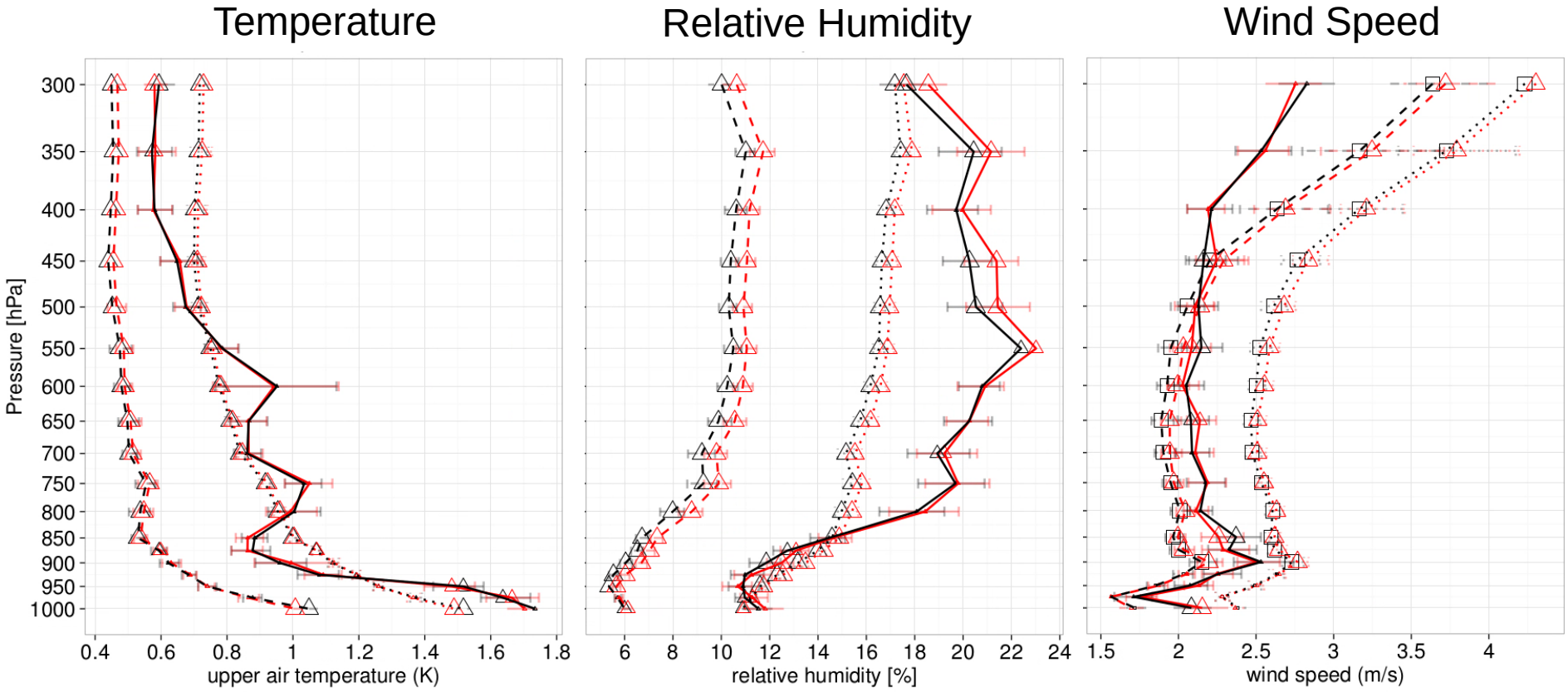
Tests with ACI (Summer Period)

Percentage Improvement of **COSMO-E CTRL** **RMSE** compared to OPR



Tests with ACI (Summer Period)

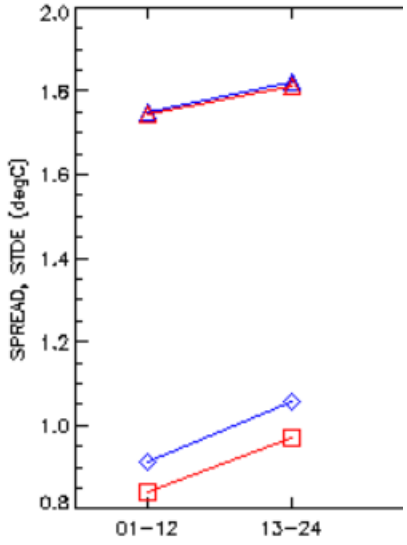
DA **First Guess Spread** and **RMSE**



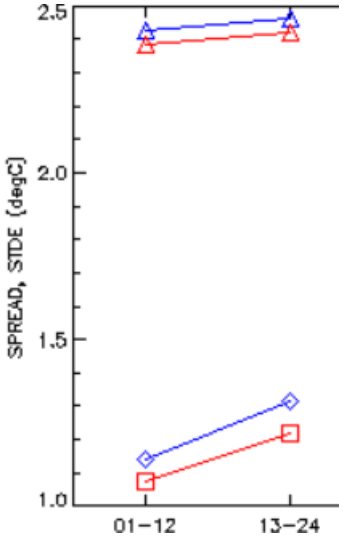
Tests with ACI (Summer Period)

COSMO-E verification against SYNOP Observations of Swiss Stations

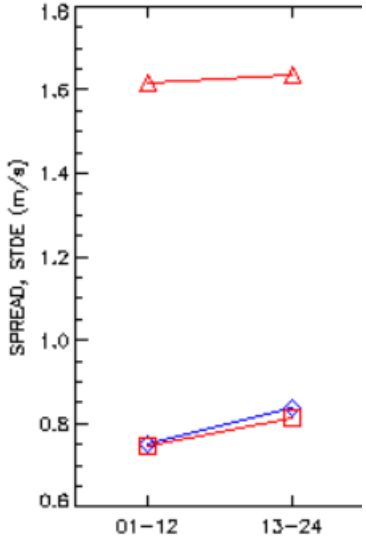
T_2M



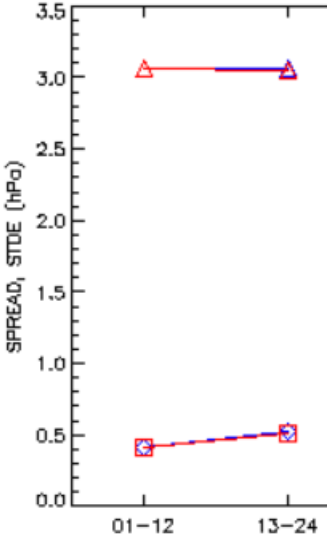
TD_2M

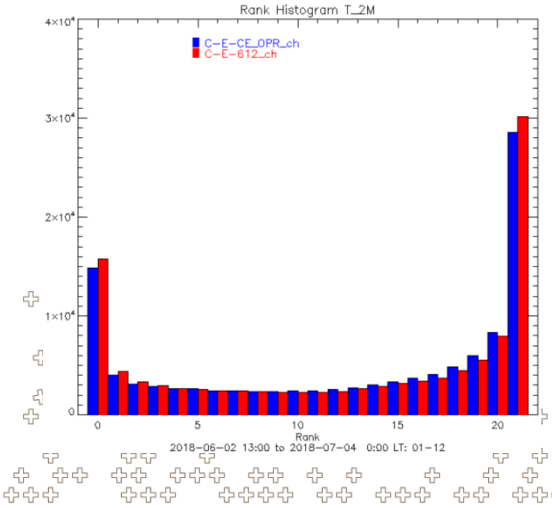


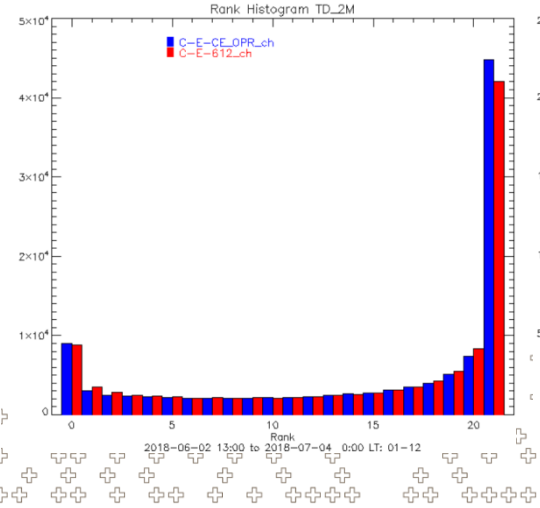
FF_10M

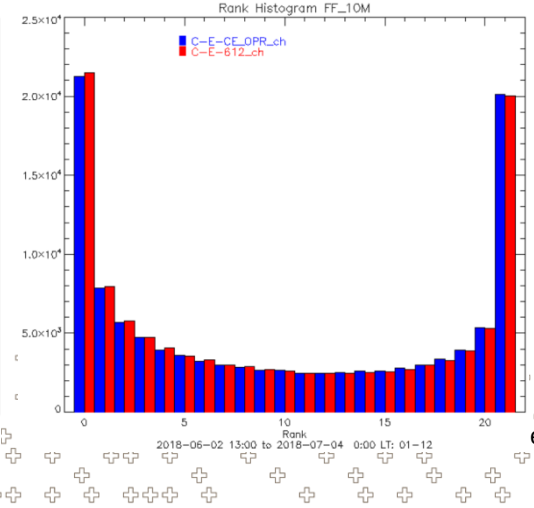


PS









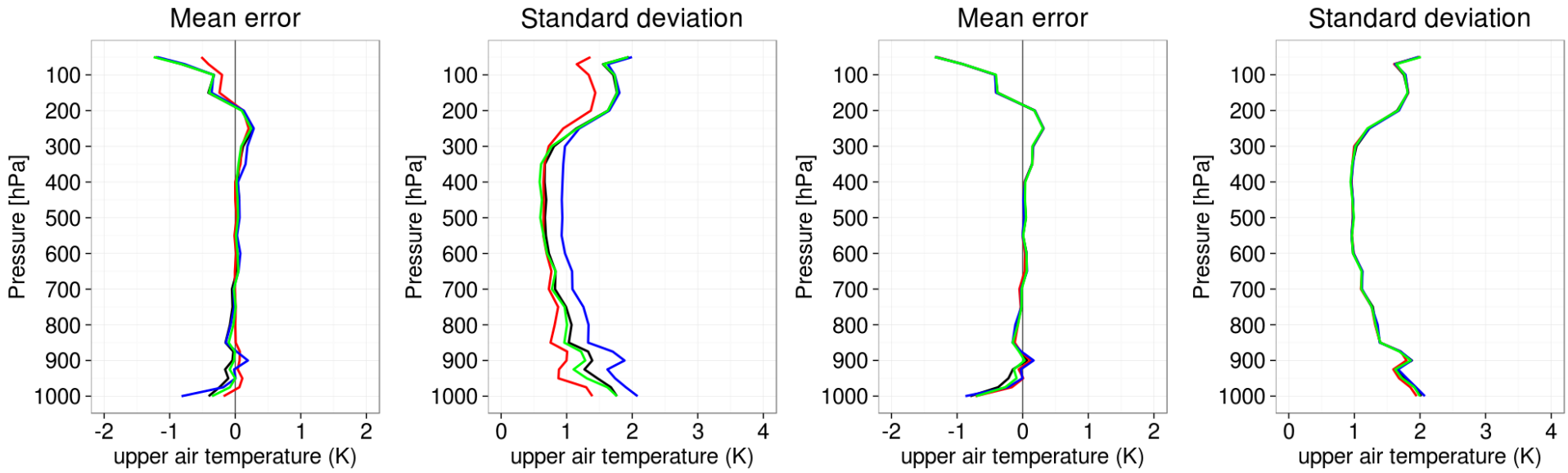
ACI
OPR

et al.

Tests with ACI: Comparison with Nudging

COSMO-E CTRL and Nudging Forecast verification against Radiosondes

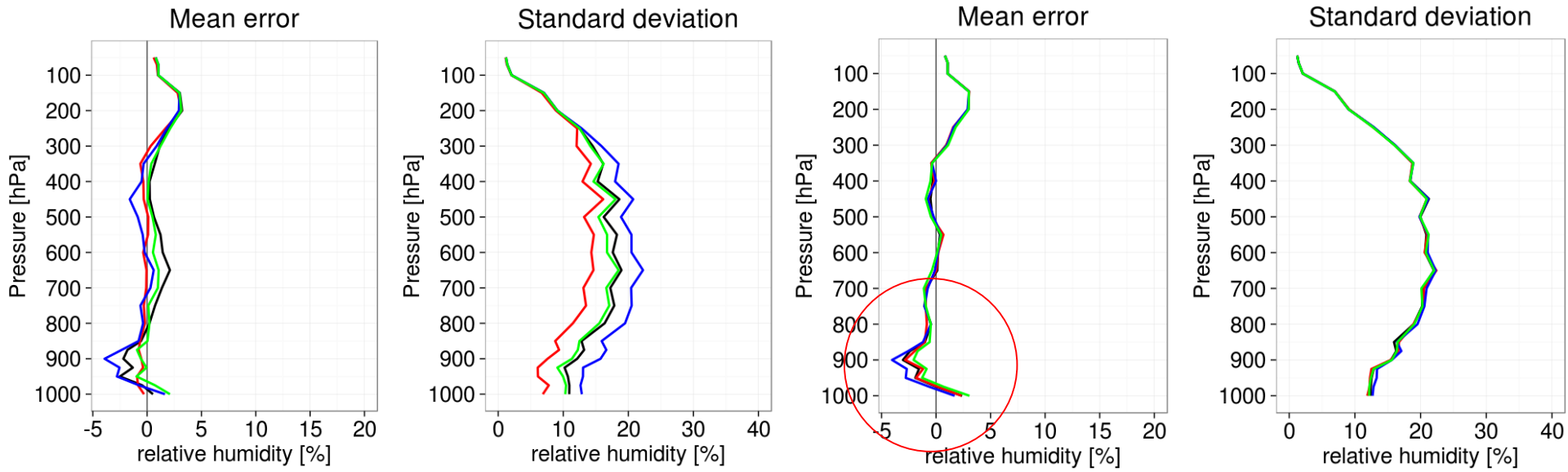
Winter Temperature



Tests with ACI: Comparison with Nudging

COSMO-E CTRL and Nudging Forecast verification against Radiosondes

Winter Relative Humidity



+0h

+12h

KENDA OPR
KENDA ACI
Nudging
No-Obs

Tests with ACI: Summary

- KENDA **Analysis** is significantly improved with ACI
- **Less** positive impact in KENDA **First Guess** and COSMO-E **forecasts**
- Improvements **larger in Winter** than in Summer
- In Winter: improvements in bias longer lasting than in STDE (not shown)
- **Nudging** Analyses still significantly closer to Radiosonde obs.
  +12h forecasts equally performing
- **Spread**:
  - Slight increase in (upper) atmosphere
  - Near surface (2m/10m): nearly no increase, even slight decrease in T and Td in summer

Tests with ACI: Conclusions & plans

- ACI goes into **right direction**, but only **modest** benefit
- Will hopefully be put into operations before next winter
- Try ACI without multiplicative inflation (input by Pieter Houtekamer, Tests of Yuefei Zheng, LMU)
- Try modified quality control in LETKF (not yet used)
- Hope for larger improvements with COSMO-derived B-Matrix

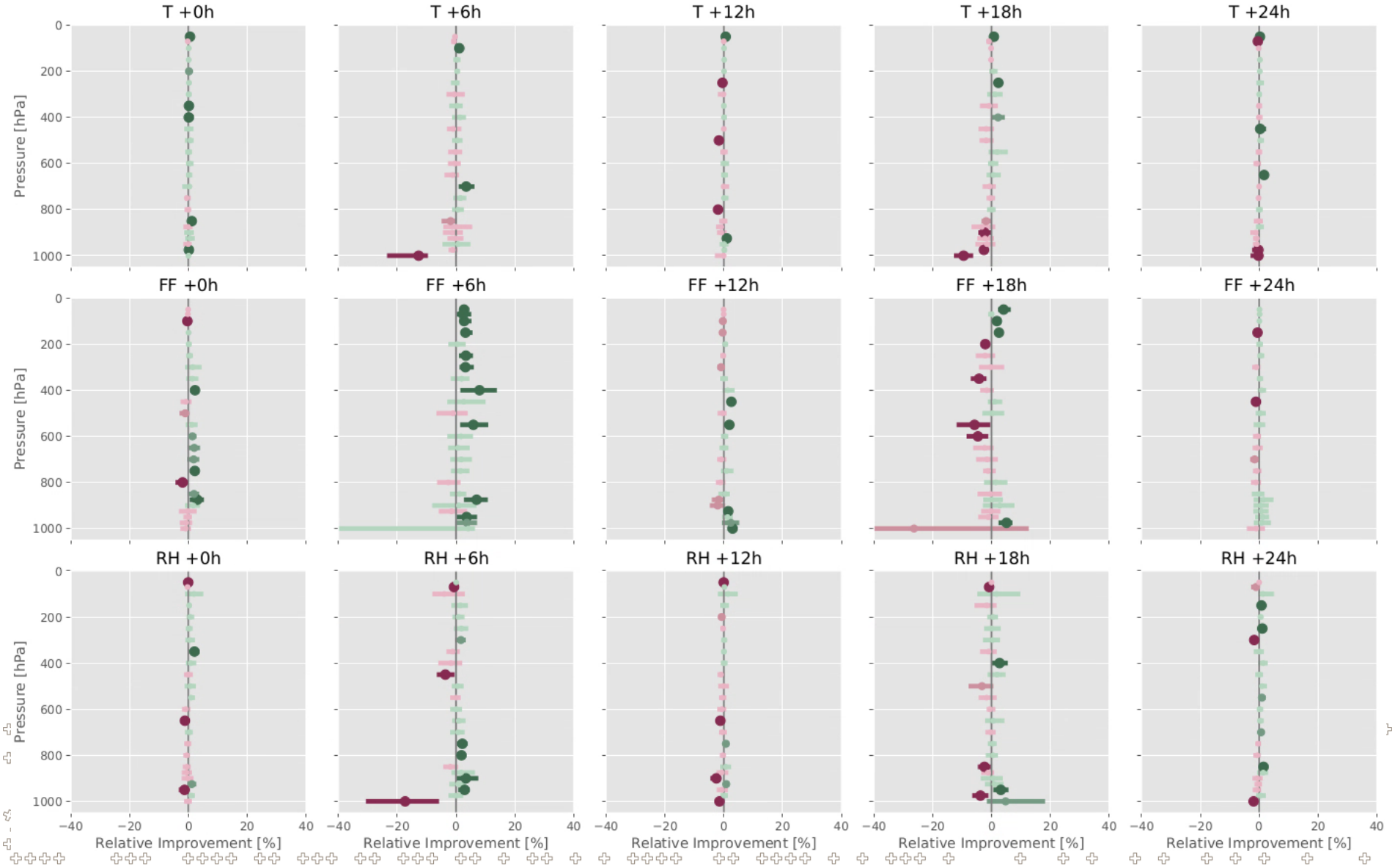
KENDA Tests with COSMO in single precision (SP)

KENDA Tests with COSMO in SP

- Test COSMO single precision in KENDA Cycle
- LETKF unchanged (i.e., double precision)
- Parallel Suite running from 2018-06-06 to 2018-08-18
- Using same LBCs and Observations as operational

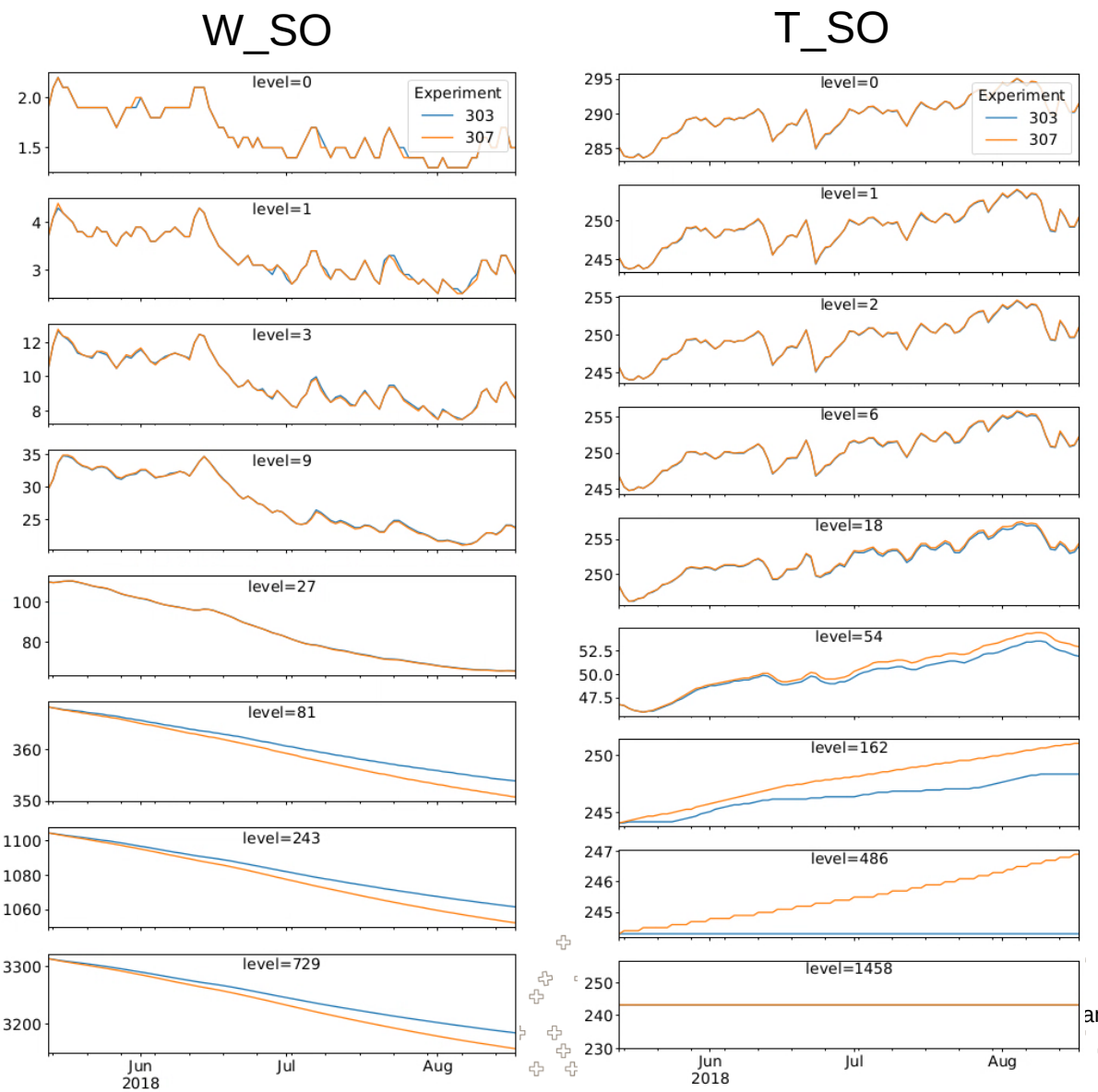
KENDA Tests with COSMO in SP

Percentage Improvement of COSMO-E CTRL RMSE compared to OPR



KENDA Tests with COSMO in SP

Domain average of W_SO and T_SO for selected soil levels



Single
Double

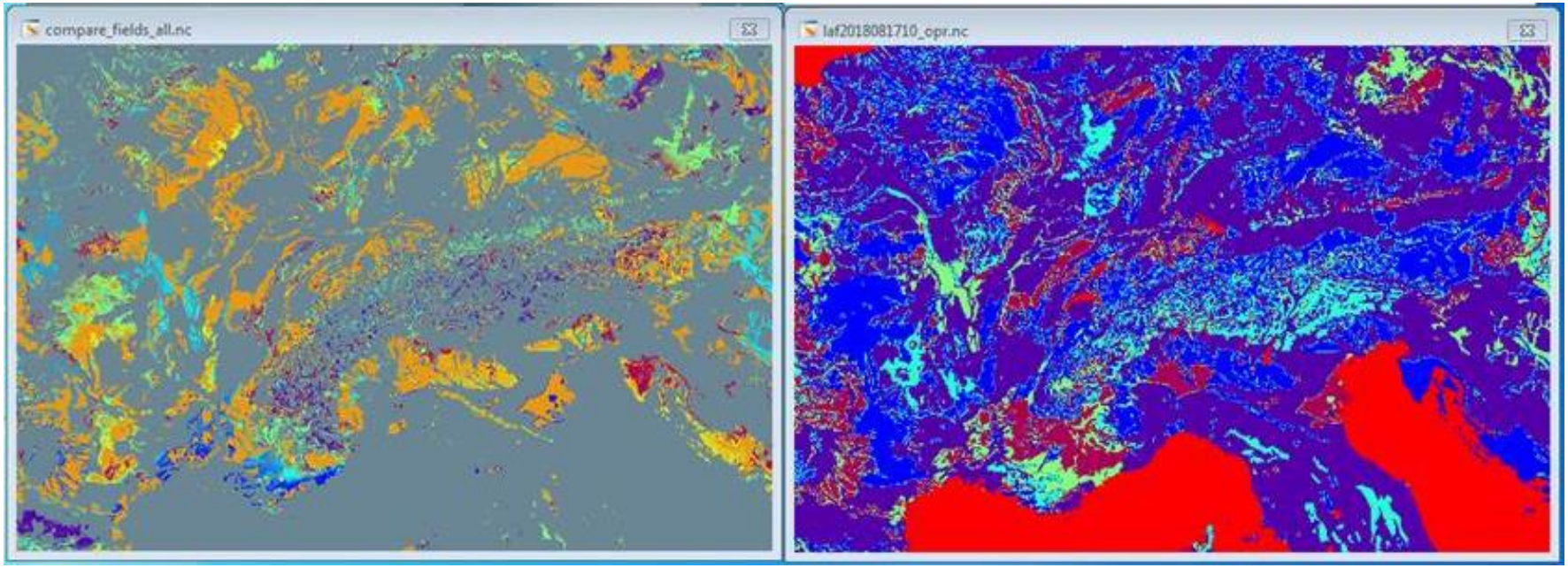
Differences
in lower levels

KENDA Tests with COSMO in SP

Difference of T_SO at 17.8.2018

Difference in T_SO between SP and DP
orange colour: up to 18K difference

Soil types



SP Tests: Summary and Conclusions

- 1h COSMO forecast in KENDA mode is **between 20% and 30% faster with SP**
- **Neutral results** for forecasts up to +24h lead time verified against radiosondes and SYNOP (latter not shown)
- KENDA cycle with COSMO in SP works well in atmosphere
- However: drift in soil moisture and temperature, large differences between SP and DP soils already after a couple of weeks!

Assimilation of temperature and humidity profiles from Raman Lidar at Payerne

Assimilation of Lidar Observations

- Lack of temperature and humidity obs in PBL
- Raman Lidar can provide temperature and humidity profiles with high temporal and vertical resolution
- Investigate impact of Lidar profiles in the operational, convective-scale ensemble DA and NWP system of MeteoSwiss
- Two case studies: a convection and a low stratus case

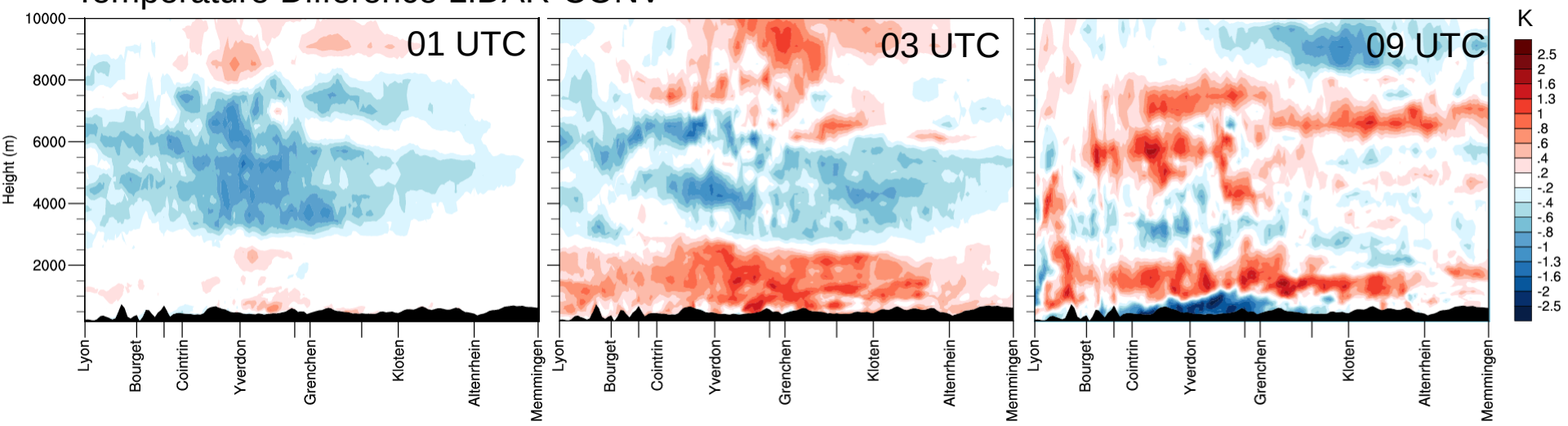
Experimental Setup

- KENDA assimilation at 24.08.2017 from 00UTC to 12UTC
  - CONV (assimilation of conventional and Radar obs)
  - LIDAR (additional assimilation of Lidar T and RH profiles)

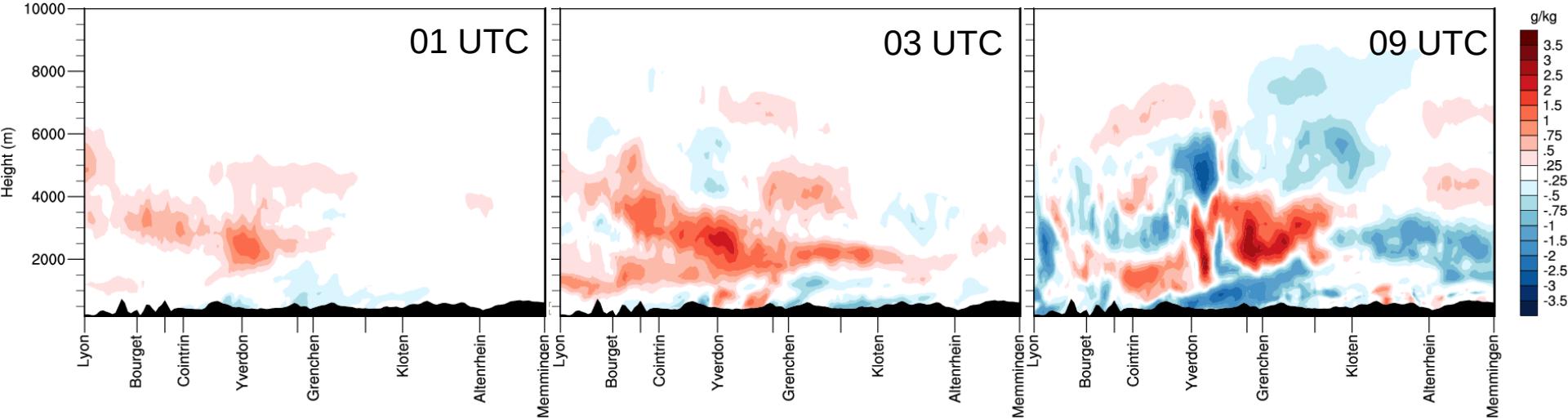
- COSMO-E forecasts (CTRL and ensemble) started at 12UTC from CONV and LIDAR analyses

Effect of Lidar Obs on Analysis Means

Temperature Difference LIDAR-CONV

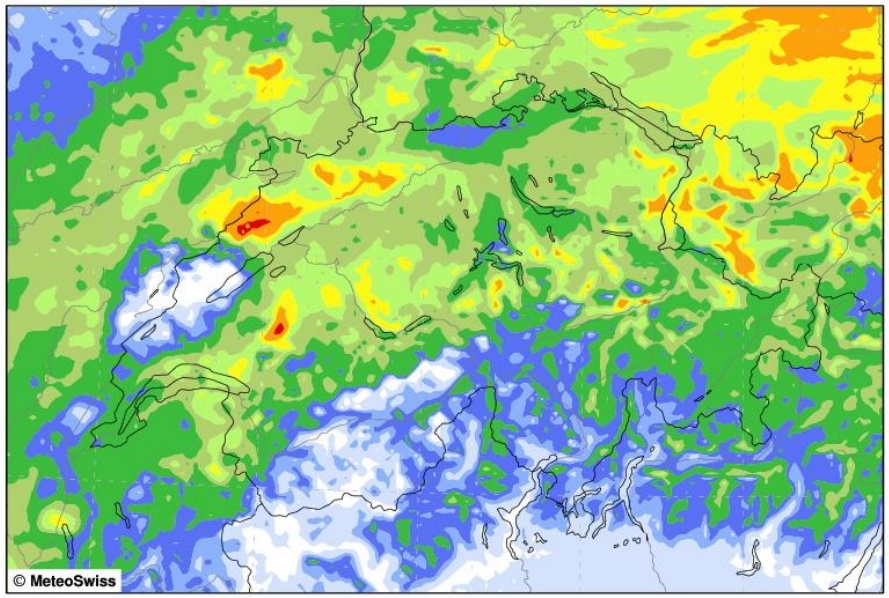


Specific Humidity (q_v) Difference CONV-LIDAR

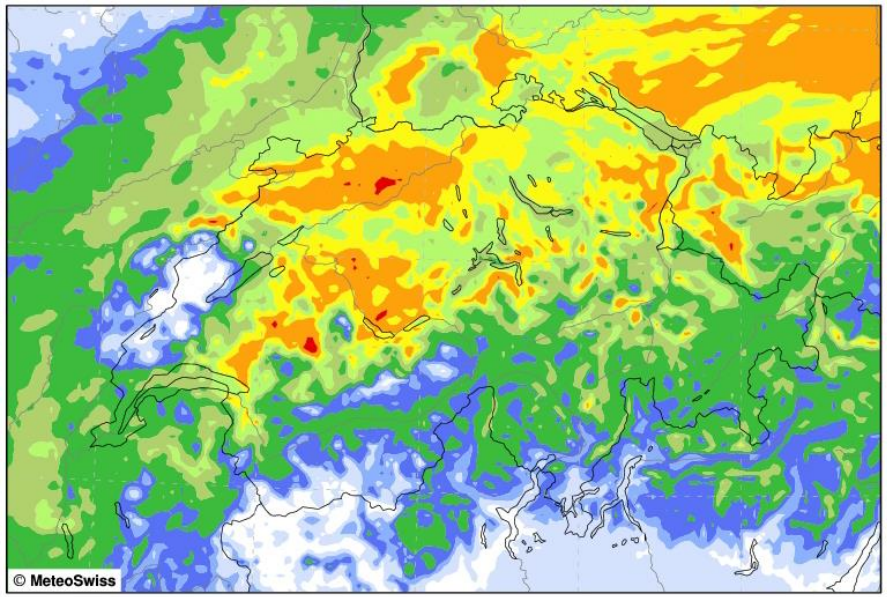


Pre-convective Environment

CAPE of Analysis Means valid at 12UTC (IC of forecasts)



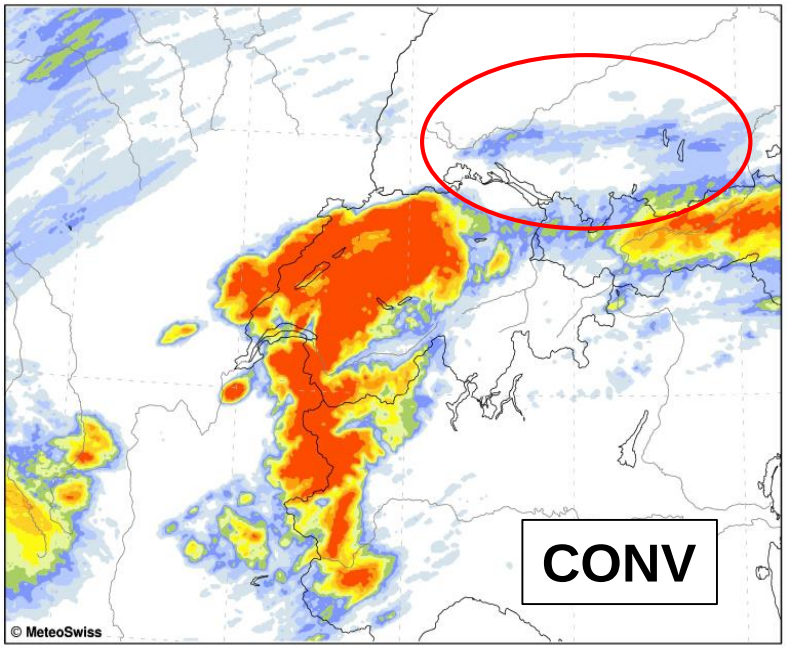
CONV

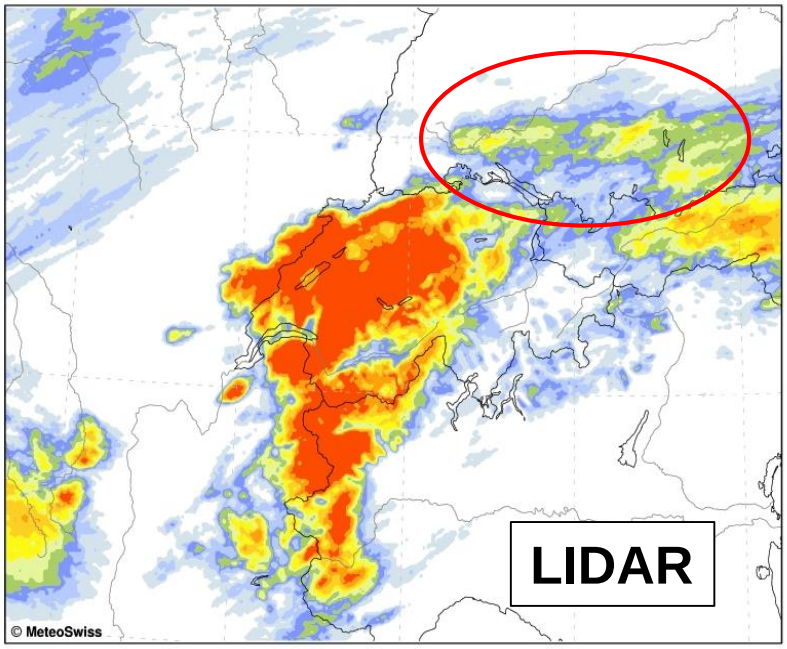


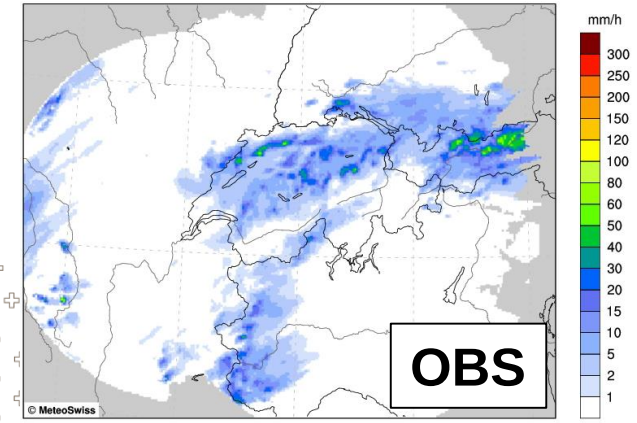
LIDAR

Precipitation Forecasts

Probability that 24h precipitation sum exceeds 1mm







Assimilation of Lidar Obs: Summary

- Raman Lidar observations close a gap in PBL observation system
- Continuous temperature and humidity profiles from Lidar in Payerne (average availability of 60%)
- Quality approaching that of radiosonde observations
- **Successful** assimilation with COSMO KENDA for a convection and low stratus case
- **Lidar obs successfully adjusted the pre-convective environment, allowing for a more skilful precipitation forecast**
- Impact **smaller** for the low stratus case (not shown)

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