Regional Cooperation for
Limited Area Modeling in Central Europe

LACE
nwp central europe

RC LACE Data assimilation activities

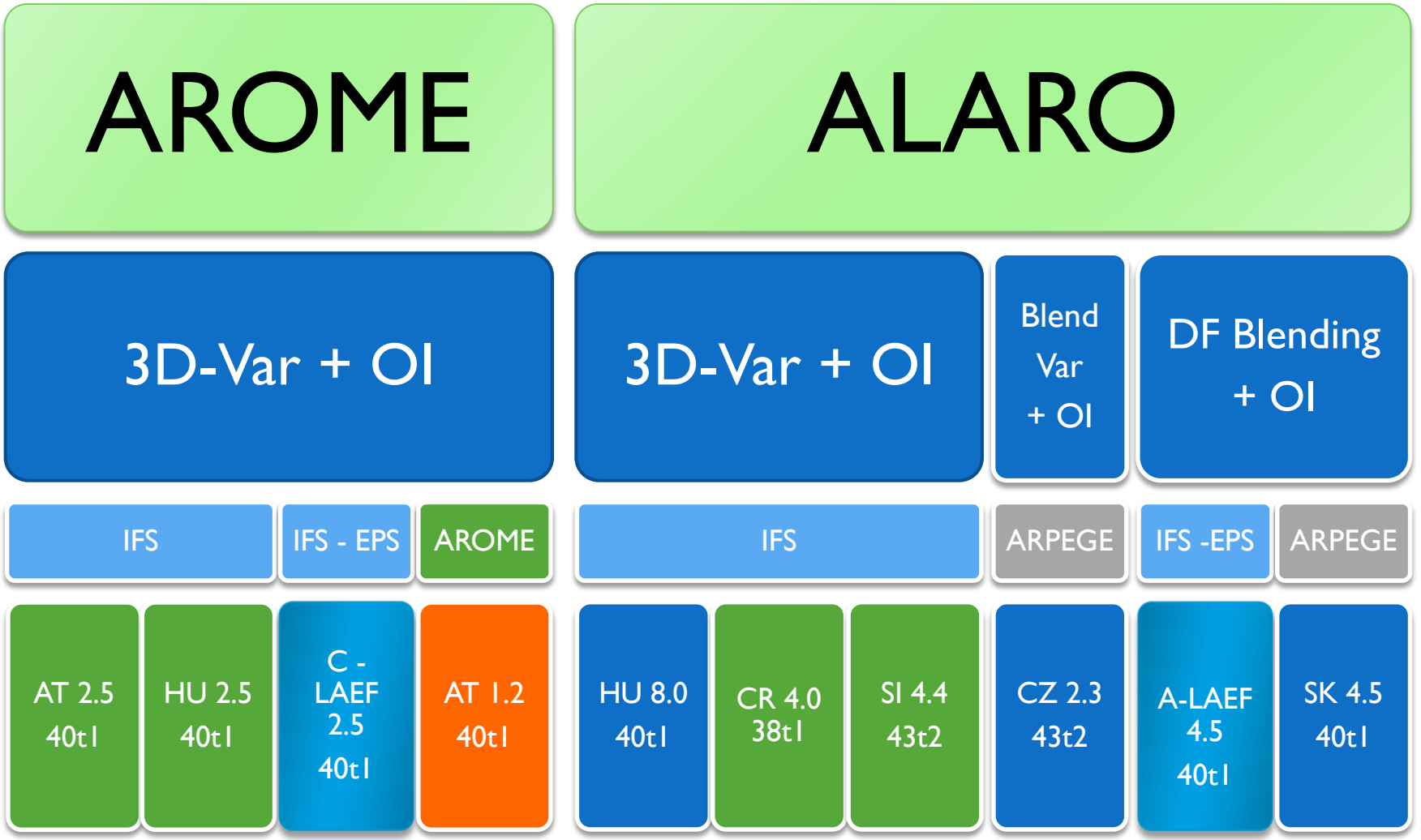
Benedikt Strajnar & LACE DA teams

ZAMG DHMZ Czech Hydrometeorological Institute OMSZ IMGW METEO ROMANIA SHMÚ ARSO METEO Slovenia

Outline

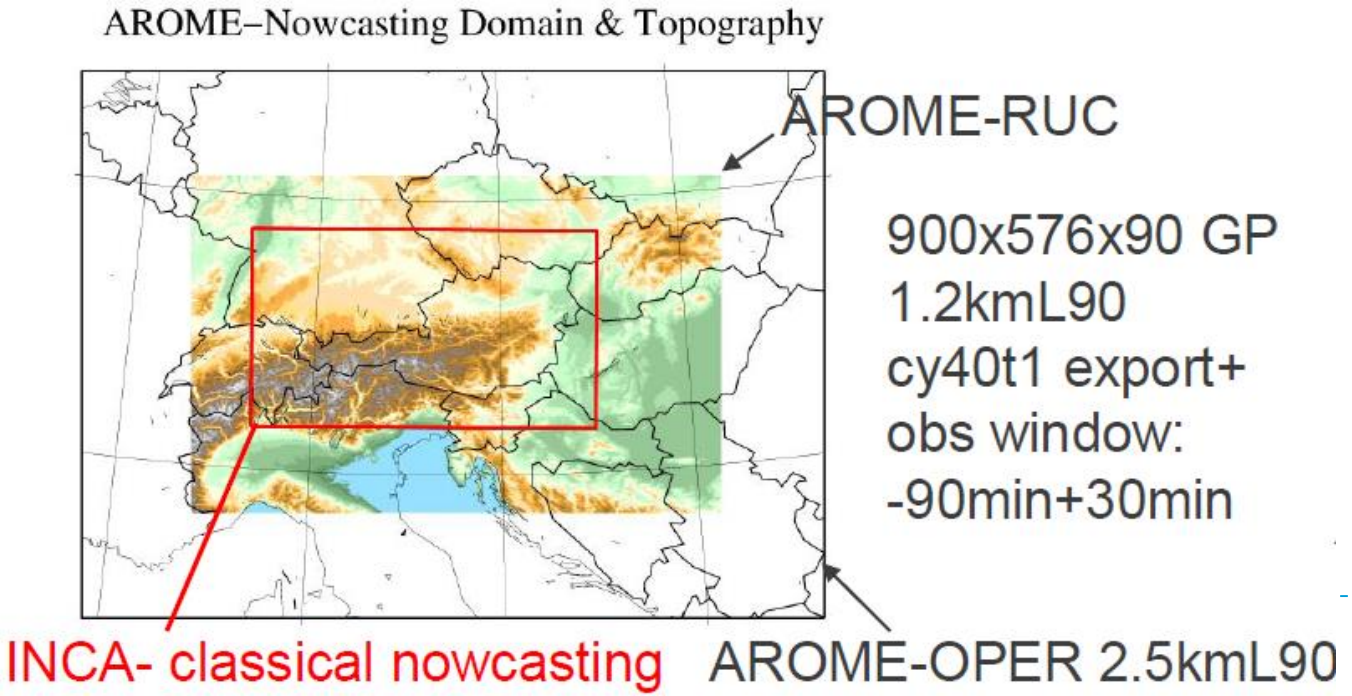
- Status
- Operational AROME RUC
- Progress in land satellite products SEKF
- Progress with upper-air observations:
  - Radar (OPERA)
  - Aircraft data (Mode-S)
  - GNSS (STD)
  - Microwave telecommunication links (MICROLINK)
- Summary and outlook

Operational DA systems in RC LACE



First operational 1h system: the AROME-RUC (ZAMG)

- Hourly-cycled system at 1.2 km, 30 min cut-off time, 120 min obs. window, high-res. observation (RADAR, Mode-S, ZTD)
- Spin-up control: hourly assim. cycle with backphased IAU -1h and -15 min
- Production cycle: 12-h forecast based on 1h assim/fg. trajectory plus IAU [0,+ 7.5 min], LHN (INCA RR analysis [0,+35 min]), FDDA nudging of surface station data [0,+30min]



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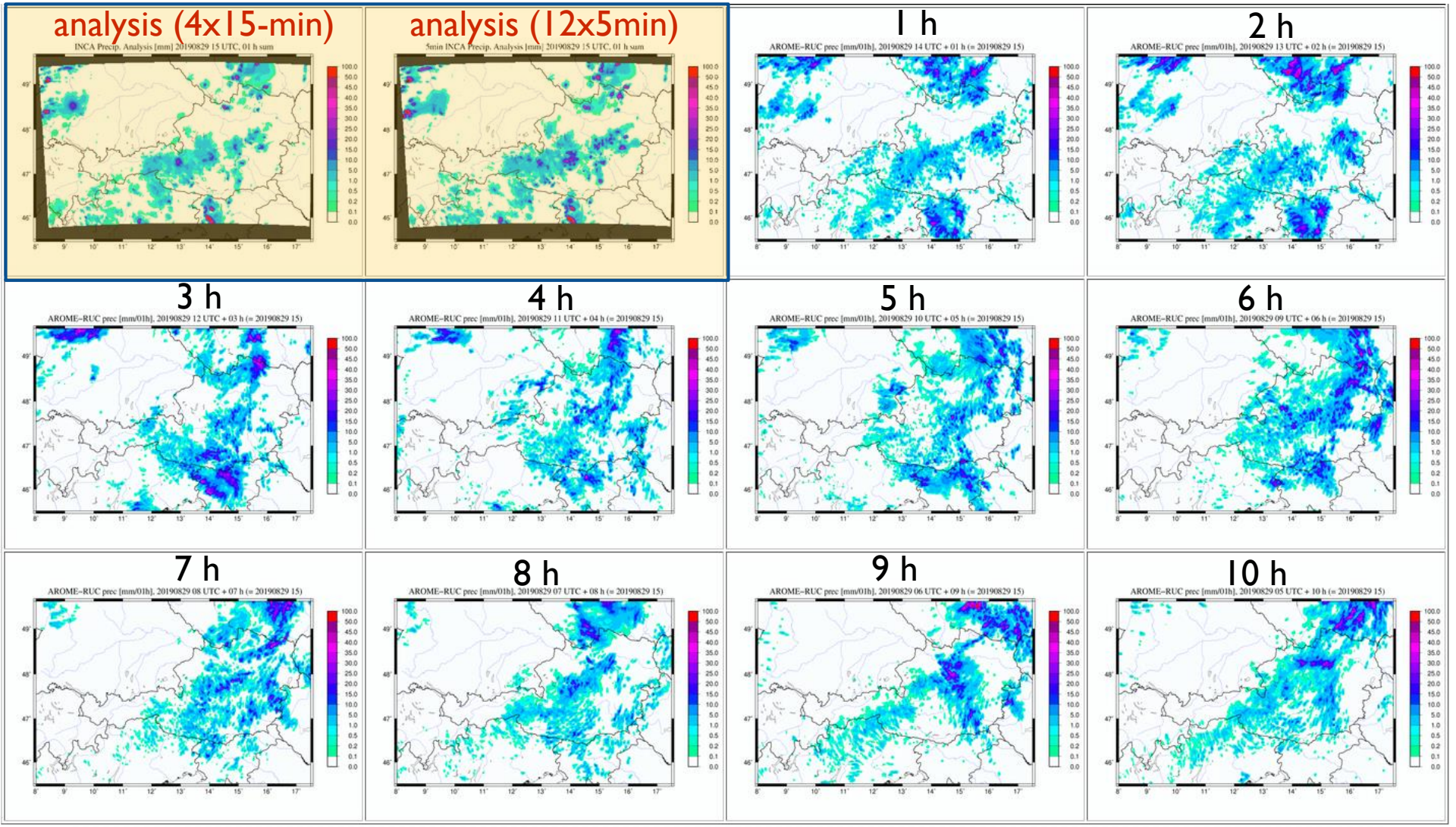
AROME-RUC precipitation nowcast



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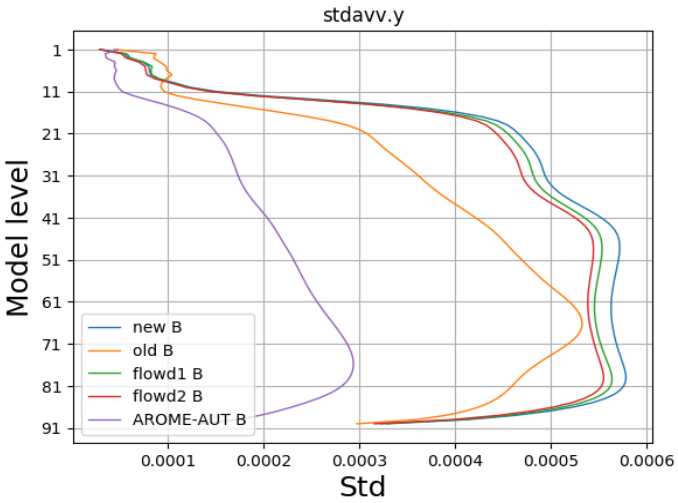
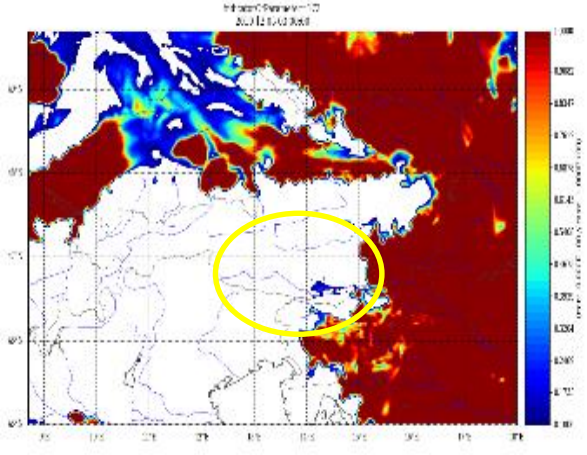
The AROME-RUC (ZAMG)

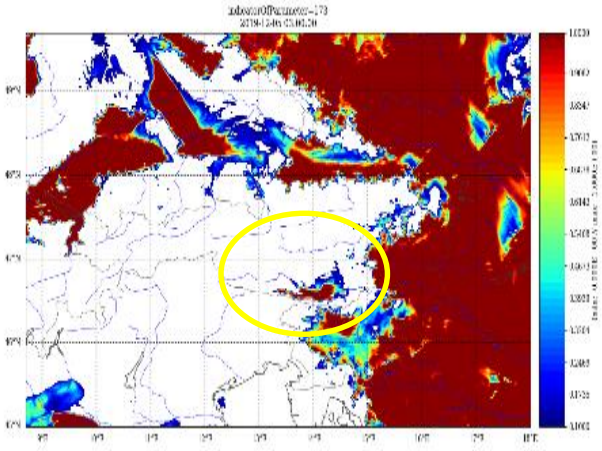
- Improvement with respect to 2.5 km AROME suite could be demonstrated also for low cloudiness.
- Can be related to resolution but also adjusted B-matrix



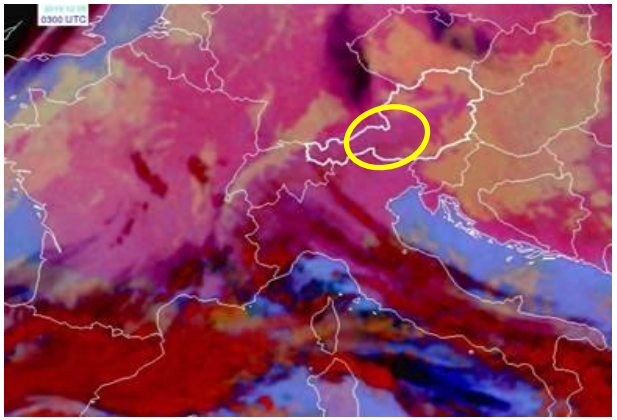
Vor Sigma_B's used by ZAMG (RUC EDA).



AROME-2.5 km



AROME-RUC

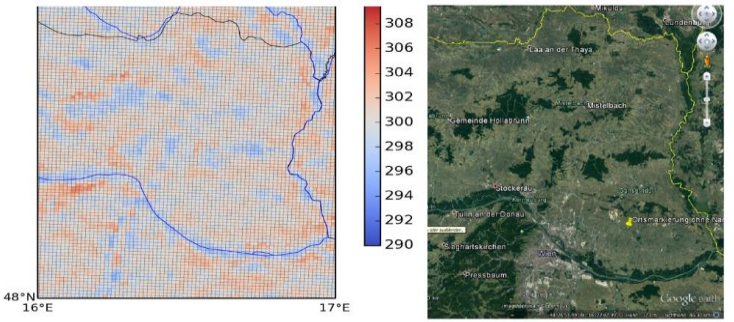


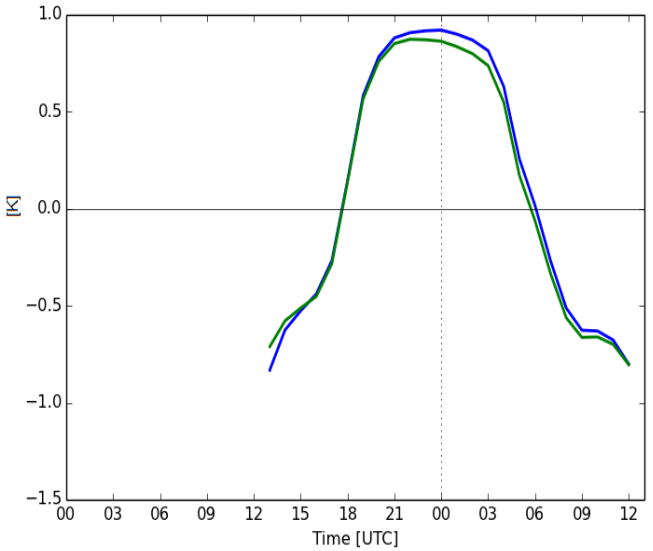
MSG cloud product

Surface assimilation – remote sensing products in SEKF

- Assimilation of LST:
  - preparation of input satellite-derive observations (MSG land surface temperature downscaled with Sentinel 3 data).
  - Small but positive impact of 2 m temperature, as compared against Austrian weather station data.
- Moisture assimilation (SCATSAR-SWI)
  - Tests at different resolutions (2.5 and 1.25 km), observation errors (glob. and loc.) and dynamical settings.
  - AROME-SURFEX forecasts at 1.25 km warmer and drier compared to station measurements.

An example LST product.

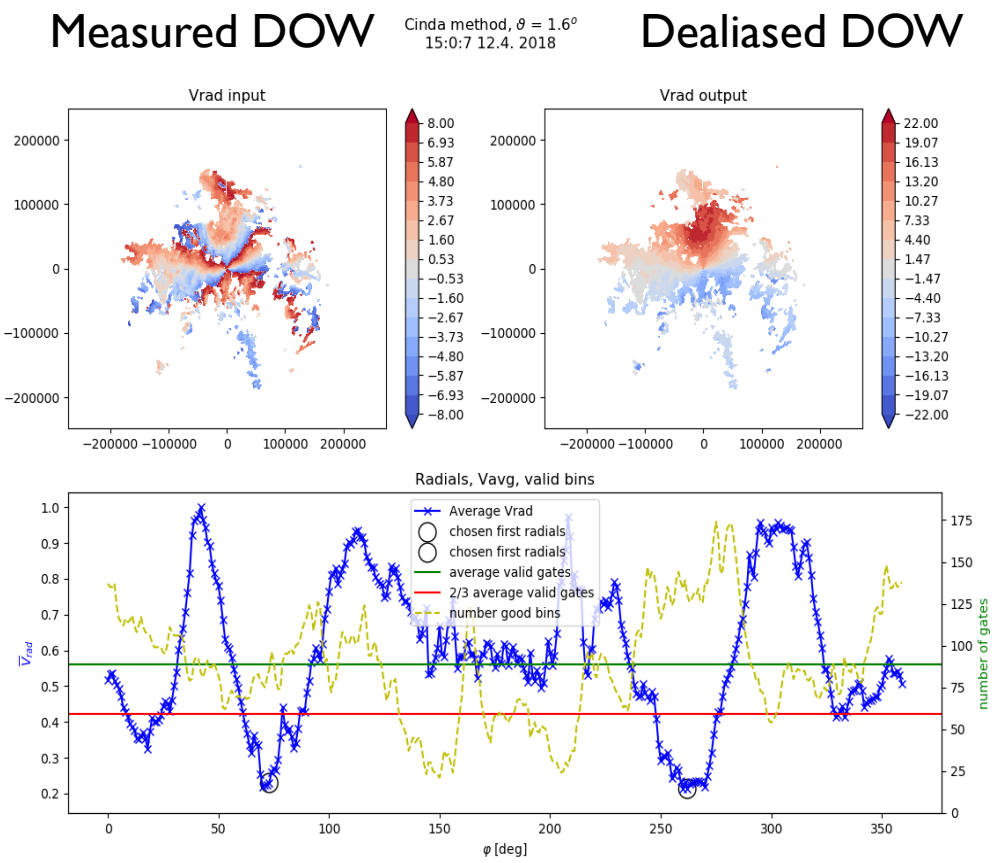




Improvement of 2 m temperature bias (green) by assimilation of LST.

Radar assimilation

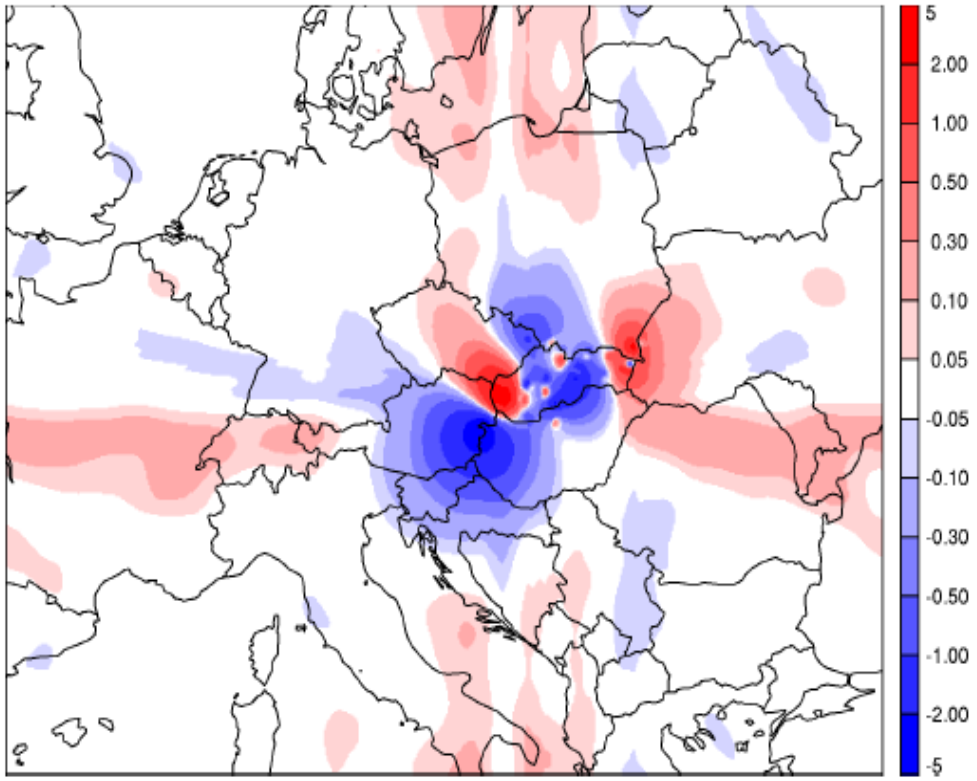
- Radar DA operational at ZAMG
- Reflectivity:
  - Ongoing validation of obs. Operator with ALARO (prognostic graupel on/off)
- Radial winds:
  - Existing methods for de-aliasing coded and applied.
  - Ongoing inter comparison with model, radiosonde and Mode-S.
  - The most prominent method to be included to the HOOF software.



Dealiasing process using the Cinda method.

Assimilation of GNSS STD

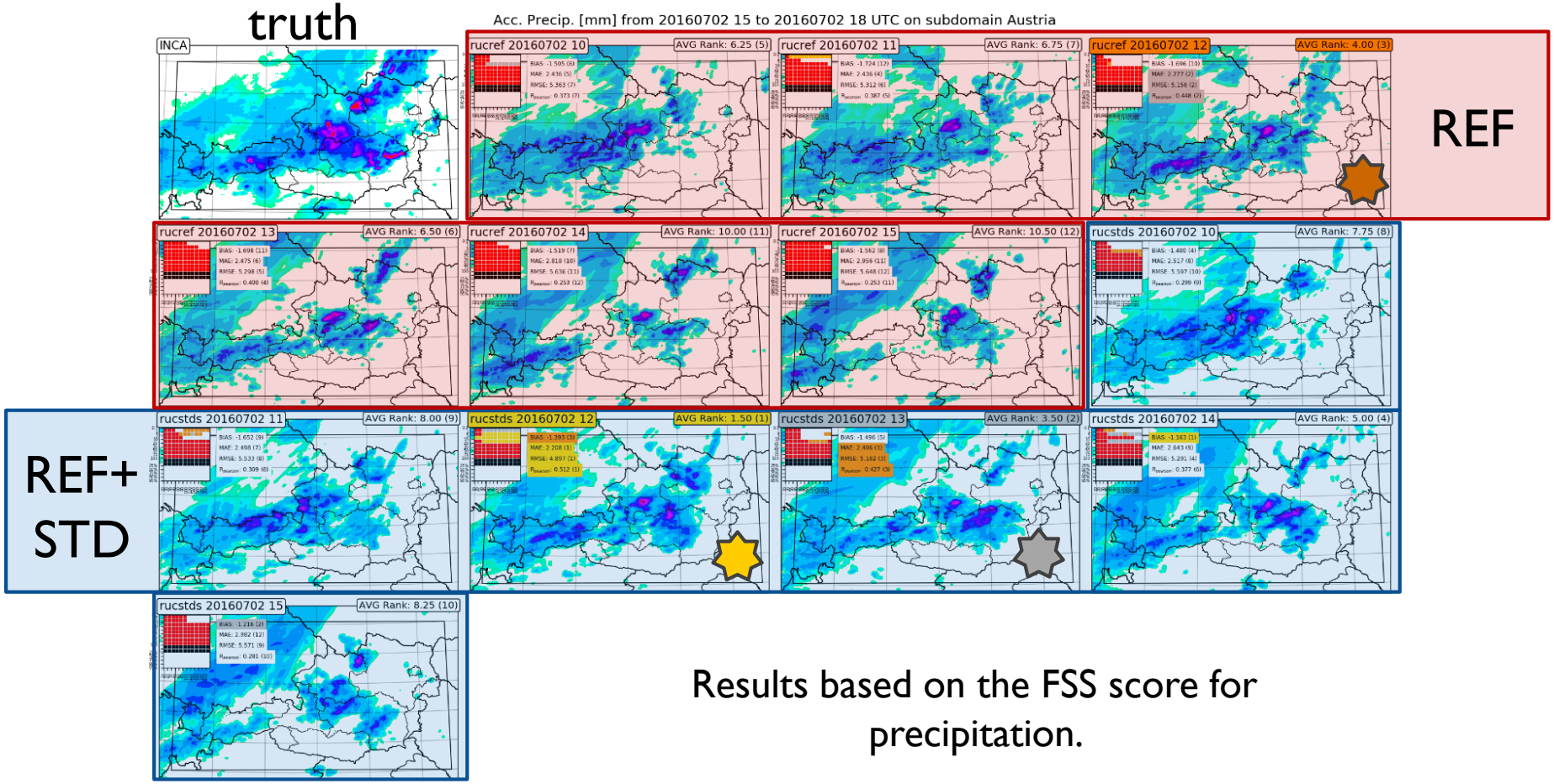
- Slant Total Delay STD code reviewed and phased to cycles cy43 (stay at KNMI)
- Code still under validation (e.g. TL/AD tests)



Specific humidity STD increment at level 60/87 in ALARO-SK 4.8.

Assimilation of GNSS STD(2)

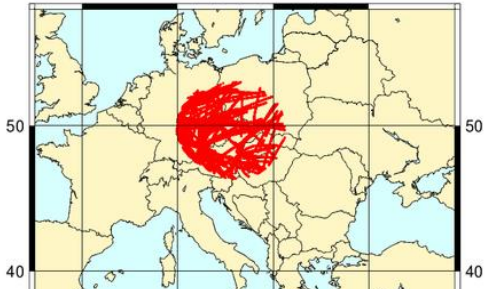
- Impact of STD (Austria, phased cy40t1)

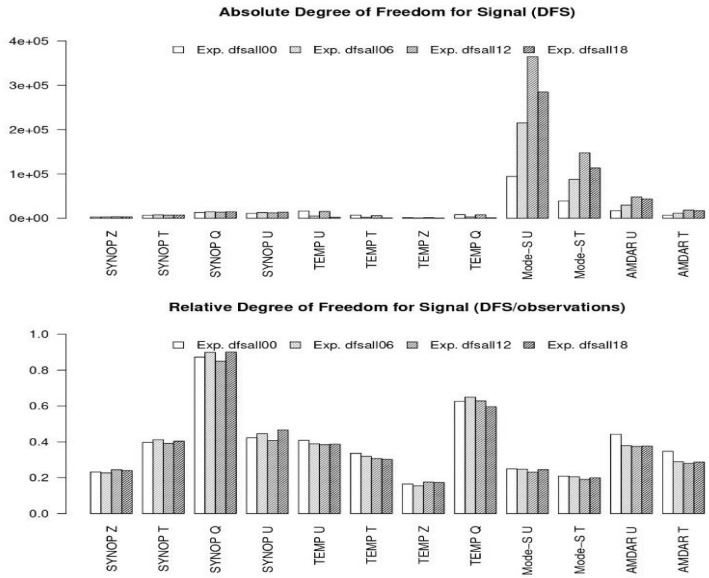


Results based on the FSS score for precipitation.

Assimilation of aircraft observations

- Increased operational exchange (Mode-S MRAR from CZ)
- Ongoing coordination with EMADDC (KNMI) regarding real-time preprocessing of data
- Further experiments of Mode-S impact (Slovakia).
- Limited experimentation with AMDAR humidity impact (small/mostly neutral).



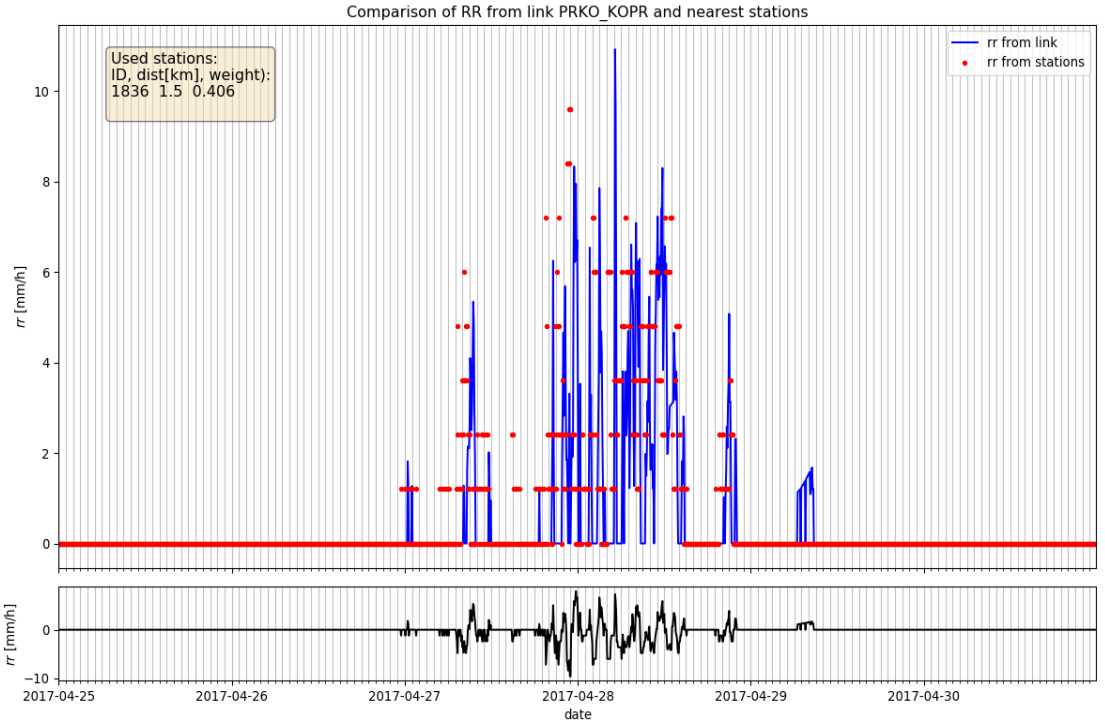


Impact (weight) of Mode-S in analysis diagnosed by DFS (ALARO-SK)

Attenuation of microwave links

- Feasibility study with a sample data set from 600 data links in Slovenia.
- A first goal: efficiently separate attenuation data in rainy and dry conditions.
- Wet/dry period and attenuation dynamically modelled by factor graph approach. Baseline modelled as a second-order linear state-space model.
- Relation between attenuation and rain modeled as a power law equation.

Intercomparison of rain estimates from microwave links (blue) and nearby station measurements (red dots).



Summary and outlook

- LACE DA now focuses on development of hourly DA systems. First operational implementation in AT, under design and evaluation in CZ, HU, SI.
- Ongoing validation of land surface products in SEKF for SURFEX.
- Upper air observations: most efforts planned in assimilation of radar, Mode-S and GNSS products.