Regional **C**ooperation for
Limited **A**rea Modeling in **C**entral
Europe

Working Area Data Assimilation

Work Plan

Prepared by:	Area Leader Máté Mile
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1 Introduction and background

During the recent years, LACE data assimilation activities focused on the local development of "baseline" data assimilation systems at the LACE centres. It meant usually time demanding and technical challenges for the colleagues to build and later to maintain these local systems beside the their scientific works. The LACE DA Work Plan is trying to support this local efforts with basically short-term portable developments and also to target common achievable goals for long-term researches. For example short-term developments like the use of (new) observations and its pre-processing are recognised as vital and well-shared activities in LACE. On the other hand the limitations of the widely used 3DVAR require long-term developments to alleviate e.g. the representativity error in time by increased assimilation cycle frequency.

The Work Plan of 2018 will deliver actions already started in the previous years and also will give few updates to common actions. These DA activities can be grouped into algorithmic developments and the use of observations.

2 Goals

The main data assimilation goals to be attained in 2018 are the following:

- Progress on algorithmic developments. The work on hourly updated analysis cycle (1h RUC) identified as an important activity in LACE. In 2018 the work on **non-cycled hourly** updated DA systems for mainly nowcasting purposes is being continued and activities about the **hourly RUC** systems are also planned. In connection with the hourly assimilation systems, the background errors of the DA systems are going to be studied in a separate action. Furthermore there is a plan, idea to cooperation in the field of flow-dependent background errors with LACE predictability group by using ensemble data assimilation system. Another important action is to improve surface assimilation system based on **Extended Kalman-Filter** (EKF) method which action was started around 2014-2015 and to be continued further in 2018. Both conventional observations and satellite-derived products are going to be tested for operational and special project purposes. However, the developments of **OOPS project** would be important to closely track, it seems there is no manpower to be able to do so. Most probably the OOPS novelties are

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going to be validated, checked during new model cycle implementations (cy43t1, cy45t1, etc).

– More effective use of observations in LACE DA systems. In order to improve local DA systems, the most natural way is to extend the observation set. More experiments are expected in 2018 with the studies and possible operational implementation of **GNSS ZTD**, **Mode-S** (EHS and MRAR) and **AMV** (Geowind, HRW, Multi-Metop) observations in different LACE DA systems. Also the new **radiance observations** from Suomi NPP (CrIS, ATMS) and DMSP (SSMIS) satellites (ATMS is already introduced in OPLACE) are planned to monitor and to use in data assimilation systems. Regarding the use of **RADAR** reflectivity and radial wind, the OPERA data and pre-processing are more and more examined. In 2018 this action is going to be progressed and an additional proposal is also forwarded to LACE Council in order to support the cooperation in this field. All these observational activities will be and have to be harmonized with OPLACE maintenance and development for the possibility of (re)distribution and pre-processing of these data sources.

3 Main R&D activities

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

Description and objectives: The hourly updated assimilation approach ensures efficient method to employ more observations with reduced representativity error in time. Hourly analyses can be carried out by fully cycled (RUC) and non-cycled data assimilation systems. In 2018 the following studies are going to be carried out:

- The experiments of AROME/Nowcasting (ZAMG) test version are going to be continued in 2018. The higher resolution (1.2km) experiments will include hourly 3DVar, RADAR data assimilation plus latent heat nudging and IAU as well. More details about its exact plans are expected after the second half of 2017 when related LACE stays will be executed.

- The investigation of hourly RUC system is also planned regarding the use of sub-hourly LBC coupling (ARPEGE or IFS) in assimilation cycle and about the extended use of observations.

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Proposed contributors, Estimated efforts: F. Meier (At), P. Scheffknecht (At), F. Weidle (At), M. Nestiak (Sk) B. Strajnar (Sl), M. Pietrisi (Ro), 12 months, 4 months LACE stay for Mirela Pietrisi (Ro) in Vienna

Planned timeframe: whole year

Planned deliverables: report on LACE webpage

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

Description and objectives: The more accurate representation of background error statistics is crucial in mesoscale DA systems. In 2017 discussion was started to create feasible plan for 2018 (and also for years after) about the representation of flow-dependent background error statistics. Recently the following ideas are foreseen to be potentially feasible in this subject:

- Representation of time-dependent background errors from a suitable LAM (or perhaps common LACE) EDA providing robust daily statistics. Also objective filtering procedure has to be considered to avoid possible spurious sampling noises.

- Representation of spatially varying background errors by the previously tested grid-point σb maps. The upcoming model cycles (cy43t1 and cy45t1) will also deliver related source code developments which can be also considered.

- Last but not least local efforts to perform more accurate B matrices or to upgrade background error representation are going to be reported in the LACE action.

Proposed contributors, Estimated efforts: A. Stanesic (Cr), K. Horvath (Cr), 5 months

Planned timeframe: whole year

Planned deliverables: report on LACE webpage

Action/Subject: *Surface assimilation using Extended Kalman-Filter*

Description and objectives: The Extended Kalman-Filter approach is able to use conventional and non-conventional observations to generate surface analysis. In this LACE action both AROME and ALARO models are considered to be utilized with EKF, but more experiments have been

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carried out and currently are planned to execute with AROME model. In 2018 the following actions are foreseen:

- Continue 1D-column validation with conventional observations

- Assess the impact of the EKF analysis at the beginning and at the end of the assimilation window.

- Optimization for operational framework

- Validation of newer model cycles and SURFEX releases

- Study the use of ASCAT-Sentinel-1 (soil moisture) and Sentinel-3 (surface temperature) products in EKF for special project purposes

Proposed contributors, Estimated efforts: V. Tarjani (Sk), S. Schneider (At), J. Vural (At) 6 months (3 weeks LACE stay at OMSZ for Viktor Tarjani (Sk), 1 week LACE stay at ZAMG for Viktor Tarjani (Sk))

Planned timeframe: whole year

Planned deliverables: report on LACE webpage

Action/Subject: *Assimilation of radiance observations in DA systems*

Description and objectives: The main goal of this action is to maximise the benefit of the use of satellite radiance data available via OPLACE system. The current list of activities is planned to be investigated in 2018:

- Monitoring and first evaluation of the use of radiance observations from SuomiNPP and DMSP

- Improve bias correction scheme for radiance observations (LAM aspects, LAM VARBC predictors, etc)

Proposed contributors, Estimated efforts: P. Benacek (Cz), A. Trojakova (Cz), F. Meier (At), M. Mile (Hu), B. Strajnar (Sl), M. Pietrisi (Ro), 8 months

Planned timeframe: whole year

Planned deliverables: report on LACE webpage

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

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Description and objectives: RADAR reflectivity and radial wind observations are essential components of a mesoscale DA system especially with increased analysis cycles frequency. In 2017 discussion was started to target common RADAR data assimilation goals in LACE for the next 3 years and moreover to request additional (manpower) support from LACE Council. In 2018 a strenghten cooperation and more efforts on RADAR assimilation are planned. In advance (before the DAWD and Council meetings) the following actions are foreseen now:

- The validation and the use of OPERA volume data by the application of HDF5 reading in Bator and prepopera.py tool. Continuation of local work started at several LACE Members.

- Comparison of different RADAR QCs in terms of quality indices and error signals. Furthermore, a more effective cooperation between NWP DA and remote sensing colleagues is also wished.

Proposed contributors, Estimated efforts: T. Kovacic (Cr), A. Stanesic (Cr), F. Meier (At), M. Nestiak (Sk), B. Strajnar (Sl), M. Mester (Hu), A. Dumitru (Ro), 12 months**,** 3 week LACE stay for Mate Mester (Hu) in Ljubljana, 3 weeks LACE stay for Alina Dumitru (Ro) in Prague, 3 weeks LACE stay for Alena Trojakova (Cz) in Bratislava and in Ljubljana, 3 weeks LACE stay for Michal Nestiak (SK) in Budapest

Planned timeframe: whole year

Planned deliverables: report on LACE webpage

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

Description and objectives: The meteorological use of GNSS path delays are getting wider and wider by the development of new types of GNSS products. The most commonly tested ZTD is going to be closer to operational implementation at many centres, but other products like slant delay (and its obervation operator) is just under development. In 2018 the following activities are foreseen for this action:

- Study the pre-selection of active GNSS stations, the observation error and its application in an operational system.

- Extend and tune the VARBC settings for the use of ZTD. Define new VARBC predictors and predictor selection for ZTD

- Examine the impact of GNSS RO products

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- Explore other new type of products and its availability inside LACE

Proposed contributors, Estimated efforts: B. Strajnar (Sl), F. Meier (At), M. Imrisek (Sk), M. Mile (Hu), 6 months

Planned timeframe: whole year

Planned deliverables: report on LACE webpage

Action/Subject: *Assimilation of Mode-S (EHS and MRAR) observations*

Description and objectives: The aircraft derived Mode-S EHS and MRAR observations have a growing network inside LACE and in ALADIN/HIRLAM community as well. In 2018 more efforts will be put on the work of this type of observations. The following activities are currently planned:

- Explore the newly available Mode-S EHS and MRAR observations

- Investigate the impact of Mode-S EHS

- Continue the application of Mode-S observations in DA systems with increased assimilation cycle frequency.

Proposed contributors, Estimated efforts: B. Strajnar (Sl), P. Benacek(Cz), A. Bucanek(Cz), P. Scheffknecht (At), 8 months

Planned timeframe: whole year

Planned deliverables: report on LACE webpage

Action/Subject: *Study the use of AMV products (Geowind, HRW and Multi-Metop)*

Description and objectives: The atmospheric motion vectors provide reliable wind information to NWP data assimilation systems. Beside the long time used Geowind AMV, the new type of AMVs with increased number of wind vectors can serve considerable amount of data in a relatively small NWP domain. In 2018 the following actions are planned:

- The tuning and separation of AMV observation errors with respect to retrieval channels

- Study the distribution and quality of new Multi-Metop AMVs in LAM DA systems

Proposed contributors, Estimated efforts: F. Meier (At), B. Strajnar (Sl), A. Trojakova (Cz), 5 months

Planned timeframe: whole year

Planned deliverables: report on LACE webpage

4 Summary of resources

Subject	Estimated manpower	From LACE	Other(HIRLAM, ALADIN)
Hourly DA system	12	12	
LACE EDA	5	5	
Surf. Assim EKF	6	6	
Radiance	8	8	
RADAR	12	12	
GNSS delays	6	6	
Mode-S	8	8	
AMV	5	5	
Total	**62**	**62**	

5 Meetings, events and list of LACE stays

1) 28th ALADIN Workshop and HIRLAM All Staff Meeting 2017, 16-20/04/2018 Toulouse. France.

2) 40th EWGLAM meeting and 25th SRNWP workshop 2018

3) 7 participants at DA Working Days 2018

1) LACE stay: Viktor Tarjani SHMU (EKF Assimilation) – 3 weeks, in Budapest (OMSZ), 2018

2) LACE stay: Viktor Tarjani SHMU (EKF Assimilation) – 1 week, in Vienna (ZAMG), 2018

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3)LACE stay: Mate Mester OMSZ (RADAR pre-processing) – 3 weeks, in Ljubljana (ARSO), 2018

4)LACE stay: Alina Dumitru MeteoRom (RADAR assimilation) – 3 weeks, in Prague (CHMI), 2018

5)LACE stay: Alena Trojakova CHMI (RADAR quality control) – 1 weeks, in Ljubljana (ARSO) and 2 weeks in Bratislava (SHMU), 2018

6)LACE stay: Michal Nestiak SHMU (RADAR quality control) – 3 weeks, in Budapest (OMSZ), 2018

7)LACE stay: Mirela Pietrisi MeteoRom (Hourly DA systems) – 4 months, in Vienna (ZAMG), 2018

6 Risk and constrain

The main risks for the next years are:

- The OOPS refactoring of DA configurations becomes invisible for LACE and the new source code (despite the aim of the refactoring) might give a bigger "blackbox" effecting more difficult local installation and validation procedure than it is now.

- The cooperation should be more effective for most of the DA actions.

- Supporting ALADIN countries in the frame of ALADIN DA kit actions requires more efforts from LACE colleagues.