
Use of dace-observation-operators in ICON-KENDA

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Outline

- ▶ Motivation
- ▶ Changes in dace-code and namelists
- ▶ Results from test experiments
- ▶ Summary, Outlook

Motivation

- ▶ up to now: COSMO-operators (implemented in dace-code) used for (KENDA-)MEC/ILAM
- ▶ unified code for observation operators for ICON global and ILAM (online/MEC)
- ▶ use of “local” cdfin-files from (DWD) data-base, QC similar to current KENDA setup, interpolation, grid point selection
- ▶ unification of operators started with AIREP, other observation system will follow
- ▶ relevant also for 4DEnVar (ILAM) (TL, adjoint)
- ▶ first application: “new” Mode-S Data, see Christoph's talk

Changes in code and namelists

- ▶ committed to dace-dev and icon-master branch
- ▶ new namelist switch dace_obs_op: enables use of dace-operators for selected observation types
- ▶ list of dace-processed files necessary
- ▶ in &observations part of namelist:

```
read_cdfin      = T      ! read files for COSMO oper.  
read_netcdf     = T      ! read files for dace oper.  
obs_files       = 'cdfin_acars.nc' 'cdfin_amdar.nc'  
                'cdfin_modes.nc'  
dace_obs_op     = 'AIREP'
```

Changes in code and namelists

- ▶ temporal interpolation for dace-operators implemented (by Steffi Hollborn) to ensure 4D-LETKF
- ▶ blacklist check for dace-operators only for obs-types not processed with COSMO-Operators
- ▶ dace: bilinear interpolation used (horizontal); for Wind and Temperature spline-Interpolation (vertical). Can be changed by namelist to have similar settings as in COSMO

```
int_nn          = T
vint_lin_t      = T
vint_lin_uv     = T
```

further namelist/code changes (1)

- ▶ switch off obs close to boundary, near-surface-check as in COSMO:

```
&REPORT check = 'AREA'      use = 'forget' /
&REPORT type  = 'AIREP'     excl_bnd = 0.2 /
&rules
  comment      = 'Exclude AIREPs near surface'
  obstype      = 2          ! obstype AIREP
  asurf        = 3          ! up to 10 hPa above surface
  use          = 'passive'
/
```

further namelist changes (2)

- ▶ flight phase check, roll angle check as in COSMO:

&AIREP_OBS

chk_phase = 0 ! (0) flight phase chk
(1=reject unsteady)

chk_rollangle = 3 ! (0) roll-angle check
(1=reject bad, 2=require good,
3=wind only)

/

code and namelist changes

- ▶ prethinning (before first-guess check) in MEC/ILAM
(mo_icon2dace.f90, mo_veri_obs.f90)
- ▶ only used for Mode-S currently

&THINNING

```
comment   = 'Mode-S'  
obstype   = 'AIREP'  
codetype  = 146 ! MODE-S  
d_km      = 40  ! ca 40 km  horizontal distance  
dlev      = 10  ! 10 hPa vertical distance  
state     = 'dismiss' ! dismiss observation  
pass      = 0  ! before fg-check
```

/

- ▶ thinning for AMDAR has to be done in LETKF now
- ▶ still different to COSMO: redundancy-check, flight track check

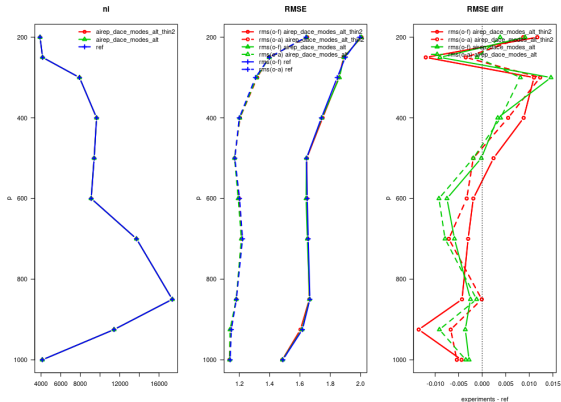
Experimental setup

- ▶ Experiments with ILAM-online to test dace-operators
- ▶ shown here: results from test-phase for new Mode-S data

```
ref      : COSMO Operators ("Routine-setup")
alt      : AIREP dace operators, "old" Mode-S data
alt_thin2: AIREP with dace operators; "old" Mode-S data;
          2-step thinning used for AMDAR
```

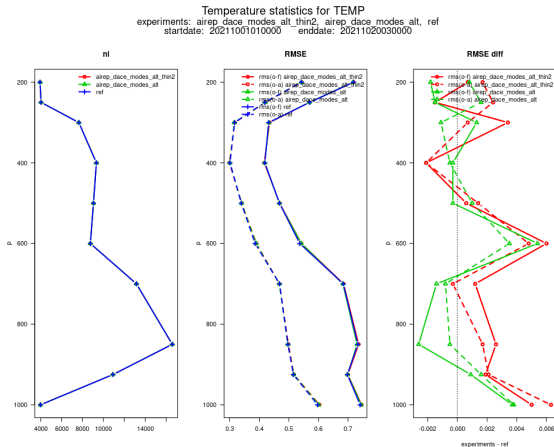
Analysis cycle: scores for TEMP

Wind statistics for TEMP
experiments: airep dace modes alt_thin2 airep dace modes alt, ref
startdate: 20211001010000 _enddate: 20211020030000



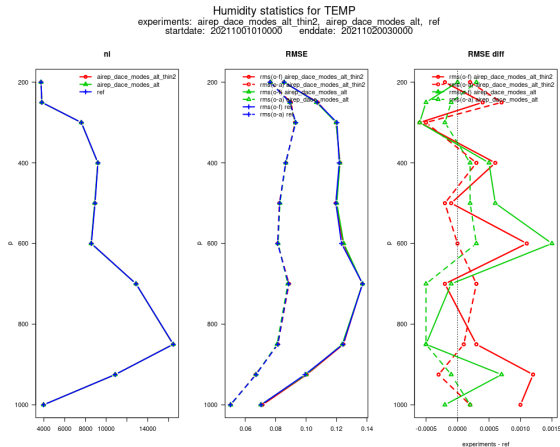
COSMO/dace AIREP Operators, Analysis-cycle, RMSE; COSMO op.,
dace op. 2step thin, dace op

Analysis cycle: scores for TEMP



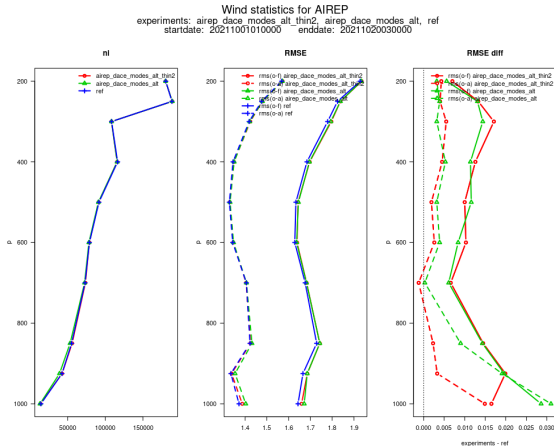
COSMO/dace AIREP Operators, Analysis-cycle, RMSE; COSMO op.,
dace op. 2step thin, dace op.

Analysis cycle: scores for TEMP



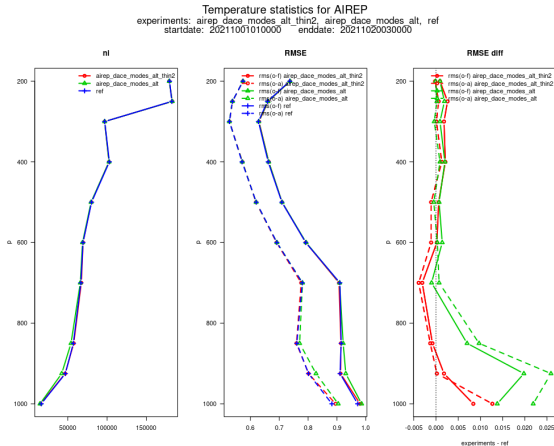
COSMO/dace AIREP Operators, Analysis-cycle, RMSE; COSMO op.,
dace op. 2step thin, dace op.

Analysis cycle: scores for AIREP



COSMO/dace AIREP Operators, Analysis-cycle, RMSE; COSMO op.,
dace op. 2step thin, dace op

Analysis cycle: scores for AIREP



COSMO/dace AIREP Operators, Analysis-cycle, RMSE; COSMO op.,
dace op. 2step thin, dace op.

Thinning

- ▶ AIREP dace-Operators use less data below 500 hPa with thinning; larger RMSE
- ▶ different thinning compared to COSMO: spatial, not along flight track
- ▶ “2 step” thinning in LETKF

thinning namelist

&THINNING

```
comment = 'AMDAR'  
obstype = 'AIREP'  
codetype = 145      ! AMDAR  
d_km     = 40        ! 40 km  horizontal distance  
dlev     = 10        ! 10 hPa vertical distance  
plevel   = 500 100   ! pressure level boundaries  
state    = 'passive' ! set to passive  
rule1    = 'status'  
rule2    = 'data'  
rule3    = 'time'
```

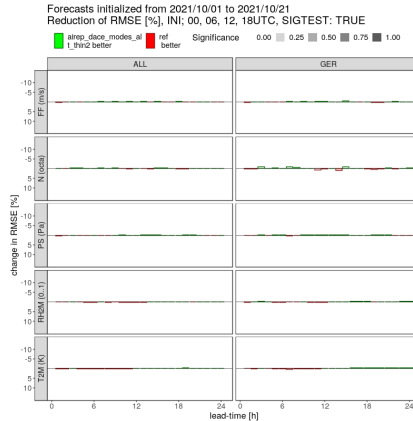
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&THINNING

```
d_km     = 20        ! 20 km  horizontal distance  
dlev     = 5         ! 5 hPa vertical distance  
plevel   = 1050 500
```

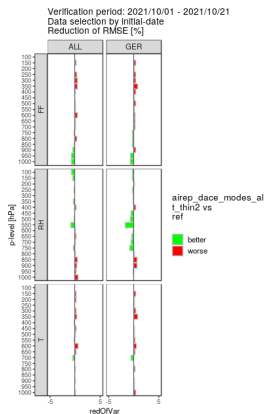
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Forecast scores



SYNOP: COSMO op., dace op. 2step thin

Forecast scores



TEMP: COSMO op, dace op. 2step thin

Summary and Outlook

- ▶ use of dace-AIREP Operators for ILAM implemented
- ▶ similar results as with COSMO-Operators
- ▶ slightly increased RMSE for AIREPS below 500 hPa can be reduced by “2-step” thinning
- ▶ other observation systems follow (TEMP,SYNOP,...)