DA activities at ZAMG in 2017

(Florian Meier, Stefan Schneider, Phillip Scheffknecht, Florian Weidle, Jasmin Vural, Christoph Wittmann)

ALARO 4.8km/LAEF 11km (0 man month):

No changes, both run with CANARI surface assimilation in case of LAEF observations are perturbed.

AROME (0.5 man month):

New E-Suite with 3D-Var based on cy40t1 export started in early summer (operational still cy36t1). E-suite should replace operational version before migration to new HPC (end of 2017). Additional national pressure observations in the alpine area were found to be responsible for degradation of AROME 10m wind forecasts under specific weather conditions "alpine pumping". F. Weidle did several tests to define a reasonable blacklisting of these stations to improve the forecast.

 AROME-Nowcasting hourly DA(Testversion):

Running test periods (2.5 man month)

AROME-Nowcasting 2.5km was hourly run for July 2016 and January 2017 including 3D-Var radar assimilation and latent heat nudging. An IAU-cycling configuration was used. 1.2km time series are planned when new HPC is available.

MODE-S (4 man month)

We got Austrian MODE-S EHS test data from Austrian ATC "Austrocontrol" in KNMI-ASCII format. Phillip Scheffknecht managed to convert them to obsoul format and is currently running first assimilation experiments.

RADAR-Assimilation (2.5 man month)

The HDF5-reader was modified and is now working properly. Also bator-pre-thinning as in bufr-reader is included. prepopera.py pre-processor was adapted such that it can handle all OPERA-data within our domain, national Austrian data and foreign data from bilateral exchange. Some site specific information missing in the raw files is added via prepopera.py. Interpolation of first guess to 1.2km domain was modified such that hydrometeors are interpolated, but also old ISBA fields needed for 3D-Var. In the past radar assimilation failed due to missing hydrometeors for simulated reflectivity. A case study including 40 radar stations was made.
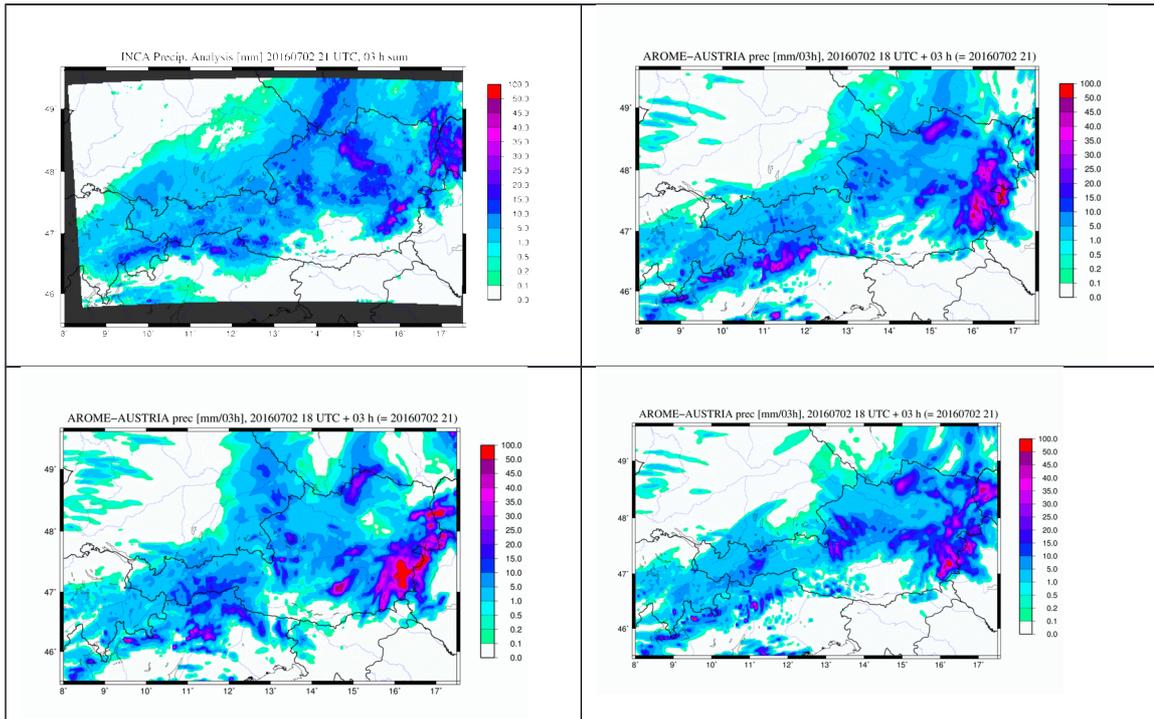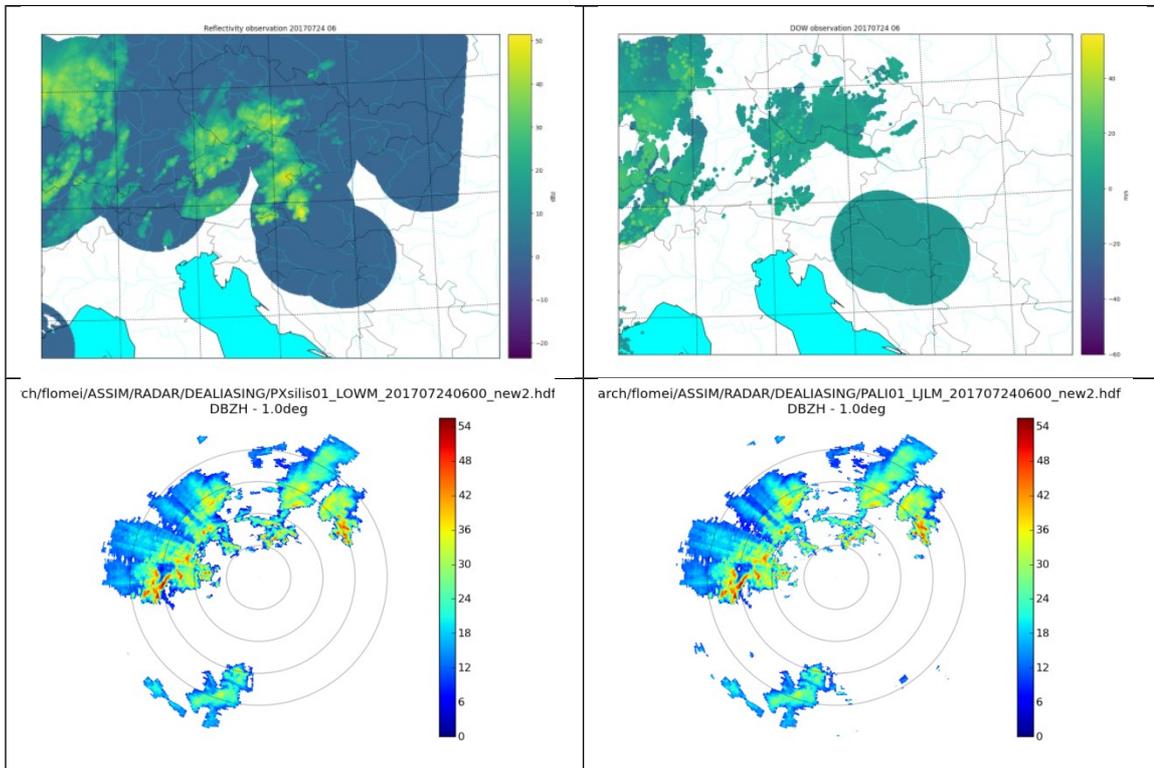
Fig. 1: Impact of the new HDF5-RADAR reader on 03h precipitation 20160702 18UTC+3h: top left INCA analysis, top right AROME without radar DA, bottom left AROME with radar DA (bugged CONRAD+BUFR reader), bottom right AROME +RADAR DA latest version (only Austrian radars)
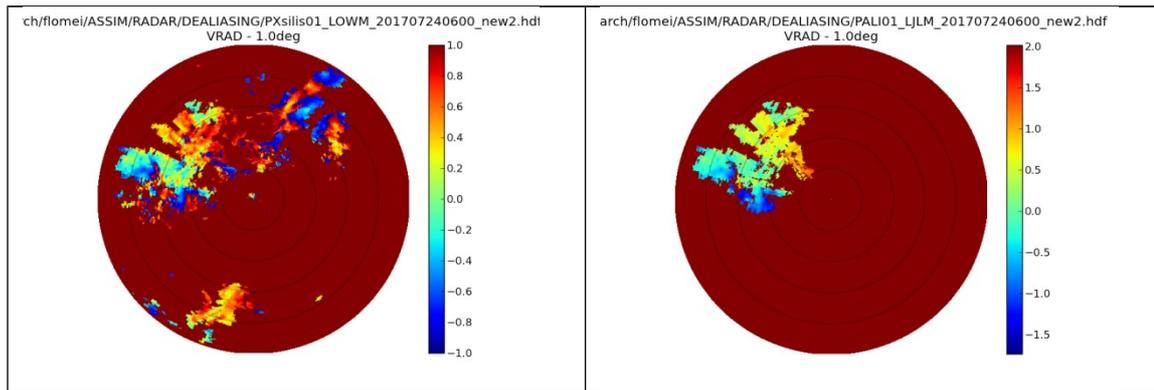
Fig. 2: Assimilation of OPERA-RADAR data into AROME 2.5km on 24th July 2017 06UTC elevation 1.5°: top left reflectivity observations in SCREENING, top right Doppler wind observations in SCREENING.
32 OPERA radars from Belgium 1, France 8, Germany 9, Poland 4, CZ 2, SK 2, HU 2, SL 2, HR 2 and 4 Austrian radars (Austrocontrol) and 1 Italian (bilateral exchange)
Middle: reflectivity observation 1° elevation from Ljubljana RADAR (left OPERA, right bilateral exchange + Austrian QC). Bottom: same for Doppler wind (bilateral data after de-aliasing).
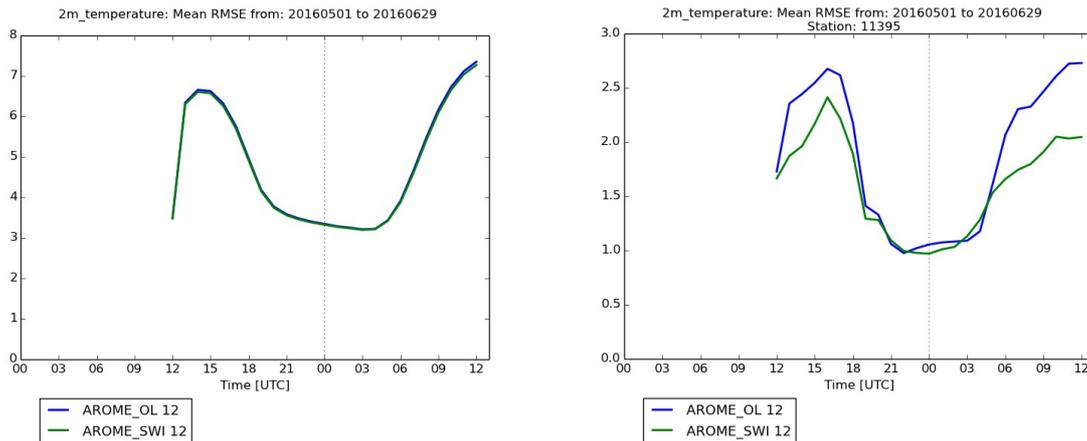
latent heat nudging (1 man month)

A tuning of the LHN for the two AROME nowcasting test months was made. A slight modification of the nudging function following Stephan's 2008 approach was included in the code.

Cloud analysis/cloud nudging (0.5 man month)

Some last adaptations to the code were made since the ALADIN workshop, which allow reading more information about the satellite properties directly from the input file (instead of hard coded constants in the code). Several case studies were run. It seems that cloud masking is not well performing in convective and rainy situations. Negative impact on precipitation amount was observed. Further tests will be done by Florian Weidle.

Soil moisture assimilation (Stefan Schneider (3.5 man months), Jasmin Vural (2 woman months)):

Setup of an assimilation configuration with SURFEX 8.0 (SODA and OFFLINE adapted to assimilate WG1 to WG6 in the ISBA diffusion scheme) for sEKF assimilation of SWI data and AROME CY40T1 (adapted with HIRLAM components to run ISBA diffusion scheme). Test runs for the period January-June 2016 and validation against SYNOP stations in Austria has been computed. For flatland stations (below 300m), there is a significant improvement for T2M and RH2M short-range forecasts (see Fig. 1, right side). For higher stations and precipitation in general, there is no clear impact of the assimilation.

For the rest of the year it is planned to investigate the results in more detail and to test additional assimilation settings. Furthermore it is planned to test SURFEX 8.1.

Fig. 3: RMSE for T2M averaged for all SYNOP stations in Austria (left) and the SYNOP station Andau (right). The verification period is from 20160501 to 20160629. Blue is AROME without data assimilation, green is the AROME run with SWI assimilation.

Soil temperature (Stefan Schneider (1.5 man months)):

With the same configuration as described above, a working environment has been set up at ZAMG to test the assimilation of T2M data in SURFEX 8.0 with the sEKF. Input data come from the INCA system, which provides T2M data already in gridded format as required by SODA. The system is up and running (one assimilation run per day at 12UTC with a forecast range of +24 hours), but the results are not satisfying so far.

It is planned to start the work on implementing the option to assimilate land surface temperature data in SURFEX 8.1 in autumn 2017.

Other activities:

GPS radio occultation assimilation (Florian Meier 0.25 man month)

Under the framework of a scientific project, we got test data from a private space technology company. Single observation assimilation into AROME with 2D and 1D operator and tangent point drift correction was technically OK. Further tests are postponed to 2018, when more data will be available. The setting of background values above model top needed for the observation operator (Abel integral) should be considered.

GPS-ZTD assimilation

A master student is currently running tests with Austrian national and E-GVAP data and AROME and static bias correction.

Conclusions:

- SURFEX: SURFEX 8.0 SEKF with diffusion scheme was run for a longer period

- Operational run is expected to be soon completely based on cy40t1; blacklisting of some mountainous pressure observations was found to be benefitial for 10m wind forecast.
- A two month test period with hourly AROME nowcasting 2.5km was run July 2016 and January 2017.
- RADAR: HARMONIE HDF5-reader and prepopera.py was adapted, pre-thinning as in bufr-reader is now also available. OPERA data and other foreign data can be assimilated as well.
- MODE-S: We got national data, investigation just started
- Latent heat nudging: some tuning for the test period was done