

Report from LACE DA Working Days 2015 in Bratislava
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Short progress summary:

There were not many algorithmic developments except implementation of BlendVar in Czech Republic. There is a general trend towards increased analysis update frequency (RUC), which brings challenges as observation availability to constrain hourly analyses, control noise accumulation and imbalances, coupling (strategy and frequency) and estimation of background error statistics. Regarding longer term algorithmic developments it was proposed to involve all RC LACE Members in validations of the OOPS LAM 3DVAR prototype to get familiar with new structures of the code. Main efforts were devoted to upgrades of model cycles and/or enhancements of observation usage. Following successful implementation in Slovenia Mode-S data quality was investigated in Czech Republic and Austria, the Mode-S data will be soon available also in Hungary. Impact studies with HRW and validation of VarBC for GNSS ZTD were done in Hungary and just started also in Slovenia. Quality control packages (INCA2, BALTRAD) for radar data were studied in Austria and radinace VarBC behaviour for LAM in Czech Republic. Work on surface aspects (testing EKF, snow initialization) continued in Hungary and Slovenia.

Status Presentations:

Operational and pre-operational DA systems briefly summarized:

	Austria ALARO	Austria AROME	Croatia ALARO	Slovenia ALARO	Slovakia ALARO	Slovakia ALARO	Romania ALARO	Czech R. ALARO	Hungary ALARO	Hungary AROME
Resol.	4.8L60	2.5L90	8L37	4.4L87	9L37	4.5L63	6.5L49	4.7L87	8L49	2.5L60
Cycle	36t1exp	36t1exp 37t1_op1	35t1 38t1_bf3	38t1_bf3	36t1	38t1_bf3	38t1_bf3 40t1_bf5	38t1_bf3	38t1_bf3	38t1_bf3
Coupl.	IFS 3h	IFS 3h	IFS	IFS	ARP 3h	ARP 3h	ARP 3h	ARP 3h	IFS 3h	IFS 1h
Method	OI	3DVAR+ OI_main	3DVAR+ OI	3DVAR+ OI	OI+DF Blending	OI+DF Blending	3DVAR+ OI	OI+ BlendVAR (DF Blend + 3DVAR)	3DVAR+ OI	3DVAR
Cycling	6h	3h	6h	3h	6h	6h	6h	6h	6h	3h
Bmatrix	NMC	ENS-laef	NMC	Downsc. IFS ENS			ENS	Downsc. ARP ENS	Downsc. IFS ENS	Downsc. ALD ENS
Speciality	LCORRV; additional snow melting							sigma_coe f=0.67; REDNMC =1.7; IDFI in prod		

yellow: upgrades since last DA Working Days

Slovenian report (Benedikt Strajnar)

Ongoing tests of SST replacement by a local sea model (POM) is under evaluation. The second Mode-S radar installed (cca 80 000 obs per day). ALARO operational runs coupled by ARPEGE global model are also produced due to Slovenian forecaster request.

Outcomes of **EUMETNET ADD Feasibility Study**:

- Mode-S EHS over western Europe (DE,BE,FR (2016),UK) ~5mil obs per day
- Mode-S MRAR in Central Europe (SI,CZ ~200 000 obs per day)
- proposal to EUMETNET for a common pre-processing center for both Mode-S data to provide service and/or tools

There are also ongoing tests of GPS data (from E-GVAP test + local data) and evaluation of LandSAF snow cover DA (snow either removed or added 10cm in the analysis by an external tool). **Observation monitoring pointed VARBC issues** (highly variable BC and divergences of predictors). Regarding plans for short term: improve observational usage (GPS, Mode-S, satellite, HRW, radar data) and for long term to consider 1H RUC requested by a power users.

Romanian report (Simona Tascu)

Migration work to new HPC was being done. Regarding DA activities many efforts have been dedicated to make validation with cy38t1_bf03 and to be able to assimilate conventional and satellite observations. Future plan is to calculate new B matrix with new ALARO model configuration and to continue validation with cy40t1.

Croatian report (Antonio Stanesic)

Main efforts dedicated to the set-up and evaluation of ALADIN 4km (ALADIN 4 better for almost all surface parameters, except more clouds and neutral scores for precipitation, upper-air were not yet evaluated). Plans comprise implementation of 3DVAR on 4km, assimilation of more data (MODE-S, GPS) and revitalisation of work on radar DA.

Hungarian report (Mate Mile)

Operational suite was upgraded to SMS system. **Occasional screening crashes for AMSU-B NOAA18 have been encountered in rtov_calcbt_basic.F90**. Use of SEVIRI for AROME was tested and the default VARBC settings was not found adequate (slow and almost zero BC) and local adaptation was suggested (increase of the adaptivity via Nbg in passive assimilation during VARBC warm-up). High Resolution Winds (HRW) observation were studied in AROME – significantly higher number of good quality data were found compared to standard AMVs, DFS confirmed analysis sensitivity to HRW data and impact study showed mostly neutral impact, but for particular cases the data might be beneficial. Validation of VARBC for GNSS ZTD continued. Future plans comprise work on AROME surface assimilation implementation (OI_main) and computation of ENS DA B matrix, 1h RUC, surface DA using EKF, to continue work on GNSS ZTD and HRW. There is an agreement to get Mode-S data, but due to limited manpower radar DA activity is postponed.

Slovakian report (Michal Nestiak)

Evaluations of a new domain (4.5L63, OI+DF blending) and main efforts dedicated to a large upgrade of automatic synoptic and radar network, satellite data receiver and HPC installation.

Austrian report (Florian Meier)

Experimental setup of an **AROME RUC/RAP nowcasting** consisting hourly +12h forecasts based on operational AROME (OPER) guesses (ranges +3h,...,+7h), runs on a smaller domain (2.5L90 with less grid-points), coupled by AROME-OPER and surface from ALARO, assimilated data as OPER + radar data has been tested. Spin-up problems for temperature and precipitation encountered, so future plans comprise solving spin-up problems, add more data, switch to cy40t1 and soil interpolated from AROME-OPER, B-Matrix?

There has been also progress regarding radar QC with remote sensing group (indices from INCA2, Baltrad and improved local algorithm for DOW de-aliasing), further observation under evaluation: Mode-S (MRAR from Slovenia and EHS from KNMI), GPS ZTD (**EGVAP test data are too late for RUC +2:28h**) and HRW.

Czech Rep. report (Antonin Bucanek)

Main efforts were devoted to the operational implementation of BlendVar. The BlendVar showed significantly improved fit to observations at analysis time, impact on forecast is smaller, but mostly positive, there is also apparent improvements of temperature and humidity bias. **Sensitivity of surface analysis (OI) to presence of instantaneous and cumulative fluxes was noticed.** The soil increments are modulated - mostly decreased - by fluxes with significant impact on 2m and even 850hPa scores, but no final conclusions are available yet.

HIRLAM's status (Roger Randriamampianina)

From HIRLAM DA activities, the use of RADAR reflectivity and radial wind, AROME-Arctic OSE and OSSE and the impact of Large-scale mixing on AROME model were summarized. In HARMONIE scripting system the RADAR observations can be assimilated either in HDF5 or MF BUFR format. Also the creation of RADAR super observations and the use of blocked pixels (beam blockage) are under evaluation. The results of an AROME-Arctic study has been introduced. It was concluded that the assimilation of Bouys and satellite observations play important role in the system especially on areas, where conventional observations are underrepresented. Regarding large-scale mixing (LSM), comparative results has been shown with the use and without the use of LSM method in HARMONIE. It was pointed out that in HARMONIE the use of LSM is beneficial, but it is difficult to study the impact of an observation together with the LSM. Furthermore such assimilation system is far from optimal currently, therefore improvement is needed especially on the representation of the B matrix.

Mode-S data assimilation at CHMI (Alena Trojakova):

Preliminary evaluation of Mode-S data over Czech airspace was done. Data quality was evaluated with respect to AMDAR and NWP. Mode-S MRAR observations are of good quality and ready for data assimilation just after the basic data selection based on statistics differences with respect to NWP model. Mode-S EHS data needs further investigations. For more details see the dedicated report B. Strajnar (2015).

Radiance bias correction in LAM ALADIN/Cz (Patrik Benacek):

Main issues related to radiance bias correction in LAM were presented:

- observation errors increase within 6h-assimilation window, which influence quality of VarBC and cloud detection scheme. The shorter time-window was suggested to reduce this effect.
- Sparse vertical level in stratosphere affects VarBC and rejection of VarBC predictor_5 and

- stratospheric-peaking channels for AMSU-A and IASI were recommended
- The new background error constraint on VarBC parameters was investigated with promising results to reduce VarBC response to the flow-dependent NWP model bias.

Hourly RUC and OOVAR validation (Mate Mile):

Many LACE countries are interested to **developments towards increased analysis update frequency (RUC)** mainly for warning forecast purposes covering short- and very short-ranges. In near future 3DVAR method will be the core of RUC systems and conventional, radar, GNSS and geostationary satellite observations will be used. Challenges to tackle are observation availability to constrain hourly RUC analysis, control noise accumulation and imbalances, coupling (strategy and frequency) and estimation of background error statistics. Promising results were obtained this year in Austria and for more details see materials from the first RUC meeting on RC LACE web.

The **prototype of OOPS LAM 3DVAR (OOVAR)** became available at the end of 2014 thanks for Meteo France. Although the OOPS project is already in a mature phase and new cycles are seriously involved in OOPS refactoring, the LAM modifications are still under discussion. The prototype is a mock-up version of LAM 3DVAR and one should not expect clear and validated version. The prototype was tested in Hungary (prototype was compiled, but validation is still ongoing) and first experiences showed that good knowledge on OOP and C++ is needed to understand the new variational method data-flow.

Meteo-France session (Claude Fischer):

Road-map for OOPS assume to run single resolution 4DVAR at ECMWF by the end of 2015 from OOPS layer and multi-incremental 4DVAR by the end of 2016, a full experimental 4DVAR only in 2017 (double suite in spring 2017 earliest). At the moment it is not clear for how long the current Fortran interface will stay in the code due to maintenance overhead (at least till CY45).

Possible options for LACE contribution to OOPS LAM prototype are either to test program, which is under development, to call obs operators from OOPS layer or to put efforts in refactorisation of obs operator code (HOP), where is a possibility to add/validate specific observation type (Mode-S, SEVIRI, 3D refractivity).

Regarding perspective of J_k and 3DFGAT configurations Meteo France abandoned J_k as not large benefits were found to support more complicated scripts and a special B matrix. Probably HIRLAM plans to be involved in both configurations.

Correction of model global radiation forecast using Kalman-Filter (Tomislav Kovacic):

A special application of Kalman-Filter has been introduced for removing bias of global horizontal irradiance forecasts. The method was implemented in Croatia with ALARO 8km using 1 year long forecasts and measurements. In conclusion the verification showed improvement on bias, however the rmse and stderr are not always reduced.

Surface Assimilation using EKF method in Hungary (Helga Toth):

Two different EKF surface assimilation setups were introduced, one is for agricultural purposes of an EU project and another is for operational AROME surface analyses. In the project the EKF is used with non-conventional satellite measurements to make LAI and WG1, WG2 analyses and for operation conventional gridded observations are tested to analyze TG1, TG2 and WG1, WG2 parameters. The future plan is to replace CANARI OI surface assimilation with EKF based analyses in the operational

ALARO and AROME DA systems.

OPLACE status report (Alena Trojakova):

To minimize data provision problems OPLACE system reliability and monitoring has been improved. Furthermore, time availability of observations was enhanced to support 1H RUC and/or nowcasting applications by extra update at +15min. Based on a discussion with participants (main OPLACE users) one more update will be introduced at +50min. Regarding non-LACE countries access to OPLACE, the last year's request from Turkey has not been finalized and a new request was received from Tunisia in May 2015. There are no technical problems and a decision from RC LACE Council is awaited. The exchange of surface synoptic data within RC LACE is working well and data are ready for operational use. A new data type was added in April 2015 - Mode-S Meteorological Routine Air Report (MRAR) aircraft temperature and wind observations were kindly provided by Slovenian colleagues.

General Discussion and Continuation of the Work:

The general discussion consist the following issues:

- *LACE contribution in OOPS.* During discussion, LACE DA colleagues agreed that there is no new DA development in LACE which should be recoded in OOPS compliant way for new common cycles, but there is an interest to learn and follow the latest changes regarding the project. Considering the local installation of OOVAR in Hungary and knowing the limited manpower resources, LACE colleagues proposed the following steps for the LACE contribution:
 - Each LACE member should contribute with 1 month manpower which together is roughly 7 months contribution.
 - Primarily the LACE contribution begins with the validation of OOVAR which is already installed, started at OMSZ. It means colleagues will work on the Hungarian environment and make validation exercises there via either remote connection or short stays.
 - Furthermore LACE is willing to contribute on the validation of other OOPS toy models (HOP test harness) and on the implementation of LAM (and LACE) specific observations.
 - The LACE contribution to OOPS is coordinated by the LACE DA AL (Mate Mile).
- *Diagnosing and monitoring of bias information and the evolution of predictors in VARBC scheme.* Due to several VARBC issues noticed in LACE, it was decided to share information among LACE partners and LACE DA systems in order to compare different VARBC setups. To make this comparison, LACE forum topic should be opened and a common period should be tested, provided by everyone. Also external inputs are going to be received by Meteo-France colleagues to check the performance of the ARPEGE and the AROME DA systems.
- *RADAR data exchange and common quality control (QC).* LACE colleagues agreed that doing QC commonly for 7 different RADAR networks is a difficult exercise. Considering the latest and perhaps the most advanced QC tool from Austria (including both INCA2 and BALTRAD QC elements) it was proposed to collaborate more with Austrian remote sensing division and to try making QC with combined Austrian tool for other LACE RADAR sites as well. To contribute in this activity Mirela Pietrisi, Tomislav Kovacic and Michal Nestiak are willing to work on this subject in the frame of LACE stays (2, 1 and 1 month respectively). This proposal will be forwarded to LACE PM by DA AL. Furthermore there is a need to collect, exchange

new RADAR data samples due to latest changes in RADAR networks at several LACE centres and to access OPERA data as well.

- *LACE contribution in COPE*. Beside OOPS project there is another very important and recent development on observation pre-processing in OOP context which is coordinated in COPE (Common Observation Pre-processin Environment) project. So far LACE DM was involved in COPE discussions and participated with very limited manpower (2 months). During the discussion, colleagues agreed that LACE has the interest to participate in COPE, but again it is difficult to find significant manpower to this. A proposal suggested to involve colleagues to COPE contribution from non-LACE countries who interested to get access to OPLACE data and who provide manpower for OPLACE maintenance (however the details of this cooperation is still under discussion!). Also in case of successful OOPS contribution proposal (see above) and common agreement, similar exercise can be realized for COPE.
- Flow-dependent background error representation. To this long term goal, the first tested approach using grid-point sigmaB maps showed more difficulties than it was expected. In the future, the use of online EDA information will be discussed and estimated regarding available tools and computer resources.

During the discussion section the following topics were identified to futher work so called TODO-s:

- Open VARBC topic for diagnosing and monitoring VARBC scheme and to make comparative investigations
- Make clean environment for OOVAR for LACE colleagues with access to HMS computer and continue validation.
- Upgrade OPLACE with the following discussed elements:
 - Implement available radiance observations from other satellites (SSMI?)
 - NowcastingSAF 15min cloudtype (CT) product for snowcover
 - OPLACE run at +50 min every hour.
 - OPLACE common email (oplace@met.hu)
- Discuss RADAR QC proposal with LACE PM
- Update operational namelists on LACE webpage

AOB:

Next DAWD will be held in OMSZ (Budapest) which is expected to be in September 2016 making one week distance from upcoming EWGLAM meeting.