NWP activities at ARSO (Slovenia)

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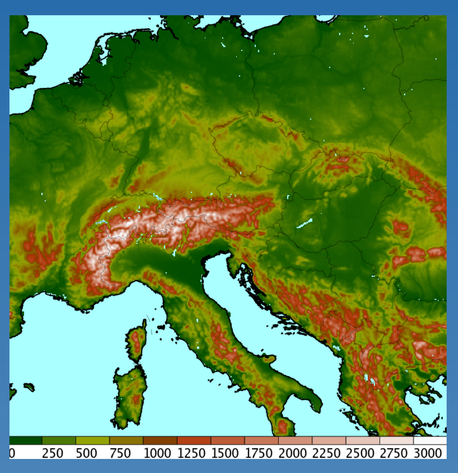
Operational suite (ALADIN-SI)

Model characteristics:
- code version cy43t2_bf10, ALARO-v1B physics,
- 4.4 km horizontal resolution, 87 vertical levels, 432 x 432 horizontal grid points,
- 180 s time step,
- coupling with ECMWF (6h lag), 1h (assim. cycle) / 3h (forecast),
- space-consistent LBC at initial time,
- production runs to 72 h (every 6 h), 4 runs to 36 h.

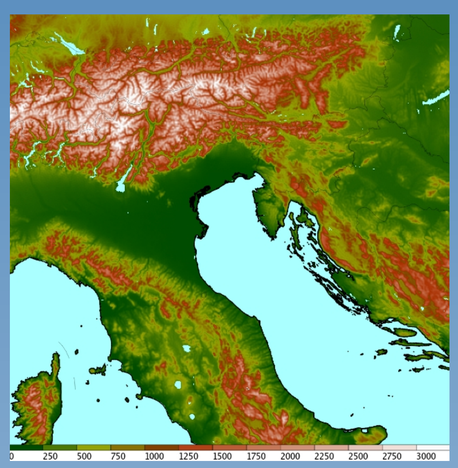
Data assimilation:
- 3h 3D-Var for atmosphere, OI for soil,
- static downscaled ensemble B-matrix,
- observations (mostly from the OPLACE system): SYNOP, AMV, HR-AMV, TEMP, AMSU&MHS, SEVIRI, IASI, ASCAT, OSCAT, Mode-S MRAR SI/CZ, MUAC EHS, ZTD (passive).



Operational ALARO 4.4 km/87L model domain.

ALARO-RUC for nowcasting

Setup:
- code version cy43t2_bf10, ALARO-v1B physics,
- 1.3 km horizontal resolution, 87 vertical levels, 589 x 589 horizontal grid points,
- domain centered in the North Adriatic Sea
- 60 s time step,
- coupling with ECMWF (lag 6h to 12h), every hour,
- space-consistent LBC at initial time,
- cutoff times:
  - assimilation: 70 min after nominal time,
  - production: 35 mins after nominal time,
- 36h forecasts every hour,
- upper-air DA: 1h 3D-Var, static ENS DSC B matrix,
- all observation as in operational + radar reflectivity,
- output every 5 min, plots and movies available for subjective validation.



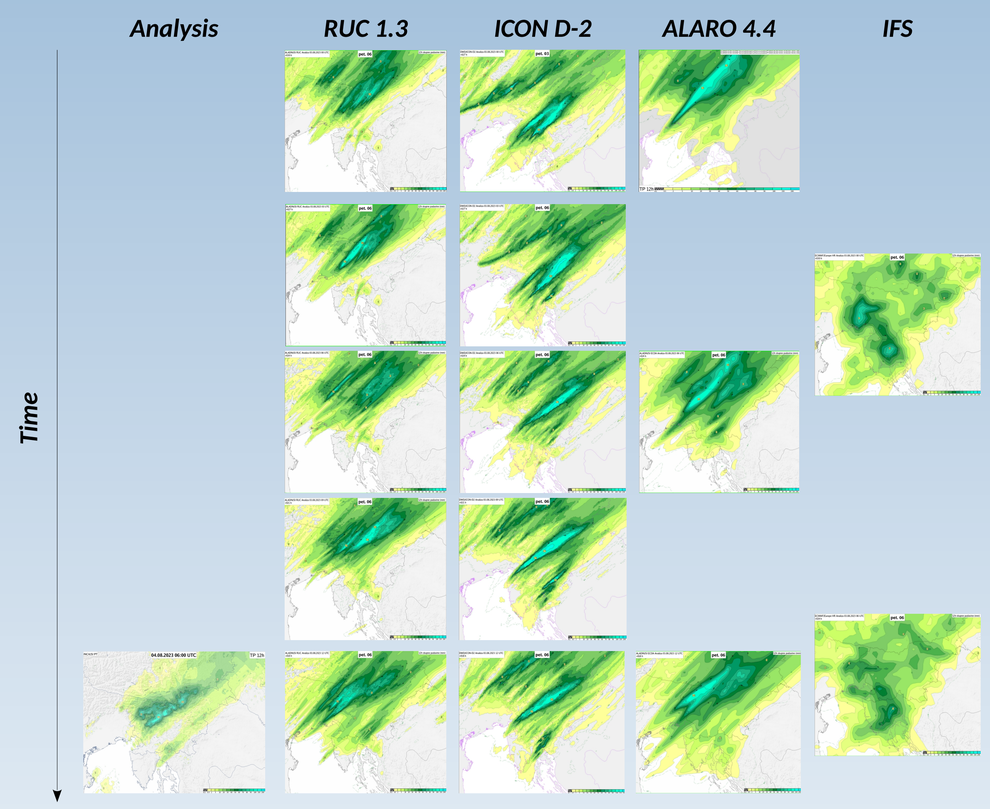
Operational 1.3 km/87L ALARO-RUC model domain.

The challenging weather of summer 2023

Fast moving long travelling storms
- frequently developing over SE of France and traveling for over 1000 km reaching southern Alps and beyond

Record tying hail size
- a hailstone of size 12 cm was observed

Extreme flash flood event
- the floods from beginning of August (over 200 mm in 24 hours across many stations)



12 accumulation of precipitation [mm] for the main flooding event of summer 2023 in Slovenia, for the night from 3rd to 4th of August: analysis [bottom left], consecutive runs for 1.3 km RUC model [second column], DWD ICON D-2 [third column], operational 4.4 km model [fourth column] and IFS model [last column].

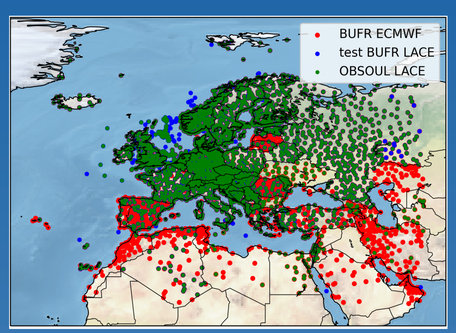
HPC system at ARSO

Technical characteristics (SGI ICE X):
- 190 Sandy Bridge/Broadwell compute nodes with 3160 cores,
- two Infiniband FDR networks,
- CEPH file system and HA NFS, robot tape libraries

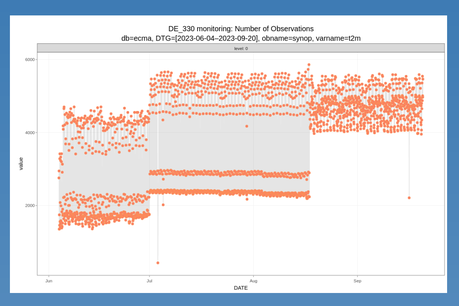
Software:
- OS: SGI ProPack on top of Suse Enterprise Server,
- Intel ONEAPI 21 compiler, openMPI 4.05,
- Open PBS job queueing system,
- EcFlow suite management.

DE_330 related activities (DestinE)

- Production of LBC from global IFS forecasts on large domain over Europe (DEOL) to be further used by local DE twin
- Monitoring of available observations for possible use in DA within local DE twin (mainly from ECMWF and OPLACE), with 30 min and 12 h cut-off time



DEOL domain with observations coming from various sources

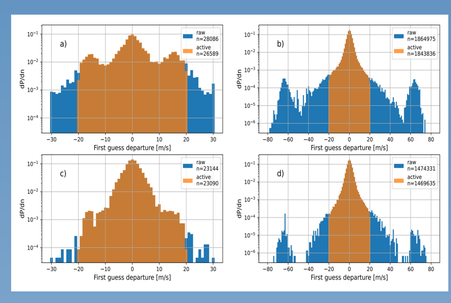


Increasing number of available (12h) surface stations included in European Observation Monitoring for DE_330 project

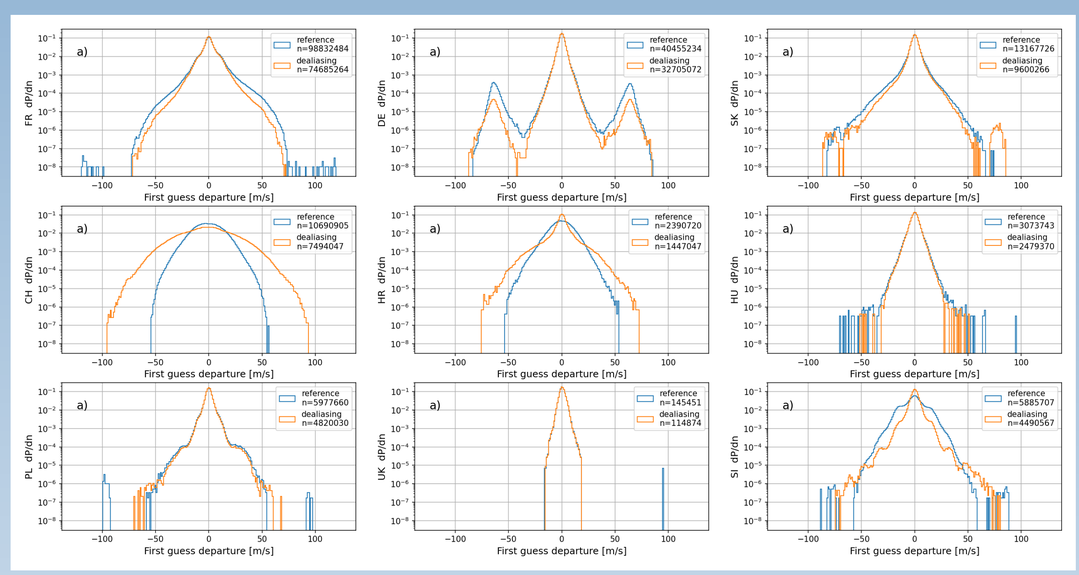
Number of rapidly available (30 min) surface observations for DE_330 observation monitoring

Validation of wind dealiasing

- Dealiasing using torus mapping method (Haase 2004),
- Analysis over whole year 2021:
  - Comparison of colocated observations of aircraft, radiosondes, radar,
  - Comparison of first guess departures in ALARO-SI domain,
  - Analysis of effect of DA quality control.
- Conclusions:
  - Torus mapping is robust, but dependent on noise,
  - Correctly dealiases ~90% of data,
  - Dealiasing significantly improves quality of radial wind measurements, radar observation quality is comparable to aircraft and radiosonde data,
  - Increases acceptance rate in DA, with a stricter quality control threshold for data with small NI proposed.
- Procedure is already included in Homogenization Of OPERA Files (HOOF) software in Python.



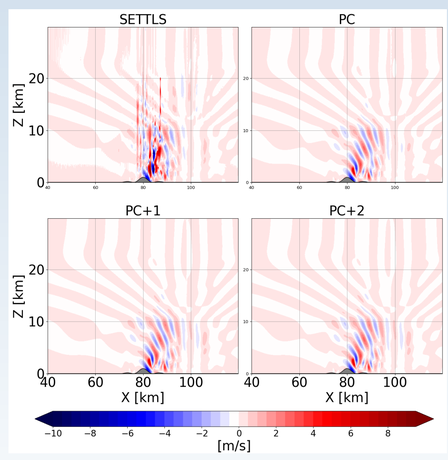
Distributions of first guess departures for data colocated with aircraft observations with or without quality control before (top row) and after (bottom row) dealiasing, for SI datasets (left column) and German datasets (right column).



Distributions of first guess departures for aliased (blue) and dealiased (orange) data for radar networks for each of the countries considered. Note the log y scale.

Stability analysis of a non-hydrostatic model

- Academic 2D experiments in the vertical plane using the non-hydrostatic model (cy46t1) to analyze the stability of various 2 TL SI schemes.
- Under the given conditions, the Stable Extrapolating Two Time-Level Semi-Lagrangian (SETTLS) scheme is found to diverge while the predictor-corrector (PC) scheme converges with increasing number of iterations.



Evolution of the non-hydrostatic vertical wind over an orographic barrier after one hour, calculated by different schemes: SETTLS (top left), ordinary PC (top right), PC with one (bottom left) and two (bottom right) additional steps. The spatial discretization was set to $\Delta x = \Delta z = 200$ m, the time step $\Delta t = 15$ s, and the initial horizontal wind to $v = 4$ m/s. The top of the hill is 1000 m high.