Working Area Data Assimilation

# Progress Report

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| **Prepared by:** | Area Leader Benedikt Strajnar |
| **Period**: | 2018 (from January to December) |
| **Date**: | 07/03/2019 |

## Progress summary

The report summarizes the RC LACE DA activities between January and September of 2018. Seven RC LACE stays with a total duration of 5.75 months supported activities on hourly DA systems and the radar data assimilation. As usual, considerable part of the DA efforts were devoted to upgrades in the local DA systems and maintenance duties. These mainly local DA efforts are summarized in the first section of this report.

Concerning the research oriented actions, the efforts were put into using new meso- and convective-scale observation sources and adjusting the assimilation systems to be able to profit from their high spatial and temporal resolutions, while taking into account the basic initialization constraints (spin up) and proper specification of background error covariances. Another area is implementation of EKF for surface data assimilation.

Most of manpower was invested into radar data assimilation, the member countries started to make progress with the use of OPERA volume data, the new pre-processing tool HOOF was developed in Slovenia which helps with homogenization and better selection of data from different radars. Quality of OPERA data was investigated, and this prepares most member countries to move towards the actual assimilation of this data (minimization) and real-case tests in 2019. The operational use of Mode-S aircraft observations is increasing and there are efforts to incorporate more data and arrange a common processing with KNMI. The operational assimilation of GNSS tropospheric delays (mostly ZTD) has progressed by employing advanced bias correction scheme and further experiments with more observations, which resulted in operational use in Hungary, while other members still experience unsatisfactory results. Initial experiments with other GNSS data (slant delays) are ongoing. The use of satellite observations was also investigated focusing on the specification of bias correction for limited-area challenges.

Within the algorithmic developments, efforts were devoted to decrease the spin up in the hourly cycling by incremental analysis update, adjustments in the B-matrix and by applying different cycle frequency for upper-air and surface data assimilation.

## 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 RC LACE countries is presented in the following table (yellow colors indicate the system upgrades and additions made in 2018):

| DA | AUSTRIA ALARO | AUSTRIA AROME | CROATIA ALARO | CZECH ALARO | HUNGARY ALARO | HUNGARY AROME | SLOVAKIA ALARO | SLOVENIA ALARO | ROMANIA ALARO (pre-operational) |
|---|---|---|---|---|---|---|---|---|---|
| Resol. | 4.8L60 | 2.5L90 | 8L37 | 4.7L87, 2.3 (Mar 2019) | 8L49 | 2.5L60 | 4.5L63 | 4.4L87 | 6.5L60 |
| Cycle | 40t1 | 40t1 | 38t1 | 43t2_bf8 | 38t1_bf3 | 38t1_bf3 | 40t1 | 40t1 | 40t1 |
| LBC | IFS 3h (lagged) | IFS 1h (lagged) | IFS 3h (lagged) | ARP 3h | IFS 3h (lagged) | IFS 1h (lagged) | ARP 3h | IFS 1h/3h (lagged) | ARP 3h |
| Method | OI + dyn. adapt | OI_main + MESCAN + 3DVAR | OI + 3DVar | OI + BlendVar | OI + 3D-Var | OI_main + 3D-Var | OI + DF Blending | OI + 3D-Var | OI + 3D-Var |
| Cycling | 6h | 3h | 6h | 6h | 6h | 3h | 6h | 3h | 6h |
| B matrix | - | Downscaled LAEF 11 km | NMC method | Downscaled AEARP | ALARO EDA | AROME EDA | - | Downscaled ECMWF ENS | Downscaled AEARP |
| Initialization | DFI | No (SCC) | No (SCC) | IDFI in production, SCC | | | No | No (SCC) | No (SCC) |
| Special / new observations | Additional snow melting | Snowgrid +SAT snow init. | | Mode-S EHS | | GNSS ZTD | | HRW, IASI, ASCAT, Mode-S EHS | |

In Austria, the operational ALARO (only OI-surface) and AROME (3DVAR+OI_MAIN) DA systems all cy40t1 export run mostly unchanged. The migration from MSG-10 to MSG-11 was done for Geowind and SEVIRI data. HARMONIE Observation monitoring (ObsMon) was installed for AROME. A parallel AROME ESUITE started this summer including assimilation of radar reflectivity from Austrian, German and Slovenian stations and MODE-S winds from Slovenia, KNMI and Austrocontrol. Due to data policy only part of this data can be used in next operational version.

In Czech Republic, local efforts were mainly dedicated to validation and operationalization of a new cycle cy43t2_bf8. BUFR data processing and message handling (BUFR SHIP, BUOY and TEMP data processing by BATOR) was explored and improved. The higher density of TEMP observations with corrected time and position was investigated in 3DVAR, which resulted in improved fit of the analysis to observations and very small positive impact for +6h forecast.

In Slovakia local effort was dedicated to computation of EDA based B matrix for ALARO system and to investigation of bug in FESTAT on cy40t1. The new 6-hour cycle of AROME 2L73 was technically implemented and validated. The development of EKF surface assimilation is ongoing.

In Slovenia the use of observations in operational suite (cy40t1) is significantly improved by high resolution AMVs, KNMI processed Mode-S EHS data, AMDAR humidity, radiance data – IASI and ASCAT winds. Cy43t2 was compiled and validated. Research on the impact of SST information on forecast was continued by publishing a paper in QJRMS.

Regarding Romanian local work, ALARO DA system based on cy40t1 is in pre-operational state on 6.5km with conventional observations. There is effort to introduce also geostationary satellite data but for the time being it is not finished.

In Croatia, a study of different approaches to B-matrix sampling was carried out. The other local effort was devoted to radar assimilation mainly. An overview of HDF5 files from different radars was prepared. A case study was performed using Croatian, Slovenian and Hungarian radars with promising results.

In Hungary, the GNSS ZTD data were operationally implemented in AROME, mainly following previous work by M. Mile. The work on radar data pre-processing has started.

**Efforts:** 7 months (local work)

**Contributors:** roughly 1 person per countries

**Documentation:** Reports on RC LACE web

**Status:** ONGOING

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

**Description and objectives:**

In Austria, further sensitivity experiments with AROME-nowcasting at 1.2 km were carried out. Although earlier results suggested better performance of 2-hourly assimilation cycling compared to hourly cycling due to spin up, the sufficient levels of noise in the hourly first guess were finally achieved with extended incremental analysis update (IAU, -45 min to +5 min addition period, Fig. H1) and were further reduced by improved tuning of the system (decreased REDNMC from 2.5 to 1.3). The effect of nudging on the initial noise was also investigated but it's effect on this aspect was found to be minimal. An approach of modifying the background-error covariances by adding recent NMC differences to the sampling data set for B calculation was tried in offline method but so far did not visibly change the spin up (Fig. H1 right).

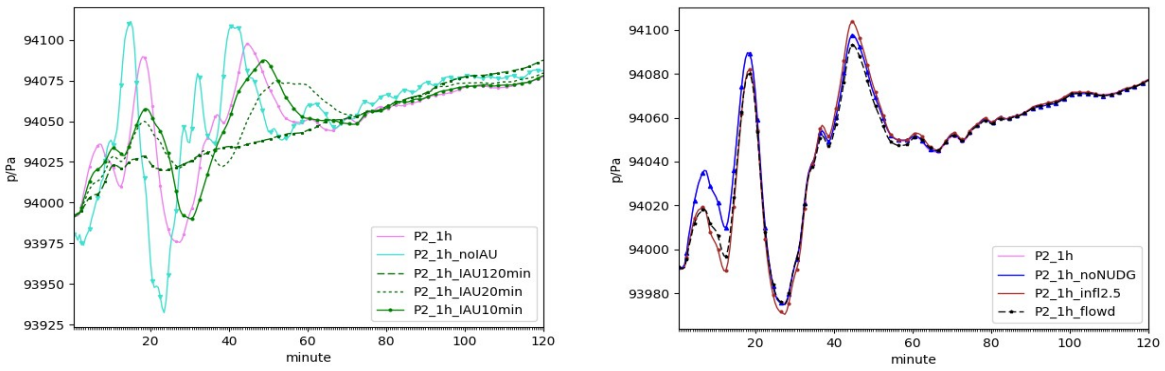


*Figure H1: Left: ECHKEVO diagnostics of surface pressure in AROME-RUC 1.2km with different IAU windows length (pink is reference). Right: 5-min IAU reference (pink), switched-off LHN and nudging (blue), REDNMC2.5 instead of 1.3 (brown) and experiment using modified B, where NMC differences of the day were added to the sample (black).*

The RC LACE stays in Vienna were devoted to objective verification of AROME/Nowcasting systems, with focus on the comparison of precipitation fields of INCA and AROME nowcasting system by fraction skill scores and object-based verification (MODE). The goal of this evaluation was to determine the exact forecast-range where NWP can outperform traditional nowcasting systems like INCA. The results shows that INCA outperforms AROME nowcasting system only in first two hours of forecasts. For larger accumulations of precipitations the AROME nowcasting outperforms INCA after first hour of forecast. A novel object-based verification method (MODE) was used to identify the structure of the modeled precipitation field in comparison to observations and analysis (INCA). It was found that the number of individual precipitation elements (objects) was overestimated in AROME. Spin up issues in the system were also addresses by checking the evolution of pressure and temperature tendencies in time at selected model grid points. IAU reduces the temperature oscillations but not the oscillations in pressure field. More details can be found in Mirela Pietrisi's stay reports.

Investigation of hourly cycling started in Hungary, where an hourly 3D-Var was combined with surface OI at various time resolution (1 h, 3 h, 6 h). Results (Fig. H2) indicate that combining the 3- and 6-hourly OI in the hourly system improved 2 m temperature and relative humidity and well as precipitation scores compared to 1-hourly surface data assimilation, presumably because there is too little surface data available hourly.

In Czech Republic, a Rapid refresh (RAP) system using hourly VarCanPack analysis on the operational ALARO domain is under evaluations. Behavior of variables affected by spin up (surface pressure tendency and total precipitation) is examined.

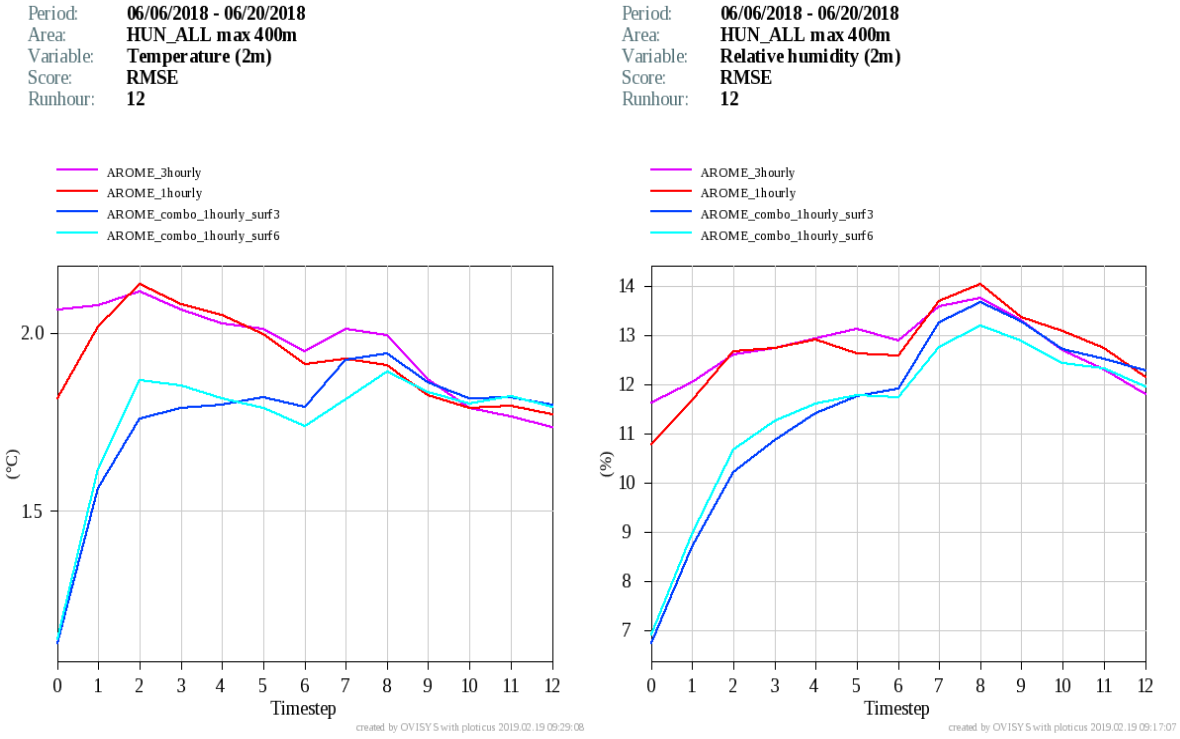


*Figure H2: RMSE of 2 m temperature (left) and relative humidity (right) in time (hours). Shown are Hungarian operational 3h AROME and 1h AROME RUC using several combinations with surface OI.*

**Efforts:** 11 months

**Contributors:** F. Meier (At), P. Scheffknecht (At), M. Pietrisi (Ro), A. Várkonyi (Hu), P. Benáček (Cz)

**Documentation:** Report on RC LACE web

**Status:** ONGOING

**Action/Subject/Deliverable:** ***Studies of background error statistics in 3DVAR***

**Description and objectives:**

In Slovakia, a new LAEF-based B-matrix was computed and validated by performing single-obs experiments.

In Croatia, a study comparing three different B-matrix sampling approaches and their influence on forecast was created. The B-matrices compared are derived using standard National Meteorological Center (NMC) and two ensemble data assimilation (EDA) methods, one with unperturbed LBCs (ENS) and one with perturbed LBCs (ENSLBC). Diagnostic comparison showed that ensemble techniques shifts correlations towards small scales. This is the most pronounced for ensemble with unperturbed LBCs. The use of the new ENSLBC based B-matrix reduces spin up in first hours of forecast. The

verification shows modest improvement for experiment with new ENSLBC based B-matrix compared to the NMC-based one, Fig. B1.

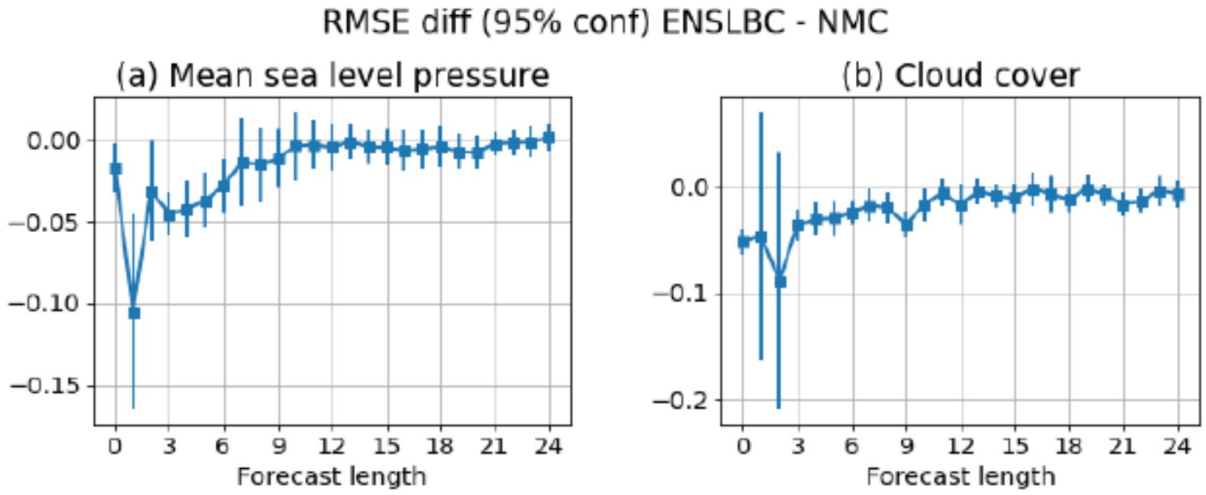


*Figure B1: Relative RMS reduction of MSLP and cloud cover by using ENS instead of NMC method for the B-matrix calculation.*

In Czech Republic, a new B-matrix was computed for the 2.3 km model domain. A large sensitivity of high-level humidity background-error estimation to the choice of sampling period was detected (Fig. B2), which resulted in detrimental effect on scores in combination with MSG radiance assimilation. The unwanted degradation can be mitigated by tuning the observation errors for radiances and the background-error covariances.

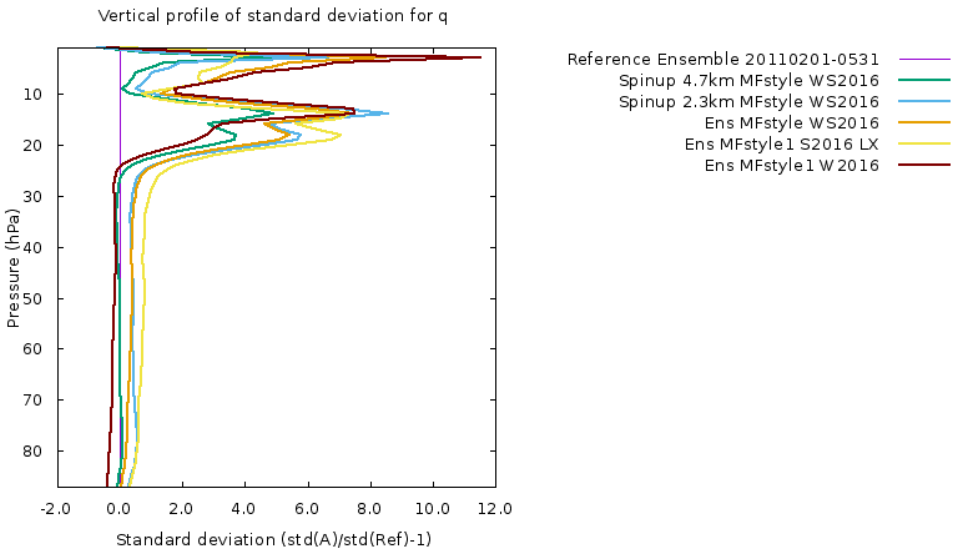

*Figure B2: Sensitivity of specific humidity background error estimation on resolution, sampling technique and season.*

**Efforts:** 6 months

**Contributors:** M. Derkova (Sk), A. Stanešić (Cr), A. Bučánek (Cz)

**Documentation:** /

**Status:** ONGOING

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

**Description and objectives:**

In Austria, SODA in SURFEX8.1 has been modified so TG1-8, WG1-8 and WGI1-8 can be used as control variables and soil moisture data from level 1-8 can be used as observation. Furthermore, the option to use a local observation error (provided in an ASCII file) instead of XERROBS_M has been coded and tested. Some (but not all) modifications have been tested with regard to soil moisture data. Assimilation of SCATSAR-SWI (a combined ASCAT & Sentinel-1 soil moisture data set for several soil layers on a 1 km grid) shows a positive impact on T2M in short-range AROME (CY40T1 with HIRLAM modifications to use ISBA-DIF) forecasts (see Fig. S1). These will be published in a scientific journal (under review in GMD).

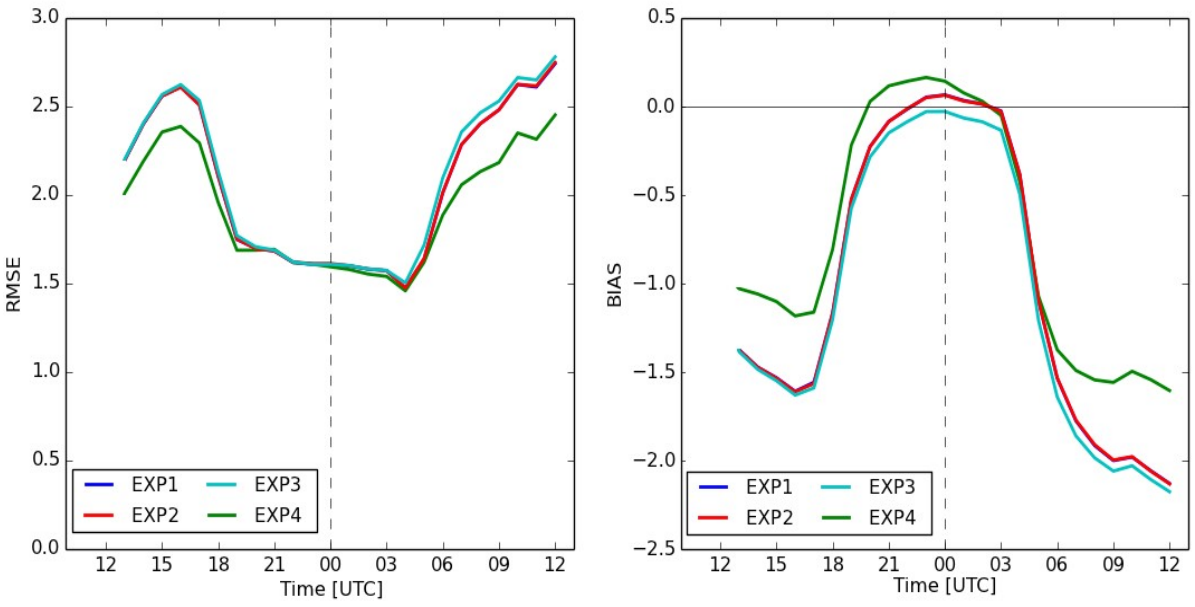


*Figure S1: Assimilation of SCATSAR-SWI in Austria: RMSE (left) and bias (right) for T2M forecasts from 20160501-20160629, averaged for all SYNOP stations in Austria located below 300 m. EXP1 is the*

*reference run, EXP2 and EXP3 are experiments with assimilation of superficial soil moisture, EXP4 is with assimilation of all available soil moisture data (down to ~60 cm in the ground).*

In Slovakia, sensitivity analysis of 2-L and 3-L ISBA force restore scheme for soil volumetric water content has been started using the offline SURFEX and 1-column setup. A new method is proposed to allow efficient computation of EKF Jaccobian matrices H and M in 1-column runs. It may be especially useful for higher dimensional control space like in the diffusion scheme. The new method is used for investigation of the nonlinear behavior of coupled ISBA-CANOPY (ISBA-DIAG) scheme that is acting as observation operator in EKF analysis of soil moisture. Soil moisture and temperature analysis is performed by SEKF (by J. F. Mahfouf) within SODA, using 4 control variables. Screen-level analysis are replaced by a grided product (INCA-SK analysis, Fig. S2). A comparison of SEKF to OI_MAIN is planned.

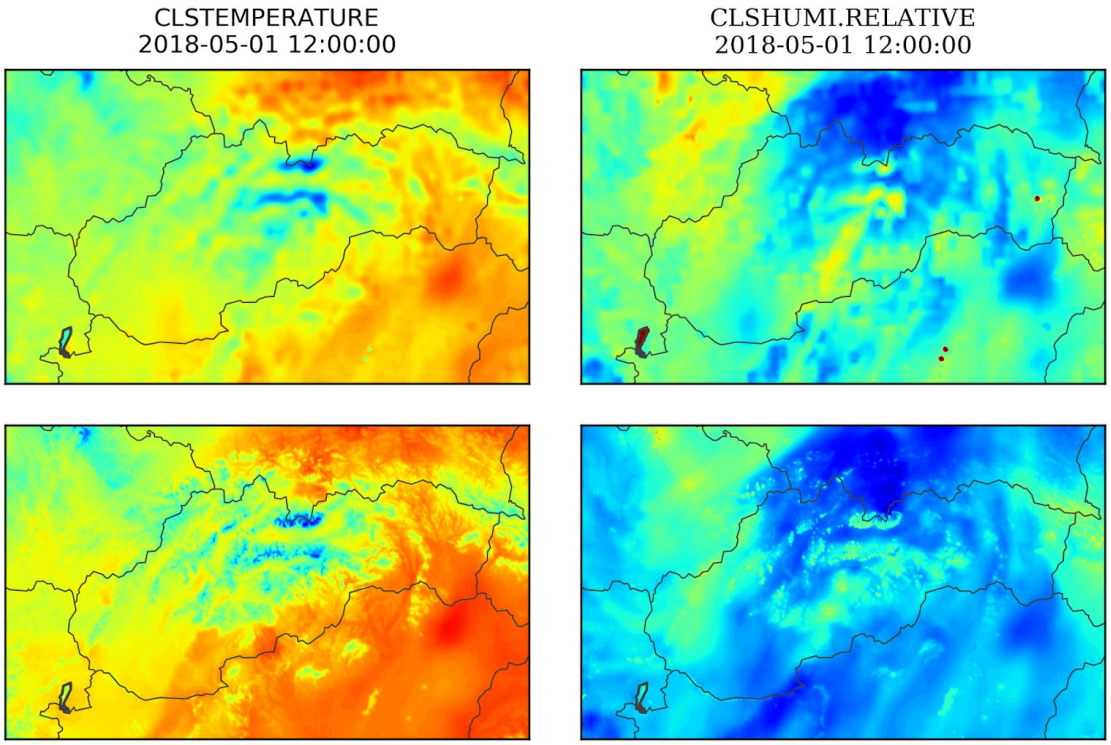


Figure S2: SEKF in Slovakia: standard analysis of 2 m temperature and humidity (top) and INCA-SK analysis (bottom) to be used as a proxy to compute analysis increments in the soil.

**Efforts:** 10 months

**Contributors:** S. Schneider (At), J. Vural (At), V. Tarjáni (Sk)

**Documentation:** /

**Status:** ONGOING

**Action/Subject/Deliverable:** ***Object (OOPS) and LACE's contributions Oriented code refactoring***

**Description and objectives:**

No new action has been made in 2018 in terms of LACE's contribution in OOPS refactoring.

**Efforts:** 0 months

**Contributors:**

**Documentation:** /

**Status:** ON HOLD (no manpower)

**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, its use and more accurate assimilation requires further examination. In Austria and Slovenia, technical tests with ATMS data were performed, passive experiments will follow in 2019. A new RTTOV coefficient file and a noise mask file were necessary to assimilate NOAA-20 radiances.

Patrik Benáček (Cz) is proposing reconfiguration of VarBC for LAM. Two approaches were considered: adjusting the adaptivity (NBG parameter) and implementation of dynamic adaptivity (after Cameron and Bell, 2016). Extensive testing showed that the VarBC-LAM methods outperform the use of global coefficients from ARPEGE providing the better quality of the first-guess in the 3-hour assimilation cycle with the largest normalized impact ((RMSEexp – RMSE ref)/RMSEref) of 2 – 3% for temperature and wind components in middle troposphere (Fig. V1).

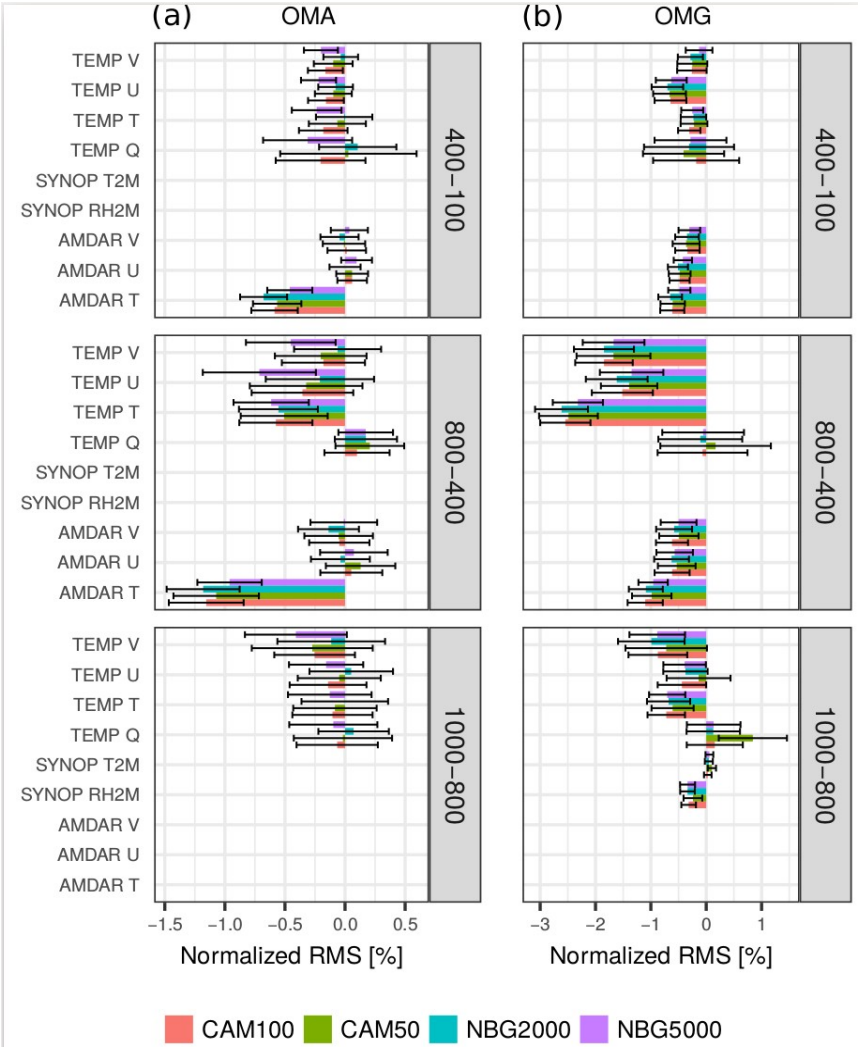


*Figure V1: The normalized RMS of OMA (a) and OMG (b) residuals evaluated for different VarBC-LAM configurations (CAM stands fro Cameron and Bell (2016), NBG to modified adaptivity setting) with respect to conventional observations from 01 Dec 2015 to 31 Jan 2016. The VarBC-global method is used as a reference experiment. Error bars represent 95% significance level.*

**Efforts:** 6 months

**Contributors:** P. Benáček (Cz), F. Meier (At), B. Strajnar (Si)

**Documentation:** /

**Status:** ONGOING

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

**Description and objectives:**

Apart from Austria, where the earlier local radar development allows for assimilation of both reflectivity and wind, the member countries just started the implementation of radar DA by

strengthening the collaboration 2018. This allowed us to provide user feedback to OPERA as the main pan-European data provider. Several issued and inconsistencies in the data sets and also lack of updates of documentation. The feedback document could be found in RC LACE forum in section "Data Assimilation/OPERA users group". There were two internal hangout meetings this year related to effective distribution of work on radar DA within the group.

Five radar-related RC LACE stays were executed, with topics from radar preprocessing to quality-control. The group first focused on the reflectivity data, because the wind currently includes no quality control and needs dealiasing. The group realized that the BATOR code of cy43t1 is preferable as it fully support the OPERA ODIM information model. The BATOR-HDF5 reader of cy43t1 was back-phased to cy40t1 by Alena Trojáková in order to make it available for testing in all RC LACE member countries. It was shown that we may not fully rely on the quality control provided by OPERA.

Because of still-existing in-homogeneity in the OPERA data set in terms of structure and metadata, a Python-based homogenization tool called HOOF (Homogenization of OPERA OIFS Files) was developed in Slovenia. Its functionalities are splitting of the merged OIFS files to separate measurements, rearranging the content according to specification in namelist retaining only the desired variables (e.g. reflectivity and/or radial winds) and possibility to encode prescribed meta data separately for individual radars or for the whole data. This allows processing the entire OPERA data set with BATOR. The tool along with documentation was made available on the RC LACE forum. A companion Python tool allows for checking all possible values for a given parameter and validate the default values used in BATOR. The tool was well accepted and already (beta) tested in several LACE countries.

In Slovakia, Cooperation and technical help were given on investigation OPERA OIFS quality control during a RC LACE stay (A. Trojáková) in Bratislava. The back-phased BATOR43T1 was tested locally at SHMU. Investigation of BATOR input/out for RC LACE radars is ongoing after another RC LACE stay (M. Neštiak) in Budapest.

In Austria, the AROME-RUC uses data from Austria and bilateral exchange with Germany (Slovakia and Slovenia). The back-phased version of BATOR cy43 was tested in a case study against HARMONIE-HDF5-BATOR. This needed updates of locally used pre-processor PREPOPERA. The new RC LACE tool HOOF was technically tested. It was found that PREPOPERA is rather slow compared to HOOF due to additional features like interpolation/superobbing/vertical thinning. The observation operator for reflectivity (cy40t1) was compared to recent changes in cy43t1: it was found that quality check was modified and that MF changed number of profiles and search radius from 100 km to 200 km. The latter requires significantly more memory in screening. Due to the fact that the operator cannot inject observed echos into the model, in case nothing is simulated within the search radius, the saturation of profiles with high observed reflectivity firstly tested during the stay at MF in 2015 was reconsidered. A stay of Idir Dehmous (Algeria) at ZAMG delivered a HDF5-Doppler simulation program (Fortran+Python+Epygram), which might be used as first guess for dealiasing. For the historic period (July 2016) Doppler winds had suspicious high impact (DFS), which indicates that aliasing was still an issue. VAR-QC was considered as a possible solution.

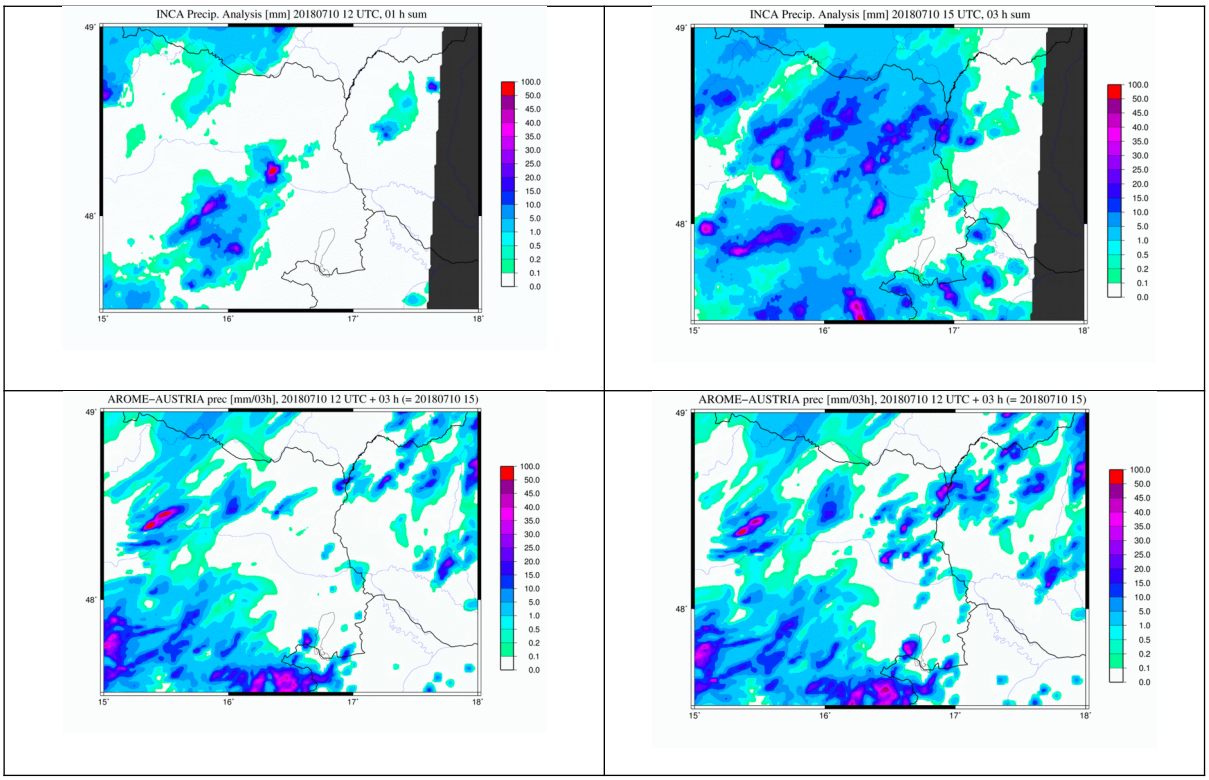


*Fig. R1: Example of impact of radar data on a case study of flash flood in Vienna 10th July 2018 (INCA rain before model init time top left), INCA rain during first 3 hours of integration (top right), AROME-RUC1.2+RADAR (bottom left) failed due to no strong cell in the surrounding, the same with saturated profiles if threshold DBZ exceeded (bottom right).*

In Croatia, An independent review of ODIM HDF5 files from radars within Croatian ALARO NWP model domain was made (report on RC LACE web page). The conclusions are that OPERA files were homogeneous enough over this area, but that the minimum measurable reflectivity can not be calculated from the included metadata. The review pointed out some differences in wind encoding, namely the normalization of provided wind by Nyquist velocity for some radars. A case study on 8th November 2017 was analyzed. For this case only data from Croatian, Hungarian and Slovenian radars were used. Radar data assimilation helped to remove wrongly forecast rain in reference operational run.

In Czech Republic, the radar DA was initiated during a stay of Alina Dumitru. HOOF tool was tested in combination with BATOR cy43, and feedback was provided to Slovenian colleagues.

In Slovenia, the HOOF toll was developed and documented and a few user-reported bugs were corrected. The tool was tested and meant to be used with BATOR cy43. A master thesis on processing of (aliased) Doppler winds was initiated.

In Hungary, the radar DA work started after stay of Mate Mester in Ljubljana where he participated on development of HOOF. The back-phased BATOR cy43 was installed after some technical issues.

**Efforts:** 22.5 months 2.5(At)+ 5.5 (Sk) + 4.5 (Cr) + 2 (Hu) + 2(Cz) + 6(Si)

**Contributors:** F. Meier (At), Florian Weidle (At), B. Strajnar (Si), P. Smerkol (Si), A. Stanešić (Cr), T. Kovačić (Cr), A. Trojáková (Cz), M. Mester (Hu), M. Neštiak (Sk), A. Trojáková (Cz)

**Documentation:** Report on RC LACE web, software

**Status:** ONGOING

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

**Description and objectives:**

The usage of GNSS observations is planned in most of the RC LACE member countries, but currently only operational in Hungary.

In Slovakia the whitelist of stations based on long term first guess and analysis departures was prepared and validated. Adaptation of code to process the Slant Total Delay (STD) and encoding the data into obsoul format are ongoing.

In Slovenia, GPS observations from Slovenia and its close surroundings are available operationally from Geodetic Institute of Slovenia. Another validation attempt revealed a bug in height encoding for this data set which improves bias with respect to model, impact on forecast is still to be checked.

In Austria, GNSS-based data is evaluated with the scope of AROSA project. Because GPS-RO observations were not available in satisfying numbers in time, an OSSE experiment was started based on an AROME nature run, simulated observations written from model to BUFR file and their assimilation. Results are under evaluation. The STD code from KNMI was phased to cycle cy40t1, together with recent bug fixes. Observations have to be in specific obsoul format in a separate BATOR base. Since 2018 the national ZTD data is available from EPOSA pre-processed by Technical university of Vienna in near real-time. Hourly test in AROME-RUC and variational bias correction over a period of 16 days (July 2016) was promising.

**Efforts:** 9 months

**Contributors:** M. Imrišek (Sk), B. Strajnar (Si), F. Meier (At), F. Weidle (At), P. Scheffknecht (At)

**Documentation:** /

**Status:** ONGOING

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

**Description and objectives:**

The use of Mode-S high-resolution aircraft observations (both MRAR and EHS sub types) are fast growing observations network with increasing importance in mesoscale DA systems.

In Slovakia, there is ongoing negotiation with Slovak Air Traffic service to provide local Mode-S data. A newly employed colleague is familiarizing with processing of raw Mode-S data.

In the Czech Republic, high-resolution aircraft Mode-S EHS observations from KNMI were investigated and made operational. Quality assessment with respect to NWP showed EHS data to be comparable to AMDAR, they have good BIAS for wind and temperature. STDE is also good for wind while higher for temperature. There is no need for quality pre-selection. Preliminary results of impact on NWP forecasts show reduction of RMSE and BIAS of upper level wind and temperature in the first 10 hours of forecast (Fig. M1).

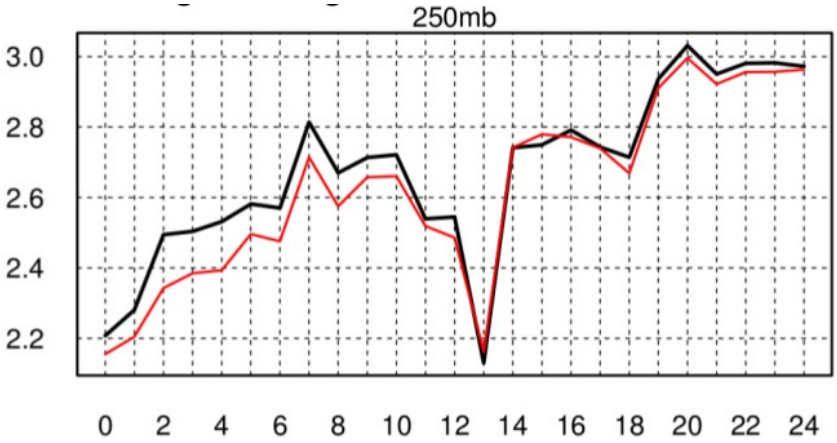


Figure 1: Time evolution of **RMSE for wind speed at 250hPa** verified against aircraft observations for period of 11 Jan – 9 Feb 2017 12UTC. **Reference** and Mode-S EHS experiment.

In Austria, new national Mode S EHS data were delivered for tests by national ATC (Austrocontrol). The latest activities were focused on the new data quality assessment (Fig. 2). It was shown that the quality of data could be improved by using the KNMI QC. Significant improvement of the ATC data quality (less outliers, better convergence of 3D-Var) allowed their use in the AROME ESUITE. Test of combined EHS and Slovenian MRAR data showed benefit within AROME-RUC 1.2 km in July 2016. Even temperature alone showed slight improvement, but the overall most came from winds. Data policy of national data beyond the project phase has to be clarified.

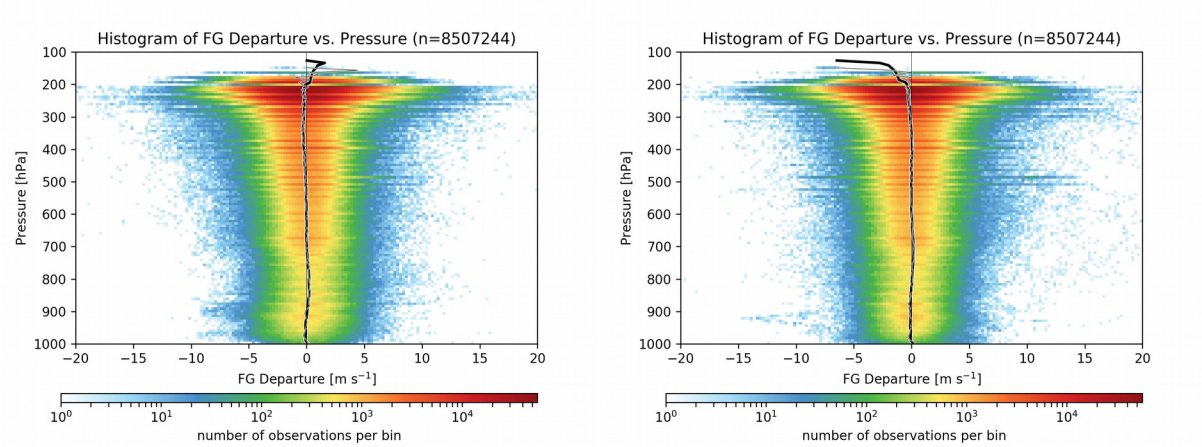


*Figure M2: 2-D histogram for wind data, showing FG departure (x-axis) and pressure (y-axis) for all observations not rejected by screening from 1 to 20 August 2018 from the AROME ESUITE for u-component (left) and the v-component (right). The thin (thick) black lines show the average FG departure for each height bin (running mean over 7 bins for the thick line) to visualize any bias in the data.*

**Efforts:** 10.5 months

**Contributors:** P. Scheffknecht (At), K. Čatlošová (Sk), B. Strajnar (Si), A. Trojáková (Cz)

**Documentation:** report on LACE web page

**Status:** ONGOING

**Action/Subject/Deliverable:** ***Assimilation of Meteosat HRW AMVs***

**Description and objectives:**

In 2018, there was only limited time devoted to HRW AMVs. In Slovenia, the HRW AMVs were added to operation suite after testing period which showed neutral impact on scores. In Hungary, the AMVs of IR, VIS and WV channels were evaluated over 15-day period, verification is to be continued.

**Efforts:** 1 month

**Contributors:** B. Strajnar (Si), Z. Kocsis (Hu)

**Documentation:** /

**Status:** ONGOING

**Action/Subject/Deliverable:** ***Two-way coupling of Ocean-Atmosphere and initialization of SST***

**Description and objectives:**

Research on the impact of SST information in Adriatic Sea on forecast along its eastern coast was continued by performing further verification analysis and comparisons with satellite data. Experiments included different SST products (ECMWF, MFS, operational POM) and two-way real time

coupling between ALADIN and POM (either in production cycle only, assimilation cycle or both). It is concluded from satellite verification that for the ocean model POM, the two-way coupling always improves SST. However, in ALADIN, high-resolution SST from POM (which has no ocean data assimilation) degrades the forecast with respect to ECMWF (daily analysis) and MFS (weekly analysis). Although the two-way coupling improves the forecast, it is not able to outperform the low resolution ECMWF product which benefits from frequent update with observations. The main conclusion of this recently published work (QJRMS) is that the development of local data assimilation for the ocean component is necessary and condition for further developments in this area.

**Efforts:** 3 months

**Contributors:** B. Strajnar (Si), P. Smerkol (Si)

**Documentation:** /

**Status:** COMPLETED

## Documents and publications

### Scientific papers

- Schneider, S. and Bauer-Marschallinger, B.: Assimilation of SCATSAR Soil Wetness Index in SURFEX 8.0 to improve weather forecasts, Geosci. Model Dev. Discuss., https://doi.org/10.5194/gmd-2018-273, in review, 2019.
- Strajnar B, Cedilnik J, Fettich A, *et al*. Impact of two-way coupling and sea-surface temperature on precipitation forecasts in regional atmosphere and ocean models. *Q J R Meteorol Soc*. 2019;145:228–242. https://doi.org/10.1002/qj.3425

### List of stay reports:

- Alena Trojáková, 2018/03: Radar data pre-processing
- Maria Monteiro, 2018/03: CPDA1.3 – implementation and validation of BATOR: SHIP&BUOY
- Máté Mester, 2018/03: Towards homogenization of OPERA radar data
- Alena Trojáková, 2018/05: Evaluation of OPERA data quality for NWP DA purposes
- Mirela Pietrisi, 2018/05: Comparison of NWP based nowcasting (AROME) with classical system
- Michal Neštiak, 2018/08: Investigation the BATOR cy43t2bf06 for radar DA
- Alina Dumitru, 2018/11: OPERA data processing by BATOR

### Other documentation

- Tomislav Kovačić: An overview of ODIM HDF5 files from radars within Croatian ALARO NWP model domain
- Peter Smerkol: Documentation for the Homogenization Of Opera files (HOOF) tool

**RC LACE DA at Joint 28th ALADIN Workshop & HIRLAM All Staff Meeting 2018, 16-20/04/2018, Toulouse, France**

**List of presentations:**

- Benedikt Strajnar: Impact of Mode-S EHS observations in ALADIN

**Posters:**

- Imrišek Martin: Data assimilation activities at SHMU
- Kovačić Tomislav: Radar data assimilation in Croatia

**National posters:** Austria, Croatia, Czech Republic, Hungary, Slovakia, Slovenia, Romania.

## Activities of management, coordination and communication

1) LACE Data Assimilation Working Days (DAWD) 2018, 19-21 September, Bucharest, Romania
2) 1st internal hangout meeting on RC LACE radar DA stays in 2018, 30 January, coordinated by B. Strajnar
3) 2nd internal hangout meeting on RC LACE radar DA stays in 2018, 21 June, coordinated by B. Strajnar
4) EWGLAM 2018, 1-4 October 2018, Salzburg, Austria
5) LSC meetings

## Summary of resources

| **Action (PM)** | **Resource** | | **LACE stays** | |
|---|---|---|---|---|
| | **Planned** | **Realized** | **Planned** | **Realized** |
| Local DA system | - | 7 | - | - |
| Hourly RUC | 12 | 11 | 4 | 2 |
| B-matrix | 5 | 6 | 0 | 0 |

| | | | | |
|---|---|---|---|---|
| Surface EKF | 6 | 10 | 1 | 0 |
| Radiance obs | 8 | 6 | 0 | 0 |
| RADAR obs | 12 | 20 | 3 | 3 + 0.75(*) |
| GNSS obs | 6 | 9 | 0 | 0 |
| Mode-S obs | 8 | 10.5 | 0 | 0 |
| AMV obs | 5 | 1 | 0 | 0 |
| Coupling with ocean | - | 3 | - | - |
| **Total** | **62** | **83.5** | **8** | **5.75** |

*(*) Report still missing.*

## Problems and opportunities

The main problems in 2018 were:

- A lot of work still booked by validation, maintenance and technical issues, partial duplication of work.
- No time and expertise to follow or contribute to OOPS-related developments.

Opportunities for more effective future work are:

- To increase the level of cooperation inside and outside RC LACE and support cooperation with other areas (e.g. DA & EPS common activities).
- To try to unify the local developments, e.g. to try to achieve approximately the same level of development in all member countries.
- To make strategical decision about LACE's contributions in OOPS.
- A common state-of-art video conference system should be used by all LACE members in agreement with ALADIN-HIRLAM community as well to avoid difficulties in communication and attract people to attend.