Working Area Data Assimilation

Work Plan

Prepared by:	Area Leader Máté Mile
Period:	2016
Date:	24/02/2016

1Introduction and background

The Work Plan for 2016 holds the structure and the main actions from last years with minor modifications. Research oriented activities can be sorted into algorithmic developments, the use of different observations and the improvement of the representation of background error statistics. Because of the underspending from last years, longer stays and more meetings are planned and going to be supported from LACE DA budget.

2Goals

The main data assimilation goals to be attained in 2016 are:

- Progress on algorithmic developments. The work on hourly updated analysis cycle (1h RUC) identified as an important activity in LACE. In 2016 this action will cover developments on non-cycled hourly updated DA systems for nowcasting and automatic forecasting purposes. In order to benefit from these systems, the use of more observations, better initialization and an accurate coupling (representation of large-scale information) have to be achieved. Also the longer perspective of such DA systems has to be drawn towards a more advanced assimilation method. Another important action about surface assimilation and Extended Kalman-Filter (EKF) will be continued in 2016 as well. Primary aim is to make an efficiently working EKF system using conventional observations and to step forward with satellite-derived products. Last but not least local validations and developments of OOPS toy models (3DVAR LAM prototype, HOP test harness) are planned to follow the refactoring activities of common DA code in OOPS project.

- Extended and more efficient use of observations in LACE DA systems. The headline observations are the RADAR reflectivity and radial wind, GNSS tropospheric delays, Mode-S and high resolution (mainly geostationary) satellite observations which will be further studied in 2016. All these observational activities will be harmonized with OPLACE maintenance and development for the possibility of (re)distribution and pre-processing of these data sources.

- Improved estimation of the background error statistics. However, the main activity of the use spatially varying sigma B maps is halted, but the improvement on the representation of background error statistics should be continued.

3Main 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 2016 LACE efforts will be continued to study the challenges of such DA systems. It is crucial to examine the completeness of the observation database used in hourly systems and to verify the sensitivity of the observations to analysis. It means that OSEs, a posteriori tuning and diagnostics have to be used for an accurate system. Beside the studies of the observation set, the best initialization method of the hourly integrations should be identified. Also it would be important and it is planned for 2016 to evaluate the correctness of LBC coupling (the representation of large-scale information) in the hourly assimilation cycle. Some of the LACE countries are going to prepare analyses with VARPACK diagnostic analysis tool in order to provide NWP inputs for nowcasting and very short-range forecasting purposes. These activities will be reported in the frame of this LACE action. Beside practical work, the most promising algorithmic developments should be taken into account for the future of hourly updated DA systems.

Proposed contributors, Estimated efforts: M. Mile (Hu), F. Meier (At), B. Strajnar (Sl), M. Pietrisi (Ro), 8 months (2 months LACE stay, Mirela Pietrisi(Ro))

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 2016 the validation of EKF analyses has to be done with the use of conventional observations. After the validation, our goal is to replace CANARI optimal interpolation method and to make an EKF based surface assimilation system running efficiently in an operational context. To this the parallelization of the surface assimilation configurations and the optimization of the EKF analysis are going to be studied. Beside the validation and optimization work, the use of non-conventional observations is also planned. The novelties of the newer model cycles (cy40t1 - SURFEX in FA format, SODA interface) will be considered and discussed during 2016.

Proposed contributors, Estimated efforts: H. Toth (Hu), J. Cedilnik (Sl), V. Tarjani (Sk), S. Schneider (At) 6 months (4 weeks LACE stay at OMSZ for Viktor Tarjani (Sk))

Planned timeframe: whole year

Planned deliverables: report on LACE webpage

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

Description and objectives: The OOPS project coordinated by ECMWF is deeply refactoring the DA part of the ARPEGE/IFS common source code. It has major effect on the LAM models (ALARO/AROME) as well where refactoring entirely changes the dataflow and the structure of the assimilation configurations. In order to follow the future of DA source code and to preserve the developments of LACE (concerning some LAM observations), contributions to the OOPS project is important and planned in 2016. The first OOPS LAM 3DVAR prototype built by MF has been already installed at OMSZ and will be used for further validation. Also the test environment for observation operator refactoring developed by Alan Geer ECMWF is available and planned to make tests on local platform. In 2016 there is also room to participate in VARBC developments in OOPS framework which is still under discussion in the project and might be interested for LACE community.

Proposed contributors, Estimated efforts: M. Mile (Hu) and 1 person/countries 7 months

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. In 2016 efforts will be put on finding better channel selection (especially for hyper-spectral radiance data) and evaluating impact on high resolution and in frequently updated analysis systems. More efficient use of variational bias correction through the definition of new predictors will be also studied in LAM DA context. In 2016 new radiance observations (SSMIS, ATMS, CrIS) are planned to implement to OPLACE system which might be also tested in the frame of this action.

Proposed contributors, Estimated efforts: P. Benacek (Cz), A. Trojakova (Cz), F. Meier (At), M. Mile (Hu), B. Strajnar (Sl), A. Stanesic (Hr), M. Pietrisi (Ro), 7 months

Planned timeframe: whole year

Planned deliverables: report on LACE webpage

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

Description and objectives: RADAR reflectivity and radial wind data samples have been collected for two months period (01/05/2012 – 30/06/2012) in raw HDF5 format, however several RADAR networks are being upgraded and a new collection would be essential for further tests. Due to manpower limitation it is difficult to estimate the progression of common LACE RADAR data pre-processing in 2016 and more local efforts with local RADAR sites are expected. For common LACE action, developments on RADAR quality control procedure and more co-operations with HIRLAM and OPERA group should be proceeded. After the RADAR network upgrades, new tests and new collection of RADAR data are proposed fetching the volume data from OPERA (with getting access to the OPERA data hub).

Proposed contributors, Estimated efforts: T. Kovacic (Hr), A. Stanesic (Hr), F. Meier (At), M. Nestiak (Sk), 4 months (1 month LACE stay at ZAMG, Tomislav Kovacic (Cr))

Planned timeframe: whole year

Planned deliverables: report on LACE webpage

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

Description and objectives: Assimilation of GNSS Zenith Total Delay (ZTD) observations has been showing good impact mainly on humidity analyses and forecasts. During 2016 more works will be done to tune variational and/or static bias correction procedure for GNSS ZTD data. There will be also continuation on the use of 3D refractivity observation and on the influence of the analyses and forecasts. Activities in the frame of an ongoing GNSS COST action (ES1206) are also being done in 2016.

Proposed contributors, Estimated efforts: B. Strajnar (Sl), A. Stanesic (Cr), M. Mile (Hu), 6 months

Planned timeframe: whole year

Planned deliverables: report on LACE webpage

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

Description and objectives: Regarding the extension of Mode-S network inside LACE, DA activities will be continued in 2016 as well. After Czech Republic, Mode-S observations from Austrian service can be studied next and also there is agreement between OMSZ and Hungarian air traffic control for Mode-S data exchange in 2016. Furthermore the Mode-S pre-processing is going to be implemented in the OPLACE system for future data sharing purposes and there is also an agreement to redistribute KNMI collected Mode-S EHS via OPLACE.

Proposed contributors, Estimated efforts: B. Strajnar (Sl), A. Trojakova (Cz), P. Benacek(Cz), A. Bucanek(Cz), J. Kemetmuller(At), A. Stanesic(Cr) 8 months

Planned timeframe: whole year

Planned deliverables: report on LACE webpage

Action/Subject: ***Assimilation of Meteosat HRW (High Resolution Winds) AMVs***

Description and objectives: In 2016, after the first successful DA impact studies with the new type of HRW AMV, the advanced use of the HRW is planned. In the NWCSAF package it is possible to tune HRW configuration in order to retrieve more AMVs e.g. to use more MSG SEVIRI channels and also there is room to improve height assignment of the AMVs which can improve further the quality of the HRW observations.

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

Planned timeframe: whole year

Planned deliverables: report on LACE webpage

Action/Subject: ***Improvement on the representation of background error statistics***

Description and objectives: The representation of background error statistics is crucial in mesoscale DA system. The first idea to bring flow-dependent structure functions by the use of grid point sigma B maps turned out to be difficult to implement with error of the day statistics from a LAM EDA system. In 2016 other solutions (for flow-dependency) will be discussed and current efforts to further improve climatological B are going to be continued in LACE DA systems.

Proposed contributors, Estimated efforts: M. Mile (Hu), A. Bucanek (Cz), 3 months

Planned timeframe: whole year

Planned deliverables: report on LACE webpage

4Summary of resources

Subject	Manpower	LACE	Other (Hirlam)
Hourly DA systems	8	8	

Surf. Assim. EKF	6	6	
OOPS	7	7	
Radiance Assim.	7	7	
RADAR Assim.	4	4	
GNSS path delays	6	6	
Mode-S Assim.	8	8	
HRW AMV Assim.	5	5	
B matrix	3	3	
Total:	**54**	**54**	

5Meetings, events and list of LACE stays

1)21th ALADIN Workshop and HIRLAM All Staff Meeting 2016, 4-7/04/2016 Lisbon. Portugal (Mate Mile).

2)38th EWGLAM meeting and 23th SRNWP workshop 2016, 3-6/10/2016 Rome, Italy, (Mate Mile)

3)7 participants at DA Working Days OMSZ Budapest Hungary, 2016

4)3-4 participants at LACE RUC progress meeting ZAMG Vienna, Austria, 2016

1)LACE stay: Mirela Pietrisi MeteoRomania (Hourly DA system developments) – 2 months, in Vienna (ZAMG), 2016

2)LACE stay: Viktor Tarjani SHMU (EKF Assimilation) – 1 month, in Budapest (OMSZ), 2016

3)LACE stay: Tomislav Kovacic DHMZ (RADAR activity) – 1 month, in Vienna (ZAMG) 2016

6Risk and constrain

The main risks to be considered regarding next year activities are:

- Time spent on research is getting less and less because of the increasing amount of operational, maintenance and validation duties. (almost every LACE centres have one or two(!) operational DA systems which have to be maintained regularly).
- There is no practice recently to make longer term (~ 3 year) planning which would be beneficial for yearly coordination.
- Thanks to the shorter stays more important activities can be supported, but it also effects insufficient time to finish complete work which is risky.
- The lack of communication is still problematic and causing sometimes duplicated works. Further improvements, developments on the communication channels have to be discussed.