Regional Cooperation for
Limited Area Modeling in Central Europe

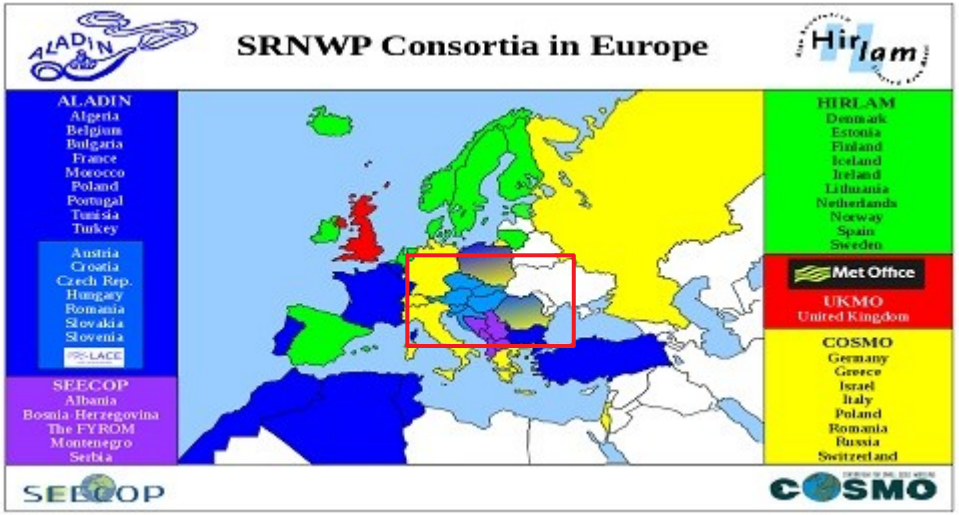
LACE
nwp central europe

RC LACE developments in 2018

Martina Tudor, RC LACE MG and many researchers

ZAMG DHMZ OMSZ METEO ROMANIA SHMU ARSO METEO Slovenia

Who? What?



NMSs of Austria, Croatia, Czech Republic,

Hungary, Romania, Slovakia and Slovenia

- common operational applications

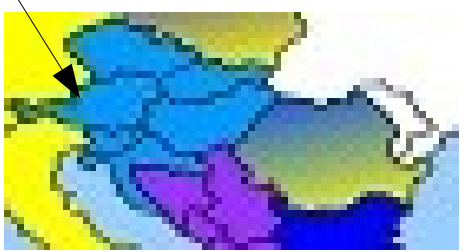
LAEF – limited area ensemble forecasting system

OPLACE – observation pre-processing for LACE

- common research activities

http://www.rclace.eu/?

You are here



Organisational changes

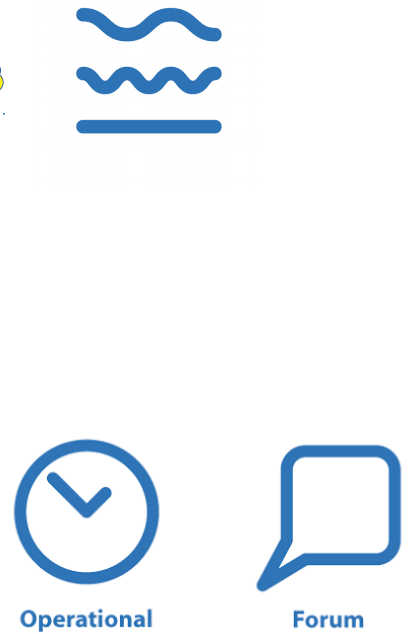
Project Manager: Martina Tudor new

Area Leaders:

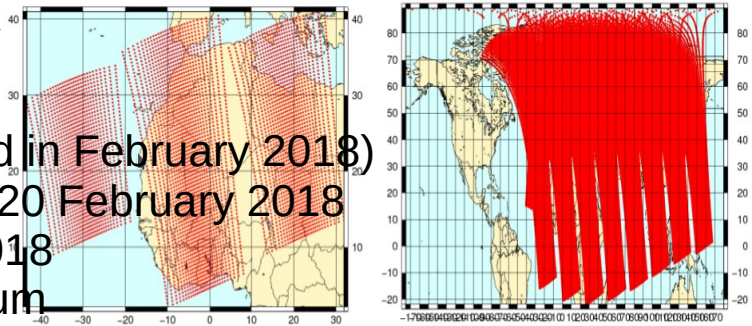
- Data assimilation (upper air and surface): Antonín Bučánek new
- Dynamics and coupling: Petra Smolíková
- Physics (and surface parametrizations): Neva Pristov
- Predictability: Martin Belluš

Data Manager: Alena Trojáková

ALADIN-LACE System Coordinator: Oldřich Španiel



Data Manager activities



OPLACE Maintenance

•ATOVS data handling corrections for Metop-A (lack of data fixed in February 2018)

•new EUMETSAT prime spacecraft Meteosat-11 (MSG-4) since 20 February 2018

- parallel data provision from Meteosat-10/11 till 6 March 2018
- information and guidelines provided on the RC LACE Forum

• coastal winds observations over the oceans from Advanced SCATterometer (ASCAT)

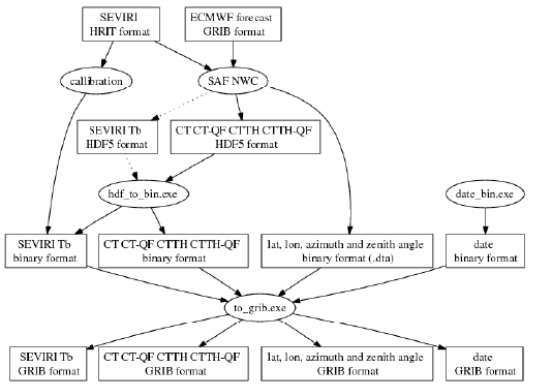
- new observations implemented in 26 March 2018, 12.5km resolution, validated (B. Strajnar)

• corrections for TEMP data processing

- adaptation to merge as much BUFR & ASCII as possible

• technical upgrade for SEVIRI

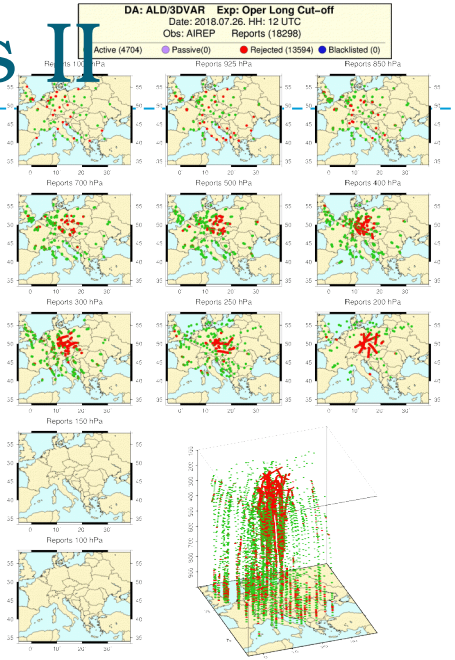
- GRIB replaced by netCDF, simpler product generation
- easier porting & more flexible for testing new NWC SAF versions
- courtesy of CMS Lanion

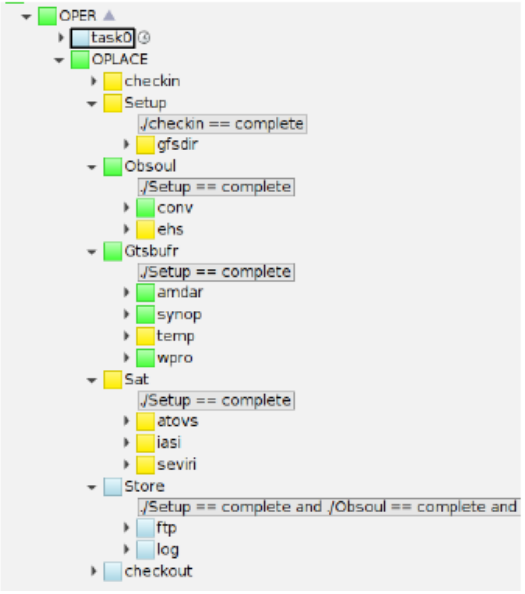


Data Manager activities II

OPLACE Development

- **redesign of the OPLACE scripts**
  - more and more data is processed
  - complexity of the system is growing
  - aim is to improve the operations
    - parallelization using ecFlow scheduler
    - more robust to avoid data issues
    - easier monitoring & supervision





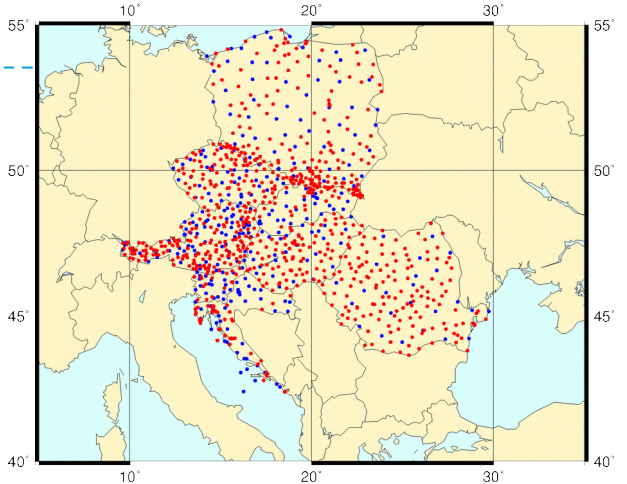
- **TAC2BUFR migration**
  - first prototype of BUFR SYNOP & AMDAR data processing in OPLACE test suite
  - further testing & the redesign is needed before operational implementation to avoid delays in OPLACE data provision
  - pre-processing of BUFR SHIP&BUOY data
  - evaluation of BATOR handling of SHIP&BUOY in collaboration with M. Monteiro

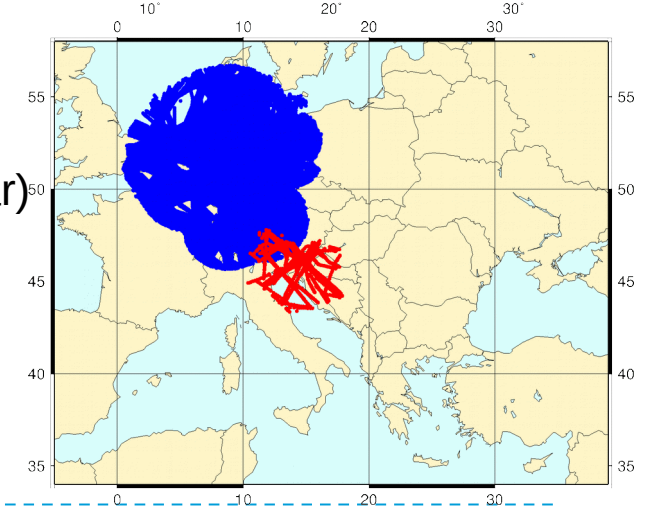
Data Manager activities III

OPLACE national data exchange and access

• high resolution surface synoptic data exchange
- stable and reliable for operational use
- only minor updates

• high resolution aircraft data exchange from modern air surveillance systems
- Mode-S MRAR from ARSO/Slovenia
- Mode-S EHS from KNMI/Netherlands
- stable and reliable data provision
• extension by Mode-S MRAR from the Czech Republic - ongoing
• Mode-S EHS from Slovenia and the Czech Republic - ongoing
• negotiation with KNMI about processing our data started (B. Strajnar)
• All Members explore availability of Mode-S data.





• **OPLACE access for non-LACE countries**
- currently two non-LACE users (Tunisia, Poland)
- LACE Council agreed to mitigate requirements to one month

Data Manager activities IV

ODB support

- **support with configuration and usage of DA configurations provided**
- update of simple DA scripts for cy43t2 is planned for autumn

- **ALADIN data assimilation starters kit (DAsKIT)**
- ALADIN coordinated acvivities to enhance implementation for ALADIN Members without operational DA, (Al, Be, Bu, Mo, Po, Pt, Ro, Tu, Tk)
- considerable manpower (cca 10 FTE) is being gathered for DA R&D
- opportunity for RC LACE support & to gain permanently missing manpower
- RC LACE collaborations and tools were promoted
- common meeting LACE DA WD and DAsKIT WD organized in Bucharest

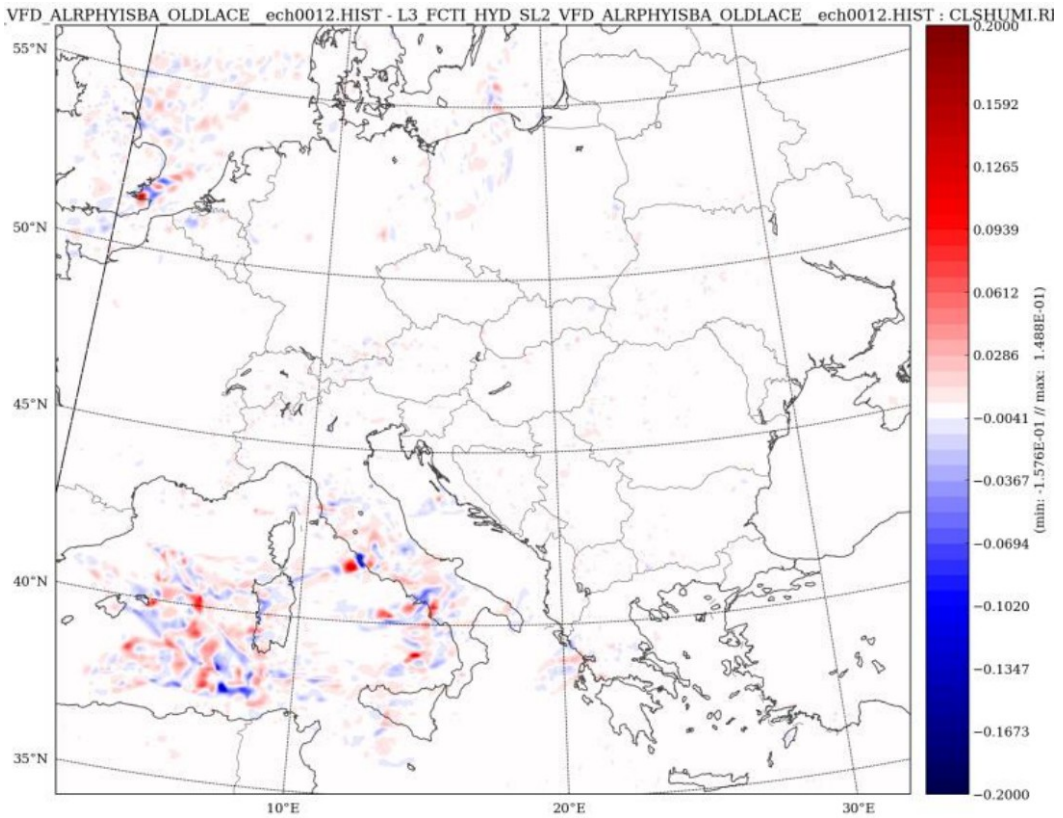
ALADIN-LACE System Coordinator

- **Phasing of common ALADIN cy46 and cy46t1**
  - graupel problem when using – fast-transcendentals in compliation of several phy routines
  - misplaced IF LGRAPRO switch

- **Technical preparation of cy43t2 export version and porting support**

- **Production of common verification scores from LACE Members operational model outputs**

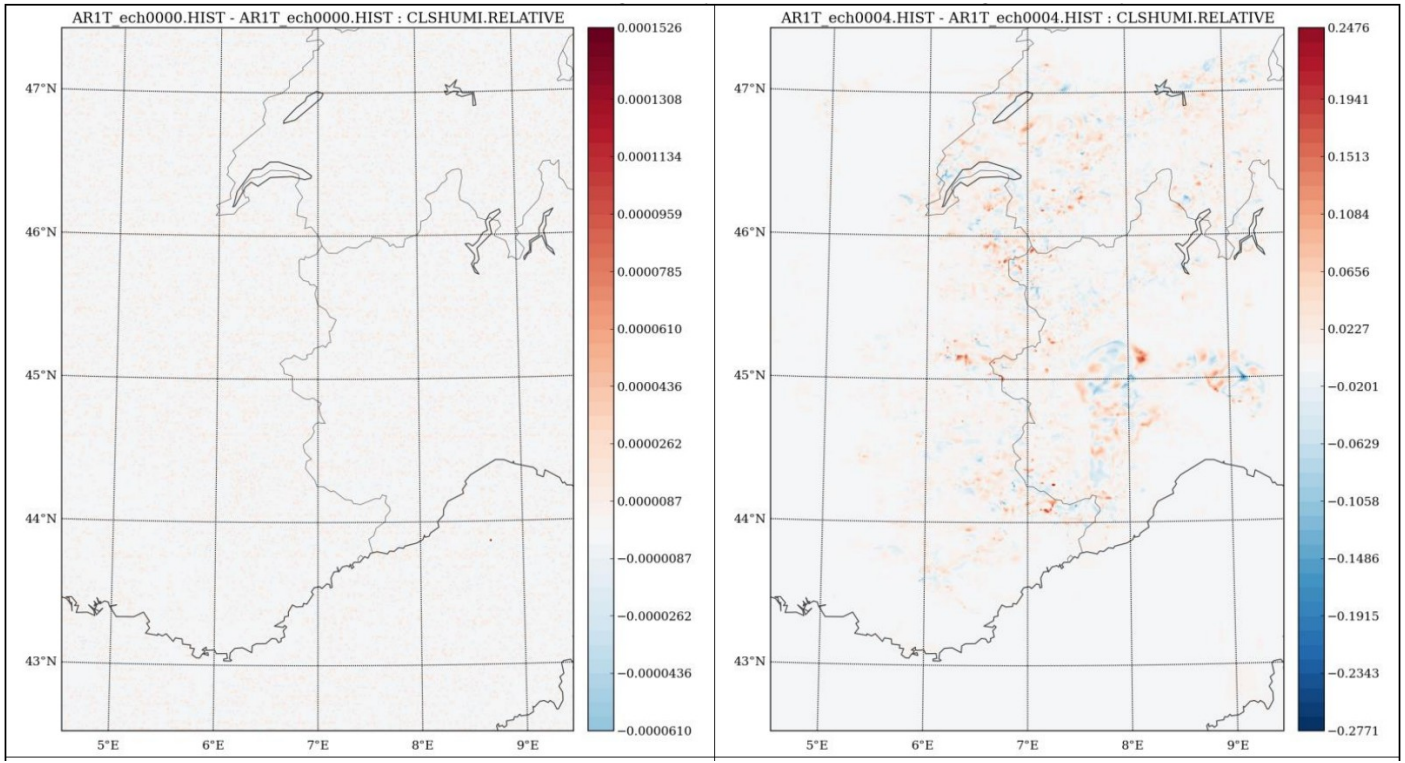
- **Administration and maintenance of the RC LACE web site and forum**



Differences in 2m relative humidity after 12 hours of integration

ALADIN-LACE System Coordinator II

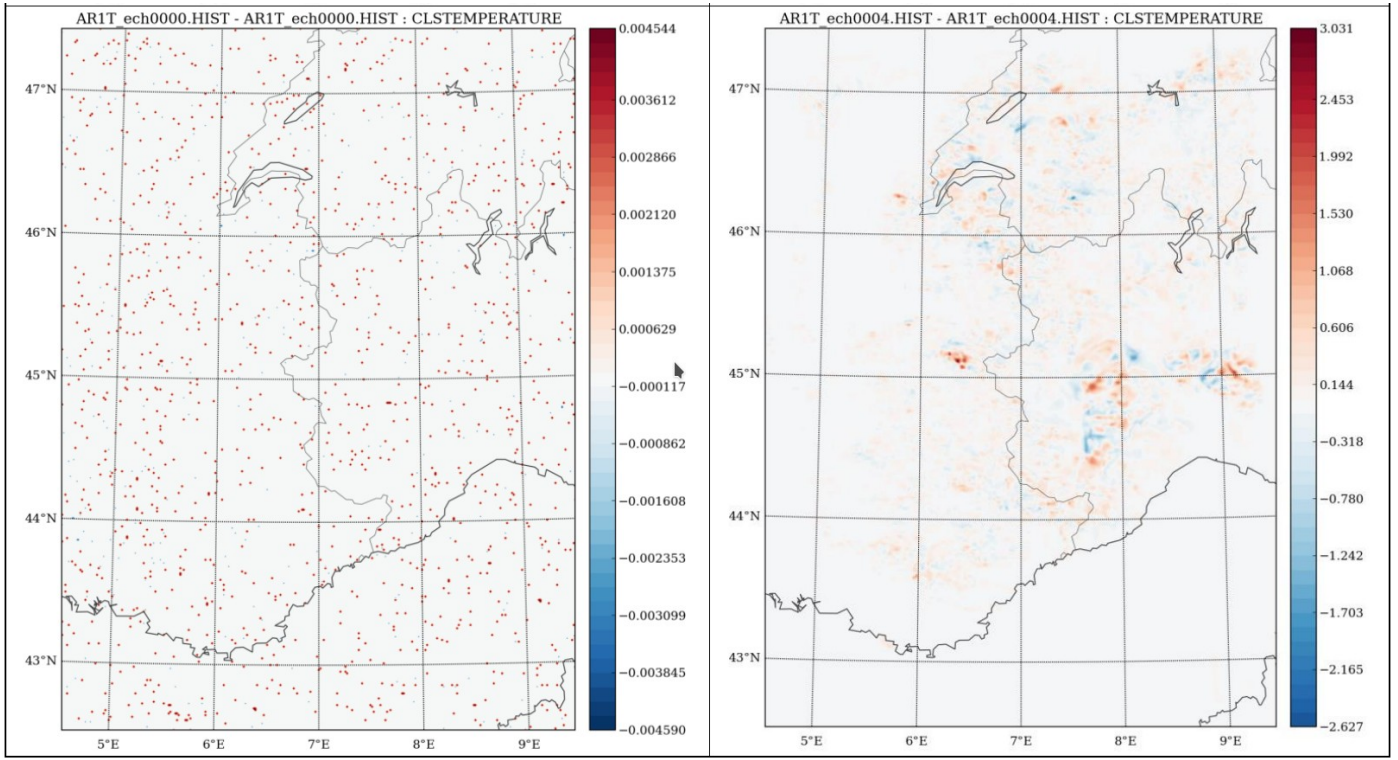
- **test single precision in cy43t2_bf06**
- one mitraillette test, AROME with CheapPCiter
- single precission needs 40% less time
- comparison of meteorological fields at initial time and 4 h forecast



Differences in AROME 2m relative humidity in the initial file (left) and after 4 hours of integration (right).

ALADIN-LACE System Coordinator III

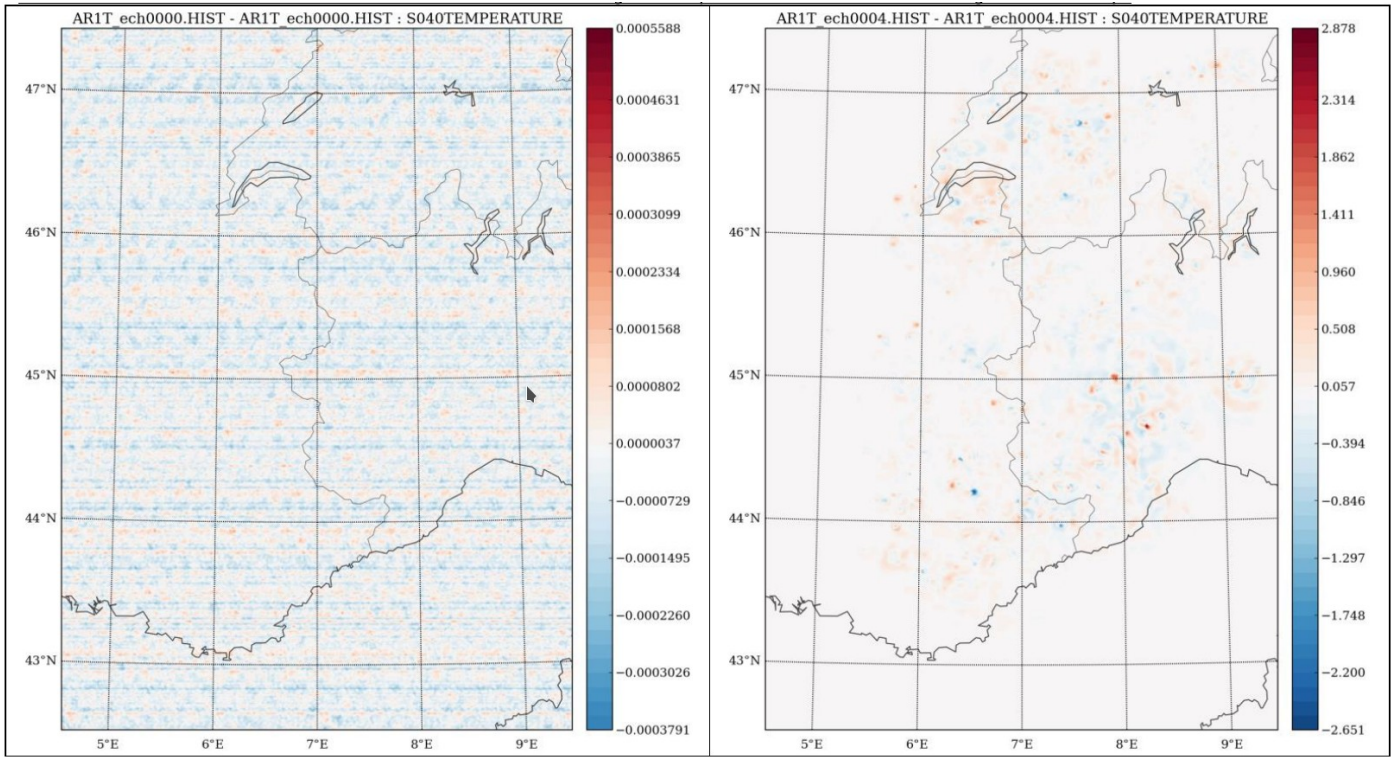
- **test single precision in cy43t2_bf06**
- one mitraillette test, AROME with CheapPCiter
- in the beginning the differences are random and negligibly small
- after 4 hour forecast, temperature and humidity show a clear signal in differences



Differences in AROME 2m **temperature** in the initial file (left) and after 4 hours of integration (right).

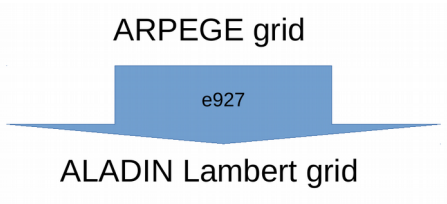
ALADIN-LACE System Coordinator IV

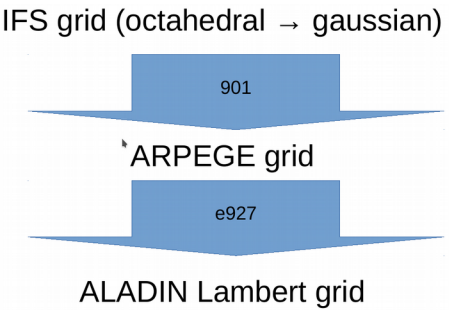
• **plans**
- adiabatic runs, switching off different model components, trying to diagnose where the differences come from
- ALARO physics

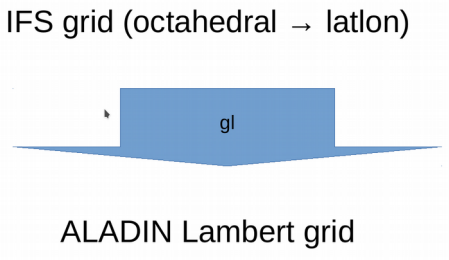


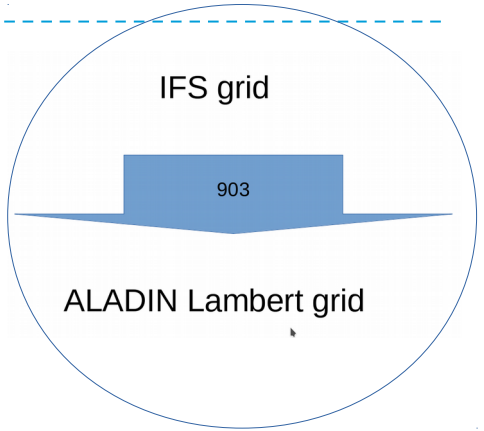
Differences in AROME S40 **temperature** in the initial file (left) and after 4 hours of integration (right).

Operational LACE LBCs from IFS









Currently

ARPEGE: 8 km resolution, 105 levels
IFS: 15.4 km resolution, 60 levels
LBCs are on a quadratic grid

IFS HRES LBCs use a combination of configurations 901 and e927, but 901 requires data on reduced GG for input

IFS ENS LBCs use gl (and e927 for vertical interpolations)

Configuration 903 is working!
Thank you Ryad El Khatib!
Testing under way

Data assimilation area

Operational implementation of full data assimilation systems
- combined upper air and surface data assimilation in all countries

(Two-)hourly updated data assimilation systems - AROME 1.2 km in At

Background error statistics in 3DVar - ensemble based B matrix (Sk, Cr)

Surface data assimilation using extended Kalman filter (At, Sk)

Radiance observations in DA systems
- a new configuration of VarBC suitable for LAM

Link to web page with reports

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

Radar reflectivity and radial wind
- back-phased BATOR, quality check OPERA, homogenisation pre-processor

Assimilation of GNSS path delays and Mode-S observations

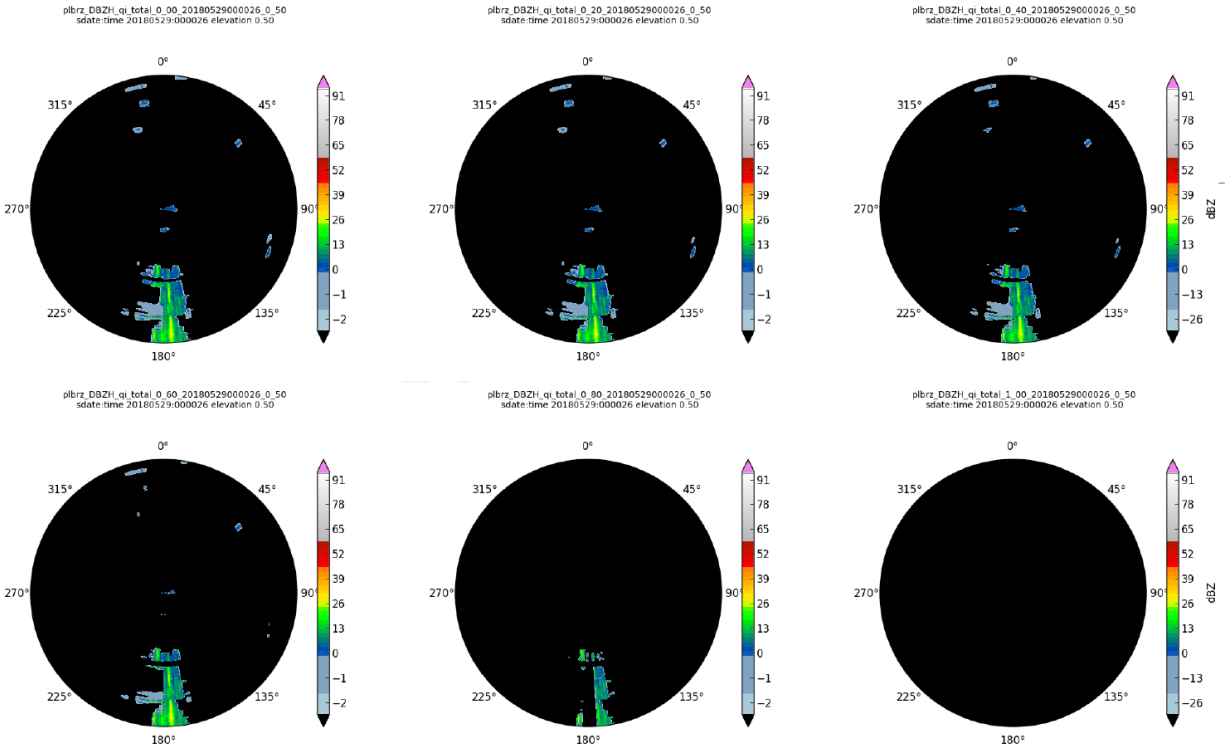
See presentation by Antonín Bučánek on Tuesday 15:00!

Radar data assimilation

The review of available technical solutions for radar data pre-processing
OPERA data for the radar data from abroad, but additional preprocessing is needed
The radar data homogenisation is essential for the radar data assimilation!

Spurious echoes remain in the OPERA data even for large values of total quality index.

We can't fully rely on OPERA QI. The QC of radar data seems beyond the scope of NWP but it is essential for the data assimilation.



Filtered DBZH values below the threshold of 0, 0.2, 0.4 (top) and 0.6, 0.8 and 1 (bottom) Sof the OPERA total quality index (pl total) for plbrz (Brzuchania).

Dynamics and coupling area

Design of vertical finite elements scheme for NH version of the model

- Jozef Vivoda, Petra Smolíková, Juan Simarro, “Finite elements used in the vertical discretization of the fully compressible core of the ALADIN system”, accepted in MWR, 2018.

Tuning and redesign of the horizontal diffusion depending on the scale

- Several high resolution tests have been prepared in frame of the preparation work of the next operational suite of CHMI

http://www.rclace.eu/?page=13

Link to web page with reports

Dynamic definition of the iterative time scheme

- implemented in the code on the base of cy43t2 and phased to cy46t1

Terms redistribution through new vertical motion variables

- New definitions of the vertical motion variable are proposed (w5 and w6), implemented in cy46

Tuning the wind field dynamical adaptation in very high resolutions

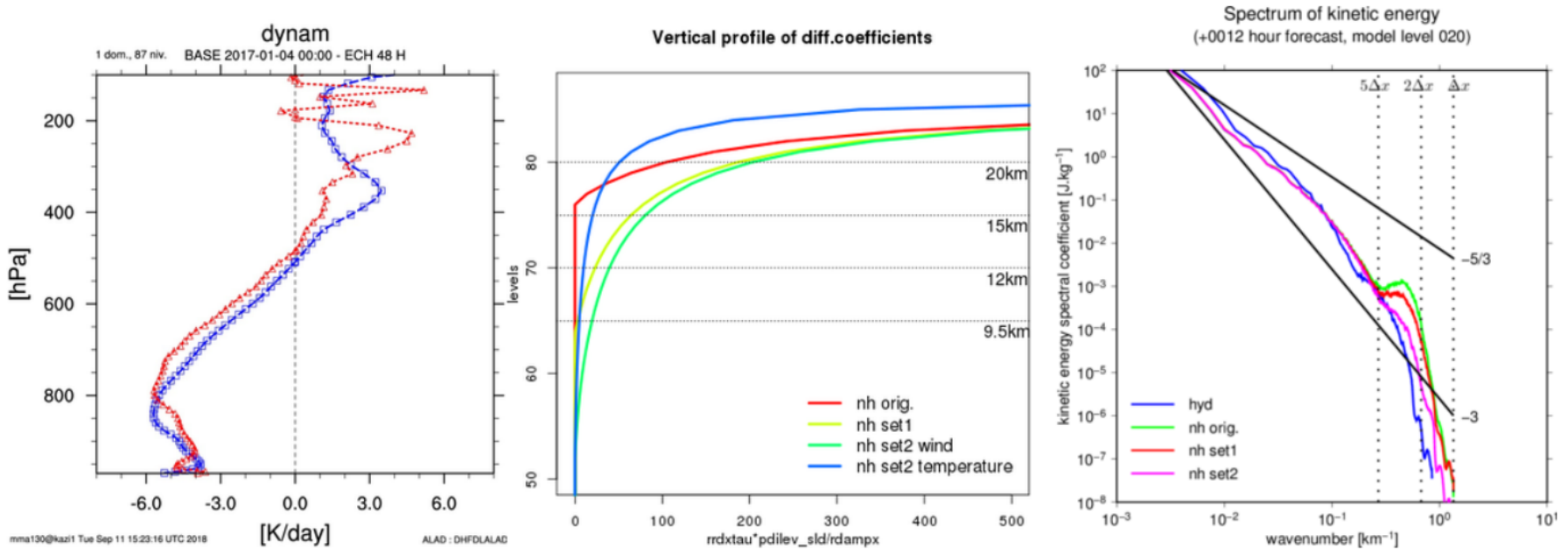
- 500 m and 250 m resolution experiments were run using high resolution topography

See presentation by Petra Smolíková on Tuesday 11:30!

Dynamics and coupling area

Tuning and redesign of the horizontal diffusion depending on the scale

- Several high resolution tests have been prepared in frame of the preparation work of the next operational suite of CHMI



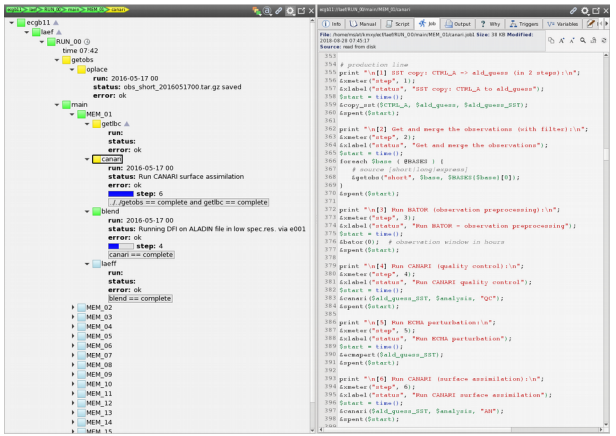
DDH characteristics (left) temp. tend dyn part for HY (red) and NH (blue), the reduced spectral diffusion coefficient vertical profiles (middle) and and kinetic energy spectra at lev 20 (right).

Predictability area

Operational

LACE nwp central europe

Optimization of ALADIN- LAEF
- B-matrix for the new ALADIN-LAEF
- validation of ENS 3DVar within ALADIN-LAEF Phase II
- analog based post-processing



ALADIN-LAEF maintenance
- operational ecFlow suite for the new ALADIN-LAEF

AROME-EPS
- developments at OMSZ and ZAMG, stochastic pattern generator and Jk 3DVar method

EPS-verificaton
ALADIN-LAEF verification tool is being developed

Collaborations
- new probabilistic methodologies to predict severe weather conditions

Link to web page with reports

Publications **http://www.rclace.eu/?page=40**

See presentation by Martin Belluš on Wedesday 11:00!

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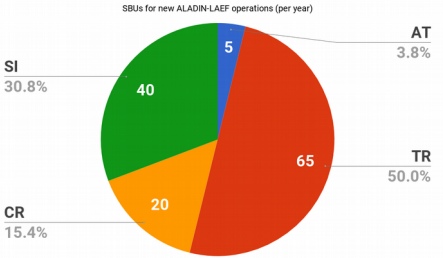
Predictability area

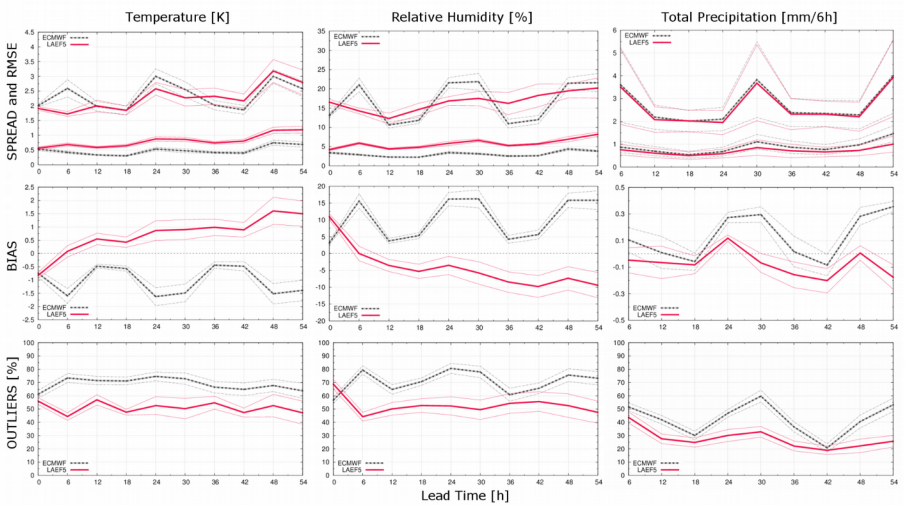
LACE
nwp central europe

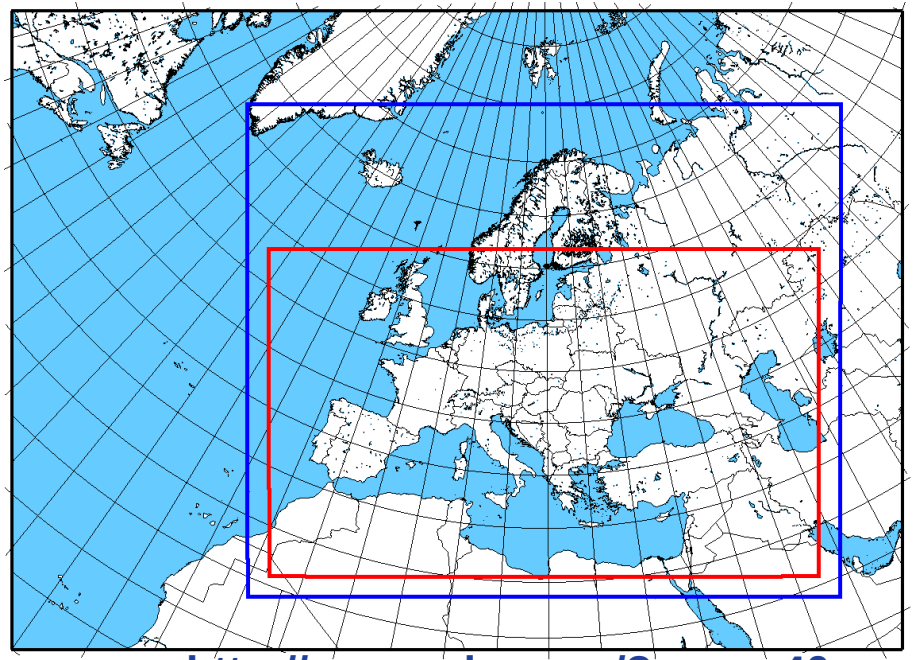
Operational ALADIN- LAEF

- resolution 4.8 km,60 levs, new domain
- new physics and perturbations
- 12x increase in total cost
- operational ecFlow suite for the new ALADIN-LAEF

Operational







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Link to web page with reports

See presentation by Martin Belluš on Wedesday 11:00!

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Physics area

TOUCANS turbulence scheme
- shallow convection closure: tuning, possible improvement in the vertical profile definition,
- analysis of numerical protection algorithm for the equation solver
- implementation of TKE-based length scales
- DDH for TOUCANS – put prog. eqs. for TKE and TTE terms into DDH arrays

Radiation scheme
- Cheap calculation of clear sky fluxes, optimized intermittent storage, further improvement in calculation of direct solar flux is planned to be done in September with aim to enter cy46t1.

Cloud scheme (ALARO-1)
- the harmonisation of radiative clouds and condensates with the microphysics cloud fraction and prognostic condensates

Microphysics (AROME and ALARO-1)
- aerosol initialization in LIMA, hail diagnostics and super cooled rain validation in ICE3, validation of prognostic graupel in ALARO-1

See presentation by Neva Pristov on Monday 15:20!

Physics area

Operational applications from ALARO-0 to ALARO-1 and SURFEX
- validation and operational use of ALARO-1vB in local applications (Cz, Hu, Ro)
- scientifically consistent ALARO transition from ISBA to SURFEX surface scheme ensured

http://www.rclace.eu/?page=12

Link to web page with reports

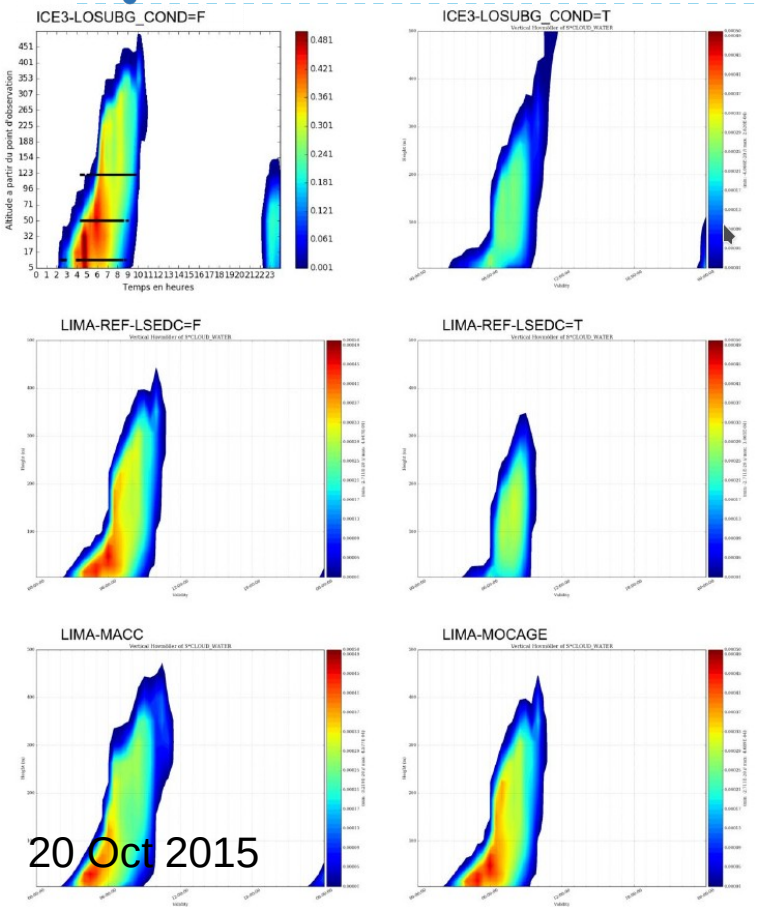
The ALARO-1vB version
Maintenance of ALARO CMC
Products for users
- hail probability, aviation related diagnostics, visibility, convective diagnostics pack

Off-line SURFEX
- ImagineS system based on offline SURFEX with ISBA-Ags (currently with 10 day time lag) - Hu
- Crocus snow pack model based on INCA analysis and ALADIN DLW – Si
- downscaling tool – Si, Sk

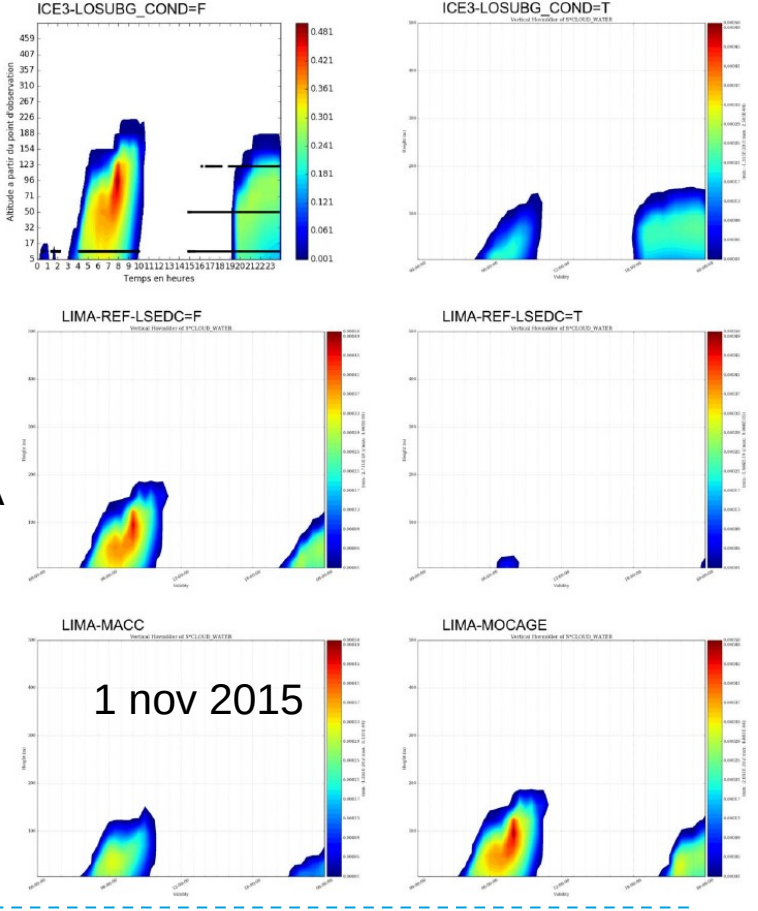
Coupling with waves/ocean
- operational wave modelling with Wind Wave Model (paper)
- Impact of two-way coupling and sea surface temeprature on precipitation forecast in regional atmosphere (paper)

See presentation by Neva Pristov on Monday 15:20!

LIMA scheme in AROME



Time-height cross section of LWC on 22nd October 2015 in 6 different cases: ICE3 without (a) and with (b) subgrid condensation, LIMA-REF with (d) and without (c) cloud sedimentation, LIMA with MACC (e) and LIMA with MOCAGE (f). In figure (a) the black horizontal lines show the observations: the duration of the fog (3 levels: 10m, 50m, 120m



Thank you

Petra Smolíková, Neva Pristov, Martin Belluš, Antonín Bučánek, Alena Trojáková, Oldřich Španiel, Radmila Brožkova, Jure Cedilnik, Jozef Vivoda, Tomislav Kovačić, Mihaly Szucs, Christoph Wittmann, Jan Mašek, Mario Hrastinski, Bogdan Bochanek, David Lancz, Simona Tasku, Benedikt Štrajnar, Patrik Benaček, Viktoria Hommonai, Florian Meier, Mirela Pietrisi, Maria Derkova, Antonio Stanešić, Stefan Schneider, J. Vural, Helga Toth, Viktor Tarjani, Peter Smerkol, Mate Mester, Michal Nestiak, Martin Imrišek, Katarina Catlosova, P. Scheffknecht, Martin Dian, Balasz Szintai, J. Kemetmuller, Piotr Sekula, Matjaž Ličar, Iris Odak Plenković, Florian Weidle, Reka Suga, Clemens Wastl, Endi Keresturi, Stjepan Ivatek-Šahdan, Mathieu Dutour Sikirić, Mate Mile and Yong Wang.

Publications

Publications

Wang Y., M. Belluš, A. Ehrlich, M. Mile, N. Pristov, P. Smolíková, O. Španiel, A. Trojáková, R. Brožková, J. Cedilnik, D. Klarić, T. Kovačić, J. Mašek, F. Meier, B. Szintai, S. Tascu, J. Vivoda, C. Wastl, Ch. Wittmann, 2017: “27 years of Regional Co-operation for Limited Area Modelling in Central Europe (RC LACE)”, published online on 23 July 2018 in BAMS, DOI:10.1175/BAMS-D-16-0321.1

Ihász I., A. Mátrai, B. Szintai, M. Szűcs, I. Bonta, 2017: “Application of European numerical weather prediction models for hydrological purposes”, published in Időjárás on January 2018, DOI: 10.28974/idojaras.2018.1.5

Dávid Lancz, Balázs Szintai, Rachel Honnert: Modification of shallow convection parametrization in the gray zone in a mesoscale model, Boundary-Layer Meteorology, 2018, manuscript submitted to publication

Bašták Ďurán, I., Geleyn, J.-F., Váňa, F., Schmidli, J., and R. Brožková, 2018: A turbulence scheme with two prognostic turbulence energies. Journal of the Atmospheric Sciences, https://journals.ametsoc.org/doi/full/10.1175/JAS-D-18-0026.1

Dutour Sikirić, M., Ivanković, D., Roland, A. et al. 2018: Operational Wave Modelling in the Adriatic Sea with the Wind Wave Model, Pure Appl. Geophys. https://doi.org/10.1007/s00024-018-1954-2

Strajnar, B., J. Cedilnik, A. Fettich, M. Ličer, N. Pristov, P. Smerkol and J.Jerman, 2018: Impact of Two-way Coupling and Sea-surface Temperature on Precipitation Forecast in Regional Atmosphere and Ocean Model, manuscript submitted to publication

Jozef Vivoda, Petra Smolíková, Juan Simarro, Finite elements used in the vertical discretization of the fully compressible core of the ALADIN system. Mon. Wea. Rev. under review