

Working Area Data Assimilation

Work Plan

Prepared by:	Area Leader Máté Mile
Period:	2015
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1 Introduction and background

The next year Work Plan will deliver several revisions to the actions started in the previous years and will bring new research items as well. Thanks to the LACE DA project – establishing operational DA systems – every LACE centres have a working assimilation system which is already operational or provides good basis for local DA activities. Hereafter these works won't be presented in Work Plan but summarized briefly in Area Report. Research activities of the next year can be sorted into three main groups as algorithmic developments, use of different observations and improving the representation of background error statistics. Due to last year underspending of LACE DA budget, two additional stays are going to be supported on the top of the preliminary planned stays. Furthermore the new action to investigate hourly RUC will be launched by a Kick-off meeting in Vienna to discuss challenges and future work.

2 Goals

The main Data Assimilation goals to be attained in 2015 are:

- Progress on algorithmic developments. Investigate the added value of an hourly updated analysis cycle (1h RUC) compared to the 3 hourly RUC. The major goal is to employ more observations in the DA system and to estimate the efficiency of the hourly update cycle with respect to forecast performance and computational costs. Further development of the Extended Kalman-Filter (EKF) will be continued. Primary aim is an efficiently working EKF system using conventional observations for surface analysis and secondary is to step forward with satellite-derived products.
- Efficient use of different observations in DA systems. RADAR reflectivity and radial wind collected from LACE centres will be further studied regarding its proper pre-processing and its impact on analysis and forecast. Further works will be pursued on other observations like the revision of satellite radiance data selection, increased use of satellite-derived wind vectors and advanced usage of GNSS Zenith Total Delay. All these activities will be joined to OPLACE activities (maintenance and development).
- Improved estimation of the background error statistics. The main efforts will be put on flow-dependent aspect of background errors estimated by spatially varying sigmab maps. Research will seek an optimal development of limited-area EPS or EDA systems for generating sigmab maps with increased spatial variance over Central-Europe. Collaboration with LACE Predictability Area is also a goal to link ensemble activities with data assimilation and vice versa.

3 Main R&D activities

Action/Subject: *Hourly Rapid Update Cycle*

Description and objectives: The so called RUC approach is operationally applied in 3 hourly analysis update frequency at three LACE centres (Slovenia with ALARO, Austria and Hungary with AROME). This 3DVAR based RUC works efficiently without significantly increased computer costs and is able to employ more observations with reduced representativity error in time. In 2015 an experimental hourly RUC will be tested and compared versus 3 hourly cycling. During this study special emphasis will be put on examining spin-up effects related to shorter background forecast lengths. To ensure a well-designed hourly RUC, wide range of observations has to be used for the assimilation system including most of the non-conventional ones like geostationary satellite products (radiance, AMVs), RADAR (reflectivity and radial wind), GNSS ZTD and Mode-S observations. A more detailed plan for this action can be found on LACE webpage (1hRUC_plan_2015.pdf).

To set out this activity, a Kick-off meeting will be organized discussing challenges, possible cooperation and work for 2015 and beyond.

Proposed contributors, Estimated efforts: M. Mile (Hu), F. Meier (At), B. Strajnar (Sl), M. Nestiak (Sk), A. Trojakova (Cz), 5 months (1 month LACE stay at OMSZ, person to be defined)

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 produce surface analysis. In collaboration with Belgian colleagues the already implemented trial version of EKF will be further examined. In order to keep the EKF algorithm in an affordable level, the optimal number of analyzed soil parameters (number of perturbed simulations) will be also assessed. In case of sufficient manpower further experiments will focus on the use of satellite observations, products as well. The novelties of the newer model cycles (cy40t1 - SURFEX in FA format, SODA implementation) will be considered during next year.

Proposed contributors, Estimated efforts: H. Toth (Hu), J. Cedilnik (Sl), V. Tarjanyi (Sk) 5 months (1 month LACE stay at OMSZ for Viktor Tarjanyi (Sk), Flat-rate stay for Helga Toth (Hu) at RMI)

Planned timeframe: whole year

Planned deliverables: report on LACE webpage

Action/Subject: *Assimilation of radiance observations (IASI, ATOVS, SEVIRI) in DA system*

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 2015 efforts will be put on finding better channel selection (especially for hyper-spectral IASI radiance data, for low peaking and window channels) and evaluating impact on high resolution and in frequently updated analysis systems. More efficient use of variational bias correction will be studied and the impact of satellite sensors AMSU-A and MHS from NOAA-19, METOP-A and METOP-B will be investigated due to the statistics obtained from passive assimilation.

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 (1 month Flat-rate stay at OMSZ for Y. Cengiz (Tr))

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 the common quality control has been successfully made by INCA2 precipitation module the conversion to MF BUFR has to be further studied regarding the transformation of quality indexes. LACE RADAR data and the samples from OPERA data hub will be compared also with respect to INCA2 and BALTRAD QCs. Besides evaluation of proper RADAR data pre-processing, experimental data assimilation studies will be continued using reflectivity and radial wind observations.

Proposed contributors, Estimated efforts: T. Kovacic (Hr), A. Stanesic (Hr), F. Meier (At), M. Nestiak (Sk), M. Mile (Hu), 9 months (1 month LACE stay at OMSZ, Michal Nestiak (Sk))

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 the next year 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 and its implementation as a new observation type. Additionally this work with a 3 weeks long stay will be supported from LACE budget because of the underspending of 2014. Activities in the frame of an ongoing GNSS COST action (ES1206) are also being done in 2015.

Proposed contributors, Estimated efforts: X. Yan (At), B. Strajnar (SI), A. Stanesic (Cro), M. Mile (Hu), 6 months (3 weeks stay for Xin Yan (At) in MF, Toulouse)

Planned timeframe: whole year

Planned deliverables: report on LACE webpage

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

Description and objectives: Modes-S observations have good quality and are proven to be valuable for DA and short-range NWP (Mode-S MRAR is operationally assimilated at Slovenia since June 2014). Regarding the potential of Mode-S data, activities will be continued to test Mode-S observations in other LACE centres and investigate future data distribution and data collection. In Czech Republic the regularly received Mode-S (MRAR and EHS as well) will be pre-processed for data assimilation. Additional stay is going to be organized in order to implement Slovenian Mode-S pre-processing application to the Czech Institute.

Proposed contributors, Estimated efforts: B. Strajnar (SI), A. Trojakova (Cz) 5 months (3 weeks stay for Benedikt Strajnar (SI) in Prague)

Planned timeframe: whole year

Planned deliverables: report on LACE webpage

Action/Subject: *Assimilation of Meteosat HRW AMVs*

Description and objectives: Atmospheric Motion Vectors (so called Geowind AMVs) are operationally assimilated by many LACE centres from Meteosat (MSG) satellites. A new AMV product (from MSG satellites, so called HRW AMVs) has been developed by SAFNWC group holds several improvements compared to Geowind AMV like increased amount of derived wind vectors and NWP first-guess independent calculation based on its advanced algorithm. In 2015 HRW AMVs will be studied in DA systems.

Proposed contributors, Estimated efforts: F. Meier (At), M. Mile (Hu), 3 months

Planned timeframe: whole year

Planned deliverables: report on LACE webpage

Action/Subject: *Investigation of spatially varying flow-dependent background error statistics*

Description and objectives: The flow-dependent background errors derived from the combination of climatological structure functions and AEARP sigmaB maps has been tested and validated by Czech colleagues. After bug corrections of the grid-point sigmaB maps algorithm, the method is able to produce correct increments on analysis but with small impact likely because of the minor spatial variability of global maps over Central-Europe. In 2015 more emphasis will be placed on the generation of limited-area grid-point sigmaB maps. To reach this goal, stronger collaboration with Meteo-France and LACE Predictability group has to be built up in order to use limited-area ensemble information for sigmaB maps calculation. Cooperation with ensemble DA activities is also expected regarding this action which will be further discussed during next year.

Proposed contributors, Estimated efforts: A. Trojakova (Cz), A. Bucanek (Cz), 4 months, (1 month LACE supported stay at ZAMG, A. Bucanek (Cz))

Planned timeframe: whole year

Planned deliverables: report on LACE webpage

4Summary of resources

Subject	Manpower	LACE	Other (Hirlam)
1h RUC	5	5	
Surf. Assim. EKF	5	5	
Radiance Assim.	7	6	1
RADAR Assim.	9	9	
GNSS path delays	6	6	
Mode-S Assim.	5	5	
HRW AMV Assim.	3	3	
SigmaB maps	4	4	

Total:	44	43	1
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5 Meetings, events and list of LACE stays

1) 25th ALADIN Workshop and HIRLAM All Staff Meeting 2015, 13-17/04/2015 Copenhagen, Denmark (Mate Mile).

2) 37th EWGLAM meeting and 22th SRNWP workshop 2015, Sept.-Oct. 2015, Serbia (Mate Mile)

3) 7 participants at DA Working Days, 2015

4) 4 LACE colleagues, 1 HIRLAM colleague at LACE Kick-off meeting, 2015

1) LACE stay: Antonin Bucanek CHMI (SigmaB Maps) – 1 month in Vienna, 2015

2) LACE stay: Michal Nestiak SHMU (RADAR Assimilation) – 1 month in Budapest (OMSZ), 2015

3) LACE stay: Viktor Tarjanyi SHMU (EKF Assimilation) – 1 month in Budapest (OMSZ), 2015

4) LACE stay: person to be defined (1h RUC) – 1 month in Budapest, 2015

5) Flat-rate stay: Yelis Cengiz MGM (Radiance Assim.) – 1 month in Budapest, 2015

6) LACE stay (underspending from 2014): Xin Yan ZAMG (3D refractivity) – 3 weeks in Toulouse, 2015

7) LACE stay (underspending from 2014): Benedikt Strajnar ARSO (Mode-S) – 3 weeks in Prague, 2015

6 Risk 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.