ACCORD activities at ARSO (Slovenia)

Jure Cedilnik, Jure Jerman, Nika Kastelec, Matjaž Ličar, Neva Pristov, Peter Smerkol, Benedikt Strajnar, Vito Švagelj

ARSO METEO
Slovenian Environment Agency

March 2023

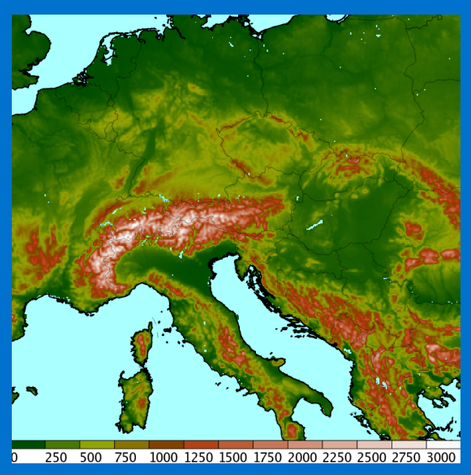
Operational suite (ALADIN-SI)

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).

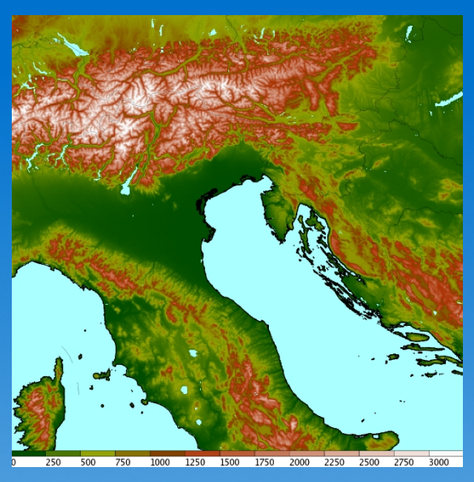


Operational ALARO 4.4 km/87L model domain.

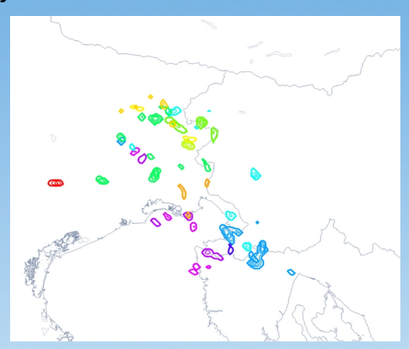
ALARO-RUC for nowcasting

Pre-operational setup:

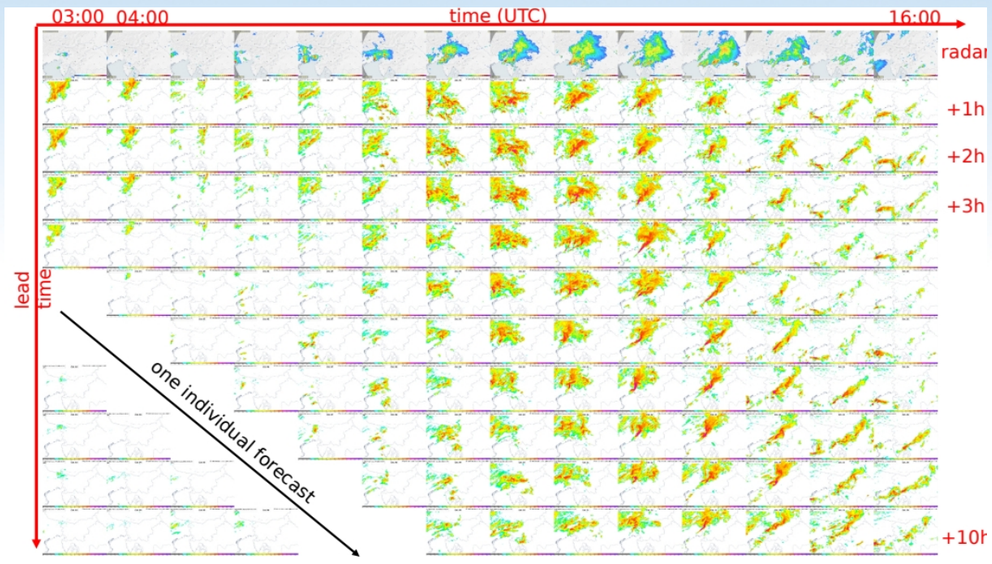
- code version cy43t2_bf10, ALARO-v1B physics,
- 1.3 km horizontal resolution, 87 vertical levels, 589 x 589 horizontal grid points,
- domain centered in the North Adriatic Sea
- 60 s time step,
- coupling with ECMWF (lag 6h to 12h), every hour,
- space-consistent LBC at initial time,
- cutoff times:
  - 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.



Pre-operational 1.3 km/87L ALARO-RUC model domain.



Severe convection associated with advancing cold front in the N-Adriatic. Left: RUC lagged ensemble (only isolines of 45 dBz simulated reflectivity and above are shown) with rainbow color determining lead time (violet shortest, red longest). Right: observed radar reflectivity.



RUC validation: poststamp visualisation plot to investigate the ability to simulate convective activity in progress (first two rows) and model consistency from run to run (differences in each column).

HPC system at ARSO

Technical characteristics (SGI ICE X):

- 205 Intel Sandy Bridge compute nodes (3280 cores, E5-2670 @ 2.6 GHz) - each with 64 GB of memory,
- 11 Intel Broadwell compute nodes (308 cores),
- two Infiniband FDR networks,
- 500 TB of disk space (HA NFS),
- 300TB CEPH file system (new),
- robot tape libraries.

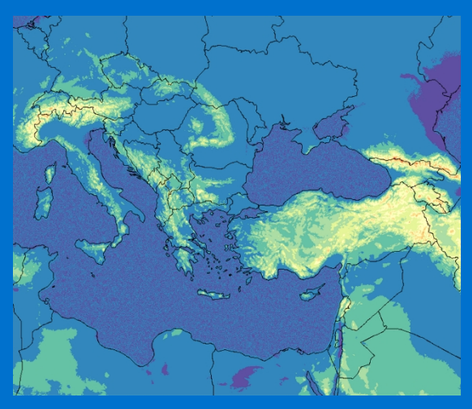
Software:

- OS: SGI ProPack on top of Suse Enterprise Server,
- 1api intel 21 compiler suite, openMPI 4.05,
- Open PBS job queueing system,
- EcFlow suite management.

Model system SEEMHEWS

One of the NWP models within the South-East European Multi-Hazard Early Warning Advisory System project:

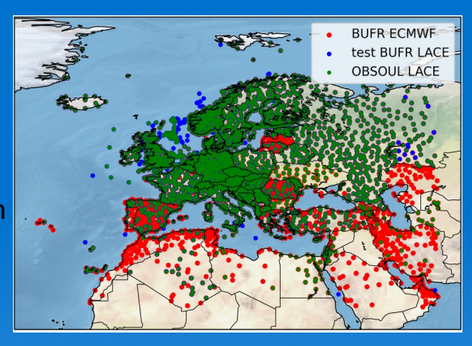
- runs at ECMWF infrastructure,
- same model version and assimilation setup as in operational ALADIN-SI,
- 2.5 km horizontal resolution, 87 vertical levels, 1429 x 1141 horizontal grid points,
- 90 s time step, non-hydrostatic,
- coupling with ECMWF, 1h (assim. cycle) / 3h (forecast),
- observations from OPLACE preprocessing system, additional regional observations available and tested.



Model domain of SEEMHEWS 2.5 km/87L model domain, run daily at ECMWF HPC.

DE_330 related activities (DestinE)

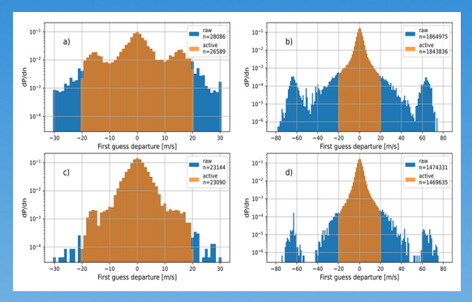
- Production of LBC from global IFS forecasts on large domain over Europe (DEOL) to be further used by local DE twin
- Monitoring of available observations for possible use in DA within local DE twin (mainly from ECMWF and OPLACE), with 30 min and 12 h cut-off time



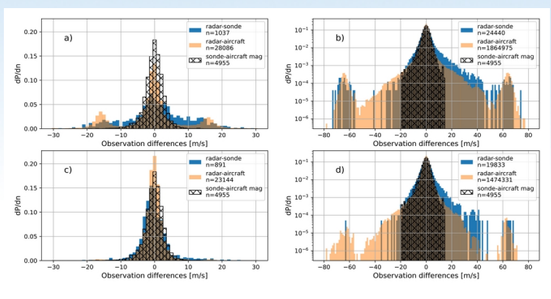
DEOL domain with observations coming from various sources

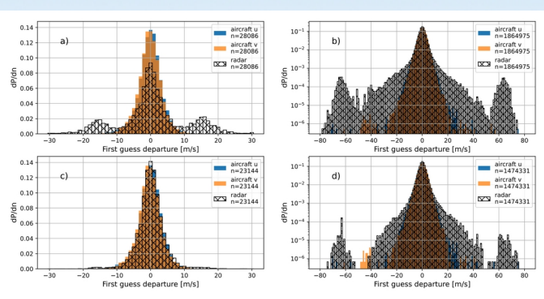
Validation of wind dealiasing

- 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.
- Low NI (~8 m/s) data from Slovenian radars, High NI data (>~ 30 m/s) from German, Slovakian, French radars.
- Conclusions:
  - Torus mapping is robust, although 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,
  - 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 HOOF.



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

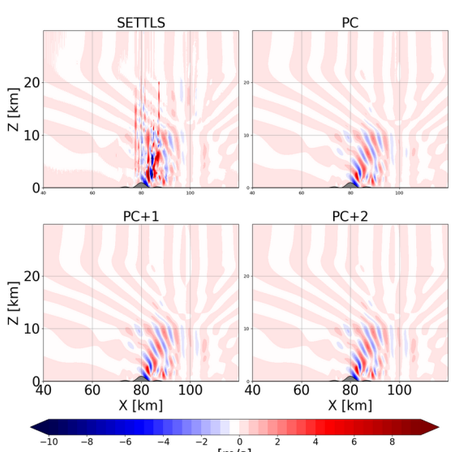




Distributions of differences of colocated observations (left figure) and first guess departures (right figure). Top rows showing aliased and bottom rows dealiased data. For datasets with small NI (left columns) and bigger NI (right columns). Side peaks corresponding to N=+/-1 are reduced by an order of magnitude.

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 SETTLS scheme is found to diverge while the predictor-corrector 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. The spatial discretization was set to Δx = Δz = 200 m, the time step Δt = 15 s, and the initial horizontal wind to v = 4 m/s. The top of the hill is 1000 m high.