Working Area Data Assimilation

Progress Report

Prepared by:	Area Leader Máté Mile
Period:	2016 (from January to December)
Date:	07/03/2017

Progress summary

In this report, the LACE DA activities are going to be summarized which have been done between January and December i.e. during the whole calendar year of 2016. Until the end of the year 3 LACE stays with a total duration of 5 months were realized supporting the activities of hourly DA systems and the use of radiance observations. The LACE stays dedicated to surface assimilation and to the use of RADAR observations have been postponed or cancelled.

As usual large part of the DA work has been booked by the operational system upgrades and maintenance duties. There is a new experimental AROME based DA system in Bratislava and there are more and more experiments with hourly analysis systems as well. These mainly local DA efforts are summarized in the first section of the LACE DA report.

Concerning research oriented actions, the use of high resolution observations and the application of high resolution DA systems for nowcasting purposes were in the main focus of the LACE centres in 2016. The Mode-S aircraft observations have wider and wider network consisting Czech, Austrian, Slovenian and already KNMI distributed EHS observations in LACE. On the other hand, there was no progress on common RADAR assimilation action and only ZAMG was active to develop further the local use of Austrian RADARs. The assimilation of GNSS tropospheric delays (mostly ZTD) has been progressed by its advanced bias correction scheme and by making further experiments. The use of satellite observations was also investigated regarding the bias correction, thinning and observation errors. In the frame of a LACE stay, the different VARBC initialization strategies have been also compared. Beside the activities related to different observation types, researches about hourly DA systems and related developments will be reported as well.

Action/Subject/Deliverable: *Towards operational implementation of full (upper air and surface) DA systems*

Description and objectives:

An overview of the current operational DA systems in LACE can be given by the following table (yellow colors indicate the latest system upgrades and tests on higher resolutions):

DA	AUSTRIA ALARO	AUSTRIA AROME	CROATIA ALARO	CZECH REP ALARO	HUNGARY ALARO	HUNGARY AROME	SLOVAKIA ALARO	SLOVENIA ALARO	ROMANIA ALARO
resolu-tion	4.8L60	2.5L90 (tests on 1.2km)	8L37 (tests on 4.4km)	4.7L87	8L49	2.5L60	9L36 (tests on 4.5km,1km)	4.4L87	6.5L49 (tests with L60)
cycle	36t1 exp	40t1 38t1	35t1 38t1	38t1	38t1_bf3	38t1_bf3		38t1	38t1 40t1
LBC	IFS 3h	IFS 3h	IFS 3h	ARP 3h	IFS 3h	IFS 1h	ARP 3h	IFS	ARP
method	OI	OI_main inline (+snow init) + 3DVAR	OI + 3DVAR	OI + BlendVAR (DF blending + 3DVAR)	OI + 3DVAR	OI_main + 3DVAR	OI + DF blending	OI + 3DVAR	OI + 3DVAR
cycling	6h	3h	6h	6h	6h	3h	6h	3h	6h
B matrix	-	downscaled LAEF	NMC lagged	downscaled ARP ENS	ALARO EDA	AROME EDA		new down-scaled EC ENS	
Special	additional snow melting			sigma_coef= 0.67; REDNMC= 1.7; IDFI in prod					

In Czech Republic local efforts was dedicated to utilize GTS SYNOP BUFR data processing, BUFR message handling and BUFR reading in BATOR. The current version of BATOR (cy38t1, cy40t1) still requires validation work and extension of Tmin/Tmax handling which is missing currently. Beside these observation reading activities, accurate background error statistics were computed uniquely for Czech BlendVar DA system. An article about the results of this new B matrix have been submitted in Tellus at the end of 2016. As local work new verification tools were also developed to evaluate the performance of hourly model forecasts against AMDAR/MRAR/SYNOP/TEMP observations and another spatial verification

tool for precipitation verification using SAL and FSS methods. The verification softwares use R-cran libraries.

In Austria the AROME surface assimilation was upgraded with new cycle implementation (CANARI-Oi_main inline from cy40t1), adaptation of MESCAN settings, lake surface temperature replacement with in-situ measurements and snow initialization by the combination of satellite products and SNOWGRID snow model. Experimental AROME/Nowcasting system is running on 1.2km horizontal resolution and with cy40t1. The B matrix of this 1.2km AROME has been calculated by ensemble method using the downscaled 2.5km AROME-EPS for forecast samples. AMDAR humidity observations in AROME/Nowcasting system were tested as well. After the necessary modifications in screening and minimization the specific humidity increments have been found realistic. More details about AROME/Nowcasting can be read in related action reports. In autumn 2016, the cloud analysis procedure of HIRLAM (made by Sibbo van der Veen) was implemented into cy40t1. This procedure is able to initialize clouds at the beginning of the model integration and preliminary results are under evaluation.

In Slovenia the background error statistics of the operational ALARO DA system was recomputed due to the new ALARO-1 implementation and to represent the structure functions of this improved physics. The computation of B matrix was carried out with Harmonie FESTAT and on ECMWF platform. Another data assimilation related activity is the two-way coupled ocean-atmosphere model which study has been continued in 2016 as well. The importance of this coupling was shown on various high-impact precipitation case studies where the fully coupled system provided better temperature and precipitation fields especially close to the Adriatic coast. At the second half of 2016, the two-way coupling experiments have been continued with long-term simulations. Preliminary results suggested that two-way coupling is very important in both, during long forecasts and in data assimilation cycling. Furthermore positive impact of the fully coupled system was mainly observed on short forecast ranges and often worse scores for longer ranges which has to be further studied.

In Slovakia both the upper-air and surface data assimilation systems have been studied. For upper-air DA, the 3DVAR implementation has been continued with ALARO (using CHMI settings) and for another 3DVAR of new AROME/SHMU configuration it was also started. The domain of this AROME/SHMU can be seen on 1. figure. For surface analysis, the CANARI configuration with cy40t1 has been validated and debugged (new bf package is available and short report can be found on LACE forum).

Furthermore a SODA test experiment was also built as new surface assimilation system in cooperation with Met Norway (Trygve Aspenes). Additionally an experimental ALARO-1 with 1km horizontal resolution has been built to test high resolution surface assimilation based on CANARI/MESCAN. With this new DA configuration the added value of high resolution local observation is under evaluation.

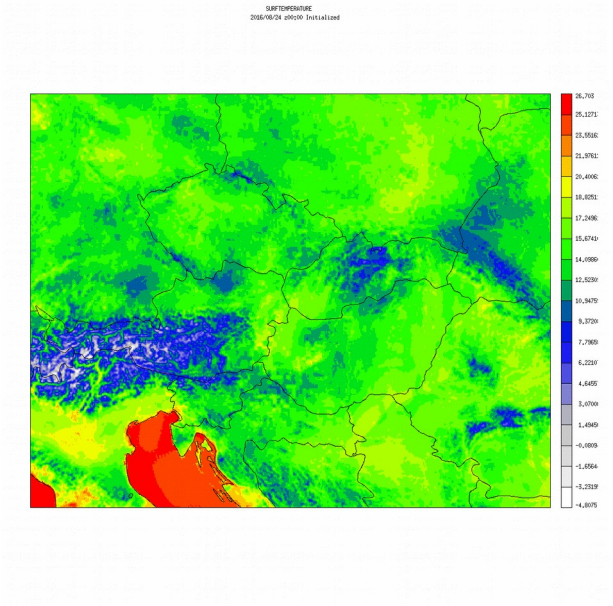


Figure 1. The domain of AROME/SHMU

Regarding Romanian local work, new B matrix of ALARO DA system was computed for 60 vertical levels and 6.5km horizontal resolution using downscaled AEARP members and 6 hours forecast differences. Also the implementation of new cycle (cy40t1) on new IBM platform was done, however, there is still validation issue with minimization of cy40t1.

In Croatia, beside the operational ALADIN-HR8 model, a higher resolution of ALADIN-HR4 is in test mode running with common cycle 38t1 and using 3 hourly assimilation cycle. This ALADIN-HR4 uses Slovenian Mode-S and SEVIRI channel 4 and 6 on the top of the operationally used observation set of ALADIN-HR8. In 2016 some issues related to LDIRCLSMOD switch and 3DVAR (NaN in minim) have been reported during DA Working Days. Also this year the CANARI-MESCAN settings and VARBC diagnostics have been investigated.

In Hungary the AROME Oi_main surface assimilation system was studied for winter and summer periods. A parallel AROME/Hungary employing Oi_main surface analyses has been started since spring 2016 to check its performance after a longer spin-up period and to get balanced surface fields before its operational implementation. The radiosonde

measurements valid at 02UTC from 2 Austrian stations were allowed to enter 03UTC AROME analyses for experimental purposes. With these additional observations the performance of the AROME forecast became slightly better and the wider assimilation window didn't harm the system during the test period. Also in AROME DA system the use of AMDAR humidity observations was explored making modifications of AMDAR reports in OBSOUL (later implemented in OPLACE by LACE DM) and blacklisting setting in screening and in minimization. The preliminary results showed promising impact and reasonable increments in 3DVAR analyses (see figure 2.). At the end of 2016, operational AROME DA system has been extended with OI_main surface assimilation scheme, the use of Slovenian Mode-s MRAR, TEMP measurements at 02UTC and AMDAR humidity observations.

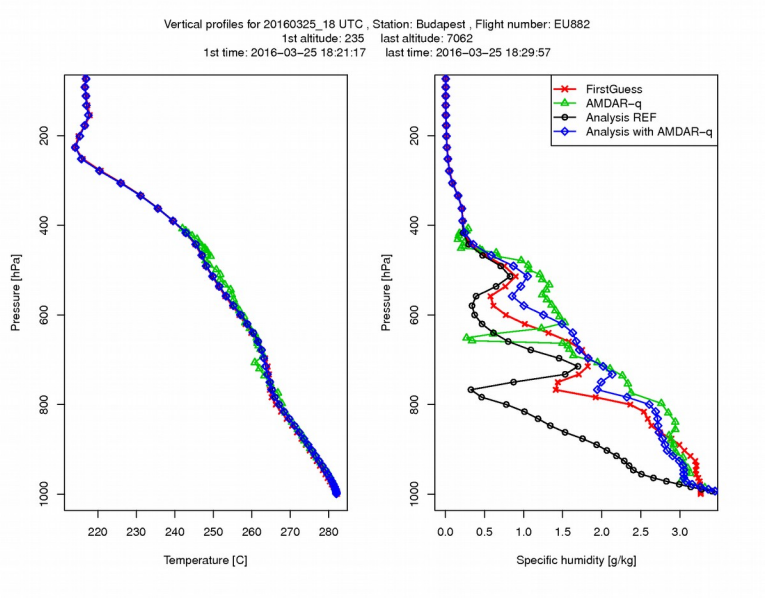


Figure 2. Comparison of AROME analyses, first-guess and AMDAR humidity observations in a case study of 25th of March, 2016.

Efforts: 6 months (local work)

Contributors: roughly 1 person per countries

Documentation: national reports on LACE webpage

Status: ONGOING

Action/Subject/Deliverable: *Hourly updated DA systems (RUC, RAP, cycled and non-cycled hourly DA systems)*

Description and objectives:

In 2016 the non-cycled hourly DA systems have been developed further for nowcasting and automatic forecasting purposes. There were no progress with RUC (cycled) assimilation system and its challenges.

In Prague a new nowcasting frame-work has been worked out using ALADIN/CHMI operational forecasting system. The aim is to generate hourly analyses by VarCanPack configuration (3DVAR-Canari) where the latest observations within 30 minutes cut-off are used i.e. SYNOP, AMDAR, AMV, SEVIRI and experimentally Mode-S (MRAR and EHS). The Canari is used after 3DVAR to better analyse screen-level parameters (2m temperature, 2m relative humidity and 10m wind) for each hourly analyses. For the proper analysis output the diagnostic of 10m wind u, v components has been also modified to be able to read wind parameters from first guess when LDIRCLSMOD switch is activated. The construction of this new nowcasting tool can be seen on figure 3. below from VarCanPack poster made by CHMI colleagues.

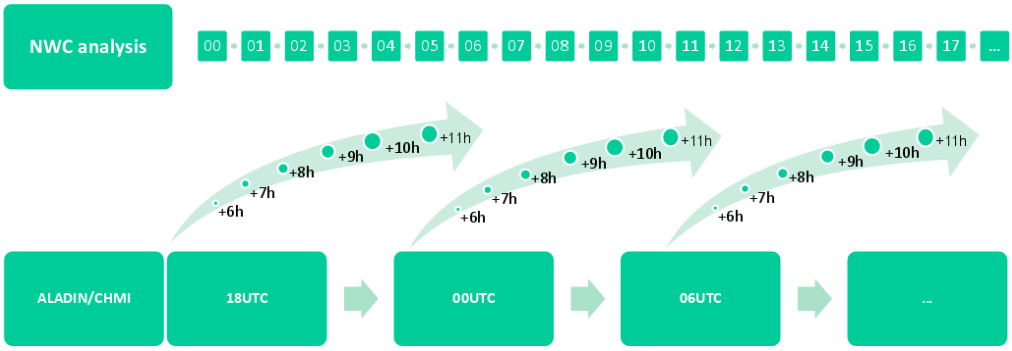


Figure 3. The scheme of the ALADIN/CHMI operational forecast used as the first guess for hourly analyses

In Austria the AROME/Nowcasting system was further developed. The new common cycle (cy40t1) was adopted to the complete system in 2016. The use of observations was extended with Slovenian Mode-S MRAR and newly available KNMI EHS (experimentally). The AMDAR humdity observation was studied in AROME/Nowcasting as well. For the 1.2km data assimilation, B matrix was constructed applying downscaled 2.5km AROME-EPS and ensemble method. The new FESTAT, FEMARS and FEDIACOV tools was utilized with grib format of forecast differences, but AROME grid point humidity still had to be corrected in FEMARS. The Austrian RADAR observations were also further tested in AROME/Nowcasting. The local RADAR-HDF5 changes have been found difficult to handle with CONRAD which has a lot of hard-coded settings. Therefore BATOR HDF5 reader modset (developed by Martin Ridal SMHI) was installed at ZAMG to avoid

the use of CONRAD. The access to OPERA RADAR data was also established to begin the work with OPERA volume data.

An Incremental Analysis Update (IAU) tool was tested in the frame of AROME/Nowcasting in Vienna. By the use of IAU, a cycled DA system can be constructed where the new analyses can be gradually added to the short-range forecasts of AROME/Nowcasting. Preliminary results showed that new IAU version can improve precipitation forecast of AROME model (see figure 4. below).

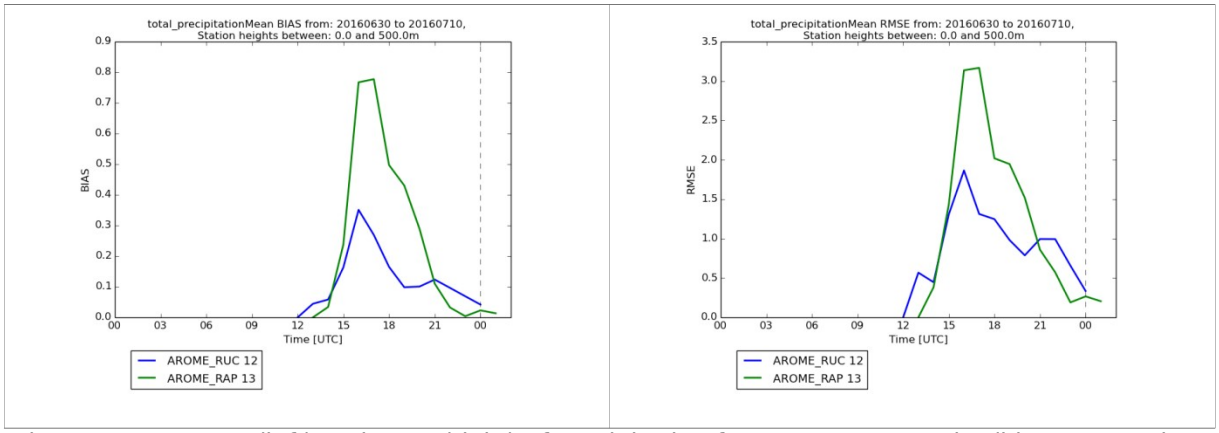


Figure 4. Mean BIAS(left) and RMSE(right) of precipitation for AROME/Nowcasting(blue-IAU version, green non-cycled AROME)

During LACE stays the performance of AROME/Nowcasting system has been evaluated in Vienna. The Latent Heat Nudging (LHN) technique implemented in 2015 was further investigated on the operational AROME horizontal resolution (2.5km) and with higher (1.2km) resolution AROME experiments. As “observed” precipitation, INCA (15 min) and RINCA (Rapid INCA, 5 min) analyses have been used in LHN scheme of the AROME/Nowcasting. Beside the LHN, 3DVAR analyses were also performed but with limited number of observations due to very short cut-off settings. During the validation of the different experiments (reference without LHN, experiment with LHN using idealized profiles, another LHN experiment using real profiles and a forth LHN with INCA 15 min analyses), two convective case studies were reported. The precipitation forecasts of the first convective case can be seen on the figure 5. below. More details about the development of AROME/Nowcasting and LHN can be found in Mirela Pietrisi's LACE stay report.

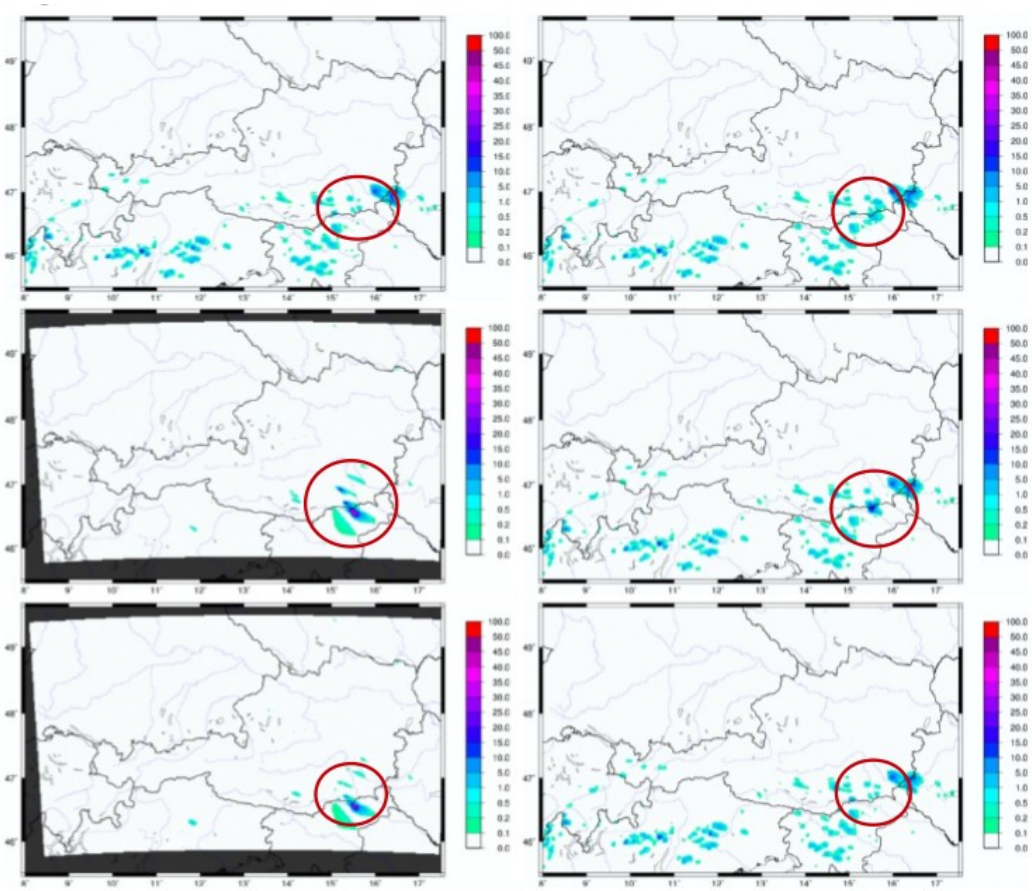


Figure 5. AROME/Nowcasting precipitation case study comparing reference AROME (upper left panel), RINCA analysis (middle left panel), INCA analysis (bottom left panel), AROME LHN with idealized profiles (upper right panel), AROME LHN with real profiles (middle right panel) and AROME LHN with INCA (bottom right panel).

Efforts: 10 months

Contributors: F. Meier (At), A. Trojakova (Cz), P. Benacek (Cz), A. Bucanek (Cz), M. Pietrisi (Ro), B. Strajnar (Sl), M. Mile (Hu)

Documentation: reports on LACE webpage

Status: ONGOING

Action/Subject/Deliverable: ***Surface Assimilation using Extended Kalman-Filter***

Description and objectives:

The EKF surface assimilation activities have been restarted at ZAMG for special project purposes. The related technical implementation of cy40t1, Surfex 7.3 and SODA 8.0 was started, but several issues were identified. At the second half of 2016 a new processing chain was built where cy40t1 AROME with Force-Restore method and SURFEX 8.0 with diffusion scheme

(for OFFLINE and SODA) have been adapted. With this new chain SODA is working, but OFFLINE is still to be fixed. Observations of the soil moisture from ASCAT and Sentinel-1 satellites (combination) and LST from Sentinel-3 are in the focus of the special projects.

The common LACE activity using EKF surface assimilation with conventional observations was in the validation phase in 2016. The dedicated LACE stay was postponed to the beginning of 2017, therefore more results are going to be reported in next year.

Efforts: 9 months

Contributors: S. Schneider (At), H. Toth (Hu), V. Tarjani (Sk)

Documentation: reports on LACE webpage

Status: ONGOING

Action/Subject/Deliverable: ***Assimilation of radiance observations (ATOVS, IASI, SEVIRI) in DA systems***

Description and objectives:

The radiance observations from NOAA and METOP satellites are already in operational use at many LACE centre's DA systems. However, it is used with its default settings which are usually fit to the global model configurations.

In Prague the use of radiance observations has been changed to make the DA settings more appropriate for ALADIN/CHMI system. The aims of this study were to determine the spatial and interchannel observation error correlation of AMSU-A, MHS and SEVIRI radiances and to tune the observation error coefficient for those sensors. Briefly the results showed the optimal thinning distance of AMSU-A, MHS ans SEVIRI is 50, 70 and 20km respectively. For the observation error coefficient (SIGMAO_COEF) the value of 0.8-1 was found optimal during the study. Also in 2016 the optimal assimilation window length of the operationally used ATOVS radiances were examined. It showed that the optimal lengths are two hours (+- 1h) and three hours (+- 1.5h) long for MHS and AMSU-A respectively. An additional experiment was carried out using a so called double difference method (Sounders, 2015) in order to compare radiances of the same instruments from different satellites (NOAA-18, NOAA-19, Metop-A, Metop-B). The results of this study is under evaluation. Last but not least during a LACE stay in Prague, the different VARBC initialization methods (mainly warmstart and coldstart) have been compared. The main conclusions of this study were that the warmstart can reduce unwanted predictor collinearity issues and be able to produce reasonable bias correction without very long spin-up period and without large data sample compared to the coldstart. An illustration about the OMG BIAS and STDV

results can be seen on figure 6. On the other hand, concerning higher peaking channels, both cold and warmstart provide too adaptive evolution of bias parameters (with the default VARBC settings) due to the larger observation sample which controls the adaptivity and probably due to the effect of larger FG error. More details about this study can be read in LACE stay report on LACE webpage.

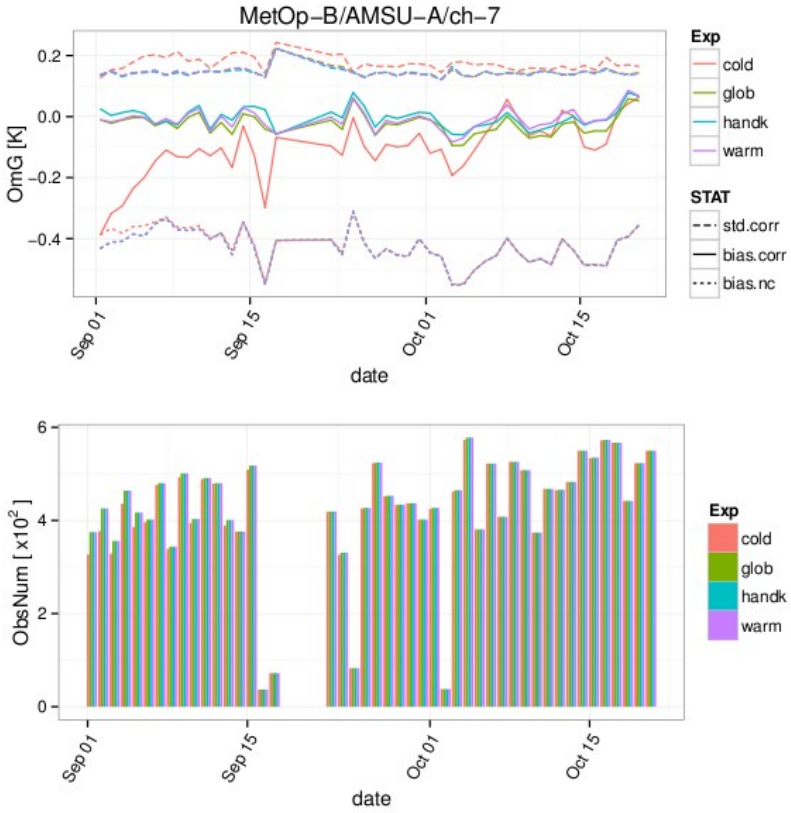


Figure 6. Observation minus first-guess BIAS and STDV for AMSU-A channel 7. Comparison of Cold, Warmstart, Harris and Kelly (reference 1) and Global (reference 2) VARBC initialization.

In Slovenian ALARO DA system too adaptive VARBC coefficients and significant fluctuations were observed in 2015. In 2016 the LAM cycled VARBCs and the use of global VARBCs at each analysis time without LAM update have been compared. However, the LAM VARBCs without appropriate tuning of VARBC settings can produce larger fluctuations in the evolution of bias parameters, but the use of global VARBCs can avoid this feature. Therefore this approach can be a good alternative for those instruments where coefficients are available from global DA system as well.

In Hungarian ALARO DA system some VARBC issues were also detected. It turned out that the use of radiance observations gave significant overestimation of precipitation forecasts in the operational model. By the diagnostic tool of Patrik Benacek, a passive assimilation study was chosen when a new set of VARBC was recomputed and the proper settings

(LISTE_LOC, mf_blacklist.b, NBG parameters) were determined. Also an analysis network time dependent blacklisting (LISTE_LOC_00, LISTE_LOC_06, LISTE_LOC_12, LISTE_LOC_18) was tested to evaluate the VARBC coefficients independently at each analysis time. That first experiments were based on coldstart initialization method and after the LACE stay more efforts have been put on warmstart initialization. Also with the shorter assimilation window and this warmstart VARBC coefficients the forecast skill of ALARO/Hungary became better in term of precipitation. The investigation will be continued in 2017 as well.

Efforts: 10 months

Contributors: P. Benacek (Cz), B. Strajnar (Sl), M. Mile (Hu), P. Sepsi (Hu)

Documentation: reports on LACE webpage

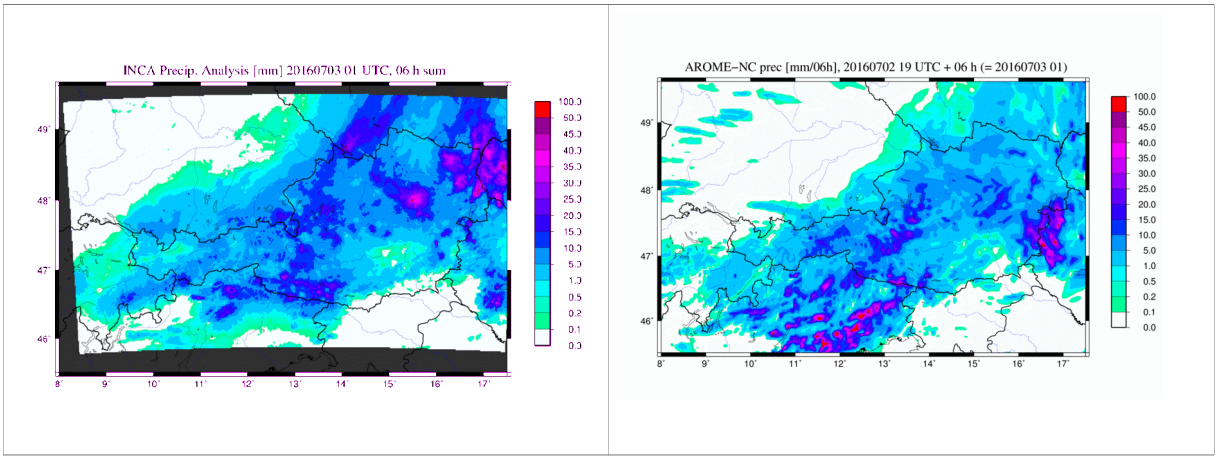
Status: ONGOING

Action/Subject/Deliverable: ***Implementation of RADAR reflectivity and radial wind***

Description and objectives:

In 2016 the common RADAR action was mainly halted and due to the difficulties of different RADAR data content and the lack of universal QC tool, only discussion and brainstorming happened.

On the other hand there was progress with the use of local RADAR data at ZAMG where HARMONIE-HDF5 reader and prepopera tool has been successfully installed. This new way of RADAR observation pre-processing provided improved results which can be seen in a case study on figure 7. The access of OPERA volume data has been also requested, but the RADAR observations from other countries have not been tested yet.



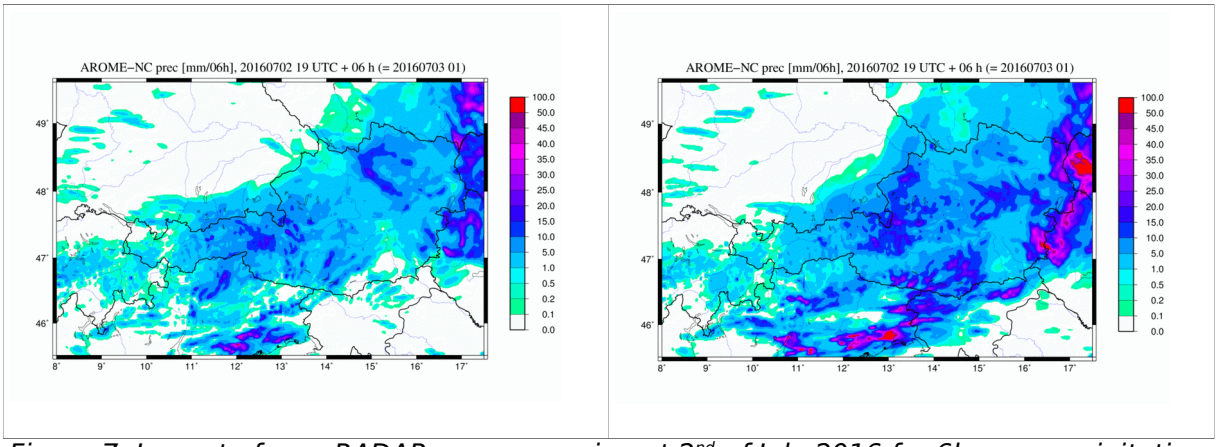


Figure 7. Impact of new RADAR pre-processing at 2nd of July 2016 for 6hours precipitation forecast (INCA analysis(top left), AROME-No RADAR(top right), AROME-RADARMFBUFR(bottom left), AROME-RADARHDF5(bottom right))

Efforts: 4 months

Contributors: F. Meier (At), L. Tuchler (At), M. Nestiak (Sk)

Documentation: report on LACE webpage

Status: ONGOING

Action/Subject/Deliverable: Assimilation of GNSS path delays (ZTD, refractivity index)

Description and objectives:

The assimilation of GNSS ZTD in AROME/Hungary was continued in 2016. The so called SGO1 GNSS ground based network (previously called SGOB) and its ZTD measurements were tested on a new period with AROME 3DVAR. Due to previous results the preselection criterias of GNSS stations was revised i.e. lower maximum bias and standard deviation thresholds were chosen to select stations with better quality of ZTD measurements. The required thinning distance was also increased to 40km to avoid observation error correlation. In this study the reference was the current operational AROME and other experiments were run with both static and variational bias correction. The use of VARBC for surface observations (for GNSS) was also extended with additional (surface) predictors (predictor 3 and 4). A preliminary example of two GNSS stations and the evolutions of the bias parameters for pred0, pred3 and pred4 can be seen on figure 8. This new study showed promising impact of the use GNSS ZTD and variational bias correction provided slightly better results than static one (see figure 9. below).

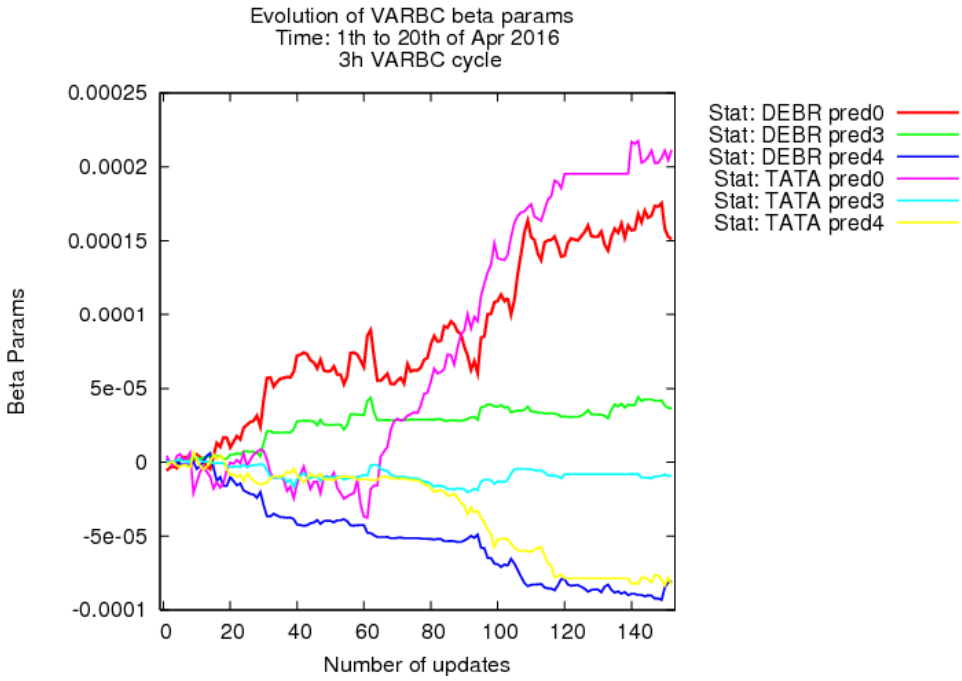


Figure 8. The evolution of (coldstarted) bias parameters for station TATA and station DEBRECEN.

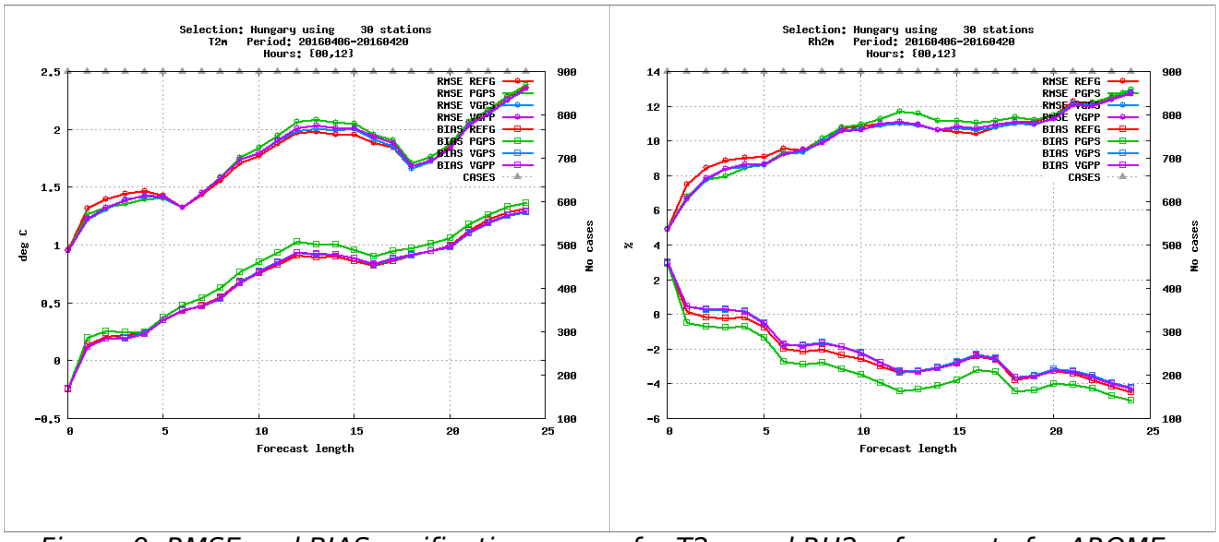


Figure 9. RMSE and BIAS verification scores for T2m and RH2m forecasts for AROME-OPER(red), AROME-ZTD with static bias corr. (green), AROME-ZTD with basic VARBC (blue) and AROME-ZTD with extended VARBC (purple)

In Slovenia the use of GNSS ZTD studies was also continued to further assess the impact of variational bias correction approach. The idea in this study was to avoid station preselection and predefined biases, observation errors computed on a training period. Therefore the VARBC was applied directly on the raw measurements. With this approach the impact of ZTD assimilation was significant and caused deterioration of forecast scores over Slovenian domain (esp. for relative humidity and surface temperature). Also it was observed that the adaptation of VARBC was slow, but certain bias existed. The first conclusion suggested that the prior data selection is essential for GNSS ZTD assimilation. Additional study in 2016 examined that the problem derived from a few stations of Slovenian GNSS network providing ZTDs with poor quality. After new preselection of GNSS whitelist (only 12 stations from the 25) the increments were smaller and comparable to other humidity observations (see figure 10. below)

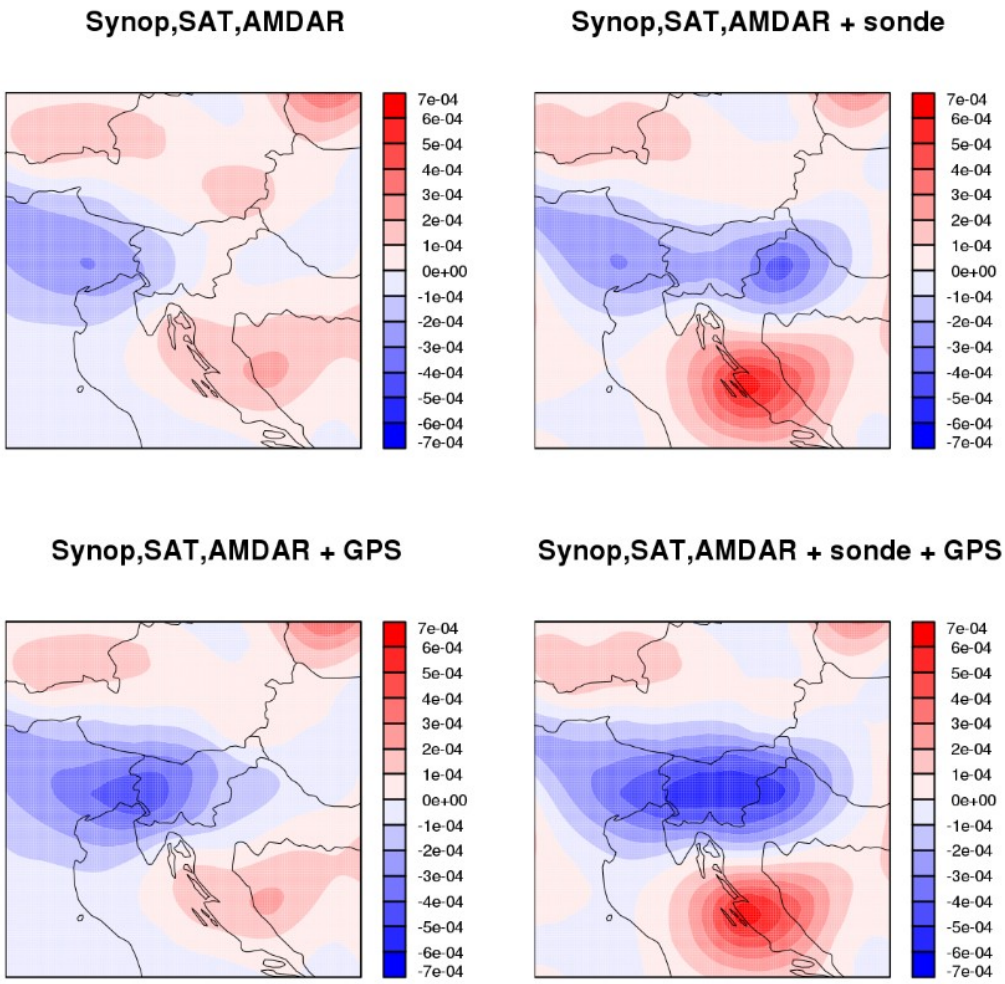


Figure 10. Illustration of relative impact of GNSS on specific humidity on level 50 over Slovenia. Increments with GNSS observations are comparable and coherent with other observations.

Efforts: 7 months

Contributors: M. Mile (Hu), B. Strajnar (Sl)

Documentation: report on LACE webpage

Status: ONGOING

Action/Subject/Deliverable: Assimilation of Mode-S observations

Description and objectives:

The use of Mode-S observations (both MRAR and EHS) have a fast growing network and increasing importance in LACE and in the mesoscale DA systems of the centres.

In Austria, Slovenian Mode-S MRAR observations are regularly used in AROME/Nowcasting. Also the KNMI distributed EHS observations have been started to pre-process locally (with a time averaging python script). The Austrian Mode-S data is going to be ready soon via a special project together with AustroControl.

In Hungary there is still negotiation between OMSZ and Hungarocontrol (HC) to exchange Mode-S observations retrieved by HC's RADARs. At the same time in 2016 the already available Slovenian Mode-S MRAR observations were studied in AROME DA system making verification for winter period focusing on cloudiness and low level wind. The OSE with Slovenian MRAR observations (on the top of the operationally used conventional observations) showed neutral impact on AROME forecast. After these experiments the Slovenian Mode-S observations have been introduced operationally in AROME 3DVAR system (together with the above mentioned AMDAR humidity and TEMP 02UTC).

In Czech Republic, an extensive study was made to review the use of aircraft (AMDAR and Mode-S) observations and its error characteristics in ALADIN/Cz. More precisely the validity of zero observation error correlation and the accurate data thinning, observation error inflation have been investigated. By the Desroziers diagnostic the horizontal and vertical observation error correlations as a function of separation distance were examined and identified that the optimal thinning of Mode-S MRAR is around 25-35km in horizontal and 15-20 hPa in vertical. Furthermore the diagnostic of AMDAR and Mode-S MRAR observation errors showed similar characteristics and the predefined errors have been found consistent with the Desroziers error estimations. As a part of this study, the optimal

observation error inflation was also examined by verifying the forecast impact with different error inflations. The outcome of these forecast impact studies (sigmao_coeff~2-3) and the Desroziers error estimations (sigmao_coeff~0.67) showed contradictory results of observation error settings which might be due to the Desroziers method has been initially computed with unchanged sigmab coeff-s (REDNMC). More details can be read in comprehensive CHMI report on LACE webpage.

Efforts: 8 months

Contributors: B. Strajnar (Sl), A. Trojakova (Cz), P. Benacek (Cz), A. Bucanek (Cz)

Documentation: report on LACE webpage

Status: ONGOING

Action/Subject/Deliverable: Assimilation of Meteosat HRW AMVs

Description and objectives:

In 2016, the use of AMV observations was not studied further. After the experiments have been made in 2015, this action is going to be continued in 2017.

Efforts: 0 month

Contributors: F. Meier (At), M. Mile (Hu)

Documentation:

Status: ONGOING

Action/Subject/Deliverable: *Investigation of spatially varying flow-dependent background error variance*

Description and objectives:

Also there was no progress in the action of spatially varying flow-dependent background error variance and probably this action is halted for an uncertain period.

Efforts: 0 month

Contributors: A. Bucanek (Cz)

Documentation:

Status: STOPPED

Action/Subject/Deliverable: ***Installation and validation of OOPS LAM 3DVAR prototype (OOVAR)***

Description and objectives:

Unfortunately the LACE collaboration to make shared work on OOPS developments, toy models was not successful, however the access to the Hungarian computer was opened, but due to lack of manpower there was no interest to try the system yet.

In the first half of 2016 there was only minor progress in OOPS related activities in Budapest. The OOVAR prototype installed at the Hungarian platform was briefly tested with single AMDAR observations in ALADIN 3DVAR, but similar incorrect increments were obtained like with single SYNOP observations. More efforts were dedicated to the new HOP driver test enviroment in 2016. The test run of HOP driver was reproduced in Harmonie scripting system (originally made by Eoin Whelan Met Ireland) and was started to build it in gmkpack and local environment. The basis of the HOP driver is cy42r2 ECMWF pack release which is significantly refactored in OOPS context. Furthermore the cy42 consists a lot of new features of fortran as well which was found difficult to compile with an older computer platform and obsolete linux edition of the Hungarian computer. Due to this dependency problem the system upgrade was made and the compilation of cy42r2 was successful on the new linux and with the newer version of intel fortran compiler. The investigation of HOP driver remains ongoing.

Efforts: 2 months

Contributors: M. Mile (Hu)

Documentation: report on LACE webpage

Status: ONGOING

Documents and publications

List of reports:

- Patrik Benacek: Tuning of 3DVAR ALADIN-Cz system for aircraft data assimilation
- Antonin Bucanek, Patrik Benacek, Alena Trojakova: New nowcasting frame-work in ALADIN/CHMI, poster presentation

- Benedikt Strajnar: Overview of ALADIN DA activities ar ARSO (part 1) (part 2)
- Florian Meier, Stefan Schneider, Jozef Kemetmuller, Christoph Wittmann: DA activities at ZAMG (part 1)(part 2)
- Mirela Pietrisi: AROME nowcasting – tool based on a convective scale operational system
- Mate Mile, Patrik Benacek: Comparison of different VARBC initialization approaches

List of presentations:

Mate Mile: “Highlights of latest LACE data assimilation activities”, Joint 26th ALADIN Workshop & HIRLAM All Staff Meeting, 4-8 April 2016, Lisbon, Portugal

Florian Meier: “AROME-Nowcasting in Austria”, Joint 26th ALADIN Workshop & HIRLAM All Staff Meeting, 4-8 April 2016, Lisbon, Portugal

Mate Mile: “LACE data assimilation activities”, 38th EWGLAM and 23rd SRNWP Meeting, 3-6 October 2016, Rome, Italy

National posters at Joint 26th ALADIN Workshop & HIRLAM All Staff Meeting, 4-8 April 2016, Lisbon, Portugal: Austria, Croatia, Czech Republic, Hungary, Slovakia, Slovenia, Romania, Available online: http://www.cnrm-game-meteo.fr/aladin/spip.php?article287&lang=en

National posters at 38th EWGLAM and 23rd SRNWP Meeting, 3-6 October 2016, Rome, Italy: Austria, Croatia, Czech Republic, Hungary, Slovakia, Slovenia, Romania, Available online: http://srnwp.met.hu/

Activities of management, coordination and communication

1) Joint 26th ALADIN Workshop & HIRLAM All Staff Meeting 2016, 4-8/04/2016, Lisbon, Portugal (participation of Mate Mile)
2) 38th EWGLAM and 23rd SRNWP Meeting, 3-6 October 2016, Rome, Italy (participation of Mate Mile)
3) HIRLAM/ALADIN/LACE/SURFEX Surface Working Week, 24-26 October 2016, Zagreb, Croatia (participation of Helga Toth)

LACE supported stays – 20 weeks in 2016

1) Mirela Pietrisi (MeteoRomania) – 16 weeks in Vienna (ZAMG), 15th of Feb. - 8th of Apr. 2016., July-Aug. 2016.

2) Mate Mile (OMSZ) – 4 weeks in Prague (CHMI), 7th of Nov. - 18th of Nov.; 5th of Dec. - 16th of Dec. 2016.

Summary of resources/means

Action	**Resource**		**LACE stays**	
	Planned	**Realized**	**Planned**	**Realized**
Local DA system	-	6	-	-
Hourly RUC	8	10	2	4
Surface EKF	6	9	1	0
Radiance obs	7	10	0	1
RADAR obs	4	4	1	0
GNSS obs	6	7	0	0
Mode-S obs	8	8	0	0
AMV obs	5	0	0	0
Flow-dep B.	3	0	0	0
OOPS	7	2	0	0
Total	**54**	**56**	**4**	**5**

Problems and opportunities

The main problems in 2016 were:

- A lot of work still booked by validation, maintenance and technical issues inside LACE DA activities.
- The communication channels are also not effective which can produce relatively large fluctuations, changes in the reported and planned activities.

Opportunities for more effective future work are:

- to increase the level of cooperation inside and outside LACE and support cooperation with other areas (e.g. DA & EPS common activities) as well.
- to consider common scripting and validation systems to reduce technical part of the DA works.
- to apply common international projects which supports the research oriented activities
- A common state-of-art videoconference system should be used by all LACE members in agreement with ALADIN-HIRLAM community as well to avoid difficulties in communication
- to make long term planning and to determine priorities for long term aims and actions.