Working Area Data Assimilation

Progress Report

Prepared by:	Area Leader Máté Mile
Period:	2013
Date:	10/09/2013

Progress summary

In the LACE DA work plan of 2013 the main 3 supported tasks were scheduled at the end of the calendar year and because of it the most important stays were not yet accomplished. However several national activities and some preparations around these tasks have been already reached.

The upgrade of OPLACE system was prepared by making LANDSAF, ASCAT products and the BUFR based SYNOP observations available for the maintenance stay which is going to be organized in late autumn.

The action of operational implementation of DA system has still an ongoing status where further issues were studied on surface assimilation in Slovakia and Romania as well. In Czech Republic the evaluation of a 3DVAR based scheme was examined in order to find an optimal Blending and 3DVAR configuration.

The main part of the work around IASI radiance observations is also planned later on, therefore only work was done in connection with SEVIRI data where the bias correction of MSG SEVIRI radiance observations were revised focusing WV channels and its better predictor selection.

RADAR data assimilation has been under extensive testing. Croatia has just finished successfully the first ALARO RADAR tests and in Hungary AROME RADAR data assimilation is approaching to the pre-operational implementation. Meanwhile the pre-processing of Slovakian and Czech RADAR data samples were successfully converted this year from hdf5 to MFBUFR which open the road to the further tests of full LACE RADAR data further on.

Concerning other relevant topics like GPS assimilation where communications were happened about data exchange and pre-processing for the upcoming flat-rate stay. The evolution of dispersion spectra was investigated with DFI Blending where the method produces the expected dispersion for blending analysis. The efficient combination of DFI Blending and 3DVAR is under examination for the time being. Last but not least EKF assimilation action, the ASCAT soil moisture assimilation study was tested for an Eastern Africa domain with 8km ALARO.

Scientific and technical main activities and achievements, major events

Action/Subject/Deliverable: Maintenance and Development of OPLACE system

Description and objectives: The common OPLACE system contains 6 main observation types and provides proper pre-processed observations for the LACE members operationally. Such system has to be maintained and developed in order to keep state-of-art level.

Thanks to the Hungarian Satellite Group LANDSAF albedo, snow and ASCAT soil moisture products are disseminated into the OMSZ and pre-processing of the final format is also started. Therefore these products are almost ready for the implementation to OPLACE. The BUFR based SYNOP observations are disseminated as well which will gradually replace traditionally coded SYNOP reports from SYNOP stations. Recently the BUFR SYNOP reaches the level when more or less the same amount of reports is included. With a parallel OPLACE system it was tested to merge SYNOP observations from both sources and checked in DA system. All these developments and the other planned ones are going to continued during the LACE supported stay in autumn.

Efforts: GB and MM – 0.5 month (local work)

Contributors: Alena Trojakova (Cz), Gergely Boloni (Hu), Mate Mile (Hu)

Documentation: reliable operation at OMSZ

Status: ONGOING STAY, PERMANENT.

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

Description and objectives: Three LACE countries are going to seek the optimal settings of local full DA system. In Czech Republic the combination of operational blending method and 3DVAR are under preparation and in Slovakia and Romania the technical validation and scientific evaluation of surface assimilation is ongoing.

In Czech Republic the evaluations of a 3DVAR based scheme for the upper-air analysis were done on selection of the background error statistics and the observation and background errors tuning (using Desroziers et al 2005) in order to find an optimal Blend+3DVAR configuration (using conventional (SYNOP & TEMP only) data). Afterwards (this autumn) more progress will be done about adding more observations (AMDAR, wind profiler, ...) and to the pre-operational implementation. In Slovakia the canari surface assimilation configuration was further investigated. Missing assimilation increments of surface liquid water content was chased and found that some surface fields (in SHMU cumulated low cloudiness) are missing in the input of canari configuration. After the correction no significant impact was observed. Due to the porting operations on new computer there were no progressions on this issue in Croatia.

Efforts: 2 months (local work)

Contributors: 1 person per countries (CZ, SK, RO)

Documentation: no

Status: ONGOING

Action/Subject/Deliverable: Further implementation of radiance data with special emphasis on IASI assimilation

Description and objectives: The aim of this action is to prepare bias correction at first for the radiance observations with the optimal selection of predictors. Then the evaluation of radiance observation impact study should follow where we are tuning the usage of radiance data especially for higher resolution models.

The assimilation of IASI observations is ongoing and for the time being MSG SEVIRI data was tested. Variational bias correction (VarBC) approach is used for an observation bias estimation and the method is based on the detection of O-G departures. Unbiased NWP model influence the observation error estimation and could lead to bad satellite data correction and degradation of observation signal in the data assimilation. We study the origin of the bias for WV channels of the MSG. Firstly the satellite bias was detected using radiosonde data and the optimal cloud type selection (NWC-SAF) was found. Secondly we focused on the quality of predictor selection and the corresponding bias parameters. Finally the impact of the new estimated bias (predictors and bias parameters) in VARBC was investigated.

Efforts: 3 months

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

Documentation: report on LACE webpage

Status: ONGOING STAY

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

Description and objectives: Because of the RADAR observations can provide very important contributions for the mesoscale processes through DA analyses, LACE decided to collect RADAR data from the member countries in order to make common RADAR data assimilation studies. The main aim for this year is to collect and verify RADAR observation from different LACE members and make first impact studies on these samples.

The technical knowledge of the conversion of Slovakian and Czech RADAR data from hdf5 format to MFBUFR was gained during this year. With this achievement we have now correct RADAR data samples from 5 LACE members and then only samples are missing from Austria and Romania. LACE stay is planned for this autumn where the extension and validation of the LACE RADAR data sample is required. Due to local work on RADAR data assimilation in Hungary, several impact studies were made with three Hungarian RADAR stations. The

selection of a suitable summer period (RADAR data was more or less seamless during that time) was done to perform impact study in AROME model at OMSZ. Compare to the operational, the RADAR observations could improve the skill of the wind, surface pressure forecasts and estimation of precipitation objects. Some spin-up problems were also observed in the very short-range temperature and humidity forecasts because of the too moist PBL close to the surface. This phenomena is causing mild degradation on surface scores during stronger daily turbulent mixing (cold temperature and moist humidity bias). To avoid such degradation blacklisting of RADAR observations was tested to filter-out low level RADAR reflectivity data. This can help to remove degradation from temperature and humidity score, but we are also losing some important information concerning precipitation. The optimal usage of the blacklisting is under examination. In Croatia the technical job on RADAR data assimilation for ALARO is finished and case studies are started to evaluate reflectivity and radial wind separately and together in DA system.

Efforts: 6 months

Contributors: R. Steib(HU), I. Sebők(HU), T. Kovacic (Hr), F. Meier(At), A. Trojakova(Cz), M. Nestiak(Sk)

Documentation: report on LACE webpage

Status: ONGOING

Action/Subject/Deliverable: Implementation of ground-based GPS data assimilation

Description and objectives: The amount of available GPS observations over Central Europe is getting more and more. This and the first promising results of its assimilation induce this action to implement GPS data in DA system. Pre-processing and basic bias correction are planned as first step in order to study GPS data in AROME DA systems. Later on VARBC is also wished to try with higher model cycle.

In this task only communication was happened till now due to the late realization of FR stay in Budapest. It seems to be the Hungarian GPS observations are going to be ready soon in EUMETNET EGVAP format and the pre-processing and static bias correction tools are already available thanks to Austrian colleagues(especially Xin Yan).

Efforts: 0.5 months (local work)

Contributors: X. Yan(At), M. Mile(Hu), E. Kucukkaraca(Tr)

Documentation: report on LACE webpage

Status: ONGOING STAY

Action/Subject/Deliverable: The evolution of Dispersion Spectra in Blending Cycle

Description and objectives: The study of the evolution of error dispersion spectra is investigated in successive steps of DFI Blending (3DVAR, BlendVar) simulated by ensemble.

The study is in a similar way as in Stefanescu et al (2006), who considered ALADIN in dynamical adaptation mode.

We would like to use DFI Blending with 3DVAR assimilation scheme. To have better overview different assimilation cycles are set up to diagnose evolution of dispersion. The results are compared with Stefanescu et al (2006) were AEARP first guess have larger variance and standard deviation than analysis which was not clearly observed. It could indicate that AEARP had insufficient inclusion of models errors in testing period, which is improved by Raynaud et al. (2011). Increase of dispersion in ALADIN forecast against AEARP analysis is quite similar to Stefanescu et al. (2006). DFI Blending, the idea is to combine AEARP analysis with information from scales which are not resolved by AEARP but by ALADIN. We can observe, that blending analysis is reducing ALADIN guess dispersion towards AEARP analysis for total wave numbers between 10-28, dispersion of blending analysis is similar to ALADIN guess in short waves (larger wave numbers) as one would expect. Over all dispersion is increased in all cycles where blending was used against dynamical adaptation, this shows need for consistent estimate of covariances for blending cycles. 3DVAR is tested separately before it is combined with DFI Blending. 3DVAR analysis standard deviation (stde) is larger than in guess for temperature and specific humidity. There is no significant increase of stde for vorticity and divergence. The main increase of dispersion is in long waves as could be seen on variance spectra (for all variables). It means that 3DVAR corrects large scales more intensively than small scales which need to be further investigated.

Efforts: 3.5 month (local work)

Contributors: A. Bucanek (CZ)

Documentation: no

Status: ONGOING

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

Description and objectives: The surface assimilation method based on Extended Kalman-Filter algorithm is recently the only way to assimilate non-conventional observations on screen level. ASCAT soil-moisture and LANDSAF albedo and snow are under scientific evaluation.

This very important LACE action has limited manpower. An ongoing study is running with ASCAT products for an Eastern-Africa region with a mesh size 8km. More conclusions and report of this work are expected at the end of the year.

Efforts: 1 month (local work)

Contributors: J. Cedilnik (SL); S. Schneider (AT)

Documentation: report

Status: ONGOING

Additional Local Works

Action/Subject/Deliverable: Mode-S data assimilation

Description and objectives: Based on the good quality of Mode-S observation and its high spatial and temporal coverage, the data assimilation of this type of aircraft observations is hoped to be beneficial. In Slovenian ALADIN DA system, Mode-S assimilation is under investigation.

The tested assimilation cycle was similar to the one used for operational, except that the analysis frequency is increased to 3 hours (so-called RUC mode). Experimental (EXP, including Mode-S) and reference (REF) cycles were run to enable fair comparison. Pre-processing procedure is considered to somewhat smooth the data but to still preserve the good spatial resolution. Mode-S observations have quite a significant impact to the local analysis and forecast and furthermore no significant degradation can be observed. In conclusion the collected data from Mode-S radar improves short-range forecasts and nowcasting.

Efforts: 2 months (local work)

Contributors: B. Strajnar (SL)

Documentation: no

Status: ONGOING

Action/Subject/Deliverable: Water vapour regimes verification using SAL

Description and objectives: The verification method so called SAL is getting more and more popular, because this feature-based method can provide very informative results about the skill of a forecast.

We verified the water vapor regimes in the atmosphere using object-based quality measure, which consider an aspect of the structure (S), amplitude (A), and location (L) . The aim was to quantitatively evaluate an impact of observational data assimilation into the NWP model. For this purpose was used geostationary satellite MSG, that is particularly well adapted to measure radiation emitted from the system earth/atmosphere at the mesoscale to the convective scale. Water vapor (WV) channels on board can provide usefull information about the moisture in the mid- and upper-troposphere. Corresponding WV absorption bands can be simulated in the Radiative Transfer Model (RTTOV) as a pseudo-observation. The SAL method was used for the verification of the model pseudo-observation with satellite measurements.

Efforts: 2 months (local work)

Contributors: P. Benacek (Cz)

Documentation: no

Status: ONGOING

List of actions, deliverables including status

Subject: Maintenance and Development of OPLACE system

Deliverables: no

Status: PERMANENT

Subject: Towards operational implementation of full (upper air and surface) DA system

Deliverables: operational implementation

Status: ONGOING

Subject: Further implementation of radiance data with special emphasis on IASI assimilation

Deliverables: operational implementation, scientific report on LACE webpage

Status: ONGOING

Subject: Implementation of RADAR reflectivity and radial wind

Deliverables: report on LACE webpage

Status: ONGOING

Subject: Implementation of ground-based GPS data assimilation

Deliverables: report on LACE webpage

Status: ONGOING

Subject: The evolution of Dispersion Spectra in Blending Cycle

Deliverables: no

Status: ONGOING

Subject: Surface assimilation using Extended Kalman-Filter

Deliverables: report on LACE webpage

Status: ONGOING

Subject: Mode-S data assimilation

Deliverables: no

Status: ONGOING

Subject: Water vapour regimes verification using SAL

Deliverables: no

Status: ONGOING

Documents and publications

List of reports:

List of presentations:

Roger Randriamampianina: "The RADAR data assimilation at OMSZ and metno", Joint 23nd ALADIN Workshop & HIRLAM All Staff Meeting, 15-19 April 2013, Reykjavik, Iceland

Mate Mile: "AROME data assimilation activities in Hungary", Joint 23nd ALADIN Workshop & HIRLAM All Staff Meeting, 15-19 April 2013, Reykjavik, Iceland

Antonin Buchanek: "Evolution of dispersion spectra during successive steps of the assimilation cycle", Joint 23nd ALADIN Workshop & HIRLAM All Staff Meeting, 15-19 April 2013, Reykjavik, Iceland

National posters at Joint 23nd ALADIN Workshop & HIRLAM All Staff Meeting, 15-19 April 2013, Reykjavik, Iceland: Austria, Croatia, Czech Republic, Hungary, Slovakia, Slovenia, Romania, Available online: http://www.cnrm.meteo.fr/aladin/spip.php?article165

Activities of management, coordination and communication

1) Joint 23nd ALADIN Workshop & HIRLAM All Staff Meeting 2013, 15-19/04/2013, Reykjavik, Iceland (participation of Mate Mile)
2) 35th EWGLAM and 20th SRNWP Meeting, 30. September - 3.October 2013, Antaya, Turkey (participation of Mate Mile, presentation "Latest developments of LACE DA activities")
3) DA Working Days 18 September – 20 September, 2013, Vienna, Austria (participation of 7 supported LACE DA people)

4) WW on flow-dependent DA methods for meso-scale developments 4 November – 8 November, Oslo, Norway (participation of Mate Mile)

LACE supported stays – 3.5 months in 2013(ONGOING!)

1) Michal Nestiak (SHMI) – 1.5 month in Budapest (OMSZ), 3 weeks in Oktober and another in December 2013

2) Patrik Benacek (CHMI) – 1.5 months in Budapest (OMSZ), 23 September – 1 November 2013

3) Alena Trojakova (CHMI) – 0.5 month in Budapest (OMSZ), 2 weeks in November 2013(?)

4) 7 participants on LACE DA Working Days, 18 September – 20 September 2013: Mirela Pietrisi, Antonio Stanesic, Benedict Strajnar, Patrik Benacek, Michal Nestiak, Mate Mile, +1

Flat-Rate supported stays – 1 months in 2013(ONGOING!)

5) Ersin Kucukkaraca (TR) – 1 month in Budapest (OMSZ), 11 November – 5 December 2013

Summary of resources/means

Subject/Action/ Deliverable	**Resource**		**LACE stays**	
	planned	**realized**	**planned**	**realized**
OPLACE	1	0.5	0.5	0
Full DA system	5	3	0	0
Radiance Assimilation	6	2	1.5	0
RADAR Assimilation	9	6	1.5	0
GPS Assimilation	3	0.5	0	0
Dispersion Spectra	5	3.5	0	0
EKF Assimilation	2	1	0	0

Mode-S	2	2	0	0
WV verif	2	2	0	0
Total	**35**	**18.5**	**3.5**	**0**

Problems and opportunities

This year many problems are arisen related to LACE DA activities given the late start for the organization and realization of important tasks. This implies that every steps of scientific work might overlap each other to get the conclusion and the problems are become obvious. Less effort to the proper technical work and even less for the documentation, publication are left and going to be left.

Also a pronounced problem is the lack of manpower which is of course the same for DA activities within LACE. To solve this only better organization of the stays and more communication between the colleagues can be viable e.g. try to use more efficiently to the common LACE forum.

The OPLACE system has strong position in DA activities and provides good basis for the developments. But we could find problems here as well which have less technical but more political roots. For the implementation of new observations, it is hard to harmonize the data policy issues and make an agreement among all of the LACE countries.