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## MEC-based KENDA for ICON-LAM

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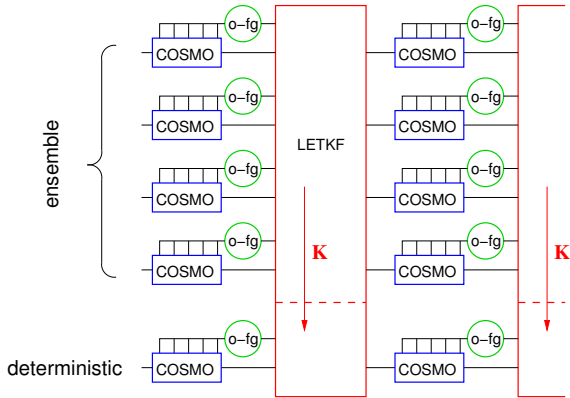
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# Content

- ▶ setup of MEC-based KENDA
- ▶ experimental setup
- ▶ first results
- ▶ outlook, next steps

# KENDA system setup (operational)



*operational KENDA setup; 'o-fg' denotes observation minus first guess, 'K' the Kalman Gain for the analysis mean. BC are taken from ICON-EU (20/6.5 km resolution)*

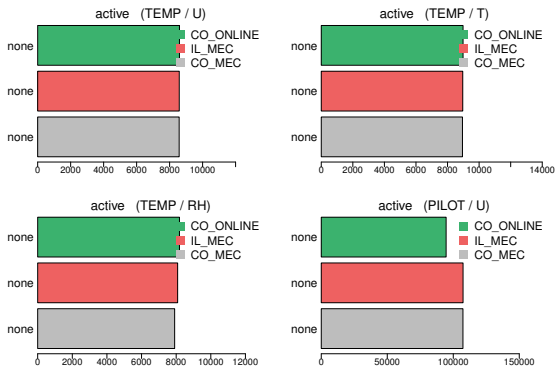
## MEC-based setup

- ▶ same as before, but (o-fg) computed by additional MEC step
  - ▶ MEC reads first guess grib files and observations from cdfin files
  - ▶ currently no temporal interpolation, observation equivalents are computed with first guess only (at analysis time; “3D LETKF”)
  - ▶ name of feedback files: fof  $\rightarrow$  mof
- ▶ for COSMO, we can compare COSMO-ONLINE/COSMO-MEC
- ▶ If the differences are not too big, compare ICON-MEC/COSMO-MEC

## experiment setup

- ▶ Model:
  - ▶ ICON-LAM, 2.5 km resolution, COSMO-DE domain
  - ▶ COSMO-DE, 2.8 km resolution
  - ▶ same BC (from ICON-EU)
- ▶ experiments done with new BACY1.0, 6 days assimilation cycle (2016052600-2016060100) incl. MODE-S
- ▶ LHN was switched on, but in ICON-LAM not used due to a bug in the source code
- ▶ forecasts from 2016052606-2016060100 (deterministic only, 24 h forecast length)
- ▶ verification of assimilation cycle; forecast verification (SYNOP, upper air and radar precipitation)

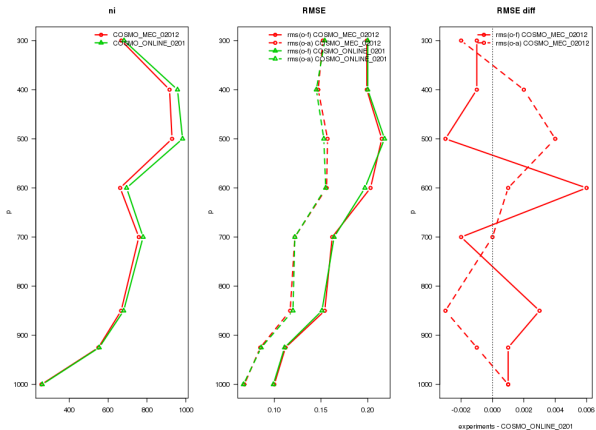
# Observation statistics



Comparison of active observations for TEMP/PILOT

# COSMO-MEC VS. COSMO-ONLINE (ass. cycle)

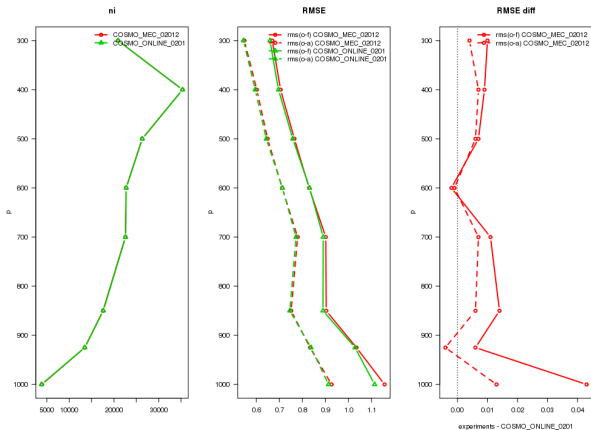
Humidity statistics for TEMP  
experiments: COSMO\_MEC\_02012, COSMO\_ONLINE\_0201  
startdate: 20160526000000 enddate: 20160531230000



TEMP verification RH COSMO-ONLINE vs. COSMO-MEC

# COSMO-MEC VS. COSMO-ONLINE (ass. cycle)

Temperature statistics for AIREP  
experiments: COSMO\_MEC\_02012, COSMO\_ONLINE\_0201  
startdate: 20160526000000 enddate: 20160531230000

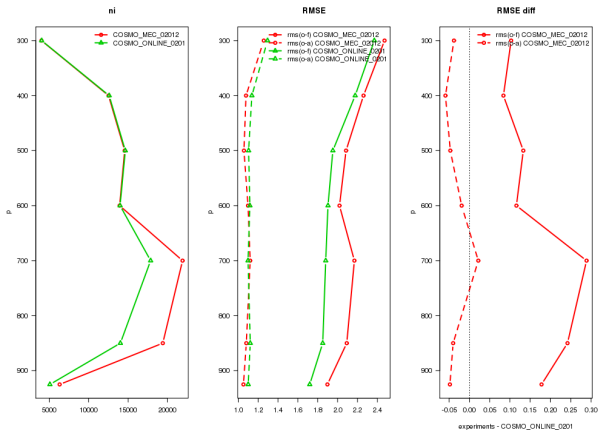


AIREP verification T COSMO-ONLINE vs. COSMO-MEC



# COSMO-MEC VS. COSMO-ONLINE (ass. cycle)

Wind statistics for PILOT  
experiments: COSMO\_MEC\_02012, COSMO\_ONLINE\_0201  
startdate: 20160526000000 enddate: 20160531230000

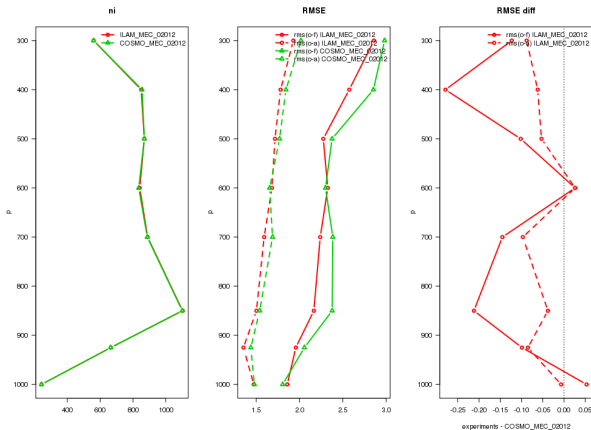


PILOT verification WIND COSMO-ONLINE vs. COSMO-MEC

- ▶ small differences between COSMO-MEC and COSMO-ONLINE; COSMO-ONLINE slightly better
- ▶ differences for PILOT are due to redundancy check; too few rejected in MEC-based setups
- ▶ ICON-MEC and COSMO-MEC are very similar w.r.t. number of used observations
- ▶ now look at ICON-MEC and COSMO-MEC/ONLINE comparison

# COSMO-MEC VS. ICON-MEC (ass. cycle)

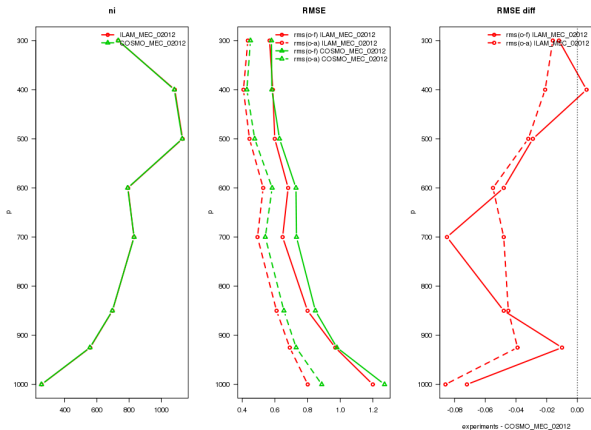
Wind statistics for TEMP  
experiments: ILAM\_MEC\_02012, COSMO\_MEC\_02012  
startdate: 20160526000000 enddate: 20160531230000



TEMP verification WIND ICON-MEC vs. COSMO-MEC

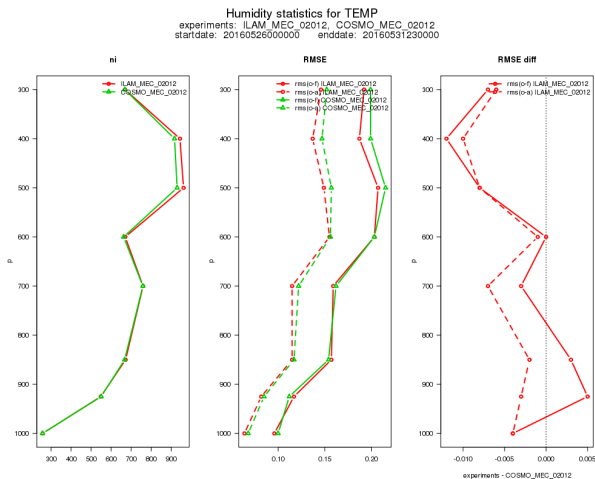
# COSMO-MEC VS. ICON-MEC (ass. cycle)

Temperature statistics for TEMP  
experiments: ILAM\_MEC\_02012, COSMO\_MEC\_02012  
startdate: 20160526000000 enddate: 20160531230000



TEMP verification T ICON-MEC vs. COSMO-MEC

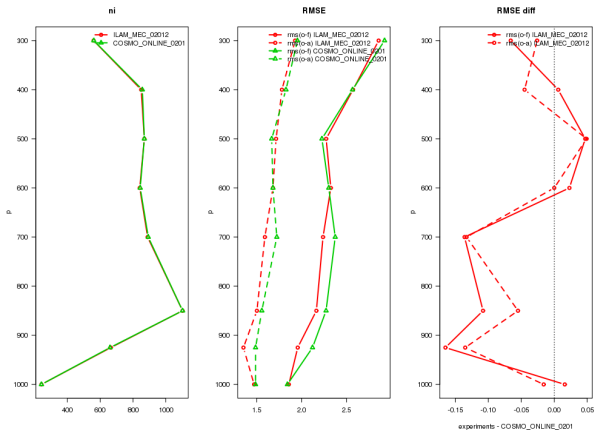
# COSMO-MEC VS. ICON-MEC (ass. cycle)



TEMP verification RH ICON-MEC vs. COSMO-MEC

# COSMO-ONLINE VS. ICON-MEC (ass. cycle)

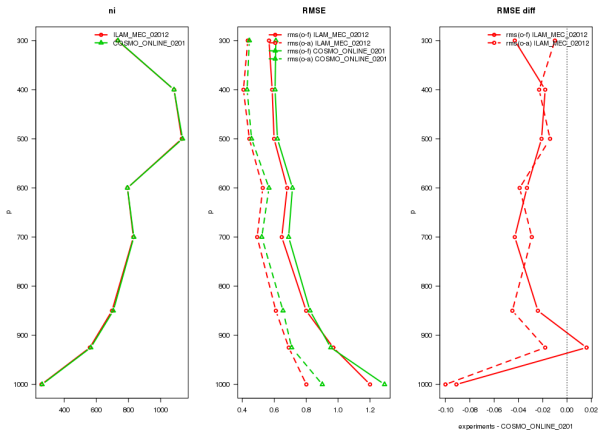
Wind statistics for TEMP  
experiments: ILAM\_MEC\_02012, COSMO\_ONLINE\_0201  
startdate: 20160526000000 enddate: 20160531230000



TEMP verification WIND ICON-MEC vs. COSMO-ONLINE

# COSMO-ONLINE VS. ICON-MEC (ass. cycle)

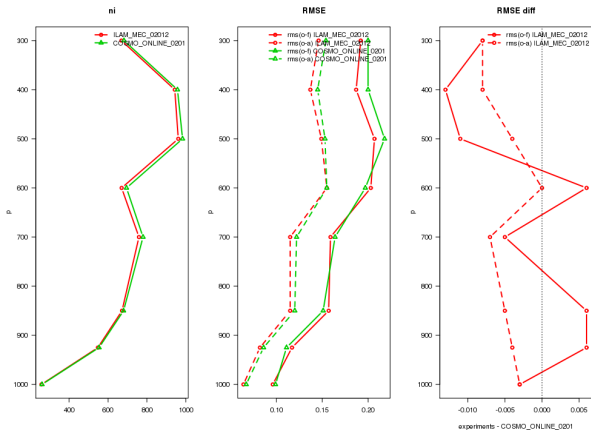
Temperature statistics for TEMP  
experiments: ILAM\_MEC\_02012, COSMO\_ONLINE\_0201  
startdate: 20160526000000 enddate: 20160531230000



TEMP verification T ICON-MEC vs. COSMO-ONLINE

# COSMO-ONLINE VS. ICON-MEC (ass. cycle)

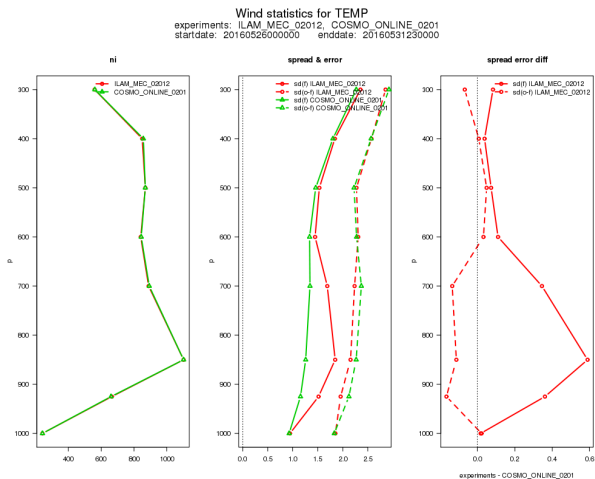
Humidity statistics for TEMP  
experiments: ILAM\_MEC\_02012, COSMO\_ONLINE\_0201  
startdate: 20160526000000 enddate: 20160531230000



## TEMP verification RH ICON-MEC vs. COSMO-ONLINE



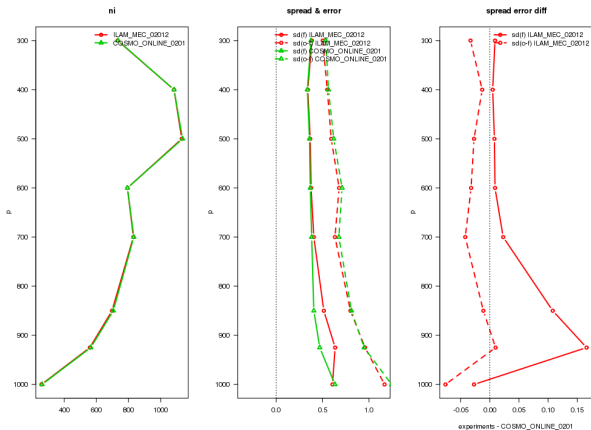
# COSMO-ONLINE VS. ICON-MEC (ass. cycle) SPREAD



TEMP verification WIND ICON-MEC vs. COSMO-ONLINE

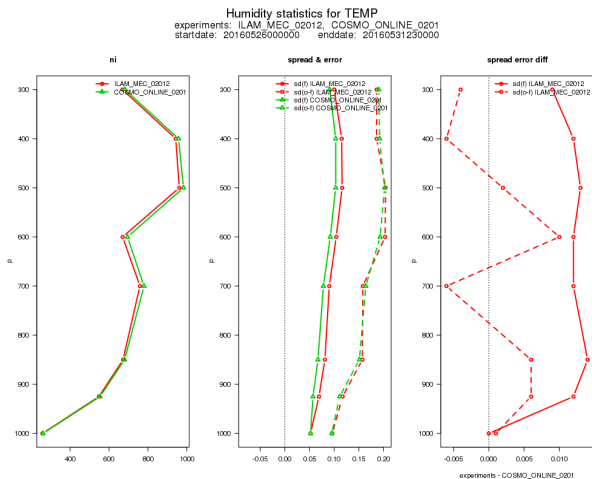
# COSMO-ONLINE VS. ICON-MEC (ass. cycle) SPREAD

Temperature statistics for TEMP  
experiments: ILAM\_MEC\_02012, COSMO\_ONLINE\_0201  
startdate: 20160526000000 enddate: 20160531230000



TEMP verification T ICON-MEC vs. COSMO-ONLINE

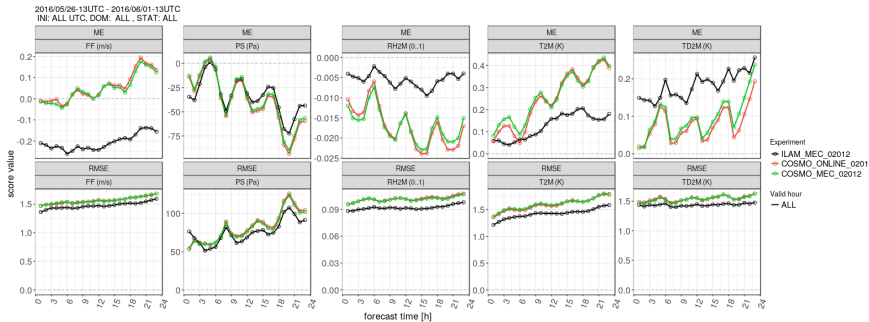
# COSMO-ONLINE VS. ICON-MEC (ass. cycle) SPREAD



TEMP verification RH ICON-MEC vs. COSMO-ONLINE

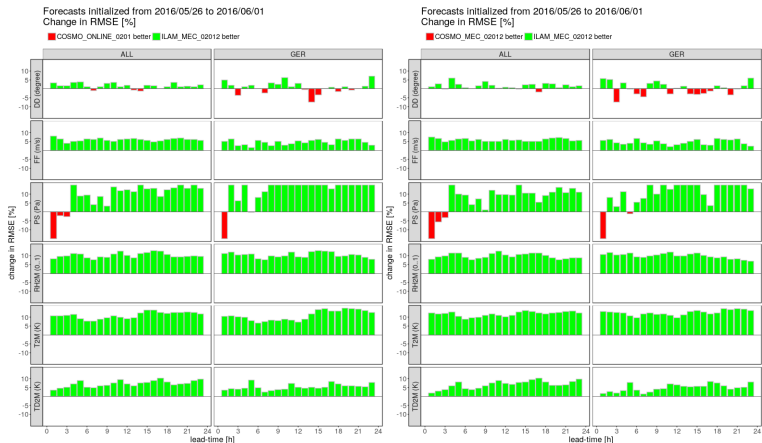
- ▶ assimilation cycle: ICON-LAM clearly outperforms COSMO-MEC, except for RH; ICON-LAM still better than COSMO-ONLINE (again except RH; neutral overall)
- ▶ Now: look at forecasts; 5 days forecasts (deterministic only, 24 h forecast time)
- ▶ SYNOP, upper air and radar verification

# FORECAST VERIFICATION



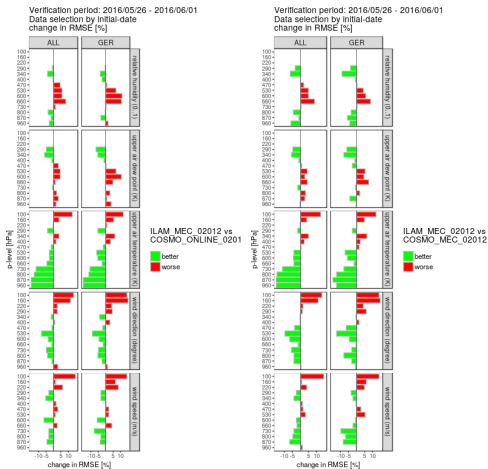
SYNOP verification ICON-MEC vs. COSMO-ONLINE vs. COSMO-MEC

# FORECAST VERIFICATION



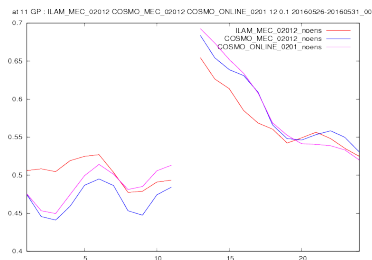
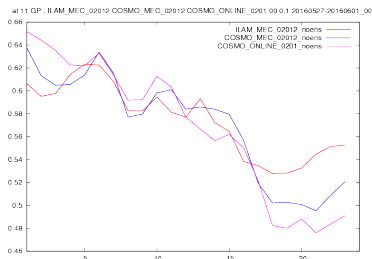
SYNOX verification, summary plot, ICON-MEC vs. COSMO-ONLINE /COSMO-MEC (left/right)

# FORECAST VERIFICATION



TEMP verification, summary plot, ICON-MEC vs. COSMO-ONLINE (left), ICON-MEC vs. COSMO-MEC (right)

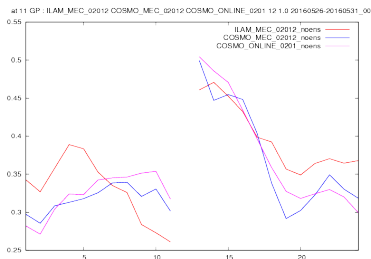
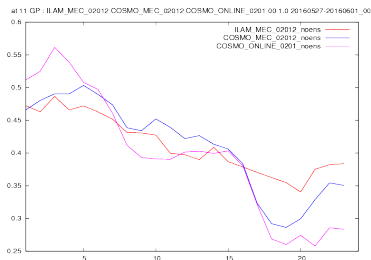
# RADAR VERIFICATION



RADAR verification new experiments, 00/12 UTC 0.1 mm threshold



# RADAR VERIFICATION



RADAR verification new experiments, 00/12 UTC 1.0 mm threshold

## Forecast summary

- ▶ ICON-LAM for SYNOP clearly outperforms COSMO
- ▶ upper air: ICON-LAM better for lower levels, worse for stratosphere; maybe due to not nudging against boundaries in ICON-LAM (no relaxation against driving model)?
- ▶ due to the LHN-bug, ICON-LAM is penalised in precipitation verification, at least in the first few hours

## summary / next steps

- ▶ ICON-LAM already outperforms COSMO for most variables; precipitation scores should be improved with LHN
- ▶ repeat experiments with LHN; test IAU, hydrostatic balancing of analysis increments to reduce noise
- ▶ tuning: namelist (G. Zaengl found several namelist-switches to be changed, e.g. relaxation at lateral boundaries)
- ▶ work on ILAM-ONLINE: use (dace) observation operators in ICON-LAM during model run
- ▶ further experiments with ILAM-MEC: (new) summer period with balanced soil from ICON-EU; winter period, ...