**Overview of ALADIN data assimilation activities
at Slovenian Environment Agency (ARSO)**

January – August 2017

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6 September 2017

Summary

In the first half of 2017, DA activities at ARSO were focused on:
- operationalization of cy40 including DA
- technical implementation and validation of new observations
- two-way coupled ocean-atmosphere model in the assimilation cycle
- radar QC and technical implementation

Table 1: Summary of DA related activities at ARSO (Jan – Aug 2017) in person/months.

Project/staff	Jure Cedilnik (pm)	Benedikt Strajnar (pm)	Total (pm)
Cy40 DA operationalization	0.5	0.75	1.25
Implementation and validation of new observations	0	1	1
Radar DA QC and technical implementation	0	1	1
Two-way coupled ALADIN+POM in assim. cycle	0	0.5	0.5
Assimilation of local GPS data	0	0.75	0.75
Total	**0.5**	**4**	**4.5**

Current operational assimilation suite

The operational setup (from June 2017) includes:
- model cycle cy40t1 (ALARO-v1b)
- 432 x 432 grid points, 4.4 km resolution
- 87 vertical levels
- B-matrix based on ECMWF EDA and cy40
- 3-hourly assimilation cycle
- ECMWF LBC coupling
- space-consistent coupling (no DFI)
- observations: SYNOP, AMV, TEMP, AMSU&MHS, SEVIRI, Mode-S MRAR

Implementation of cy40 in operational suite

After the validation of cy40 in full assimilation cycle with much improved scores for near surface temperature and humidity, cloudiness and air pressure and neutral impact on other variables, the cy40, together with assimilation, was put to operations in June 2017. The forecast improvements however originate mostly from improved model physics and not from DA.
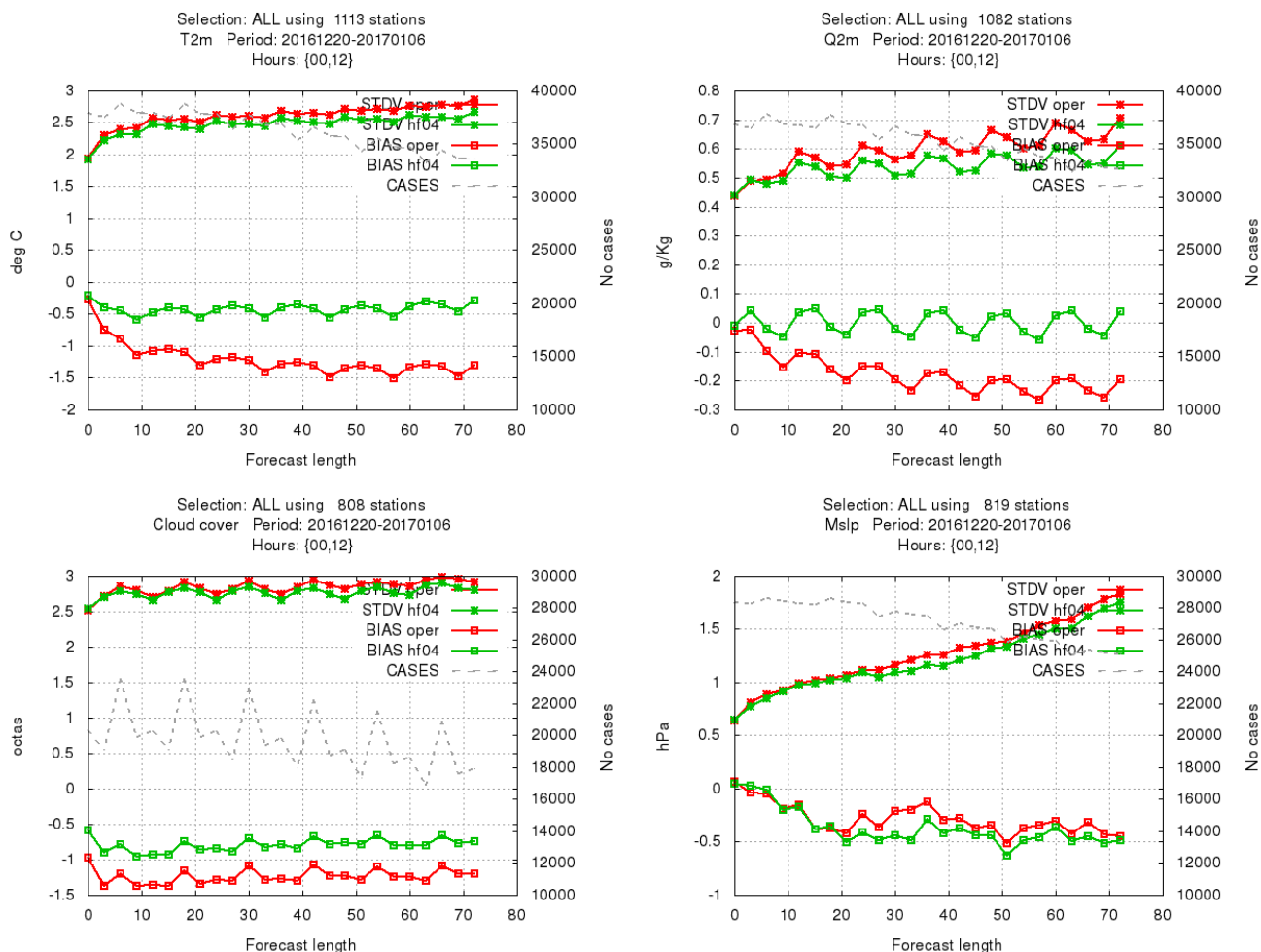
Figure: 2 m temperature and humidity, cloud coverage and pressure were among the most improved variable in pre-operational cy40 (green) with respect to the previous oper cy38t1 (red).

Technical implementation and validation of new observations

During the technical implementation of cy40t1, the assimilation scripts and binaries were updated to be able to process the additional, so far untested observations:
- additional AMVs (HRWIND)
- scaterometer data (ASCAT)
- wind profiles in BUFR

- Mode-S EHS data
- AMDAR humidity reports
- IASI
- radar reflecitivies and winds

The evaluation experiments of these observations (except radar) during 15 days period was performed. The results still have to be evaluated.

Radar DA QC and technical implementation

First experimentation on radar data assimilation started at ARSO. We applied technical steps to read local or OPERA IOFS radar data in HDF5 format with BATOR decoder. The prepopera script was applied to reduce the number of pixels. It was possible to read numerous radars except some where the wavelength was missing. A segmentation fault before the reflectivity obs. operator in minimization was also solved, so assimilation technically works and produces reasonable analysis increments.

In the mean time we concentrated on radar QC. The QC modules developed earlier for Inca were applied on OIFS files and compared. Several differences in the two existing radar preprocessing procedures for reflectivity were identified, as explained in the following table.

Quality check	Opera OIFS	INCA
attenuation	In quality index QI1, BROPO assigns smaller QI to lower dBZs and reduced dBZ based on attenuation	Attenuation stronger and computed as a separate QI
Beam blockage	In QI3	Based on SRTM, more aggressive than in Opera
Laplace test	-	implemented
Satellite cross-check	In QI2	with NWC SAF cloud type
WLAN test	Maybe partly in Q1, but some contamination persists (in SI radars)	implemented
Common QI	Minimal value of Q1,Q2,Q3 = Q4	A Product of all QIs
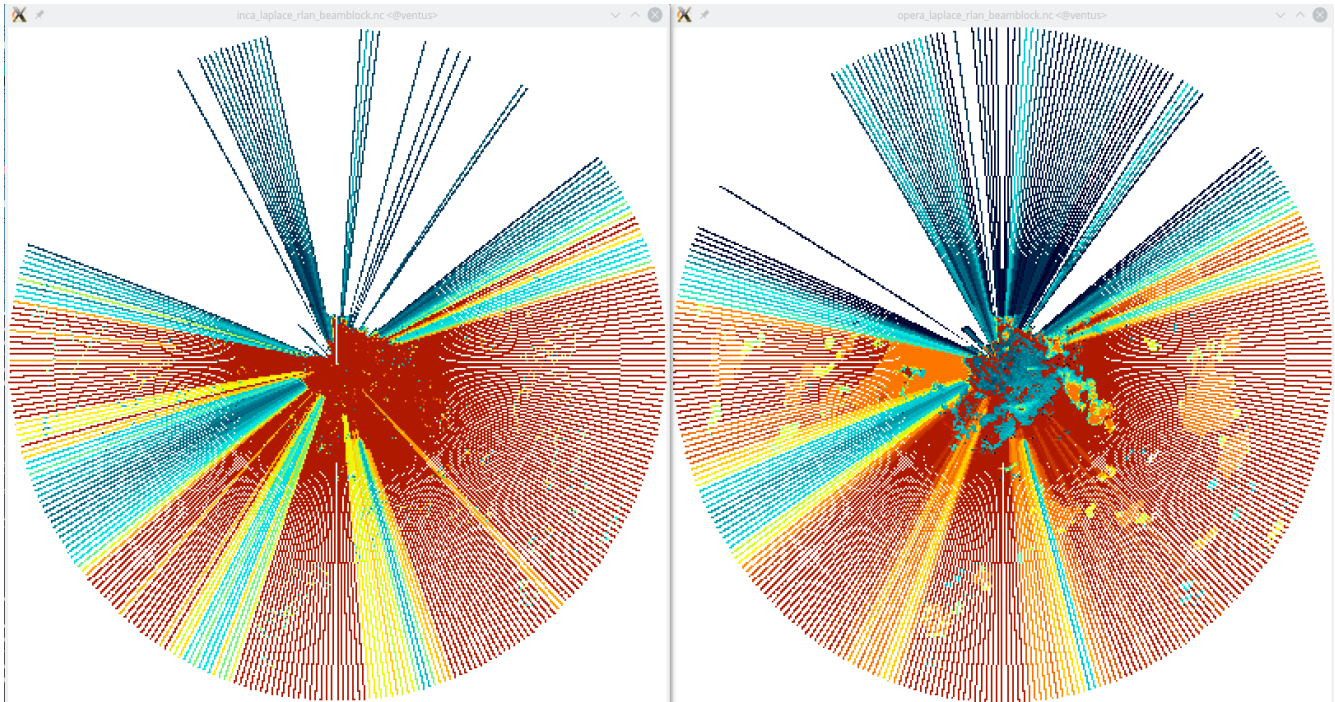
A comparison of total QI from Inca (left) and OIFS OPERA (right) for one case. Red is close to 1 (good data) and blue and black approach zero (low quality data). The more detailed QI in OPERA is a result of BROPO module (QI1 in OIFS file) where quality depends on the value of reflectivity.

So far there were no quality assessment tests with Doppler winds. Dealiasing procedures for wind were so far not considered.

Impact of two-way ocean atmosphere coupling on precipitation forecast for the coastal Adriatic region

The work on the two-way coupled system continued by validation of selected precipitation events. Various approaches to using coupling in data assimilation cycle were evaluated. Several approaches to applying the one- or two-way coupling (in the warm-up period, during the main forecast, or both) and several approaches to using SST information in ALADIN in the one-way coupled mode (POM, MFS, ECMWF) were tested. A publication on this subject is under preparation.

Assimilation of local GPS data

GPS observations from Slovenia and its close surroundings are available operationally from Geodetic Institute of Slovenia. In the previous years several experiments were carried out in order to select stations of reasonable quality. However, the current results of long term evaluation are still unsatisfactory. While the upper-air impact on humidity is neutral to slightly positive we observe significant degradation of surface fields over Slovenia (see figure). This has to be understood and currently prevents the data from the operational usage.
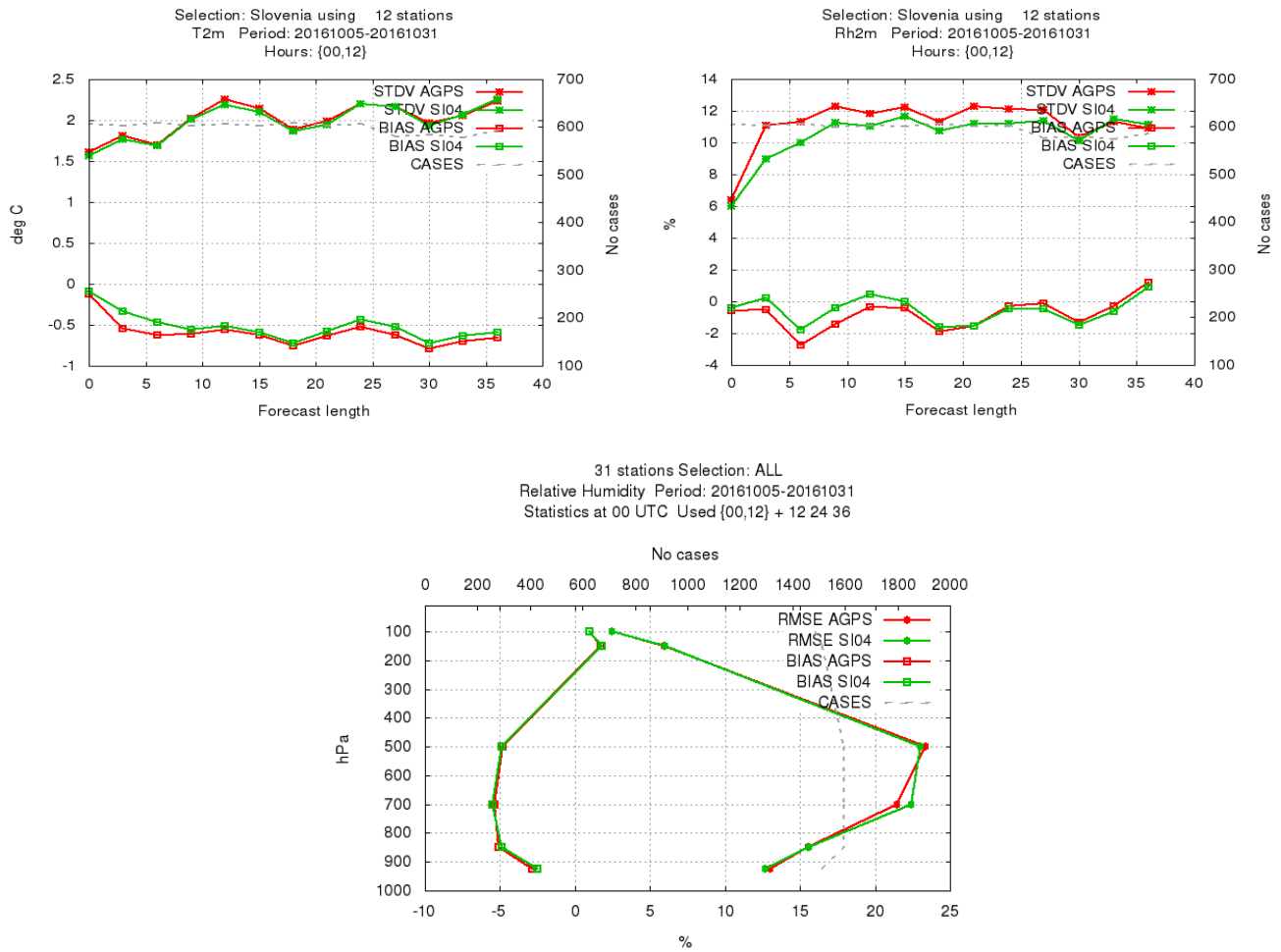
Figure: Impact of SI GPS (red) with respect to the reference (green) on 2 m temperature and humidity (top) and upper-air humidity (bottom).