Working Area Data Assimilation

Progress Report

Prepared by:	Area Leader Máté Mile
Period:	2015 (from January to December)
Date:	24/02/2016

Progress summary

In this report, the LACE DA activities are summarized which have been done in the whole year of 2015. The realizations of the planned LACE stays were changed a lot at the second half of 2015 and finally hourly RUC action, EKF surface assimilation and the use of Mode-S observations activities were supported from LACE budget as research stays.

The most important achievement regarding local DA system was the operational implementation of Czech ALARO BlendVar system at the end of summer 2015. In other LACE centres considerable amount of the manpower has been occupied with migration, cycle validation and monitoring efforts. These efforts are summarized in the first topic.

Regarding research oriented actions, the use of high resolution observations and the development of more advanced assimilation systems were mainly studied at the LACE centres in 2015. One of the most beneficial high resolution observations, the Mode-S aircraft observations have been further examined from Czech, Austrian and from one additional Slovenian radars. New type of AMV products so called High Resolution Winds (HRW) was investigated through mesoscale AROME DA systems in Austria and in Hungary. The use of GNSS tropospheric delays and RADAR data were further tested locally, however, due to limited manpower and other local duties, corresponding planned LACE stays have been cancelled in 2015. Beside the activities of the different observation types, a new action has been started to implement hourly updated assimilation systems and a Kick-off meeting was organized to discuss its future challenges. Research work in EKF surface assimilation focussed on validation issues and on the implementation of the assimilation configurations with new SURFEX and model cycle releases. Unfortunately, there were no significant progression achieved on the common RADAR data pre-processing activity and on the flow-dependent background error statistics in 2015.

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

Description and objectives:

At first and the biggest achievement in 2015 was the operational implementation of Czech ALARO BlendVar DA system. The BlendVar setup comprises an Optimal Interpolation for surface analysis, then a DF blending step to involve large scale information from global analysis before the last step when 3DVAR upper-air assimilation is performed. This new assimilation suite is running with 6 hours assimilation cycle using conventional observations (SYNOP, TEMP, AMDAR) and non-conventional Meteosat products (SEVIRI radiances, Geowind AMV). The performance of the implemented BlendVar DA system in parallel suite was convincing which led to its operational introduction at 20th of August 2015. An example of the verification scores can be seen below for temperature forecasts.

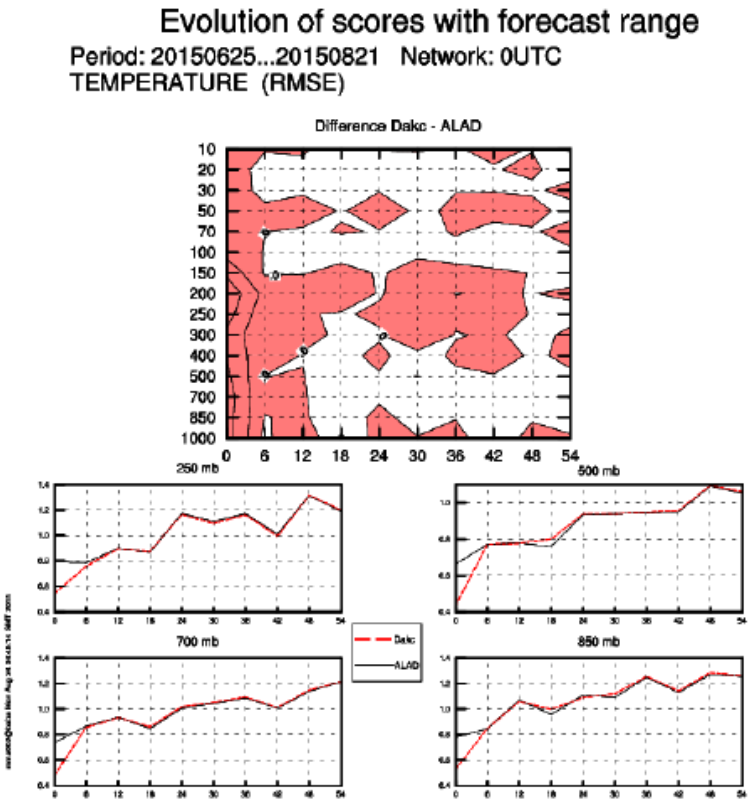

Figure 1. RMSE differences BlendVar (akc) – Reference (operational) of temperature, red areas denote positive impact of BlendVar scheme.

In Austria a new AROME nowcasting system was established with hourly non-cycled DA system running on a smaller integration domain. It uses first guesses from operational AROME 3 hourly RUC and coupled to operational AROME model as well.

In Slovenia the operational ALARO DA suite was tuned with a more advanced monitoring of the observations and the variational bias correction which helped to improve the settings of the system (e.g. cut-off time) and even to discover OPLACE malfunction. Furthermore the two-way coupled, ocean and atmospheric model in the assimilation cycle was tested. The first case studies suggested the importance of SST analysis in atmospheric model for better (convective) precipitation forecasts.

In Slovakia the cy40t1_bf05 was installed and tested for surface data assimilation system. Beside operational ALARO model, first trial of a Slovak AROME model has been started in 2015 which consists upper-air (3DVAR) DA system. Also large part of the local DA efforts was occupied by the porting issues of a new computer in Bratislava.

Regarding Romanian local work, a new cycle (cy40t1_bf05) has been installed (special thanks to Olda Spaniel) with Gfortran compiler on new platform which is producing now reasonable and comparable results with former settings (with cy36t1). The migration and validation of the DA suite was also continued in 2015.

In Croatia local data assimilation activities have been dedicated to build ALADIN 4km with CANARI and 3DVAR DA system. To this system a new B matrix of the higher resolution model configuration had to be calculated and diagnosed.

In Hungary the minor upgrades of the DA suites have been done. Regarding ALARO model the operational scripting system were changed to the SMS environment including a cycle (cy38t1) switch. Also in ALARO DA system windprofiler observations were added as passive for monitoring purposes.

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:

This new LACE action was launched in 2015 with a Kick-off meeting in Vienna. Participants from 5 LACE countries, Jan Barkmeijer from KNMI (HIRLAM representative) and Meteo-France colleagues through remote connection have been contributed to discuss key challenges of an hourly updated assimilation system and its successful future implementation. The following conclusions were deducted:

- 1h RUC system is for automatic and warning forecast purposes covering short- and very short-ranges for high priority parameters like wind speed and gust, precipitation, convective initiation, temperature around 0 Celsius, visibility and cloudiness.
- For next 2-3 years, 3DVAR will be the core of the RUC systems.
- Most important observations are conventional ones (SYNOP, TEMP, AMDAR+Mode-S), RADAR data, GNSS ZTD and geostationary satellite products with the utmost frequency and resolution.
- On short term, the initialization and background error statistics (mostly the balance operator) have to be investigated and/or tuned. On longer term, the action has to be focused on flow-dependency aspects of the structure functions.

The plans, presentations and the minute of the meeting can be found on LACE webpage with more details and regarding the local works some interesting results were further highlighted.

In Austria a first version of AROME hourly non-cycled DA system for nowcasting has been built using all available observations (including RADAR) and first-guesses from operational AROME/Austria 3 hourly RUC system. For fast production smaller integration domain and 30 minutes cut-off time has been set. Also IAU (Incremental Analysis Update) method was implemented for the initialization of the AROME nowcasting forecasts. At the end of 2015 a LACE stay was organized in Vienna to make validation studies with this new AROME hourly runs. The hourly updated DA system was tuned with a posteriori diagnostic tool (Desroziers et. al. 2005) in order to set properly SIGMAO_COEF and REDNMC in the 3DVAR. The outputs of the AROME nowcasting was also verified against INCA system. Another LACE stay was dedicated to AROME nowcasting in Toulouse with cooperation of Meteo-France colleagues. During this second stay different parameter settings of the RADAR assimilation have been tried regarding thinning distance, observation error and profile sample size in Bayesian 1D approach. Additionally hydrometeor initialization and new assimilation method (latent heat nudging) have been coded and tested as well. The hydrometeor blending was replaced experimentally with supersaturated humidity profiles in AROME model to speed-up the formation of the precipitation at the beginning of forecasts. The latent heat nudging method was developed and implemented with special 2D RADAR precipitation products (using both MF-Antilope and INCA). The nudging consists two steps, the first is to interpolate precipitation products to model grid and the second is to force model integration towards the interpolated rain products and LH tendencies similarly to IAU technique.

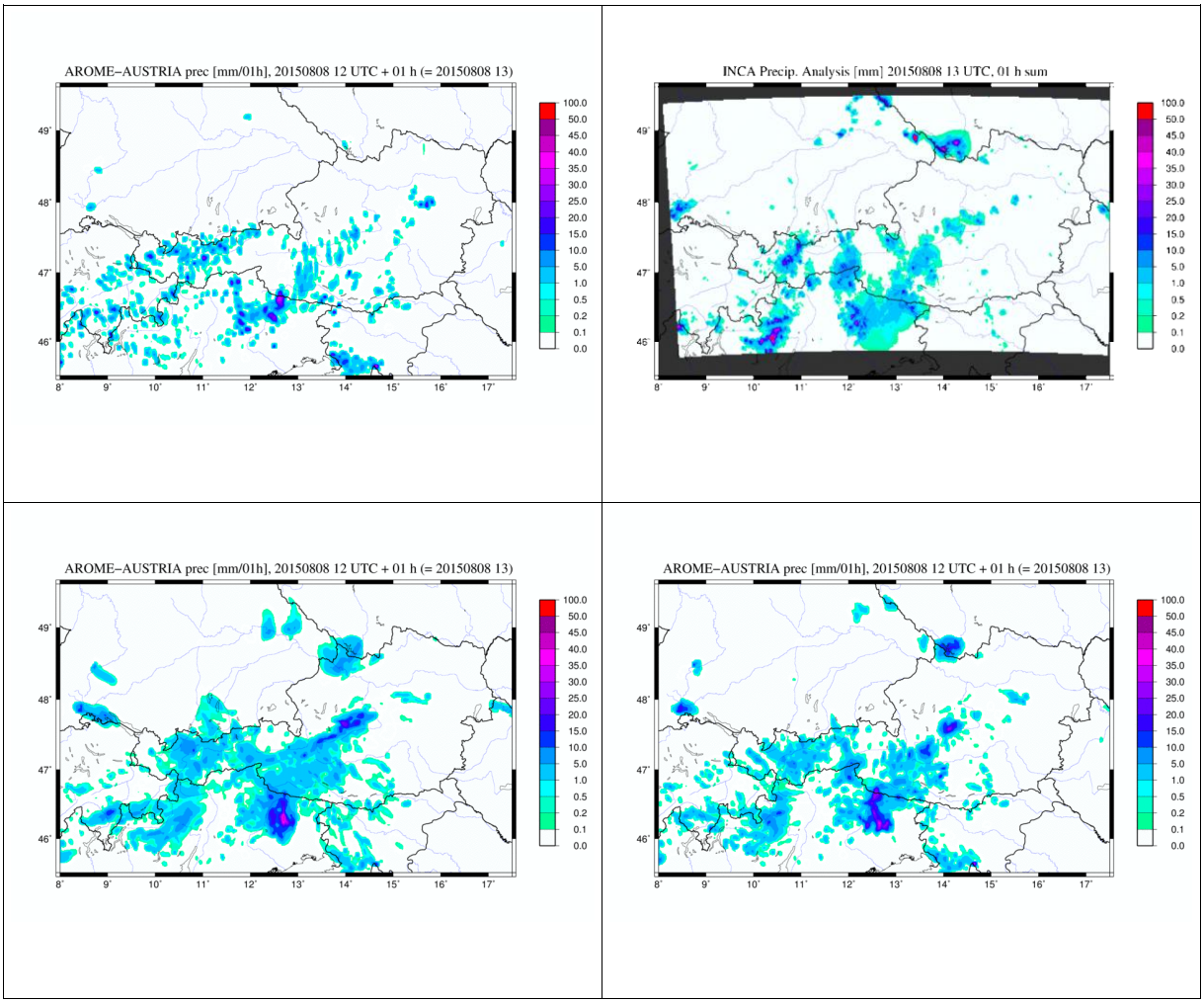

Figure 2. AROME/Austria precipitation case study comparing operational (upper left fig), INCA analysis (upper right fig), AROME with RADAR nudging settings no 1 (bottom left fig) and AROME with RADAR nudging settings no 2 (bottom right fig).

In Slovenia an experimental ALARO hourly RUC was tested for a particular case study. During this study the performance of the operational 3 hourly updated and the hourly updated experimental ALARO DA systems were compared. Due to aircraft (AMDAR+Mode-S) observation loss of the hourly RUC system, the analyzed vertical temperature profile was worse than analysis from operational 3 hourly RUC. It is an important message that adequate and plentiful observation constraint has to be ensured in every RUC analyses, otherwise the use of hourly RUC system will lead to its deteriorating results.

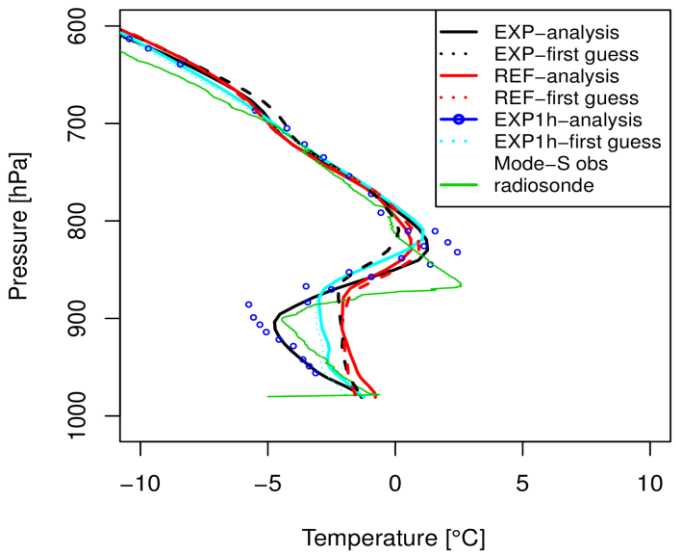

Figure 3. Slovenian case study comparing 3h RUC (black solid line) and 1h RUC (cyan solid line) temperature profile analyses. Mode-S observations (as reference) are signed by blue dots.

In Hungary, also an experimental AROME 1h RUC system was built to check inventory of the available observations. Regarding this, all 24 RUC analyses were checked in order to identify the distribution, density and frequency of the recent observation set inside the AROME/Hungary grid. This study suggested that mid-level temperature at 01, 02, 03, 04, 20, 21, 22, 23 network times is underrepresented when mainly conventional reports are not providing sufficient data. Also mid-level humidity is problematic (especially in dry regimes) at asynoptic network times (01, 02, 03, 04, 05, 07, 08, 09, 10, 11, 13, 14, 15, 16, 17, 19, 20, 21, 22 and 23). During this inventory GNSS ZTD, RADAR and Meteosat products were also considered. Also it is worth mentioning that in AROME/Hungary domain, there is usually poor coverage of observations over Northern Romania and Ukraine even for synoptic network times. This study suggested the importance of satellite radiances which can fill the data poor regions in RUC systems. Beside observation monitoring, also different initialization strategies i.e. different initial coupling techniques and B matrices were checked through Echkevo domain diagnostic tool. In conclusion the AROME EDA based B matrix and the space consistent coupling was found to be optimal for the reduction of noise accumulation in AROME RUC system.

Efforts: 7 months

Contributors: F. Meier (At), 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:

In Slovenia LandSAF snow cover product was used to initialize snow content of the ALADIN analysis. Snow was either removed or added based on satellite retrieval. The LandSAF snow product tested on a 15 days period showed positive impact on ALARO forecast scores.

Regarding the use of EKF for surface assimilation, the implementation phase of EKF method has been done from ALARO to AROME model at the first half of 2015. During a LACE stay and in the second half of 2015, the validation of the method was further proceeded. This first EKF implementation using cy36t1 and offline SURFEX v6.0 releases produced unrealistic temperature results. The reason for that is SURFEX offline runs with activated TEB scheme generated unrealistic high 2m temperature values over town tiles (see figure 4 below). The switch TOWN2ROCK nicely eliminated the problem, however this switch was used only during validation. Instead of debugging the already old version of SURFEX, a new v7.2 release (used in operational cy38t1) was tested further and found to be correct with enabled TEB scheme.

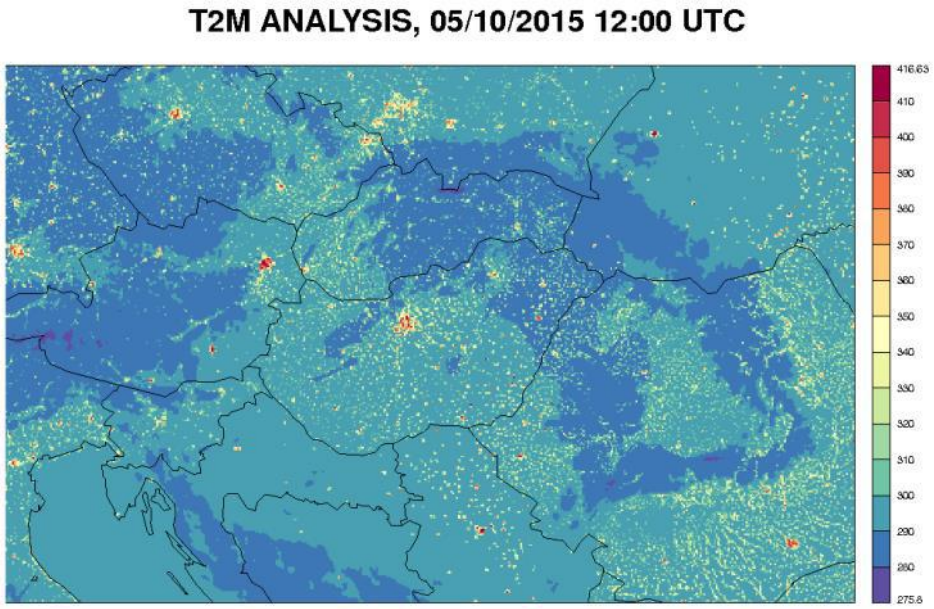

Figure 4. 2m temperature at the end of assimilation window. Unrealistic high temperature can be seen over town tiles.

Efforts: 6 months

Contributors: J. Cedilnik (Sl), 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:

In the frame of ALADIN flat-rate stay, SEVIRI radiance observations have been studied in AROME/Hungary and its DA system. First of all, the settings of variational bias correction and the channel selection were examined, because preliminary test runs suggested that default values which were probably determined for global model have to be revised. The channels 1, 5 and 8 were blacklisted after previous recommendations and only channels 2, 3, 4, 6 and 7 have been taken into account. Due to a passive assimilation experiments, the selection of the predictors (0, 1, 2, 3, 4) and the adaptivity parameter (nbg_MSG_HR=1250) were tuned. An example of the bias correction started from coldstart and the evolution of VARBC predictors can be seen on figure 5. and 6. below. The impact of the actively assimilated SEVIRI channels in AROME is under investigation and further tuning of the surface emissivity and surface temperature is needed to the proper use of SEVIRI window channels.

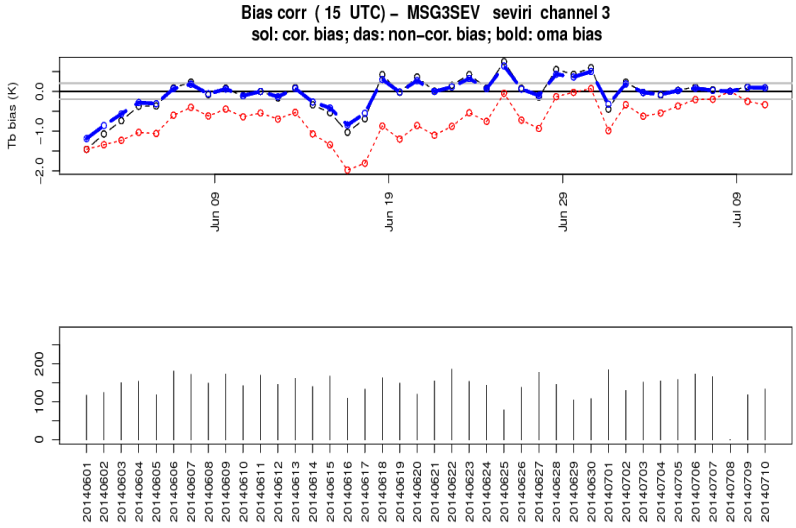

Figure 5. The evolution of corrected (black dashed line) and non-corrected (orange dashed line) OMG biases for SEVIRI ch3 at 15UTC analyses. VARBC started from 1st of June to 10th of July 2014 with coldstart.

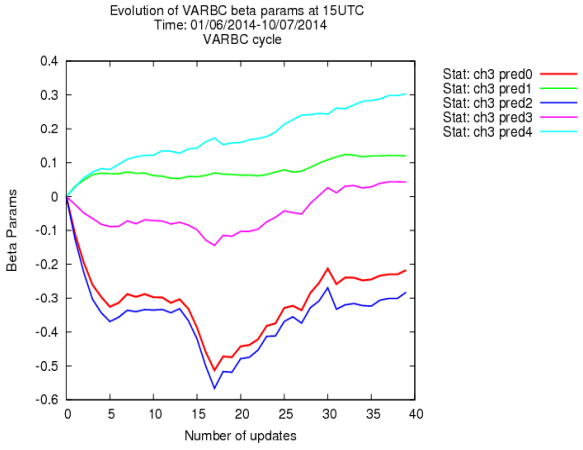

Figure 6. The evolution of β parameters for different predictors of VARBC for SEVIRI channel no 3 cycled at 15UTC analyses.

Another study doing better bias correction for radiance observation in ALARO/Cz BlendVar system has been carried out in 2015. This study investigated the adaptivity of VARBC in LAM context where the effect of the first-guess and the observation pre-processing errors to the detected bias (OMG) is much more pronounced due to the small number of observations. In order to avoid the influence of flow-dependent biases and the effect of relatively small observation sample size a new background constraint for β parameters has been proposed for the better adaptivity of VARBC scheme. This modification replaced the current approach (can be tuned by a single adaptivity parameter called NBG) and implemented a new one which nicely controls changes of bias correction in each assimilation cycle. More details of the study can be read in Patrik Benacek's poster presentation (see in the references).

$$\sigma_\beta^2 = \frac{\sigma_{obs}^2}{[C \cdot log(\frac{N}{N_{min}}) + NBG_{min}]} \quad \text{where } N > N_{min} \qquad (4)$$

$$\sigma_\beta^2 = \frac{\sigma_{obs}^2}{NBG_{min}} \quad \text{where } N < N_{min} \qquad (5)$$

Figure 7. The formulation of the proposed new background error constraint for β parameters.

Efforts: 6 months

Contributors: P. Benacek (Cz), B. Strajnar (Sl), Y. Cengiz (Tr), M. Mile (Hu)

Documentation: reports on LACE webpage

Status: ONGOING

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

Description and objectives:

In 2015 the common action regarding LACE RADAR data pre-processing halted due to the lack of manpower and RADAR network maintenances, upgrades in many LACE countries. However, the INCA2 precipitation module showed promising results for reflectivity QC, but for radial wind the INCA2 system was not mature enough. It was also realized that using one QC tool for all RADARs i.e. data from different countries is not sufficient and the combination of QC elements from different QC tools is more adequate (e.g. Austrian QC tool).

Regarding local RADAR assimilation efforts, the biggest achievements were gained in Austria where RADAR quality control has been developed with the use of INCA and BALTRAD quality indices. For the QC of radial wind additional method has been implemented after He et al 2012 which efficiently handles de-aliasing for Austrian RADARs. Later in 2015 another two QC elements were added to the QC procedure namely climate and SAFNWC quality indices

(see figure 8. for different QIs). Because of the more accurate QC, the blacklisting of lowest RADAR elevations was unnecessary for new experiments where RADAR data assimilation now showed more promising results to improve AROME precipitation forecasts. This RADAR assimilation activity was joint to the developments of AROME nowcasting system which results were already summarized above in Hourly updated DA system action.

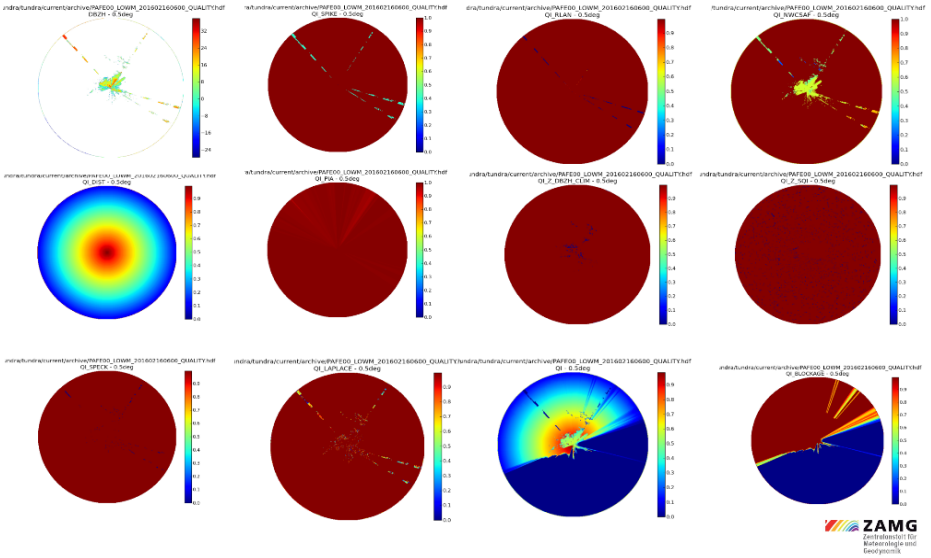

Figure 8. Different quality control elements of the Austrian RADAR QC tool.

Efforts: 6 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:

In Hungary the GNSS ZTD observations were further tested with variational bias correction method using ZTD observations from Hungarian E-GVAP network so called SGOB. During this study two way of VARBC cycling strategies have been checked. It is possible to cycle VARBC coefficients by daily update similarly to radiance observations and by the frequency of the assimilation cycle as well. Since the examined period was short, the 3 hourly VARBC cycling was chosen in AROME/Hungary RUC system to make more frequently updates during the passive assimilation experiment. As it was a first test, only predictor 0, the constant predictor was tested for the site-dependent VARBC calculations. On figure 9. an example of the evolution of VARBC parameters can be seen for 9 different GNSS receiver stations.

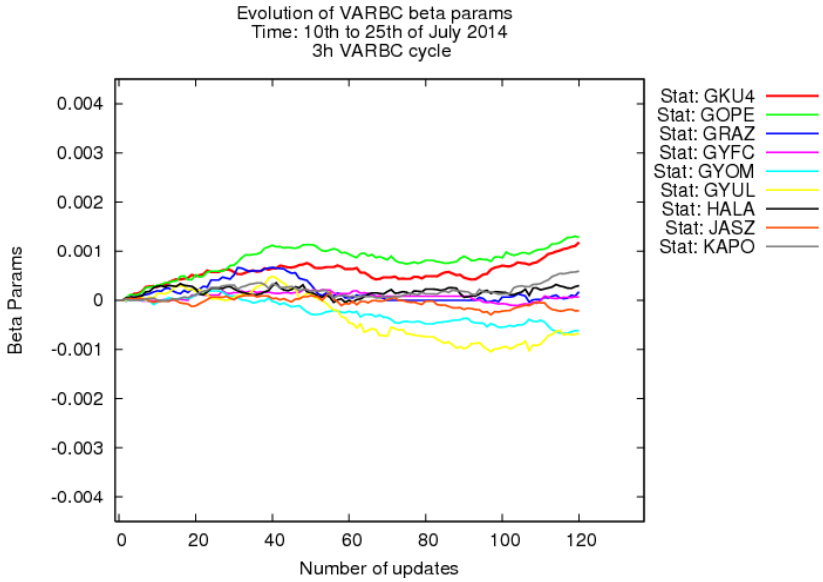

Figure 9. The 3 hourly VARBC cycling for GNSS ZTD observations. The evolution of VARBC β parameters for 9 different GNSS ground-based receiver stations.

In Austria, another very promising activity about the use of 3D refractivity observations has been continued in 2015. After the implementation of forward observation operator and TL/AD operator in previous year, the introduction of new observation type in BATOR and in SCREENING were tackled using the example of GPS RO observations. Also for refractivity observations, the BUFR file format was selected to be able to read the observations by BATOR.

Another LACE country, Slovenia started to investigate GNSS ZTD in ALARO DA system. The ZTD observations have been collected from E-GVAP and local Slovenian GPS (ground based receiver station) networks. The same procedures were applied for ZTD pre-processing (whitelist approach to select trusted sites) and bias corrections (both static and variational) than by other LACE countries. In conclusion beneficial impact of the use of ZTD observation has been observed especially for surface pressure, relative humidity, precipitation and cloud cover of the Slovenian ALARO model.

Efforts: 7.5 months

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

Documentation: report on LACE webpage

Status: ONGOING

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

Description and objectives:

In Slovenia, an additional Mode-S radar in Oljska Gora was successfully implemented and operationally used in ALARO/Slovenia DA system. This second radar is now providing Mode-S MRAR observations for Slovenian DA system and also for OPLACE users.

In Czech Republic the Mode-S observations are collected by the Czech Air Navigation Services (ANS-CZ) and shared with CHMI for evaluation and assimilation purposes. Both the Mode-S MRAR and Mode-S EHS types are provided from the radars of ANS-CZ (3 radars receive EHS with MRAR and another 2 radars receive just EHS reports). During a LACE stay the observation quality of the Czech data were carried out for each reporting aircraft and found that Mode-S MRAR observations are of overall good quality even without pre-processing, but the Mode-S EHS reports provide observations with usually larger errors and lower quality due to the indirect measurement. This validation of Czech Mode-S observations was examined against AMDAR and NWP model and it was a unique opportunity to measure quality differences between Mode-S MRAR and EHS reports. More information about the results can be found LACE webpage in Benedikt Strajnar's report.

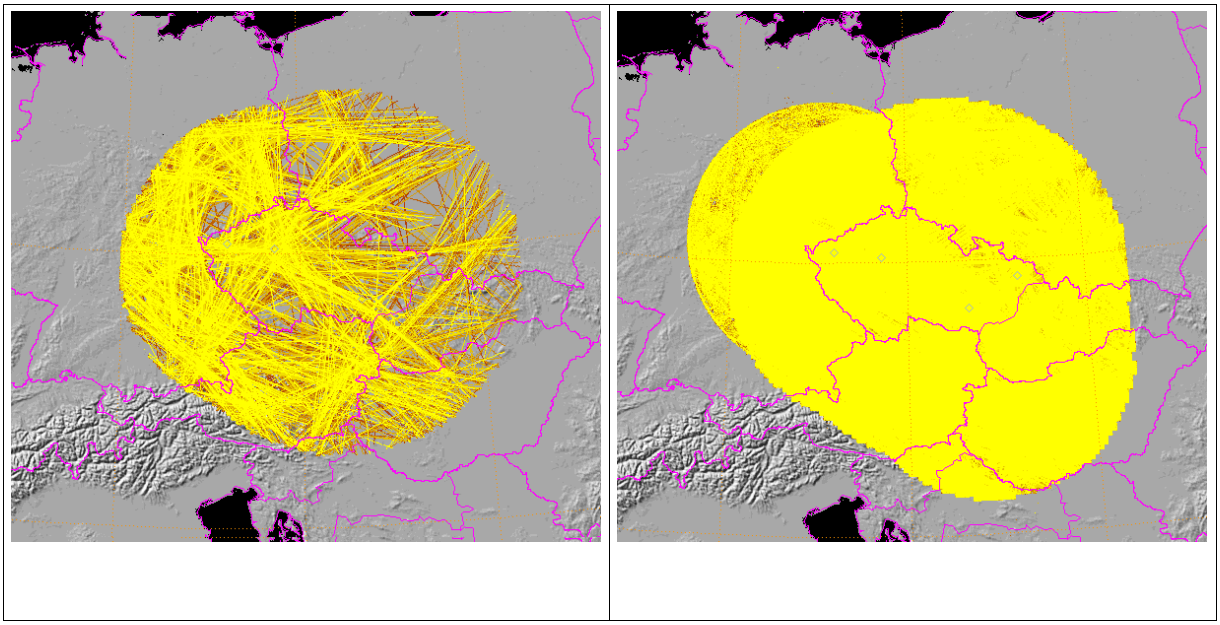

Figure 10. The coverage of Czech Mode-S radars, 3 radars provides EHS and MRAR reports (on the left) and 5 radars provides only EHS (on the right)

After the quality assessment of Czech Mode-S observations, the impact of this new aircraft data was studied in ALARO/Cz NWP system. For correct verification it is difficult to find appropriate reference because the studied Mode-S observations are localized and high resolution observations. Verification against AMDAR and TEMP observations showed mainly neutral impact, but clear positive impacts were obtained for first forecast hours in

verification against independent Mode-S observations which are considered as better reference. Additionally to the impact study of ALARO/Cz model, the use of Mode-S MRAR observations was explored to improve a near real time high resolution hourly diagnostic analysis system as well. These hourly diagnostic analyses require fast production and large number of observations where Mode-S can finely extend the assimilated conventional observation set. On figure 11. the benefit of the MRAR observations can be seen where temperature inversion was more accurately represented in analysis with the use of Mode-S MRAR. The CHMI activity of making hourly diagnostic analysis system is also incorporated with Hourly updated DA system LACE action, but currently it is reported here.

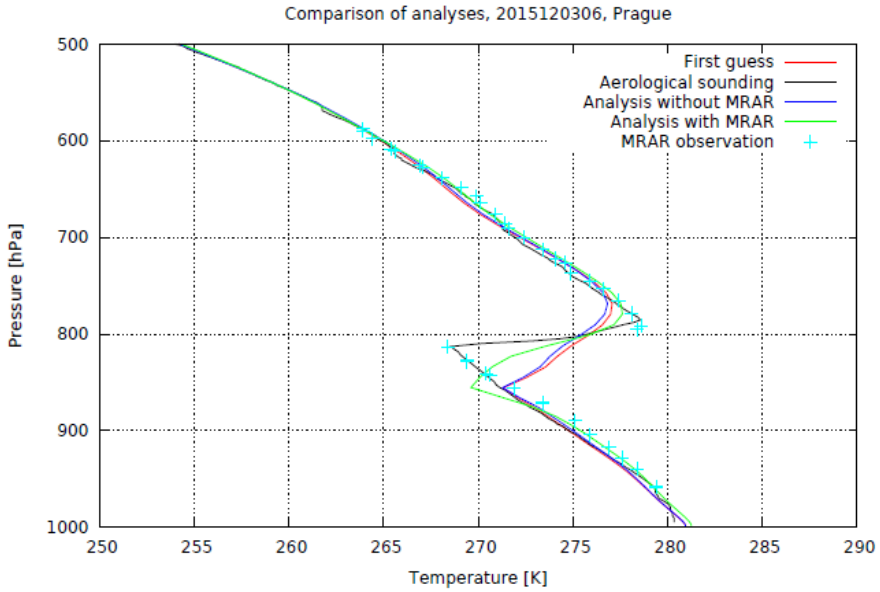

Figure 11. The comparison of analyses with MRAR (blue) and without MRAR (green) observations.

Efforts: 7.5 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:

The new AMV observation so called High Resolution Winds (HRW) derived from NWCSAF package is available through OPLACE and first data assimilation impact studies have been carried out with AROME mesoscale models in Austria and in Hungary as well. The advantages of the HRW are that the amount of AMV observations is usually higher than the Geowind AMVs which suggested the use of this observation with smaller NWP domain and

that there is no need to use NWP background information for the HRW retrieval algorithm. In both the Austrian and the Hungarian impact studies, it was found that HRW have mainly neutral impact on AROME forecast verification scores, but improvements on particular case studies (especially in heavy precipitation events) can be observed due to the use of HRW (see figure 12.).

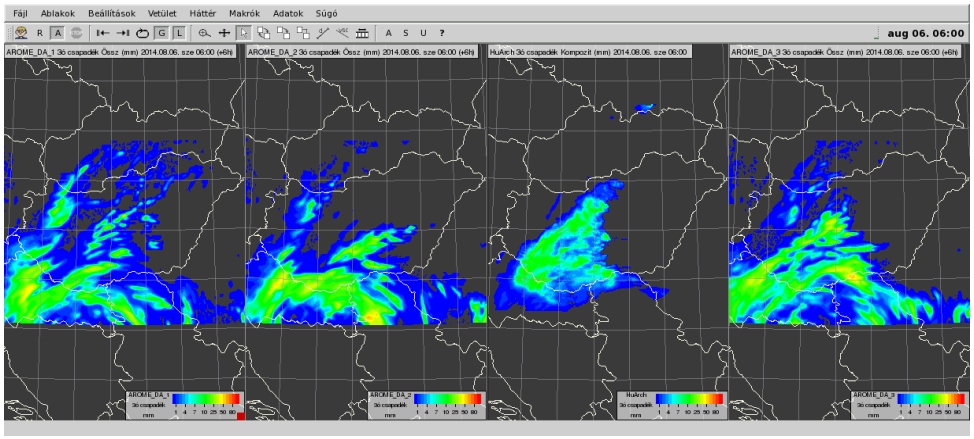

Figure 12. The 3h AROME/Hungary precipitation forecasts for 6th of August, 2014. 1.panel: Without AMV, 2.panel: with Geowind AMV, 3.panel: RADAR observation, 4.panel: with HRW AMV

Efforts: 3.5 months

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

Documentation: report on LACE webpage

Status: ONGOING

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

Description and objectives:

In 2015 this action was halted due to difficulties of the use of grid point sigma B maps from LAM EDA (or LAMEPS) systems. The existing source code is only able to generate error of the day statistics from global EDAs and the adaptation to LAM would have required significant amount of manpower. During the LACE DA working days, alternative approaches to make flow-dependent aspect of background error representation have been discussed.

On the other hand, local efforts have been put on the better representation of background error statistics in ALARO/Cz system. The use of ensemble B matrix with static coupling approach (so called local ensemble B matrix) was investigated in order to increase variance in shorter waves and not in long waves. This approach was compared to Blending, 3DVAR and BlendVar and found to be best performing for a heavy precipitation event of Czech Republic (see figure 13.). The complete verification of the method is ongoing and for more information see Antonin Bucanek's poster presentation (details in the references).

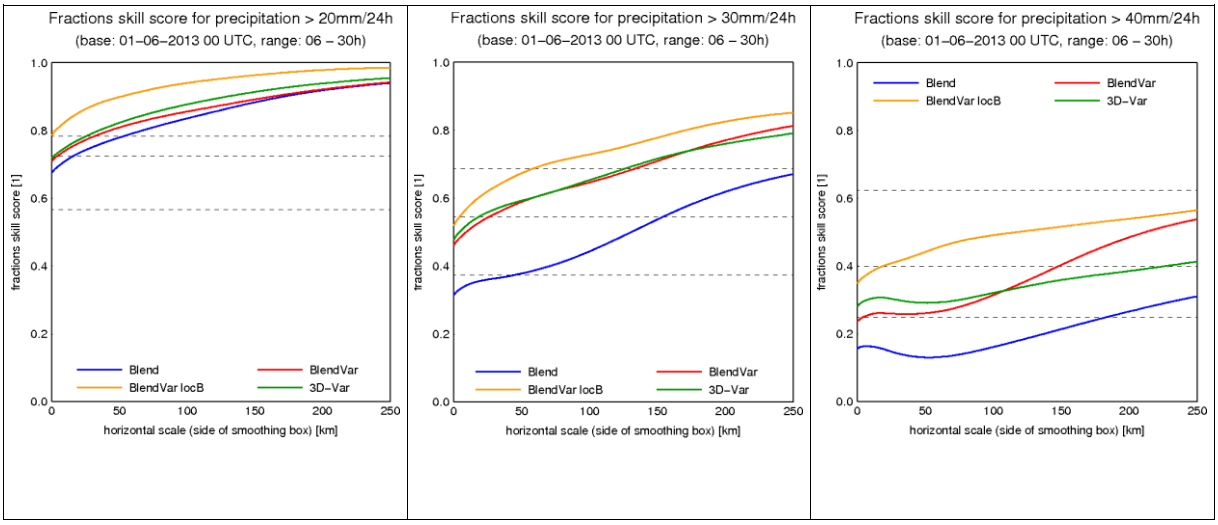

Figure 13. Fraction skill scores of ALARO/Cz precipitation forecast of 1st of June 2013 00UTC.

Efforts: 3 months

Contributors: A. Bucanek (Cz)

Documentation: report on LACE webpage

Status: ONGOING

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

Description and objectives:

In 2015 the first version, the prototype of the OOPS LAM 3DVAR (OOVAR) became available for local installation and validation. However, the OOPS project is already in a mature phase and new cycles are seriously involved in OOPS refactoring, the LAM code modifications are still at the beginning. In order to identify the key features and problems with LAM adaptation the prototype of OOVAR was shared by Meteo-France colleagues to LAM communities (HIRLAM, ALADIN, LACE) for early validation tests. In Hungary some efforts have been put on the installation and validation of this OOVAR in 2015. On the Hungarian IBM platform several modifications have to be applied to the installation of cy40 (mainpack) and to the OO dependencies as well. Because of this OOVAR is only a mock-up version of LAM 3DVAR, several changes and fixes have to be solved just to run the assimilation. Recently the OOVAR is running with ALADIN/Hungary configuration, but producing incorrect increments by single observation experiments (tested with single SYNOP and single AMDAR as well) which need to be further investigated (figure 14.).

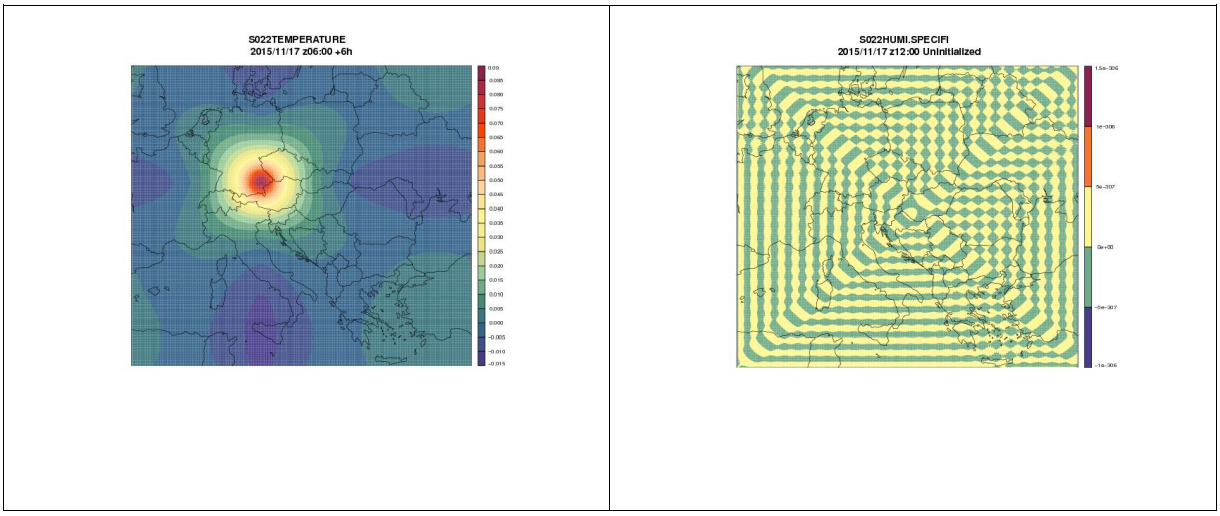

Figure 14. OOVAR analysis using single AMDAR temperature observations with ALADIN/Hungary. Horizontal increments for temperature (left) and the zero humidity field (right) in the analysis on model level 22 are plotted.

Efforts: 2 months

Contributors: M. Mile (Hu)

Documentation: report on LACE webpage

Status: ONGOING

Documents and publications

List of reports:

Benedikt Strajnar: Analysis and pre-processing of Czech Mode-S observations

Patrik Benacek: Testing IDFI and BlendVar II

Antonin Bucanek: Operational implementation of BlendVar scheme at CHMI

Mate Mile: Detailed plan for houtly RUC action

Mate Mile: OOPS LAM 3DVAR local installation at OMSZ

Alena Trojakova, Patrik Benacek, Antonin Bucanek, Radmila Brozkova: Assimilation of Mode-S observations in ALADIN/CHMI

Benedikt Strajnar: Overview of ALADIN DA activities ar ARSO (part 1 and 2)

Florian Meier, Xin Yan, Jozef Kemetmuller, Christoph Wittmann: DA activities at ZAMG

Mirela Pietrisi: AROME nowcasting – tool based on a convective scale operational system

List of presentations:

Mate Mile: “RUC, HRW, Mode-S, OPLACE, etc – LACE's DA systems”, Joint 25th ALADIN Workshop & HIRLAM All Staff Meeting, 13-17 April 2015, Helsingor, Denmark

Florian Meier: “Towards AROME rapid update cycle: Usage of satellite and radar data in Austria”, Joint 25th ALADIN Workshop & HIRLAM All Staff Meeting, 13-17 April 2015, Helsingor, Denmark

National posters at Joint 25th ALADIN Workshop & HIRLAM All Staff Meeting, 13-17 April 2015, Helsingor, Denmark: Austria, Croatia, Czech Republic, Hungary, Slovakia, Slovenia, Romania, Available online: http://www.cnrm.meteo.fr/aladin/spip.php?article269

Mate Mile: “ALARO and AROME DA systems in LACE”, 37th EWGLAM and 22nd SRNWP Meeting, 5-8 October 2015, Belgrade, Serbia

National posters at 37th EWGLAM and 22nd SRNWP Meeting, 5-8 October 2015, Belgrade, Serbia: Austria, Croatia, Czech Republic, Hungary, Slovakia, Slovenia, Romania, Available online: srnwp.met.hu

Antonin Bucanek: (Poster presentation) A dilemma of large-scales in LAM analysis

Patrik Benacek: (Poster presentation) Radiance bias correction in LAM

Activities of management, coordination and communication

1) Joint 25th ALADIN Workshop & HIRLAM All Staff Meeting 2015, 13-17/04/2015, Helsingor, Denmark (participation of Mate Mile)

2) 37th EWGLAM and 22nd SRNWP Meeting, 5-8 October 2015, Belgrade, Serbia (participation of Mate Mile)

3) HARMONIE 4DVAR WW and OOPS mini workshop 2015, 25-27/11/2015, Reading, United Kingdom (participation of Mate Mile)

LACE supported stays – 13 weeks in 2015

1) Benedikt Strajnar (ARSO) – 3 weeks in Prague (CHMI), 6th – 24th of July 2015

2) Florian Meier (ZAMG) – 6 weeks in Toulouse (MF), October-November 2015

3) Mirela Pietrisi (MeteoRomania) – 4 weeks in Vienna (ZAMG), 16th of Nov. - 11th of Dec. 2015

Summary of resources/means

Subject/Action/ Deliverable	**Resource**		**LACE stays**	
	planned	**realized**	**planned**	**realized**
Full DA system	6	6	0	0
Hourly RUC	5	7	1	2.5
Surface Assim EKF	5	6	1	1
Radiance Assimilation	7	6	0	0
RADAR Assimilation	9	6	1	0
GNSS Assimilation	6	7.5	0.75	0

Mode-S	5	7.5	0.75	0.75
HRW AMV	3	3.5	0	0
SigmaB maps	4	3	1	0
OOVAR	0	2	0	0
Total	**50**	**54.5**	**5.5**	**4.25**

Problems and opportunities

The main problems in 2015 were:

- The LACE DA resources have been loaded by the validation, migration and maintenance issues of operational systems i.e. there is only minor efforts left inside LACE to doing research on DA.
- The lack of communication and cooperation delayed the activities and produced duplicated work.

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.