Recent tests with the operational CNMCA-LETKF system

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Outline

➤ Operational CNMCA-LETKF system

➤ Experiments

- ◆ MODE-S aircraft assimilation
- ◆ Digital Filter Inititialization (DFI)
- ◆ SPPT (COSMO reference version)
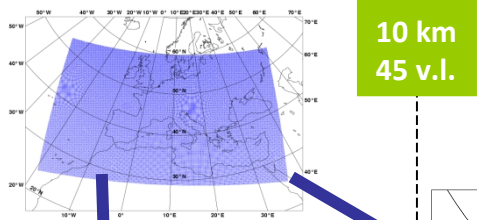- ◆ COSMO with single precision

OPERATIONAL NWP SYSTEM

Ensemble Data Assimilation:

LETKF analysis ensemble (40+1 members) every 6h using RAOB (also 4D), PILOT, SYNOP, SHIP, BUOY, Wind Profilers, AMDAR-ACAR-AIREP, MSG3-MET7 AMV, MetopA-B scatt. winds, NOAA/MetopA-B AMSUA/MHS and NPP ATMS radiances + Land SAF snow mask,
IFS SST analysis once a day

10 km
45 v.l.

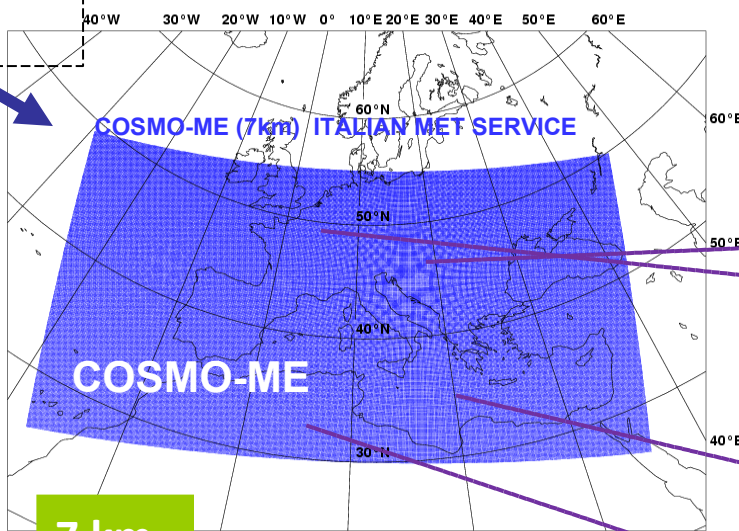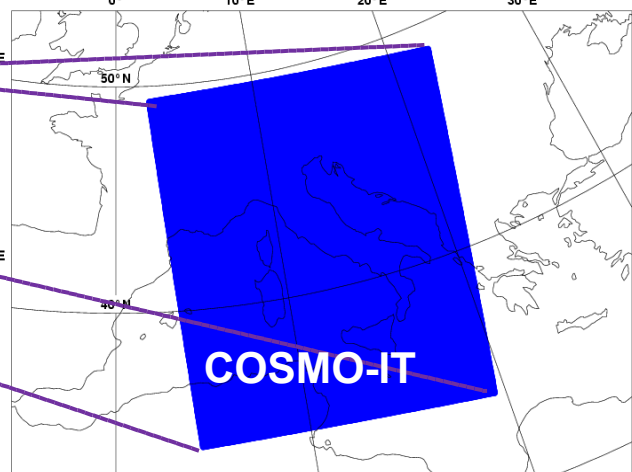**Local Area Modeling:**

2.8 km
65 v.l.
- compressible equations
- explicit convection

LETKF Analysis

Deterministic Analysis

Ensemble Prediction System:
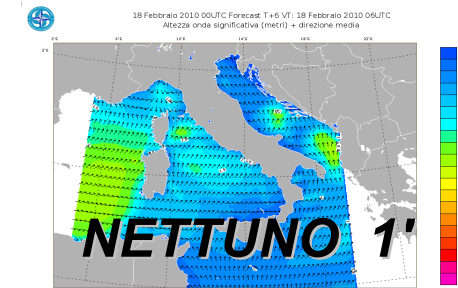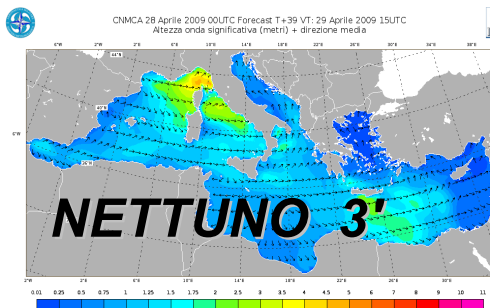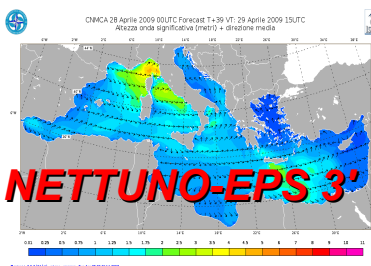
10 km
45 v.l.

COSMO-ME EPS

NETTUNO-EPS 3'

COSMO-ME (7km) ITALIAN MET SERVICE

COSMO-ME

7 km
40 v.l.
- compressible equations
- parameterized convection

NETTUNO 3'

COSMO-IT (2.8Km) ITALIAN MET SERVICE

COSMO-IT

NETTUNO 1'

MODE-S OBS INCR STATISTICS
from 10nov2014 to 10dec2014

Thinning: 30 km, 6 hPa
Observation error : uv-wind as AMDAR,
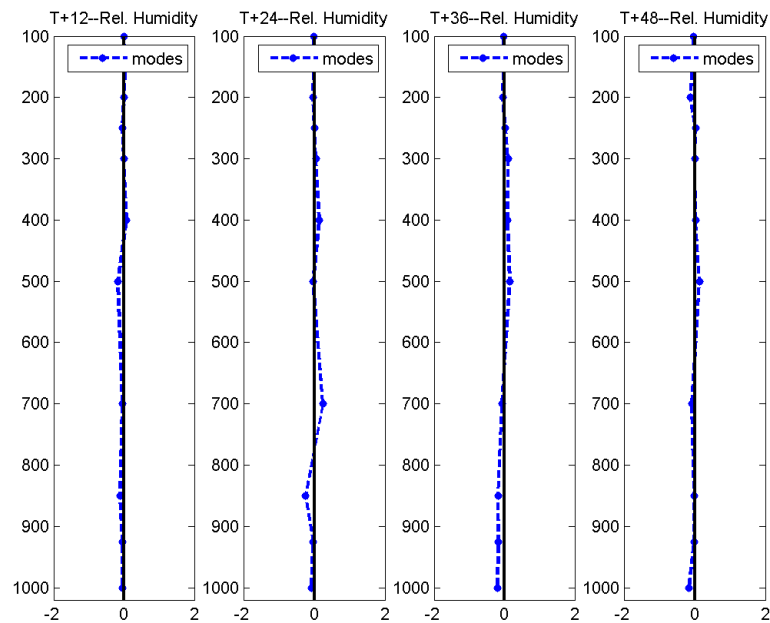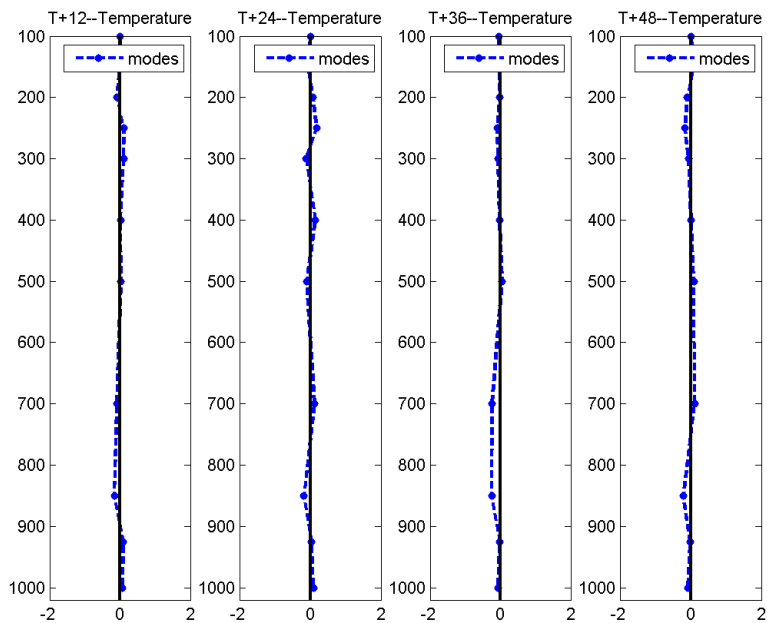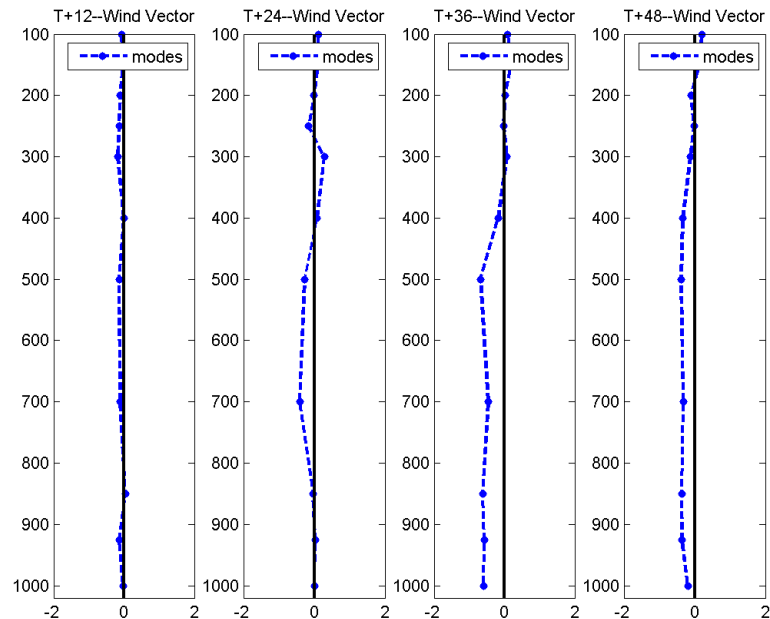temperat. about 1.5 * AMDAR T error
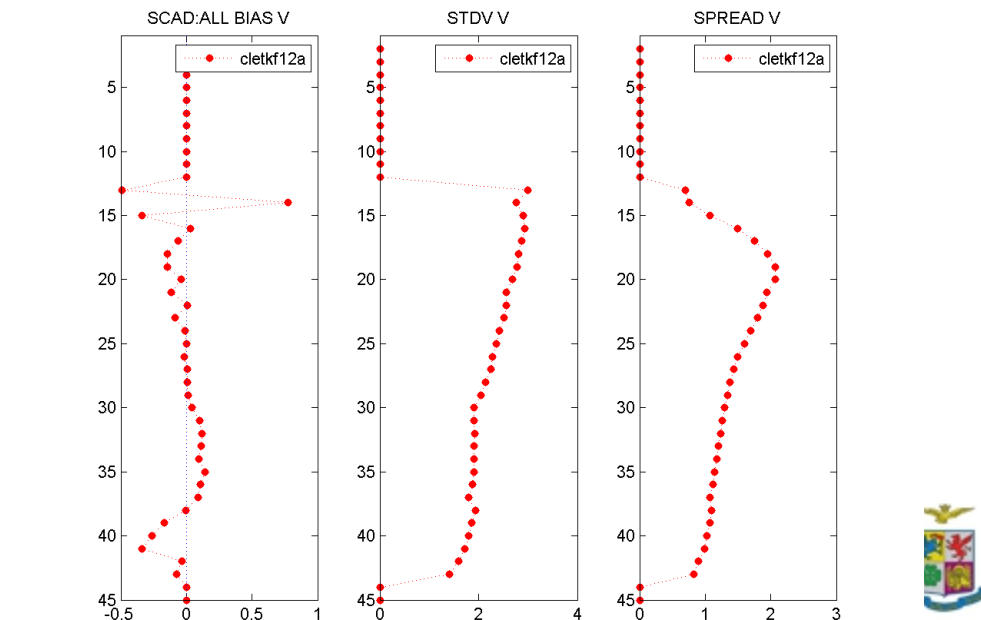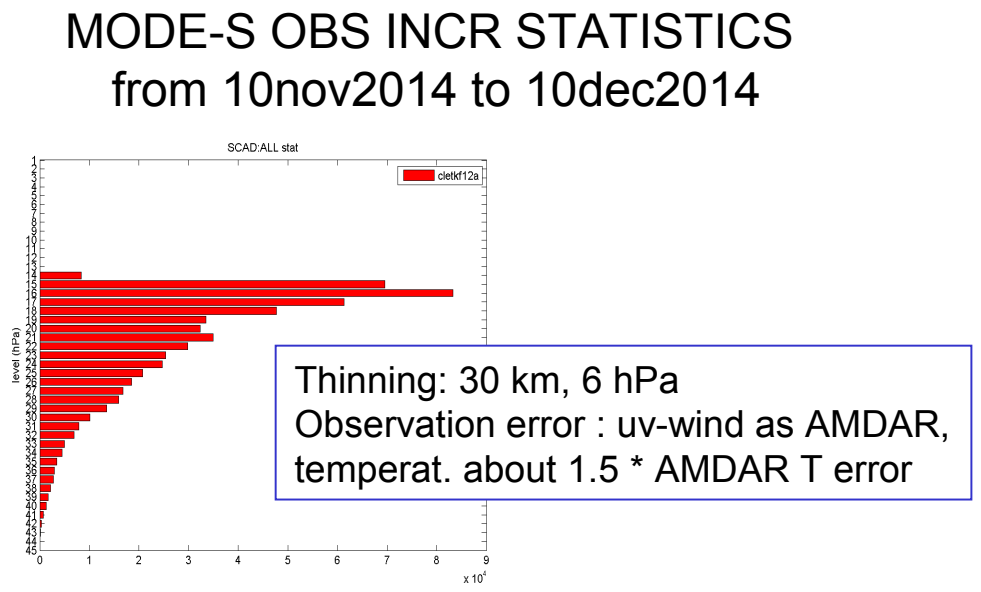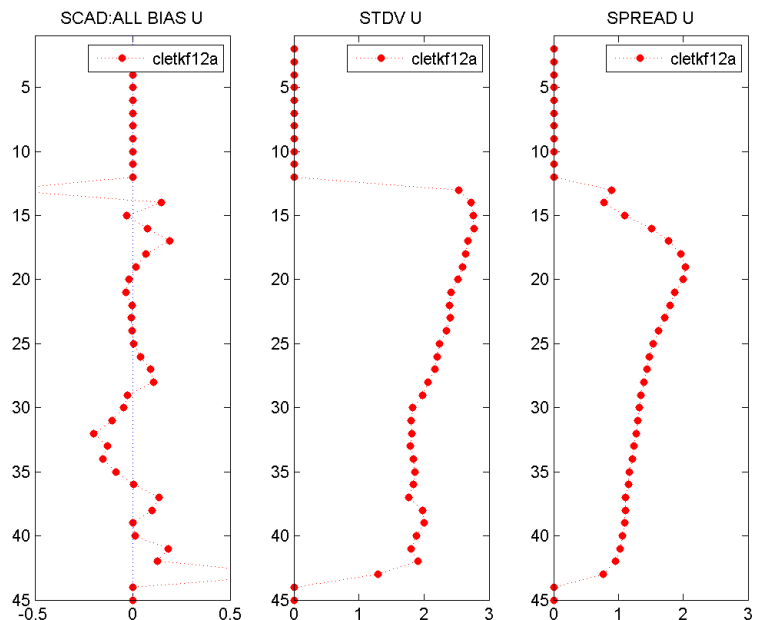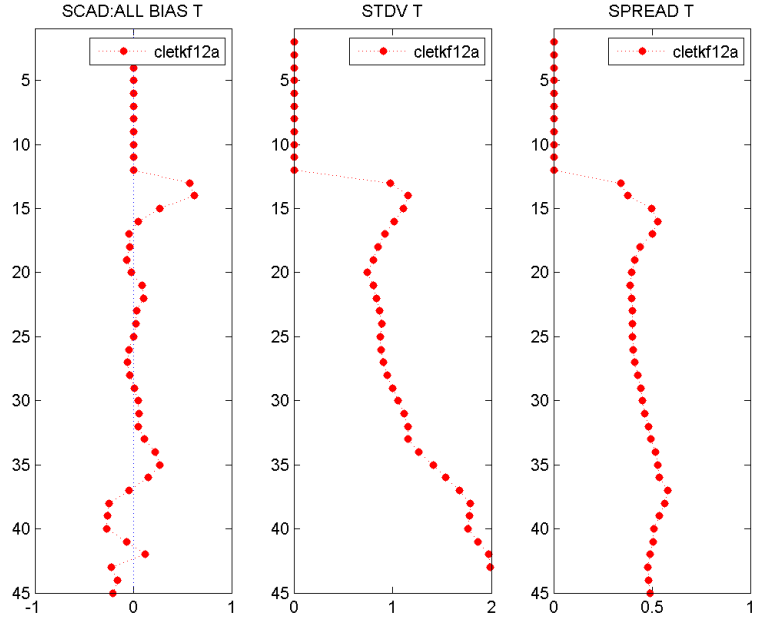
MODE-S AIRCRAFT ASSIMILATION
Forecast verification

Thinning: 30 km

Relative difference (%) in RMSE,
computed against IFS analysis, with respect
to reference run without MODE-S
for 00 UTC COSMO forecasts from
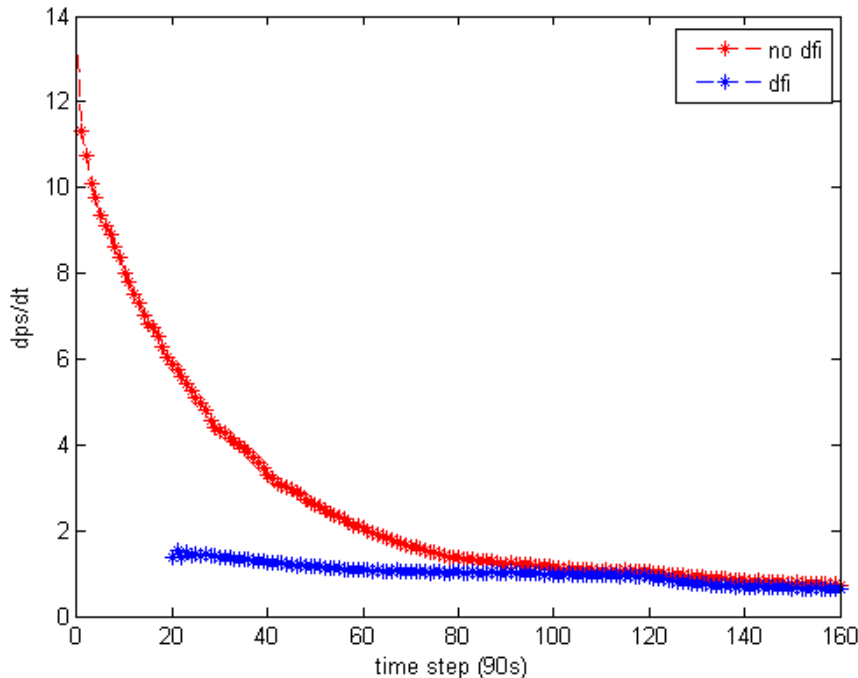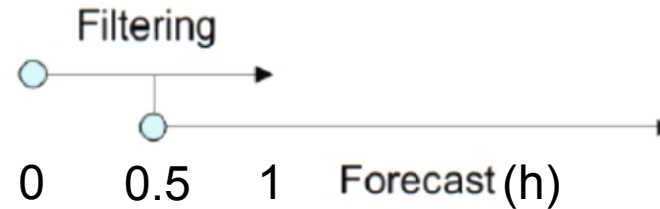11-nov 2014 to 10 dec 2014
negative value = positive impact

DFI used to avoid spurious high frequency oscillations in the first hours of forecast

DFL:
(Lynch and Huang, 1994)

Filtering

0   0.5   1   Forecast (h)

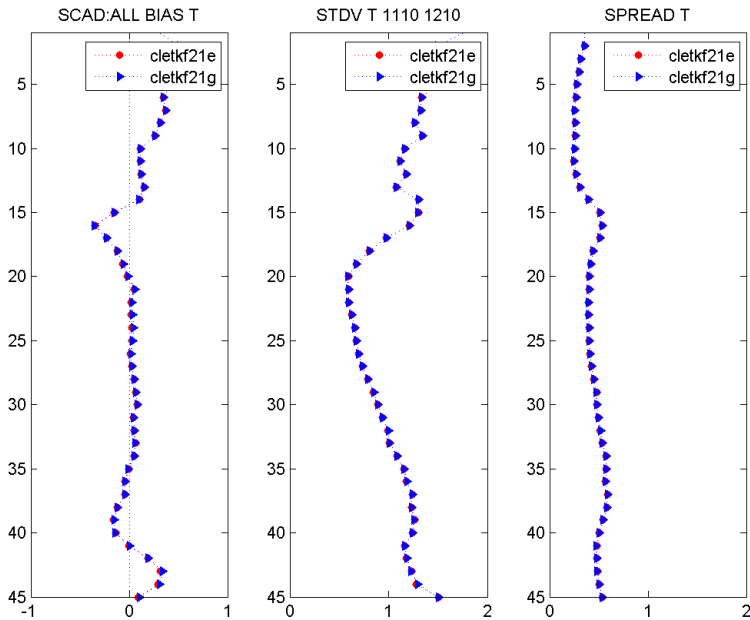DFI original:
All prognostic variables are filtered

DFI new:
- qv filtered but corrected to mantain saturated grid points at 0.5h step of filtering run
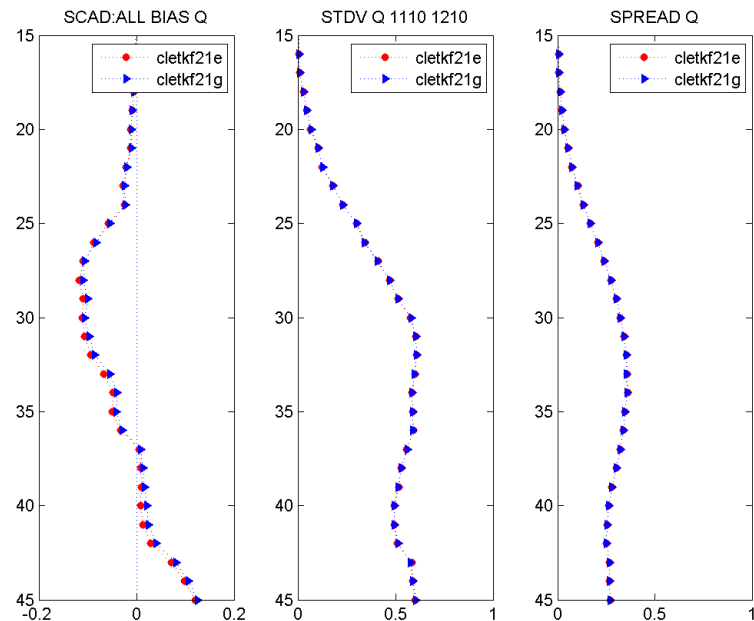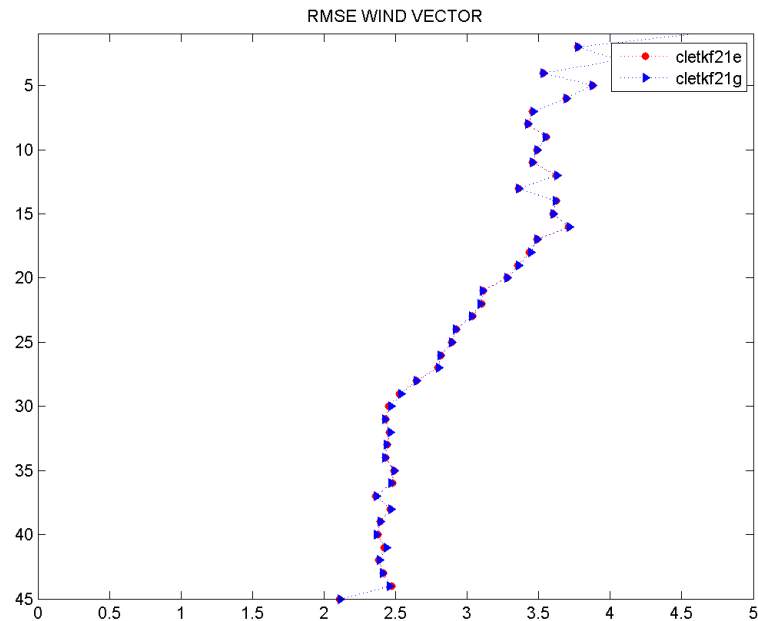- qx initialized with instantaneous values valid at 0.5h step of filtering run

RAOB OBS INCR STATISTICS
from 10nov2014 to 10dec2014

dfi_orig
vs
dfi_new

Relative difference (%) in RMSE,
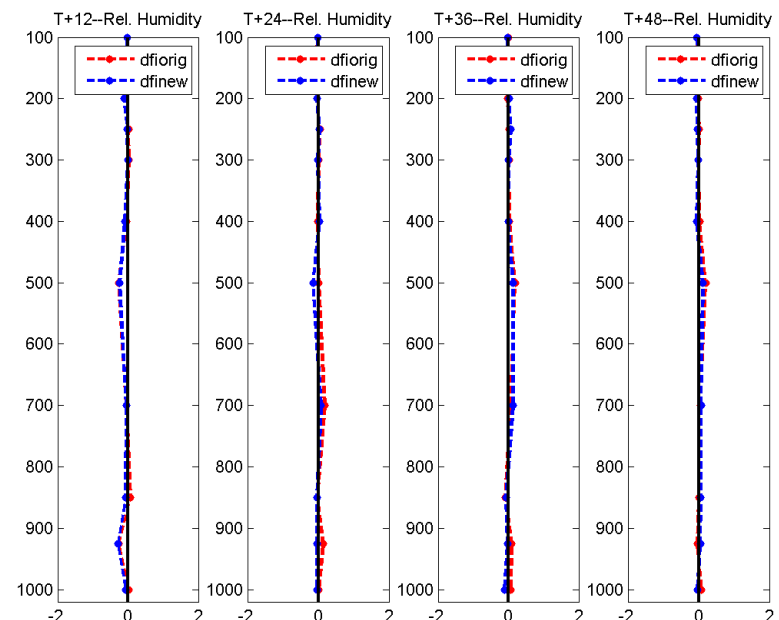computed against IFS analysis, with
respect to the reference run without DFI
for 00 UTC COSMO forecasts from 11-nov
2014 to 10 dec 2014
negative value = positive impact

**dfi_new
vs
dfi_orig**

©CN
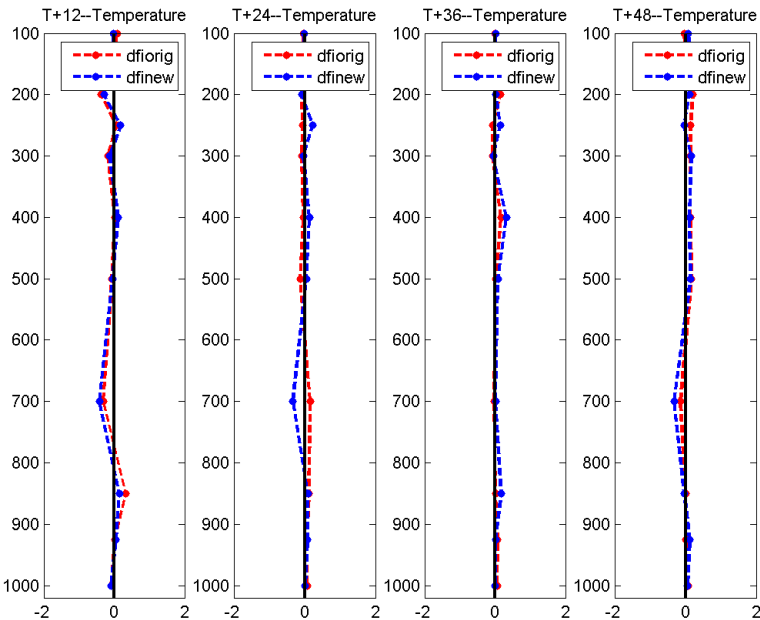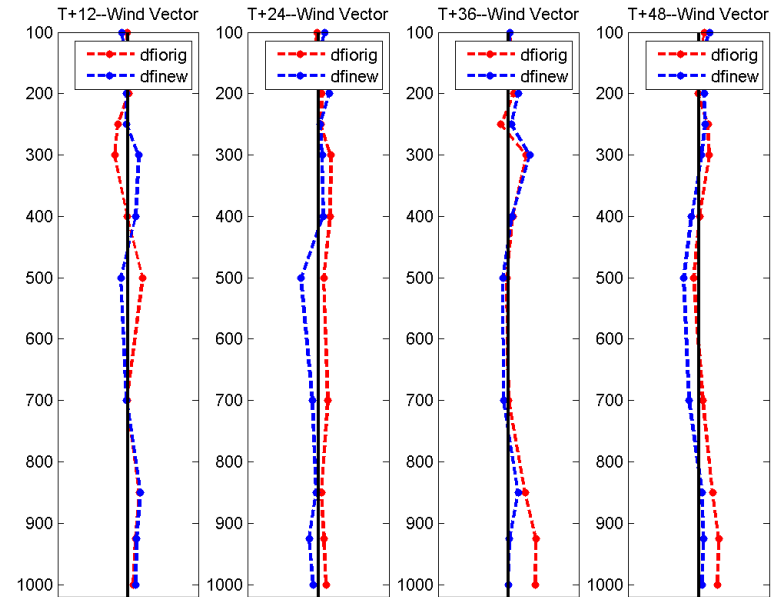
Stochastic Perturbed Physics Tendency

- Model uncertainty could be represented also with a stochastic physics scheme (Buizza et al, 1999; Palmer et al, 2009) implemented in the prognostic model
- This scheme perturbs model physics tendencies by adding perturbations, which are proportional in amplitude to the unperturbed tendencies **Xc**:

$$Xp=(1+r\,\mu)Xc$$

*$r_{m,n}$ defined on a **coarse grid** (ex. DL=4Dx)*

$r_{m,n}$ changed every n time steps (ex. DT=6Dt)

Model grid

i,j

r

time

Included in COSMO Reference Version (Torrisi et al)

Random numbers are drawn on a horizontal coarse grid from a Gaussian distribution with a stdv (0.1-0.5) bounded to a certain value (range= ± 2-3 stdv) and interpolated to the model grid to have a smoother pattern in time and horizontally in space. Same random pattern in the whole column and for u,v,t,qv variables.

RAOB OBS INCR STATISTICS from 10nov2014 to 10dec2014

SPPT
vs
reference run

stdv_rn=0.4,range_rn=.8
hinc_rn=6.,
dlat_rn=5., dlon_rn=5.
itype_vtaper_rn=2

SPPT
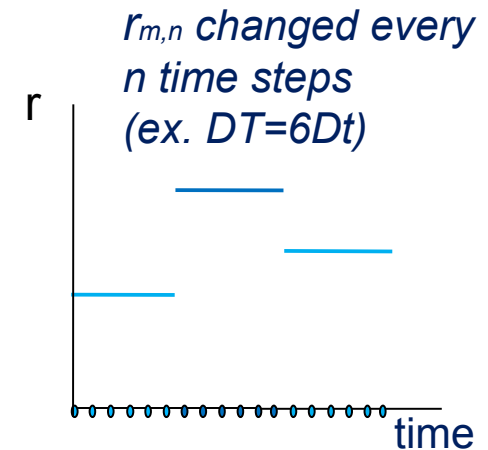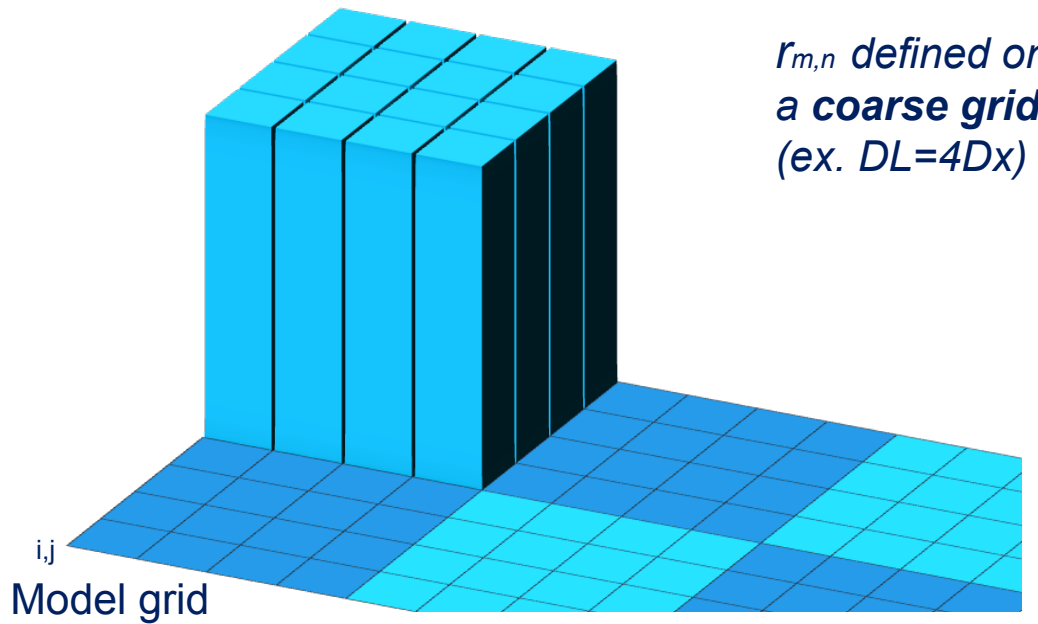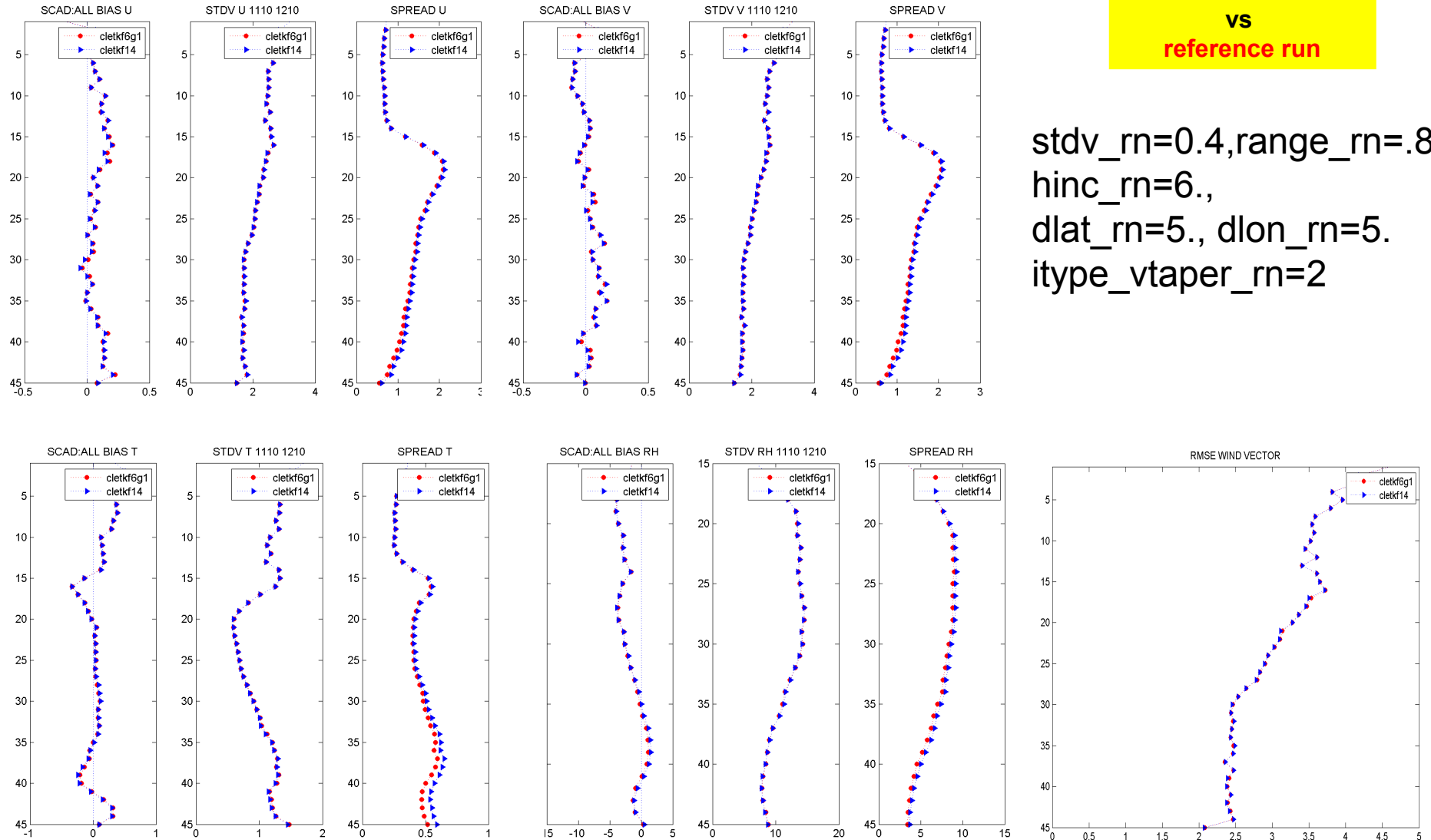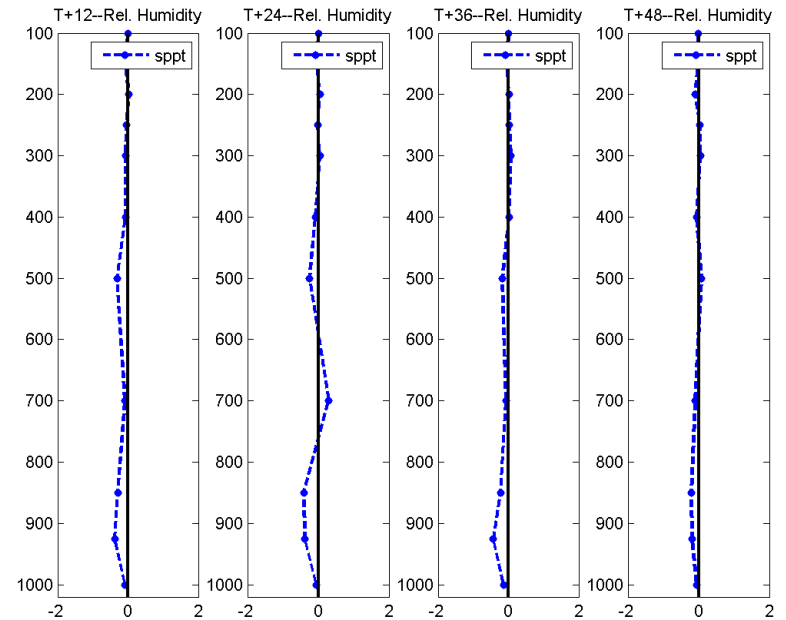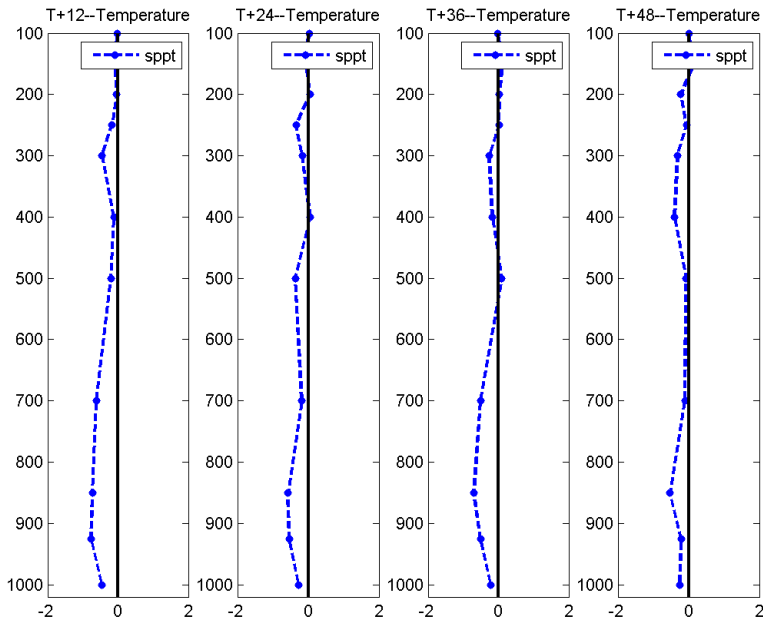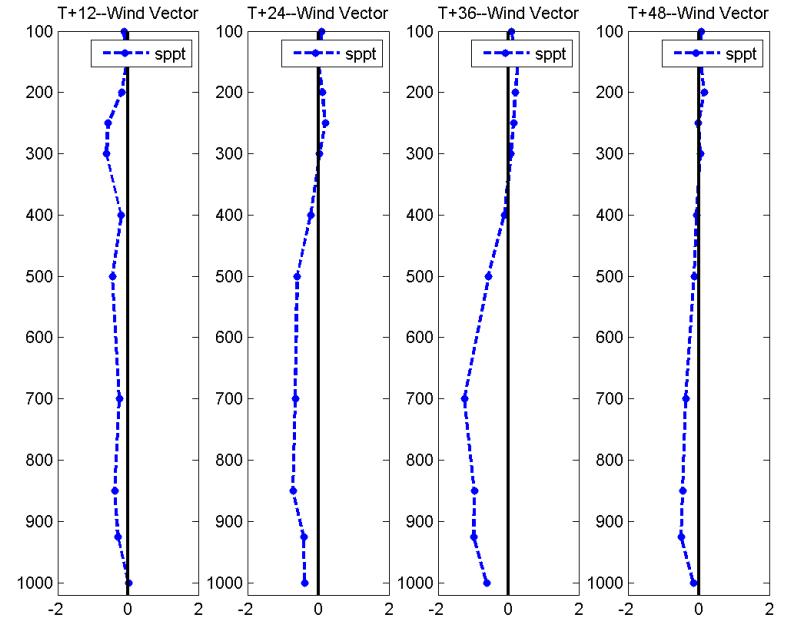## Forecast verification

Relative difference (%) in RMSE,
computed against IFS analysis, with respect
to reference run without SPPT
for 00 UTC COSMO forecasts from
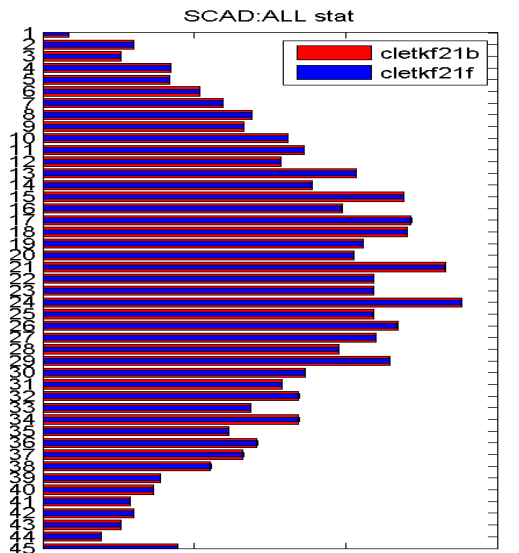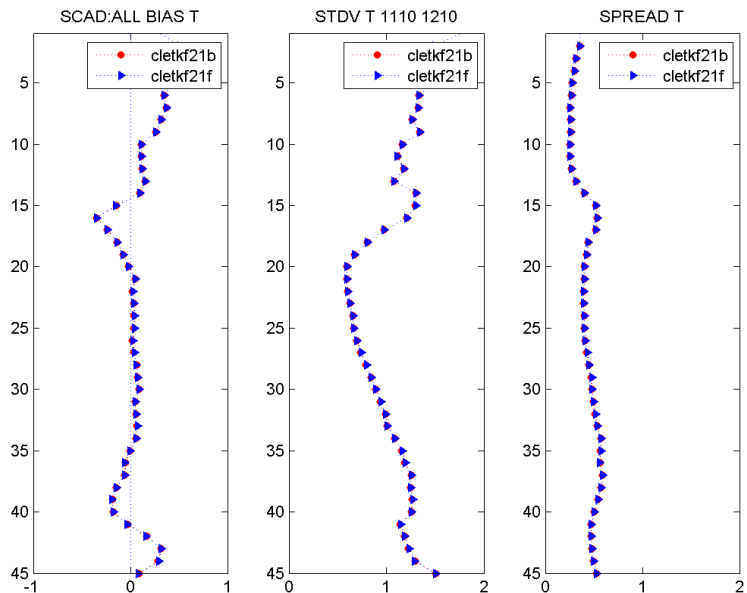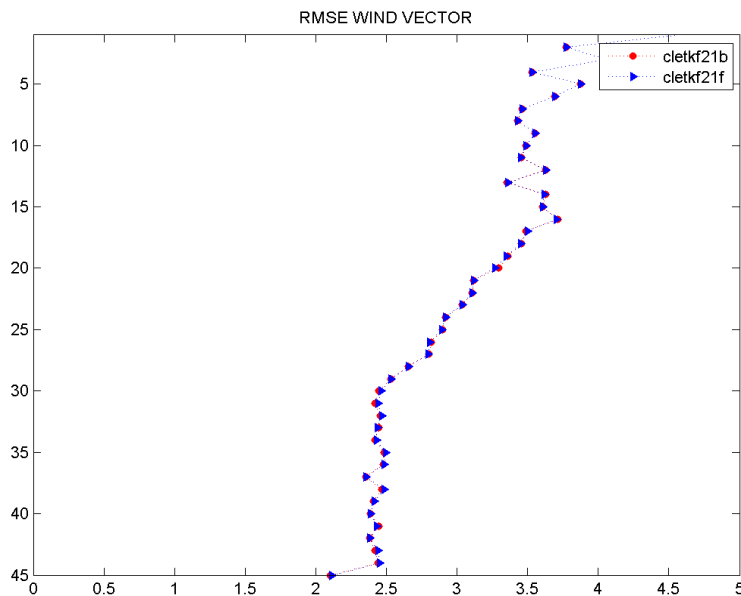11-nov 2014 to 10 dec 2014
negative value = positive impact

COSMO with Single Precision

Not in the deterministic run

RAOB OBS INCR STATISTICS from 10nov2014 to 10dec2014

Single prec
vs
refrence run

COSMO with Single Precision

Not in the deterministic run

Forecast verification

Relative difference (%) in RMSE,
computed against IFS analysis, with respect
to reference run with douple prec. real
for 00 UTC COSMO forecasts from
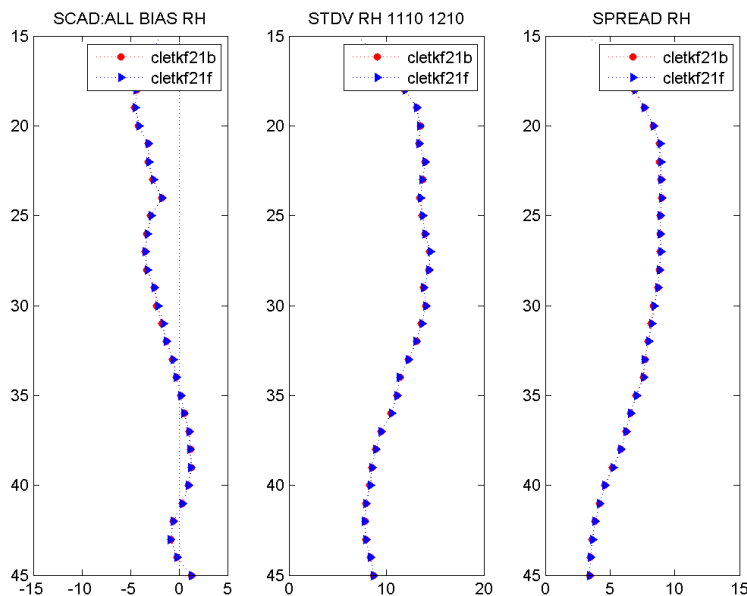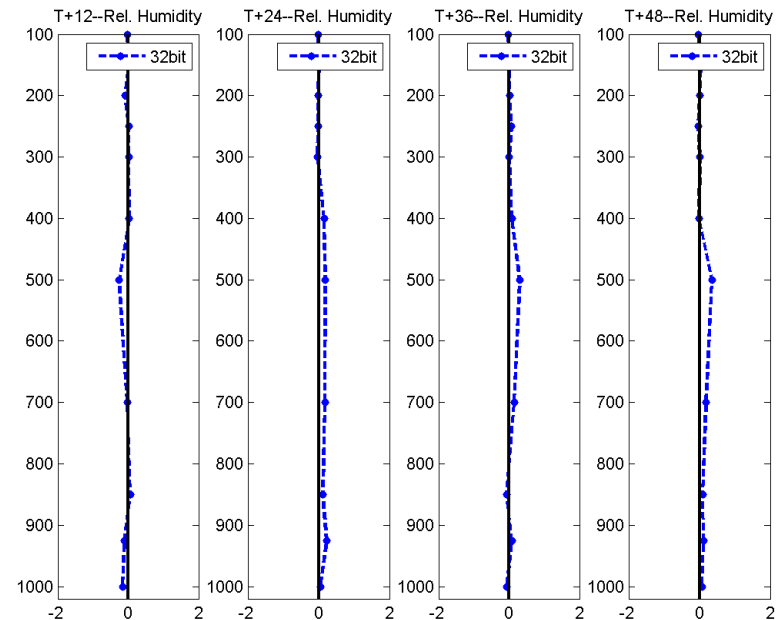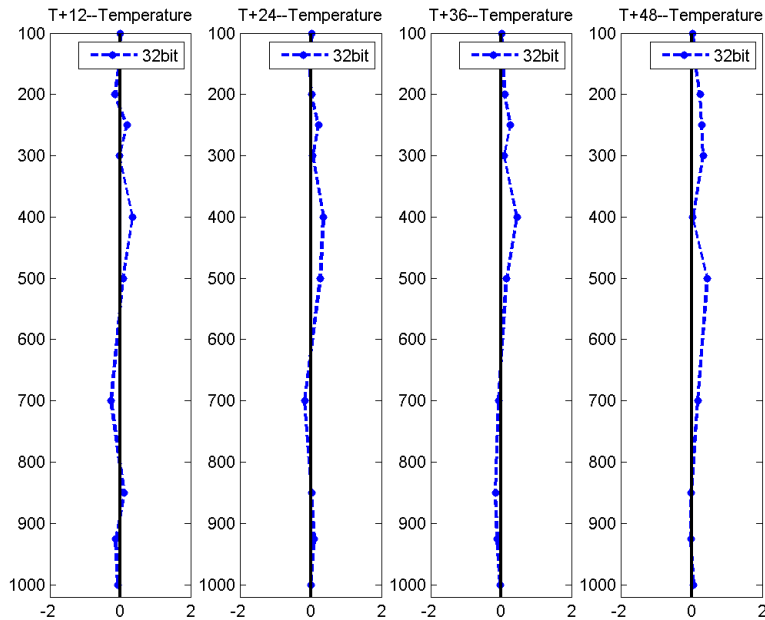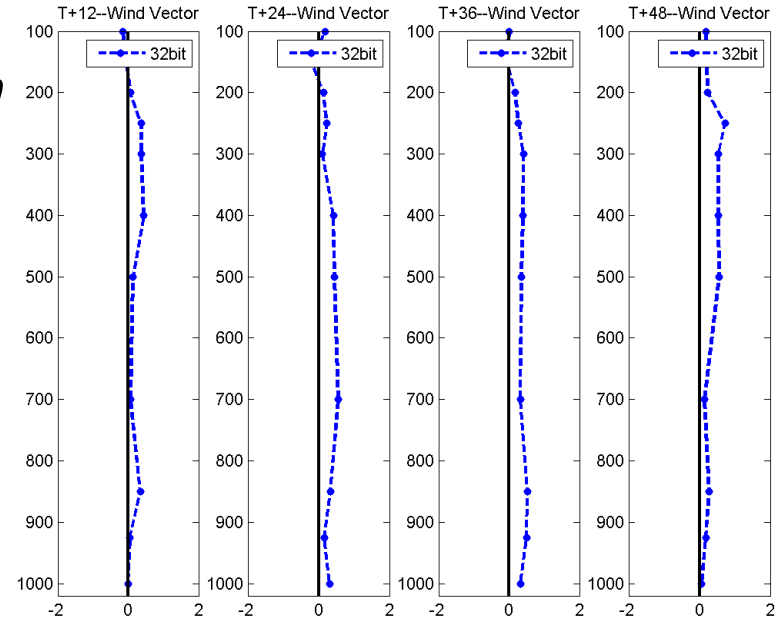11-nov 2014 to 10 dec 2014
negative value = positive impact

Current and future developments

- **Further tests using DFI and COSMO single precision**
- **Assimilation of GPS ground stations and MODES is under investigation.**
- **Monitoring of local automatic stations and satellite derived soil moisture (H-SAF)**
- **Improvenentent of radiance vertical localization**
- **Self-evolving additive inflaction/SPPT**

- **H-SAF soil moisture assimilation affecting low level variables**
- **Shorter assimilation window using KENDA**

Thanks for your attention!

MODES in BUFR format from KNMI

**Monitoring using
CNMCA-LETKF system**

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