Report from LACE Data Assimilation Working Days (DAWD)

(Joint working days with HIRLAM surface colleagues)

ARSO Ljubljana, Hungary

18 - 20 Sept. 2017

Participants:

Roger Randriamampianina (MetNorway) – LACE DAWD at 19 th of Sept. 2017
Patrick Samuelsson (SMHI) – HIRLAM Surface Working Week
Trygve Aspelien (MetNorway) – HIRLAM Surface Working Week
Samuel Viana (AEMET) – HIRLAM Surface Working Week
Emily Gleeson (Met Éireann) – HIRLAM Surface Working Week
Kristian P. Nielsen (DMI) – HIRLAM Surface Working Week
Camille Birman (Météo-France) – HIRLAM Surface Working Week
Antonin Bucanek (CHMI) – LACE DAWD
Alena Trojakova (CHMI) – LACE DAWD
Patrik Benacek (CHMI) – LACE DAWD
Tomislav Kovacic (DHMZ) – LACE DAWD
Antonio Stanesic (DHMZ) – LACE DAWD
Martina Tudor (DHMZ) – HIRLAM Surface Working Week
Benedikt Strajnar (ARSO) – LACE DAWD
Tone Zgonc (ARSO) – LACE DAWD
Mirela Pietrisi (MeteoRom) – LACE DAWD
Simona Tascu (MeteoRom) – LACE DAWD
Michal Nestiak (SHMU) – LACE DAWD
Martin Imrisek (SHMU) – LACE DAWD
Jozef Vivoda (SHMU) – HIRLAM Surface Working Week
Viktor Tarjani (SHMU) – HIRLAM Surface Working Week
Florian Meier (ZAMG) – LACE DAWD
P hillip Scheffknecht (ZAMG) – LACE DAWD
Stefan Schneider (ZAMG) – HIRLAM Surface Working Week
Jasmina Vural (ZAMG) – HIRLAM Surface Working Week
Mate Mester (OMSZ) – LACE DAWD
Mate Mile (OMSZ) – LACE DAWD
Claude Fischer (Météo-France) – LACE DAWD (remotely)
Pierre Brousseau (Météo-France) – LACE DAWD (remotely)
Maria Monteiro (IPMA) – LACE DAWD (remotely)

Short progress summary: In 2017 a joint LACE Data Assimilation (DA) and HIRLAM Surface working days was organized in order to exchange common surface data assimilation activities and to build possible cooperation for the future activities. The program consisted common sessions at the first day covering status presentations and surface data assimilation works and also a common discussion during the last day. In between LACE DA colleagues focused on upper-air assimilation topics including the use of Mode-S, RADAR, GNSS ZTD and radiance observations as well as the representation of background errors related activities. In conclusion the RADAR data assimilation action had the biggest common interest this year discussing latest results and future perspectives.

Overview of operational DA systems (with highlighted recent upgrades) :

DA	AUSTRIA ALARO	AUSTRIA AROME	CROATIA ALARO	CZECH REP ALARO	HUNGARY ALARO	HUNGARY AROME	SLOVAKIA ALARO	SLOVENIA ALARO	ROMANIA ALARO
resolu-tion	4.8L60	2.5L90 (tests on 1.2km)	8L37 (tests on 4.4km)	4.7L87	8L49	2.5L60	9L36 (tests on 4.5km,1km)	4.4L87	6.5L49 (tests with L60)
cycle	36t1 exp	40t1 (e-suite) 38t1	35t1 38t1	38t1	38t1_bf3	38t1_bf3		40t1	40t1
LBC	IFS 3h	IFS 3h	IFS 3h	ARP 3h	IFS 3h	IFS 1h	ARP 3h	IFS	ARP
method	OI	OI_main + 3DVAR	OI + 3DVAR	OI + BlendVAR (DF blending + 3DVAR)	OI + 3DVAR	OI_main + 3DVAR	OI + DF blending	OI + 3DVAR	OI + 3DVAR
cycling	6h	3h	6h	6h	6h	3h	6h	3h	6h
B matrix	-	downscaled LAEF	NMC lagged vs ALADIN EDA	downscaled ARP ENS	ALARO EDA	AROME EDA		new down-scaled EC ENS	
Special	additional snow melting			sigmao_coef =0.67; REDNMC= 1.7; IDFI in prod					

Austria (Florian Meier):

The following topics have been mentioned in the Austrian status presentation: (more details can be read in the uploaded pdf on the RC LACE webpage - http://www.rclace.eu/File/Data_Assimilation/workshops/DAWD2017/DA_Austria_2017.pdf)

- Introduction of operational DA systems
- Alpine pumping

- Cloud nudging
- SCADA windturbine assimilation
- Experiments with GPS-RO

Croatia (Antonio Stanesic):

The following topics have been mentioned in the Croatian status presentation: (more details can be read in the uploaded pdf on the RC LACE webpage - http://www.rclace.eu/File/Data_Assimilation/workshops/DAWD2017/Data_assimilation_status_Croatia_2017.pdf)

- ALADIN-HR4 data assimilation setup
- New B matrix (diagnostics and verification)
- RADAR data assimilation

Czech Republic (Alena Trojakova):

The following topics have been mentioned in the Czech status presentation: (more details can be read in the uploaded pdf on the RC LACE webpage - http://www.rclace.eu/File/Data_Assimilation/workshops/DAWD2017/CZstatusDAWD201709.pdf)

- Operational ALARO BlendVAR
- Aircraft data assimilation
- TAC2BUFR migration
- New HPC at Prague

Hungary (Mate Mile):

The following topics have been mentioned in the Hungarian status presentation: (more details can be read in the uploaded pdf on the RC LACE webpage - http://www.rclace.eu/File/Data_Assimilation/workshops/DAWD2017/dawd2017_status_pres_hu.pdf)

- Overview of the operational DA systems
- Validation of cy40t1
- OI_main issues in cy40t1
- EKF surface data assimilation

Slovakia (Michal Nestiak):

The following topics have been mentioned in the Slovakian status presentation: (more details can be read in the uploaded pdf on the RC LACE webpage - http://www.rclace.eu/File/Data_Assimilation/workshops/DAWD2017/DAWD2017_SHMU_v1_with_surfex.pdf)

- Description of the operational DA suite
- GNSS data assimilation
- Calculation of B matrix

- Data assimilation and SURFEX activitites
- High-resolution setups
- Non-GTS and IOT measurements

Slovenia (Benedikt Strajnar):

The following topics have been mentioned in the Slovenian status presentation: (more details can be read in the uploaded pdf on the RC LACE webpage - http://www.rclace.eu/File/Data_Assimilation/workshops/DAWD2017/DAWD_SI.pdf)

- Introduction of the operational DA system
- Upgrade from cy38t1 to cy40t1
- New observations (ASCAT OW, Mode-S EHS, AMDAR humidity, GNSS ZTD, HRW, Windprofiler)
- Two-way coupling of ocean-atmosphere
- New local observations – Cell phone delays

Romania (Mirela Pietrisi):

The following topics have been mentioned in the Romanian status presentation: (more details can be read in the uploaded pdf on the RC LACE webpage - http://www.rclace.eu/File/Data_Assimilation/workshops/DAWD2017/DAWD_MirelaPietrisi.pdf)

- Assimilation setup in Bucharest
- Tests with cy40t1_bf07
- Case study

OPLACE status (Alena Trojakova)

The following topics have been mentioned by Alena about OPLACE status. (more details can be read in the uploaded pdf on the RC LACE webpage - http://www.rclace.eu/File/Data_Assimilation/workshops/DAWD2017/AT_oplace201709.pdf)

- Aircraft data handling corrections and extension with non-european programs
- New SYNOP and TEMP databases, new technical upgrades
- TAC2BUFR migration
- ASCAT ocean winds
- OPLACE access for non-LACE countries
- Status of OPLACE national SYNOP observations
- Status of Mode-S MRAR and EHS observations in OPLACE

Status of HIRLAM surface DA activities *(Patrick Samuelsson)*

The following topics have been mentioned by Patrick about HIRLAM surface activities. (more details can be read in the uploaded pdf on the RC LACE webpage

- http://www.rclace.eu/File/Data_Assimilation/workshops/DAWD2017/HIRLAM_Surface_DA_170918.pdf)

- Status of surface activities and common cycles
- SMHI IMPREX project (experiments, MESCAN, SEKF, Satellite data, case study, verificiation)
- STAEKF for LAI assimilation
- MESCAN settings and tuning
- Issues with the Jacobians values in EKF surface assimilation
- Discussion on the future of CANARI

Current practice at Météo-France on land data assimilation for NWP (Camille Birman)

The following topics have been mentioned by Camille about MF surface activities. (more details can be read in the uploaded pdf on the RC LACE webpage - http://www.rclace.eu/File/Data_Assimilation/workshops/DAWD2017/birman_presentation_workshop_surfex.pdf)

- Operational NWP models at MF
- Introduction of SURFEX
- Land surface data assimilation
- Ongoing developments and future plans

Offline SURFEX forcing and output interface; CANARI (assimilation) and SURFEX (Trygve Aspelien)

In the first half of the presentation, an offline forcing and related SURFEX tools have been introduced in HARMONIE-AROME branches (harmonie-40h1.2_EKF). It might be useful for non-HIRLAM partners using this new python based tools from HARMONIE branch for surface assimilation (mostly EKF) purposes. In the second half of the presentation the future of CANARI and surface spatialization tool was discussed. In the current shape of CANARI, it is difficult to introduce for instance new surface parameters and to attach SURFEX with multiple pathes. More information can be seen in the uploaded Trygve's presentation on webpage - http://www.rclace.eu/File/Data_Assimilation/workshops/DAWD2017/offline_surfex_.pdf

EKF surface assimilation activities at ZAMG (Stefan Schneider)

Three surface assimilation activities have been highlighted, namely the SWI assimilation, LST assimilation and issues with SURFEX8.1 in the presentation. The use of sEKF surface assimilation with SWI measurements of SCATSAR (combination of ASCAT and Sentinel-1 SSM products) was introduced first. The SWI assimilation experiments were performed with ISBA diffusion scheme, AROME model based on cy40t1-SURFEX7.3 and offline SURFEX8.0 for soil data assimilation. Verification results showed significant improvement against lowland stations when SWI was assimilated in 6 layers of the diffusion scheme. The

assimilation of LST (from satellite Sentinel-3, MSG, MODIS) with similar sEKF setup than in SWI assimilation was also presented. At the end of the talk, the recent issues of SURFEX8.0 and SURFEX8.1 were highlighted. More information can be seen in Stefan's uploaded presentation on webpage - http://www.rclace.eu/File/Data_Assimilation/workshops/DAWD2017/EKF_activities_at_ZAMG.pdf

Validation of EKF surface assimilation scheme *(Viktor Tarjani)*

A detailed validation was started with a simplified 1D framework in order to be sure about the functionality of employed EKF methodology. In this validation in-situ observations were used instead of CANARI spatialization and also for the generation of upper-air forcing. The validation is still ongoing and more results are expected after the second half of 2017. Detailed information can be read about the validation in Viktor's uploaded presentation on webpage - http://www.rclace.eu/File/Data_Assimilation/workshops/DAWD2017/vt_dawd_ljubljana_sept2017.pdf

HIRLAM upper-air data assimilation *(Roger Randriamampianina)*

The following topics have been mentioned by Roger about HIRLAM upper-air data assimilation activities. (more can be read in his pdf on the RC LACE webpage - http://www.rclace.eu/File/Data_Assimilation/workshops/DAWD2017/HIRLAM_UA_DA_RR_2017_LACE.pdf)

- Operational data assimilation configurations in HIRLAM countries
- Recent reported issues (invalid zenith angle, convergence issues)
- Latest developments
    - Hourly rapid refresh developments
    - Cloud initialization
    - Back and forth nudging scheme
    - Extension of variational assimilation scheme
    - TEMP BUFR assimilation
- Future plans

VIEsion: assimilation of Mode-S data *(Phillip Scheffknecht)*

During Phillip's presentation, a special project assimilating Mode-S EHS was presented. In this, AROME simulations on very high resolution (dx – 500m) and Mode-s EHS observations from AustroControl were considered and preliminary severe weather case study was shown. The current phase of the project faced issues with 3DVar convergence and high resolution simulations. More details can be seen in Phillip's presentation on RC LACE webpage - http://www.rclace.eu/File/Data_Assimilation/workshops/DAWD2017/phillip.scheffknecht_mode_s.pdf

News on RADAR data assimilation (Florian Meier)

At ZAMG major progress on RADAR data assimilation was achieved by the implementation of new pre-processing chain using OPERA HDF5 RADAR format and prepopera.py tool. The former pre-processing process of CONRAD and MF BUFR was assumed to be bugged and the new one gave promising (verification) results and the opportunity to use RADARs from neighbouring countries as well. In an experimental AROME run, RADAR observations (reflectivity and radial wind) from OPERA data hub were assimilated collecting almost 40 RADAR sites. Some RADAR sites inside Austrian AROME domain were highlighted showing particular issues with quality of data content. All in all it was the first demonstration of extended use of RADAR observations in LACE. More details and information can be seen in Florian's uploaded presentation on the RC LACE webpage - http://www.rclace.eu/File/Data_Assimilation/workshops/DAWD2017/DA_RADAR_AU STRIA_2017.pdf

First steps towards RADAR data assimilation at ARSO (Benedikt Strajnar)

RADAR data assimilation experiments have been started in Ljubljana in 2017. The same approach as it was implemented in Vienna was investigated at the Slovenian Institute collecting and pre-processing OPERA HDF5 RADAR observations. A detailed comparison of locally used INCA2 quality control (QC) and OPERA BALTRAD QC were compared. In conclusion OPERA QC is mature enough to be able to filter reflectivity information, however, with few other QC elements (e.g. Laplace filter) it can be further extended locally. Regarding RADAR reflectivity impact on analysis and ALARO forecast, the first results are promising, but investigation should continue with more case studies and longer impact studies. More details can be seen in Beni's presentation on the LACE webpage - http://www.rclace.eu/File/Data_Assimilation/workshops/DAWD2017/DAWD_radar.p df

RADAR measurements (Anton Zgonc)

An introductory talk about the principles of RADAR measurements made by Slovenian RADAR expert, Anton. In this talk some issues with radial resolution problems in HDF5 format and the improvements of radial velocity measurements have been mentioned. These issues would be beneficial to NWP community and RADAR data assimilation as well. More technical details of Anton's presentations can be seen in uploaded presentation on RC LACE webpage - http://www.rclace.eu/File/Data_Assimilation/workshops/DAWD2017/Radar_Measur ements.pdf

Discussion with Meteo-France and IPMA colleagues (Claude Fischer, Pierre Brousseau, Maria Monteiro)

During a teleconf the following questions and topics have been discussed with MF and IPMA colleagues:

- Determination of optimal thinning distance and SIGMAO_COEF

- MF is doing OSEs in order to determine optimal thinning distances.
- For AROME, the AMDAR thinning distance is 25km
- Contact points: Pierre Brousseau, Patrik Benacek

- Correct definition of ODB subtyes for AMDAR and its effect on screening

  - There is no effect of AMDAR ODB subtypes in 002 and in 131 configurations
  - In order to book specific ODB subtypes for specific observations like Mode-S, the ODB governance should be informed and asked. Proposals about such subtype definitions should be sent to ECMWF, MF and HIRLAM experts as well.

- SEVIRI pre-processing at Meteo-France

  - Lannion center handles SEVIRI pre-processing for MF's applications and SEVIRI observations are provided in NetCDF format

- RADAR HDF5 reader and its phasing into common cycles

  - Cy43t2_bf and cy45t1 will deliver updates on BATOR and HDF5 reader.
  - Contact persons: Eric Wattrelot, Frank Guillaume

- The future of CANARI and an offline surface spatialization tool

  - CANARI will be maintained in the upcoming common cycles
  - However, observation code refactoring also effects CANARI
  - This topic will be discussed during EWGLAM meeting with Patricia(ECMWF)
  - Contact points: Patrick Samuelsson, Claude Fischer

- The peformance of CANARI-OI_main (experiences at IPMA and in LACE)

  - The OI_main performance compared with dowscaled global model surface conditions were not compared in OMSZ (ALARO 701-fullpos vs AROME 701-OI_main). Overall OI_main should improve surface conditions in such a comparison.
  - Contact points: Mate Mile, Maria Monteiro

Latest results of variational bias correction in LAM DA systems *(Patrik Benacek)*

The bias correction is an essential component of any radiance data assimilation system, however, in limited-area models the widely used VARBC method was hardly studied. In Patrik's presentation a general overview, possible sources of errors and a new formulation of VARBC adaptivity parameter were summarized. Additionally the so called coldstart initialization approach was found to be

inadequate in LAMs and either warmstart or global initialization were suggested with special considerations to initialize bias information in VARBC. The best statistical performance of VARBC can be reached compared to reference bias information (Harris and Kelly and Global) by the new adaptivity parameter and warmstart approach. More details can be seen in Patrik's talk on the webpage - http://www.rclace.eu/File/Data_Assimilation/workshops/DAWD2017/DAWD2017.pdf

Appropriate B matrix for BlendVAR *(Antonin Bucanek)*

The ALARO/Cz BlendVAR assimilation system was introduced operationally in 2015 in Prague. Such DF Blending and 3DVar combination requires unique background error representation in which the large-scale information is not corrected by derived structure functions. In order to achieve this the members of the constructed EDA system was blended with the same ARPEGE analysis. More information is written in Tonda's talk on RC LACE webpage - http://www.rclace.eu/File/Data_Assimilation/workshops/DAWD2017/bucanek_dawd2017.pdf

Comparison of NWP based nowcasting (AROME) with classical system *(Mirela Pietrisi)*

The performance of AROME/Nowcasting system in ZAMG was assessed and compared with classical INCA based nowcasting system. For the comparison and verification the so called Model Evaluation Tool (MET) was utilized which is able to perform several diagnostics and scores. Preliminary results were shown about summer period of 2016 where AROME/Nowcasting gave more skill (Fraction Skill Score differences) than INCA after 3 hours for hourly precipitation forecasts. Further evaluation and extended studies are planned for this year and for the next year as well. More details can be seen in Mirela's talk on RC LACE webpage - http://www.rclace.eu/File/Data_Assimilation/workshops/DAWD2017/DAWD_MET_tools.pdf

Global Navigation Satellite System data processing at near real-time *(Martin Imrisek)*

An overview about GNSS data processing and satellite signal path delay were presented at the beginning of Martin's talk. After that the GNSS ground-based receiver stations in Slovakia was introduced and the preliminary experiments of the assimilation of GNSS ZTD observations from the Slovakian stations were shown. Some of the plotted analysis increments reflected suspicious behaviour of 3DVar which has to be further understood. More information about Martin's talks can be read on LACE webpage - http://www.rclace.eu/File/Data_Assimilation/workshops/DAWD2017/GNSS_data_processing.pdf

Assimilation of GNSS ZTD in AROME 3DVAR *(Mate Mile)*

The assimilation of GNSS ZTD was continued at OMSZ where more observations from 3 different E-GVAP networks and the extended version of VARBC were

investigated in 2017. The additional GNSS stations from Czeck and Polish network added 30% more observations inside AROME/Hungary domain. On the other hand the passive assimilation with VARBC found to be problematic (perhaps it was never tested in the consortia) and also the 3DVar convergence occasionally was not satisfactory when GNSS ZTD was also assimilated. More details and information can be seen in Mate's presentations in RC LACE webpage - http://www.rclace.eu/File/Data_Assimilation/workshops/DAWD2017/dawd2017_ztd_pres_hu.pdf

Data assimilation of Mode-S EHS observations *(Benedikt Strajnar)*

In the frame of a LACE stay the quality and the impact of Mode-S EHS observations disseminated from KNMI and redisributed via OPLACE were studied. By a large amount of data the quality of wind and also temperature observations was surprisingly superiour (checking OMB statistics from ALARO/CHMI BlendVAR system). However, there was an issue reported about the computation of aircraft thinning distances, but the assimilation of Mode-S EHS showed promising results even without the Mode-S whitelist pre-selection. Mode details about Beni's talk can be found on RC LACE webpage - http://www.rclace.eu/File/Data_Assimilation/workshops/DAWD2017/DAWD_EHS.pdf

Discussion

The first discussion point was about the **RADAR data assimilation** studies where LACE colleagues achieved major progress during the last year.

- It was a mutual agreement that OPERA reflectivitiy observations should be used in future RADAR data assimilation studies and for this, LACE should be more active towards OPERA by sending feedbacks regularly to OPERA.

- Also there was an agreement to prepare special proposal (already circulated) for upcoming LACE Council in order to request allocated manpower for RADAR data assimilation.

- For those LACE colleagues who are working on RADAR data assimilation a dedicated LACE forum topic should be booked where recent issues, results can be discussed. LACE colleagues should subscribe and LACE DA AL should organize Video Meetings (e.g. Hangouts) in case of interest.

- A google doc would be desirable to prepare with information about OPERA data content and missing pieces what LACE colleagues found and have to be fixed before assimilation.

- Additionally it was agreed to organize 3-month equivalent LACE stays in 2018 in order to strengthen RADAR data assimilation.

Another discussion touched the topic of flow-dependent background errors. In the previously circulated documents, there were few ideas how to collaborate in this topic and LACE DA colleagues remarked their possibilities.

- Common EDA is a good idea, but it is difficult to estimate the benefit of such system in advance. Initially it would be good to see a demonstration study about a local EDA and the adaptation of its flow-dependent information in a local DA system in order to estimate the benefit of a common EDA for every LACE DA system.

- Collaboration with LACE Predictability group is essential due to they already have lot of experiences with EDA systems.

- Non-LACE partners also showed interest in this study (Wafa from Tunisia) which can be considered as an ALADIN flat-rate stay proposal in 2018.

Common discussion about surface data assimilation was taken at the end of the meeting.

- Surface data assimilation (1D-SODA) testbed is ready to use for LACE partners as well.

- The joint organization of Working Days was beneficial, however, it should be more carefully organized next time covering more common aspects (e.g. this year was more important for RADAR data assimilation which limited the time spent on surface and upper-air discussions).

- Possible topics for cooperation are observation monitoring, obstool for data assimilation diagnostic and surface assimilation using EKF method in the future

Planning

For next year the preliminary LACE DA plan was updated by the comments of LACE DA colleagues. This newer LACE DA plan for 2018 can be seen on LACE webpage   -
http://www.rclace.eu/File/Data_Assimilation/plans/DAplan2018_updated_v2.pdf

AOB/Miscellaneous

Most probably the next LACE DAWD will be held in Romania in Sibiu on the same week as LSC (and also two weeks before EWGLAM meeting).