Regional Cooperation for
Limited Area Modeling in Central Europe

LACE
nwp central europe

Overview of RC LACE data assimilation activities

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DHMZ SHMU ARSO METEO Slovenia OMSZ ZAMG ROMANIA ANM

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- Developments towards operational hourly RUC
- Diagnostics of background-error covariances
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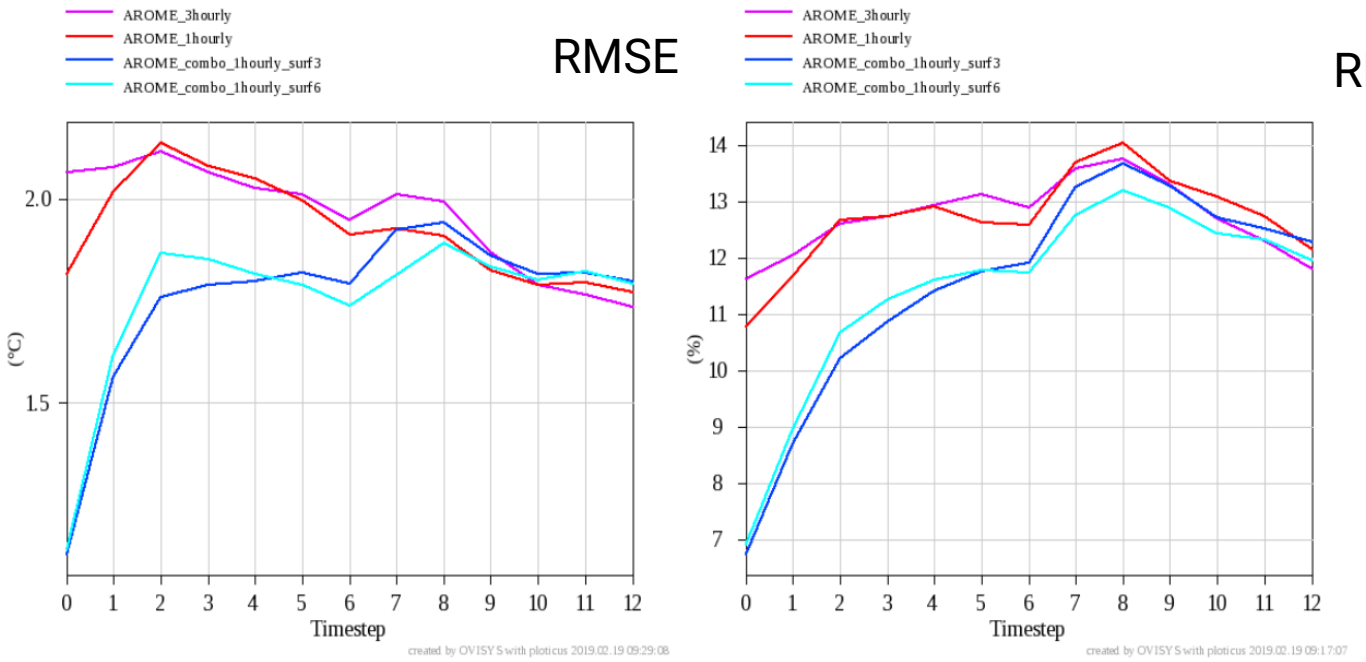
Operational status summary

DA	AT ALARO	AT AROME	CR ALARO	CZ ALARO	HU ALARO	HU AROME	SK ALARO	SI ALARO	RO ALARO (preoper.)
Resol.	4.8L60	2.5L90	4L73	2.3L87	8L49	2.5L60	4.5L63	4.4L87	6.5L60
Cycle	40t1	40t1	38t1	43t2_bf8	38t1_bf3	38t1_bf3	40t1	40t1	40t1
LBC	IFS 3h (lag.)	IFS 1h (lag.)	IFS 3h (lag.)	ARP 3h	IFS 3h (lag.)	IFS 1h (lag.)	ARP 3h	IFS 1h/ 3h (lag.)	ARP 3h
Method	OI + dyn. adapt	OI_main MESCAN + 3DVar	OI + 3DVar	OI +BlendVar	OI + 3D-Var	OI_main + 3D-Var	OI + DF Blending	OI + 3D-Var	OI + 3D-Var
Cycling	6h	3h	6h	6h	6h	3h	6h	3h	6h
B-matrix	-	Downscaled LAEF	NMC	Downscaled AEARP	ALARO EDA	AROME EDA	-	Downsc. ECMWF	Downsc. AEARP
Initial.	DFI	No (SCC)	No (SCC)	IDFI in prod., SCC			No	No (SCC)	No (SCC)
Special / new observ.	Add. snow melt.	Snowgrid +SAT snow init.	Mode-S MRAR	Mode-S MRAR Mode-S EHS M		GNSS ZTD		HRW, IASI, ASCAT, Mode-S EHS	

Hourly-updated DA systems

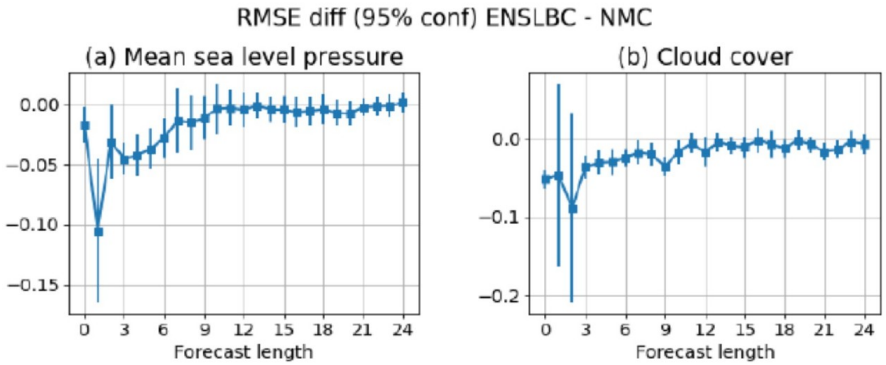
- Ongoing efforts in Austria (AROME -RUC 1.3 km, talk F. Meier, AROME 1.2)
- Hungary: tests with hourly cycling in AROME 2.5 km
  - Combined hourly 3D-Var with OI (CANARI) at different time frequency (1h, 3h, 6h)
  - 3-6 h OI for surface performed better than hourly analysis!

T2m RMSE RH2m

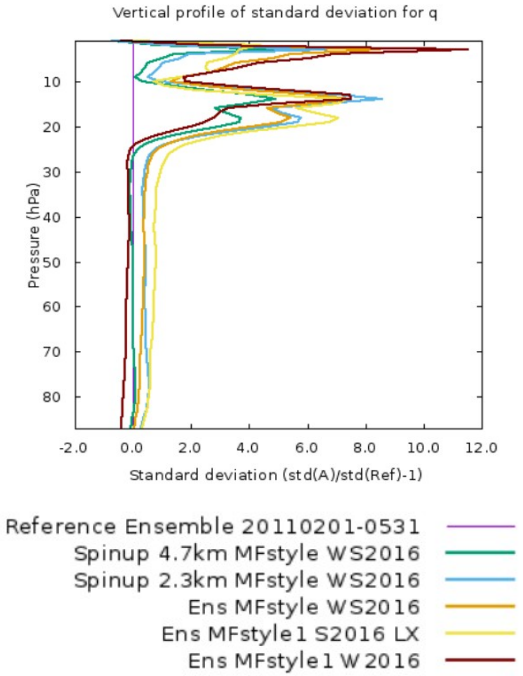


Properties of background errors in 3D-Var

- Comparative study sampling methods (NMC, ENS, ENSLBC) – A. Stanešić (CR)
  - ENS-type methods methods outperform NMC method in terms of forecast scores
- Sensitivity of ENS methods
  - Large sensitivity of high-level humidity
  - Tuning (REDNMC) is able to mitigate the impact on scores, detrimental impact on scores at 2.3 km



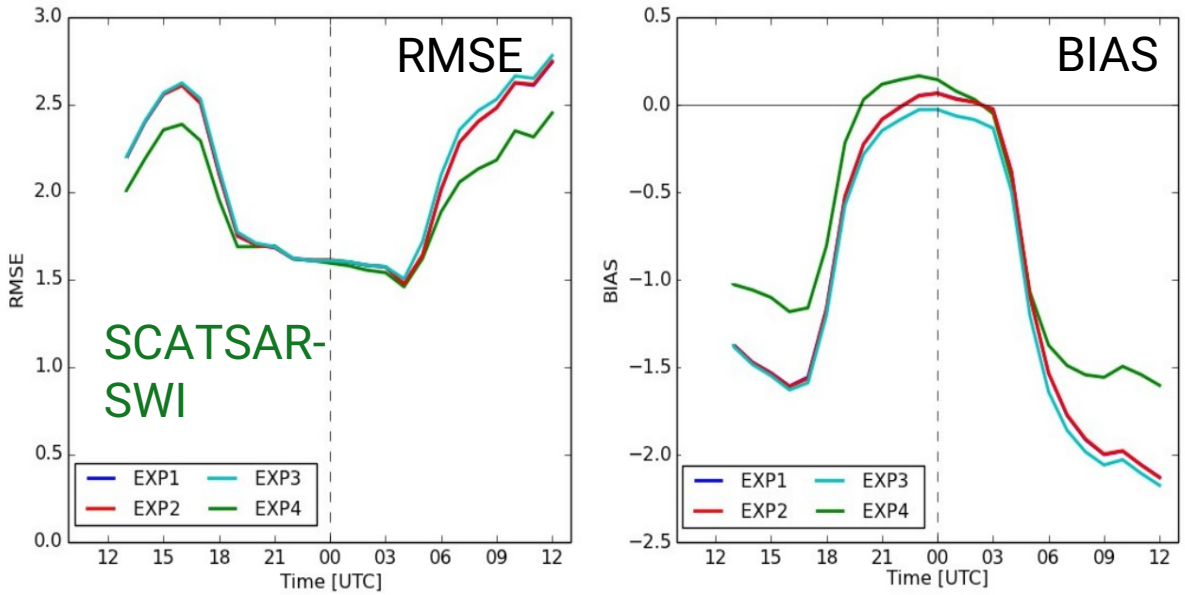
RMS reduction of ENS vs. NMC



q - background error profile

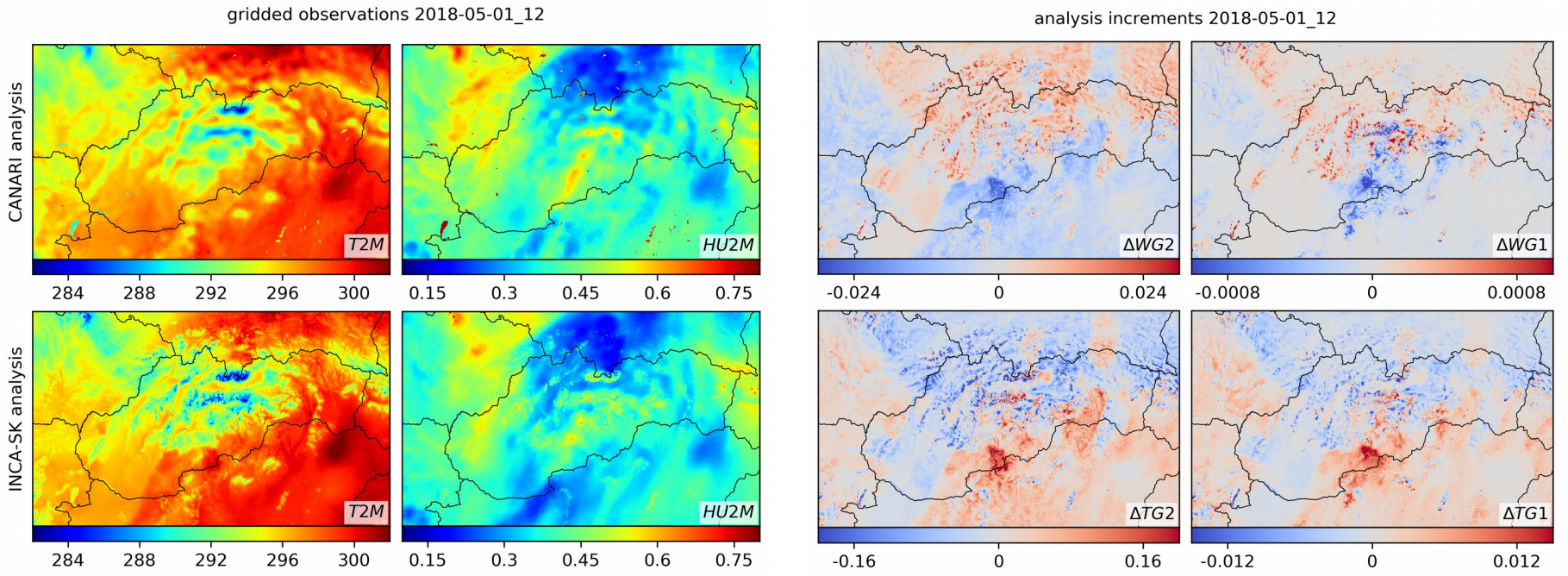
Progress in surface data assimilation – EKF

- SODA in SURFEX 8.1 (Austria)
  - Extension of control variable set to TG, WG, WGI 1-8.
  - Possibility to use locally diagnosed observation errors, using triple collocation of SCATSAR-SWI, AMSR2 and SURFEX WG data
  - Assimilation of SCATSAR_SWI (ASCAT + Sentinel) soil observations (layers 1-8) shows significant positive impact on 2 m temperature T2M in short-range AROME (CY40T1 with HIRLAM-modifications to use ISBA-DIF) – in review for GMD (Schneider et al.)



Progress in surface data assimilation – EKF (2)

- Tests with offline SURFEX at 1 km and 4 km (Slovakia, V. Tarjani):
  - Developed a novel method for computation of the Jaccobians (1-column)
  - Tests with snow assimilation
  - Screen-level (CANARI) analysis replaced by high-resolution INCA analysis (T2m, RH2m) to deduce soil increments



Assimilation of OPERA data: HOOF homogenization tool

- Several LACE members started to test OPERA data (BATOR cy40, cy43)
- Although the data comes in a common format (ODIM), a preprocessing step was still found to be necessary
- Homogenization of OPERA OIFS Files (HOOF) – properties:
  - Splits 15-min aggregates to single measurements
  - Organizes/rearranges incoming data:
    - one data set for each elevation
    - all measurements has the same quality flags
  - Fills in the (specific) metadata from namelist if missing
  - Keeps only what is needed/requested, e.g. reflectivity, wind
  - Tunable by namelist
  - Written in Python
- This enables joint processing of data from ~150 radars in Europe.

Assimilation of OPERA data: HOOF homogenization tool (2)

- Namelist items:
  - Supported file formats
  - Requested variables
  - Requested quality groups
  - Common radar attributes/defaults
  - Specific radar attributes/defaults
- Metadata browser
  - Enables browsing for metadata and containing datasets
- Available for testing at RC LACE forum http://www.rclace.eu/forum/viewtopic.php?f=37&t=582

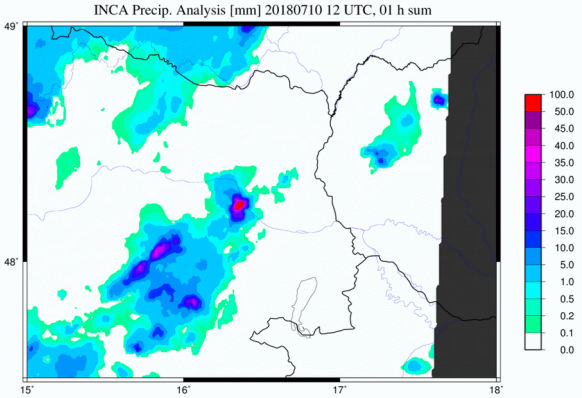
```
[FileExtensions]
{.h5 .hdf}
[SavedQuantities]
DBZ = {DBZ DBZH}
TH = {TH}
VRAD = {VRAD VRADH}
[DbzQualityGroups]
{1 2 3 4}
[RadarAttributes common]
/what/object = None
/what/source = None
/what/date = None
/what/time = None
/how/beamwidth = None
/where/lat = None
/where/lon = None
/where/height = None
/dataset/what/startdate = None
/dataset/what/starttime = None
/dataset/what/enddate = None
/dataset/what/endtime = None
/dataset/where/elangle = None
/dataset/where/nrays = None
/dataset/where/nbins = None
/dataset/where/rscale = None
/dataset/where/rstart = None
/dataset/how/sensitivity = 1.0
/dataset/how/radconstH = None
/dataset/data/what/quantity = None
/dataset/data/what/gain = None
/dataset/data/what/offset = None
/dataset/data/what/nodata = None
/dataset/data/what/undetect = None
/dataset/quality/how/task = None
/dataset/quality/what/gain = None
/dataset/quality/what/offset = None
[RadarAttributes silis]
/where/height = 910.0
[RadarAttributes sipas]
/dataset/how/highprf = 23.9
```

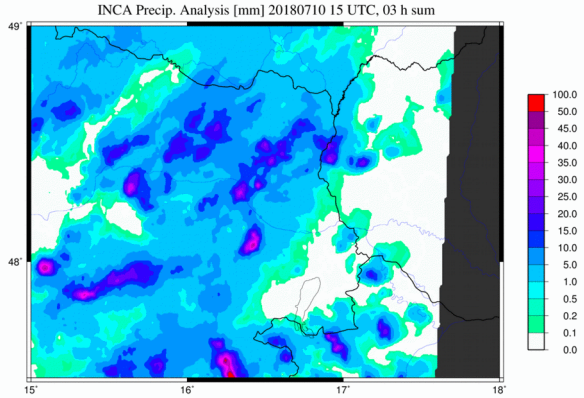
Attribute Names	Attribute Values	Number	Attribute Files
Conventions	-0.00392156862745098	89	T_PAZZ41_C_EUOC_20180814000000_silis.h5 24
dataset/data/how/CSR	0.00392156862745098	267	T_PAZZ41_C_EUOC_20180306000000_bewid. 33
dataset/data/how/LOG			T_PAZZ41_C_EUOC_20180306001500_nosmn 12
dataset/data/how/SQI			T_PAZZ41_C_EUOC_20180306000000_dkste.h 20
dataset/data/what/gain			
dataset/data/what/nodata			
dataset/data/what/offset			
dataset/data/what/quantity			
dataset/data/what/undetect			

Assimilation of reflectivity

- Austria: assimilation of reflectivity challenging when appropriate first guess (with existing convection) is not available.

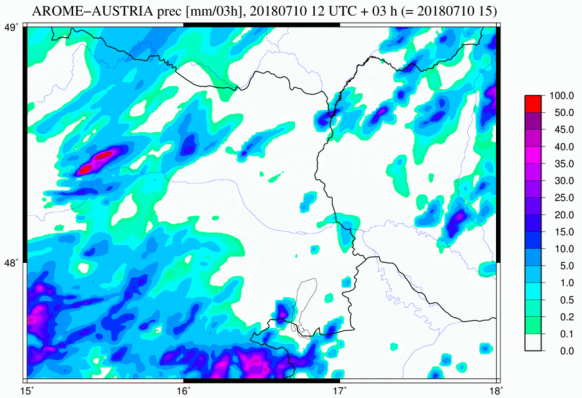
INCA analysis 12 UTC

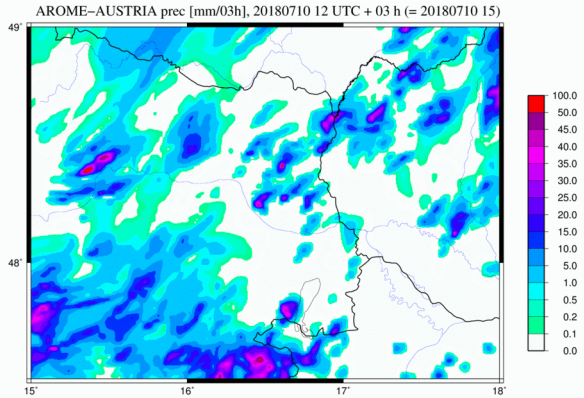




INCA analysis 15 UTC

RADAR assim. + 3h



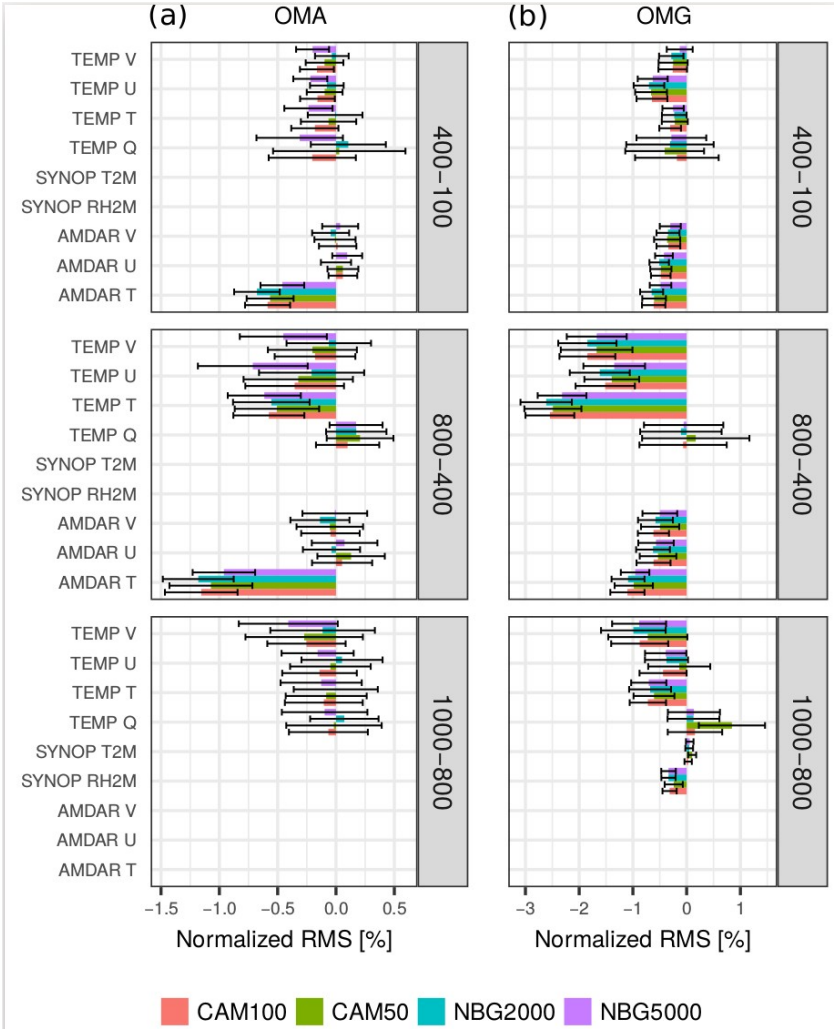


RADAR assim. (saturated profiles) + 3h

Diagnosis of VarBC in LAM

- Several experiments with adaptivity of predictors for radiances (P. Benaček)
  - Static tuning of the adaptivity
  - Dynamic adaptivity
  - Tuning improves OMG in the assimilation cycle, both methods outperform the reference using global coefficients

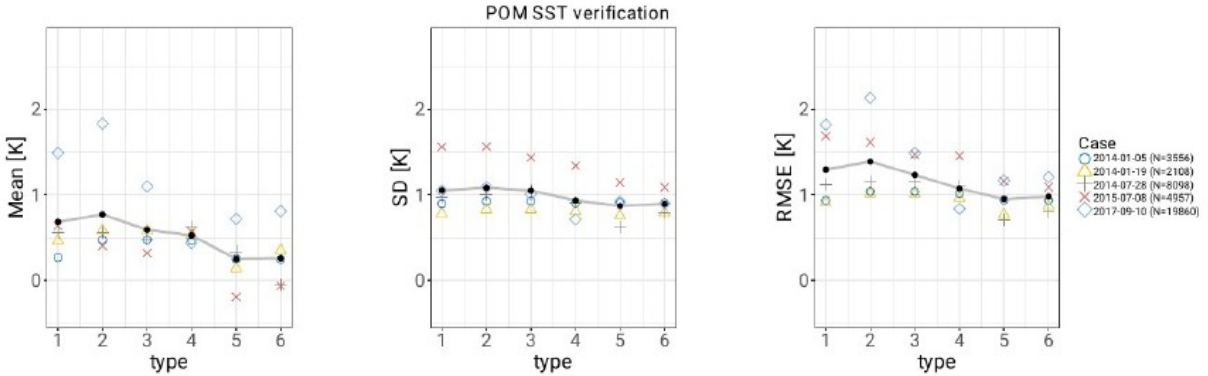
Reduction of RMS of tuned VarBC experiments with respect to using global coefficients (ARPEGE)



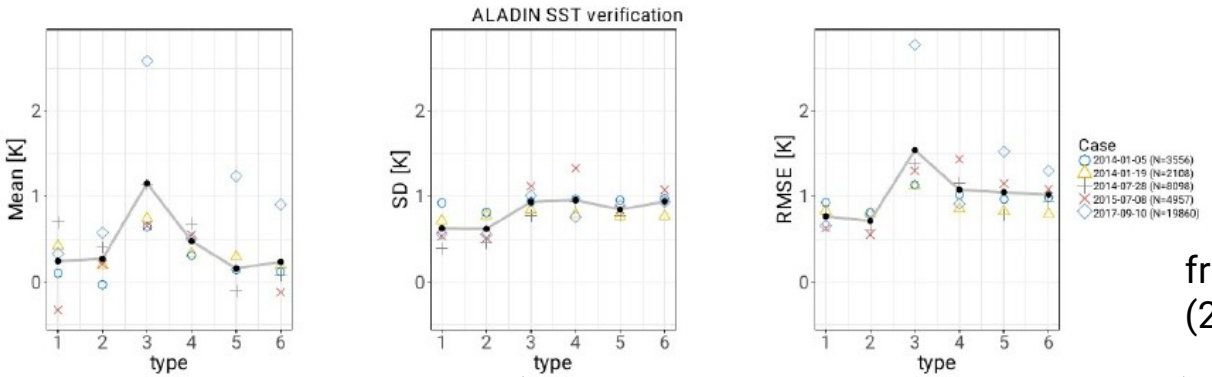
Sea-atmosphere coupling: data assimilation aspects

- Application of 2-way coupling into ALADIN 4.4 km assimilation cycle (SI)
  - Two-way coupling improves the SST, compared to 1-way coupled ocean model
  - Fresh global model SST analysis superior to coupled runs with weekly or no analysis
    → frequent ocean assimilation is necessary to improve NWP (precipitation)

SST in ocean model POM



SST in ALADIN



from Strajnar et al. (2019), QJRMS

x-axis: strength of coupling (1 – operational, 6- full coupling)

Outlook

- Further progress on radar assimilation (reflectivity, towards solution for wind)
- Numerous 1h RUC setups
- Further tests with additional classical observations (OSCAT & HSCAT scatterometers, High res. AMVs, ATMS radiances, GNSS-derived observations: ZTD, STD, GPS-RO)
- New observations (extension of Mode-S derived data, microwave attenuation in telecommunication links)
- Surface DA: towards operational EKF