Regional Cooperation for
Limited Area Modeling in Central Europe

LACE
nwp central europe

The latest data assimilation activities in LACE countries

Mate Mile on behalf of LACE DA colleagues

DHMZ SHMU ARSO METEO Slovenia OMSZ ZAMG ROMANIA ANM

LACE DA status (everything in 1 slide)

- Almost 10 operational DA systems at all LACE countries which number is increasing.
- There are experiments at 1km horizontal resolution for high resolution surface assimilation purposes.
- There is progress on the two-way (ocean-atmosphere) coupled DA system.
- There were successful implementations of RADAR reading in HDF5, IAU and cloud initialization procedures.
- The use of observations is widened (operational AMDAR Q, Mode-S MRAR, more experiments with GNSS, radiances, AMVs, etc.)
- On the other hand there were no significant step forward with common RADAR DA action inside LACE
- The validation and maintenance works are still manpower and time demanding at the LACE centers.
- More efforts and resources are needed for other actions (e.g. LACE 's OOPS contributions)

LACE DA status (okay maybe in 2 slides)

- Nowcasting applications based on adaptation of NWP system ALARO/AROME are being implemented
- DA algorithms are employed and operational forecast with different lead-times are used as the first guess
- observations are essential to constrain the analyses
  - At: AROME (1.2km 3DVAR) AROME-NWC
  - Cz: ALARO (4.7km, 3DVAR+OI) VarCanPack

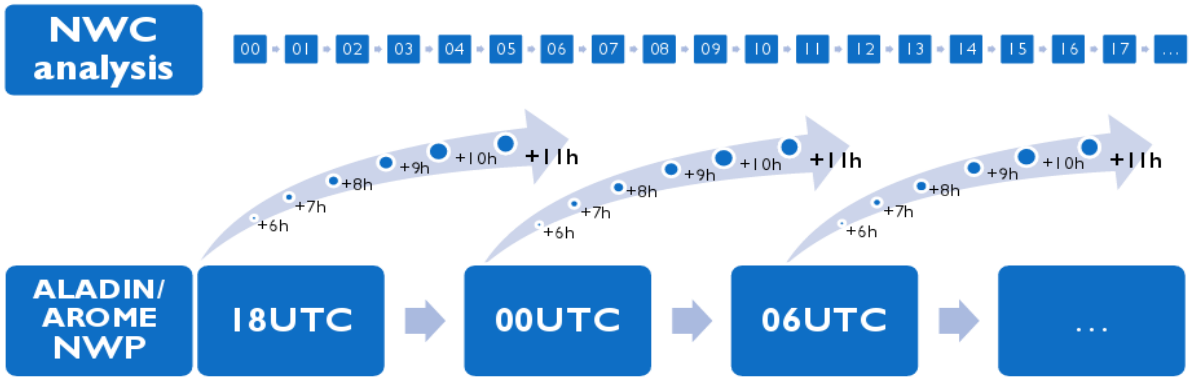

Figure: A schematic figure of a hourly non-cycled data assimilation system

Outline

- LACE DA status
- Data thinning and error correlation of Mode-S MRAR observations
- VARBC initialization in LAM
- Surface assimilation activities
- Observation pre-processing and COPE

Data thinning and error correlation of Mode-S observations in ALARO/CHMI

- Mode-S observations have high temporal and spatial resolutions
- Observation errors in current 3DVARs are assumed to be uncorrelated

- Estimate spatial error correlations by Desroziers method
- Optimal thinning distance: error correlations are less or equal than 0.15-0.2 (Liu and Rabier, 2003)
- Observations Mode-S MRAR from Czech Air Traffic Control
- ALARO/CHMI runs on 4.7km, L87 resolution using BlendVAR upper-air assimilation for Mode-S

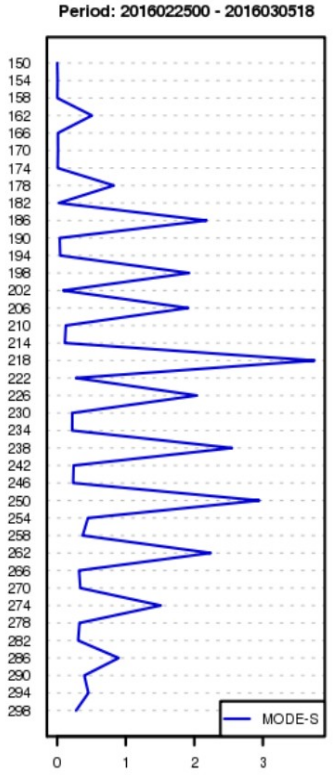

Figure: The observation number of Mode-S for pressure levels between 400-150 hPa

Data thinning and error correlation of Mode-S observations in ALARO/CHMI

- The optimal horizontal thinning distance ~ 25-35 km
- The optimal vertical thinning distance ~ 20 hPa

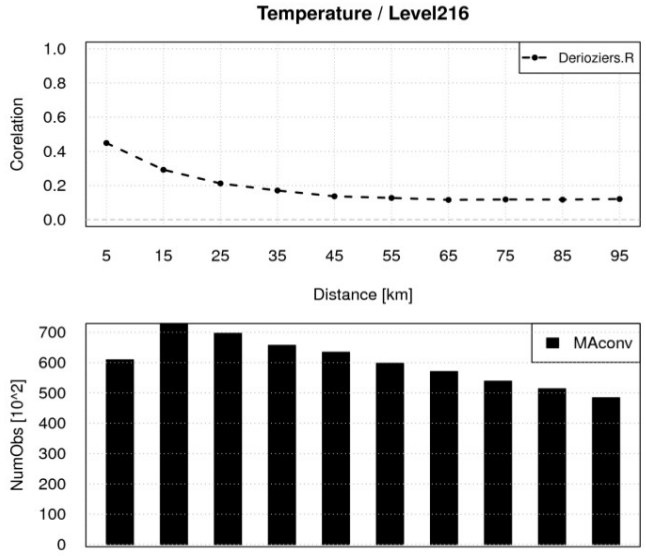

Figure: Estimates of horizontal error correlations and the number of a collocations as function of separation distance for Mode-S MRAR

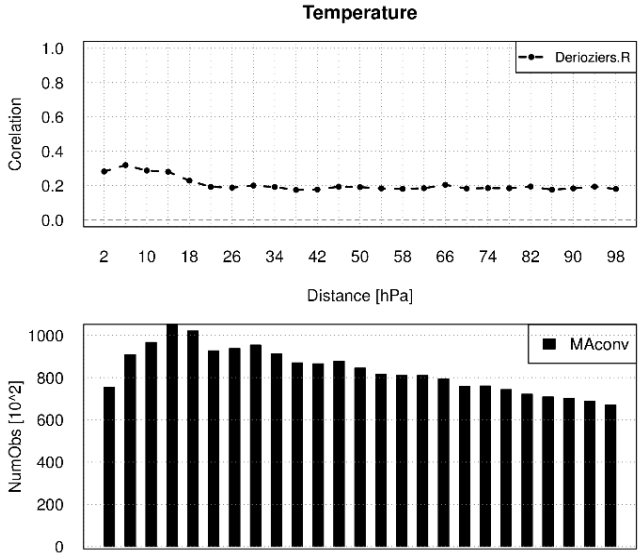

Figure: Estimates of vertical error correlations and the number of a collocations as function of separation distance for Mode-S MRAR

Data thinning and error correlation of Mode-S observations in ALARO/CHMI

- The use of Mode-S MRAR observations has positive impact in the nowcasting framework and in the first hours of NWP forecasts
- For more details see Benáček (2016): http://www.rclace.eu/?page=11

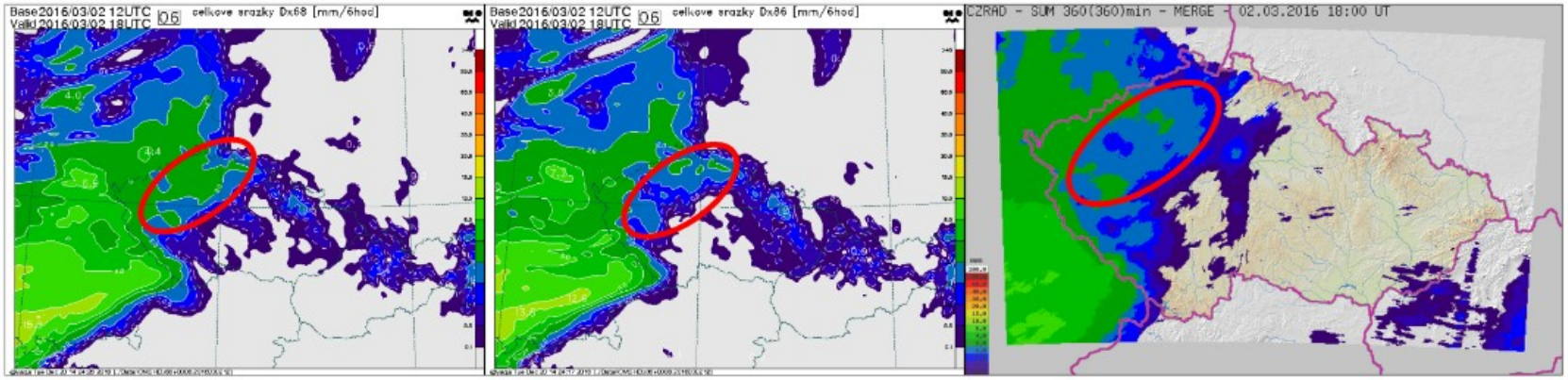

Figure: ALARO accumulated precipitation forecast at 2nd of March 2016. with forecast lead time +6h.
Reference ALARO (with default use of AMDAR + Mode-S observations) is on the left.
Experimental ALARO (with optimized AMDAR and Mode-S observations) is in the middle.
RADAR based quantitative precipitation estimate is on the right.

Comparison of different VARBC initialization methods

- Variational bias correction method is able to correct systematic errors of the observations in an adaptive manner which method is nested in the variational data assimilation context.
- However, it was studied more comprehensively in global data assimilation frameworks, the VARBC configurations can be very different in limited-area data assimilation.
- The different VARBC initialization approaches have been investigated in order to compare coldstart and warmstart with two reference experiments.

Name	X94	X95	X97	X98
VARBC initialization	Coldstart	Warmstart	Harris and Kelly	Global
Observations at 09UTC	AMSU-A, MHS, HIRS, IASI (METOP-A, METOP-B), SEVIRI Meteosat10	AMSU-A, MHS, HIRS, IASI (METOP-A, METOP-B), SEVIRI Meteosat10	AMSU-A, MHS, HIRS, IASI (METOP-A, METOP-B), SEVIRI Meteosat10	AMSU-A, MHS, HIRS, IASI (METOP-A, METOP-B)
Observations at 06UTC	AMSU-A, MHS, HIRS, IASI (NOAA-18, NOAA-19), SEVIRI Meteosat10	AMSU-A, MHS, HIRS, IASI (NOAA-18, NOAA-19), SEVIRI Meteosat10	AMSU-A, MHS, HIRS, IASI (NOAA-18, NOAA-19), SEVIRI Meteosat10	AMSU-A, MHS, HIRS, IASI (NOAA-18, NOAA-19)
VARBC config	Default	Default	-	Default

Figure: The different experiments have been investigated.

Comparison of different VARBC initialization methods

- Experiments of 09UTC analyses, Metop-A AMSU-A sensor
- Importance of bias correction predictors
  - Diagnostic proposed by Auligne, 2007

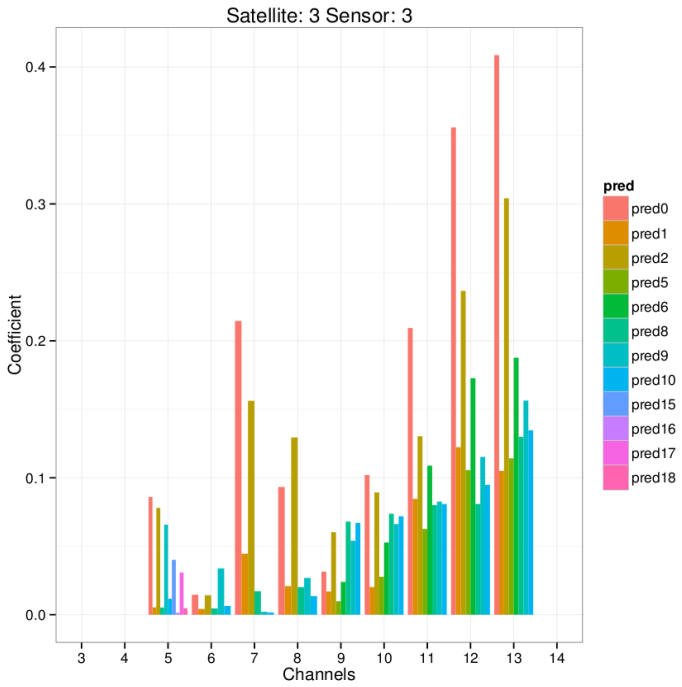

Figure: COLDSTART

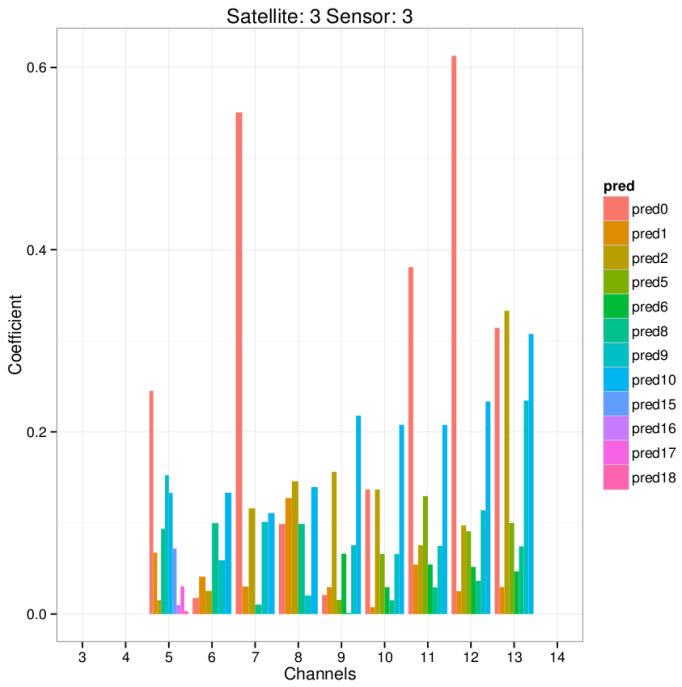

Figure: WARMSTART

Comparison of different VARBC initialization methods

- OMG statistics for Metop-B AMSU-A channel 7
- Passive assimilation of 50 days period (September - October 2015)

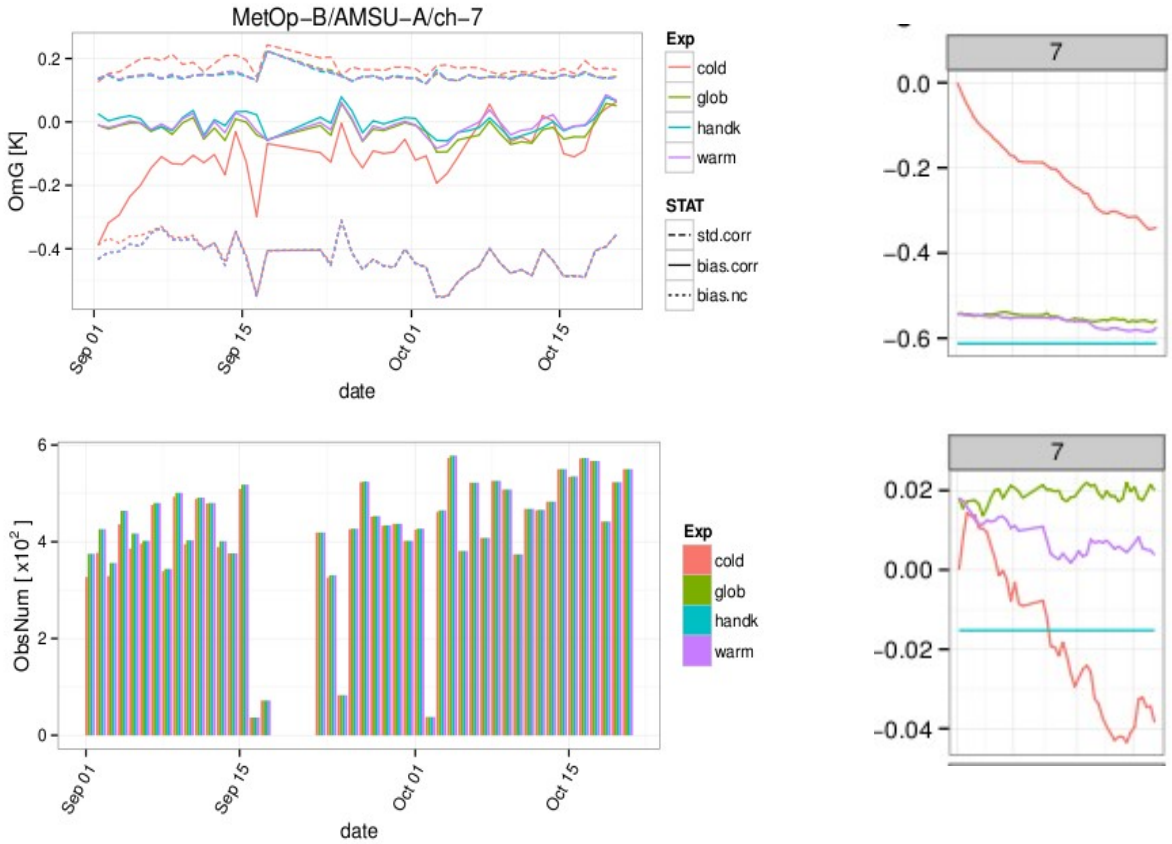

Figure: AMSU-A channel 7 OMG bias (corrected and non-corrected), OMG standard deviation on the left and the evolution of predictor 0 (top) and predictor 8 (bottom) on the right.

Comparison of different VARBC initialization methods

- Conclusions:
  - The coldstart initialization usually has collinearity issues and requires very long spin-up period in case of small observation sample
  - Also with coldstart, some of the bias coefficients are not reasonable with respect to global coefficients and the STDV of corrected OMG departures are larger than with the other approaches,
  - Warmstart gives plausible bias correction for lower peaking channels, however for higher peaking channels (together with coldstart) it provides too adaptive evolution of bias parameters. This can be explained by a combination of larger observation sample and a higher FG error.
  - The speed of convergence depends on the instrument observation sample in each analysis. Therefore with larger observation sample coldstart performs adequately (e.g. MHS, IASI)
  - The main benefit of the use of warmstart is the shorter spin-up period and more reasonable bias coefficients.
- More details in Mile and Benáček (2016): http://www.rclace.eu/?page=11

Surface assimilation activities

- The common efforts to build EKF based surface assimilation in LACE are ongoing.
- During the last year the validation of the EKF algorithm has been studied making 1D experiments and comparison with real soil conventional measurements
- On the other hand new releases of SUFREX (v8.0) and also SODA were preliminary tested.
- 1D tests for 2008-2009 (the site is located in W-Hungary)
- Forcing files from ALARO cy38t1
- SODA assimilation:
  - observations: SPOT-VGT LAI, ASCAT SWI (WG1)
  - control variables: LAI, WG1 and WG2
- Different tests with different settings:

EXP. NAME00	OBS.	XERRORS	CVAR	XSIGMA00	Scale_q, Scale_lai
E1	SWI1, LAI	0.4, 0.2	WG2, WG1, LAI	0.2, 0.4, 0.2	0.125, 0.5
E2	SWI1, LAI	0.4, 0.2	WG2, LAI	0.2, 0.2	0.125, 0.5
E5	SWI1	0.4	WG2, WG1, LAI	0.2, 0.4, 0.2	0.125, 0.5
E9	LAI	0.2	WG2, WG1, LAI	0.2, 0.4, 0.2	0.125, 0.5
E14	SWI1, LAI	0.4, 0.2	WG2, WG1, LAI	0.2, 0.4, 0.2	0.2, 0.7

Surface assimilation activities

- Experiments with SURFEX v8.0 and SODA.
- Overestimation of LAI when SWI1 observation is used in EKF

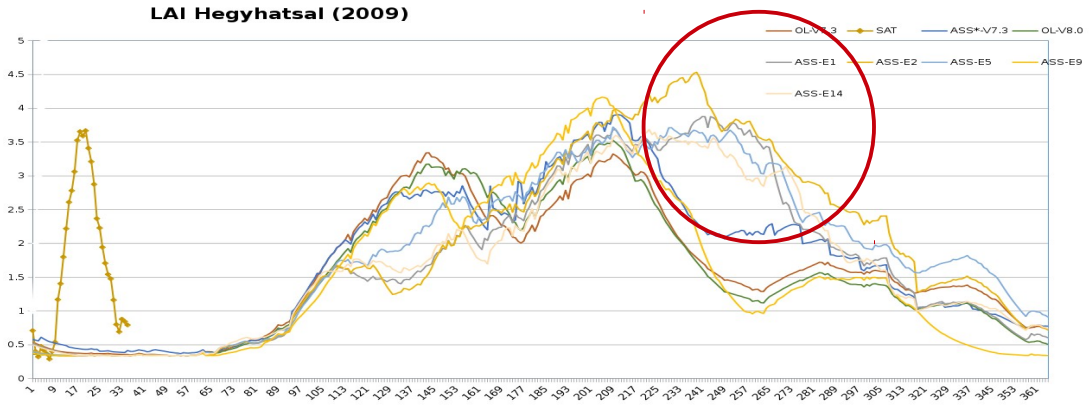

Figure: Different experimental runs for LAI in Hegyhátsál, Hungary for 2009.

- For the latest information, please contact with the LACE EKF team:
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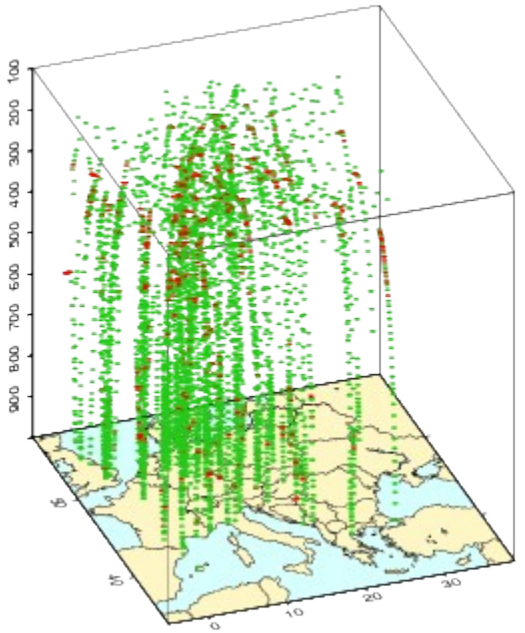
GTS AMDAR BUFR processing

- WMO is promoting migration from TAC to BUFR format of conventional observations dissemination
- following Météo France development to handle BUFR data GTS SYNOP and AMDAR BUFR data processing was tested in collaboration with Maria Monteiro and Frank Guillaume

- new routine was prepared to handle WMO AMDAR template 311010 (including humidity observations) used for European GTS aircraft data
- see M. Monteiro (2017, 2016):

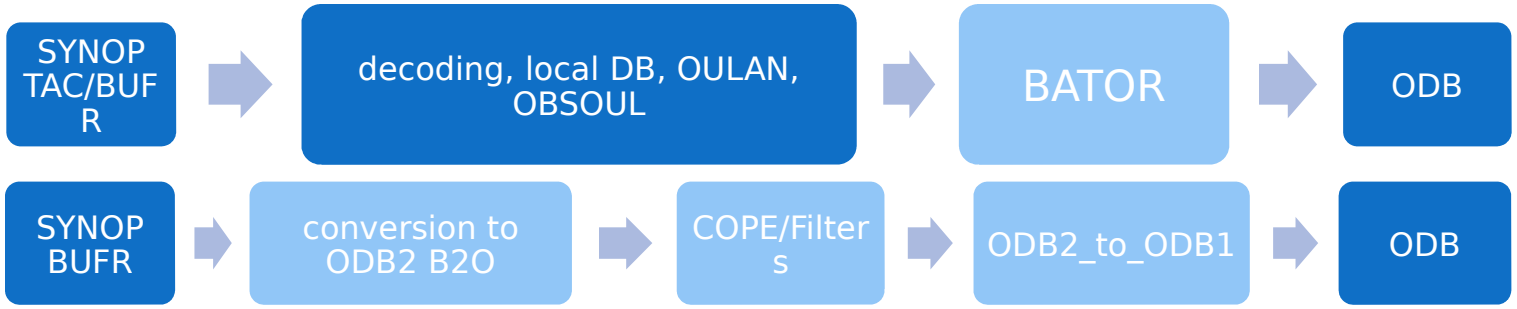
  http://www.rclace.eu/?page=11



Testing of COPE prototypes

- Continuous Observation Processing Environment (COPE) developed by ECMWF to replace current processing chain using modern and flexible software framework
- in collaboration with Anis Satouri and Eoin Whelan
  COPE prototypes were tested and compared with the current observation processing performed by BATOR

  - works technically, but there are still issues (GTS data handling, filters reproducibility, format conversion ODB2 to ODB1)
  - no clear benefits with respect to BATOR
  - see Satouri (2016): http://www.rclace.eu/?page=11



Thank You for your attention!
Questions?