NWP activities at ARSO (Slovenia)

Neva Pristov, Benedikt Strajnar, Jure Cedilnik, Peter Smerkol, Matjaž Ličar, Vito Švagelj, Jure Jerman, Matjaž Ličer, Anja Fettich

ARSO METEO
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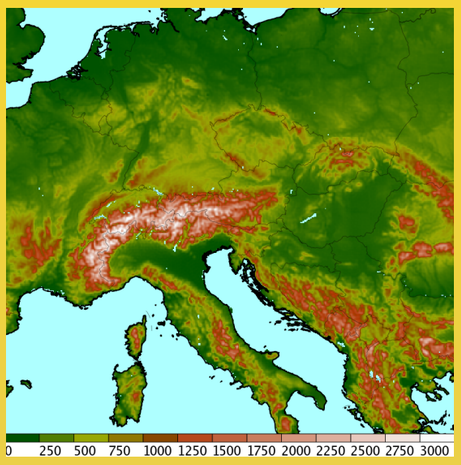
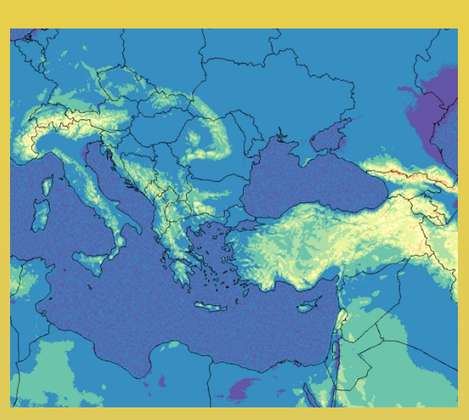
Operational suite (ALADIN-SI)
Model characteristics:
- code version cy43t2_bf10, ALARO-v1B physics,
- 4.4 km horizontal resolution, 87 vertical levels, 432 x 432 horizontal grid points,
- 180 s time step,
- coupling with ECMWF (6h lag), 1h (assim. cycle) / 3h (forecast),
- space-consistent LBC at initial 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).

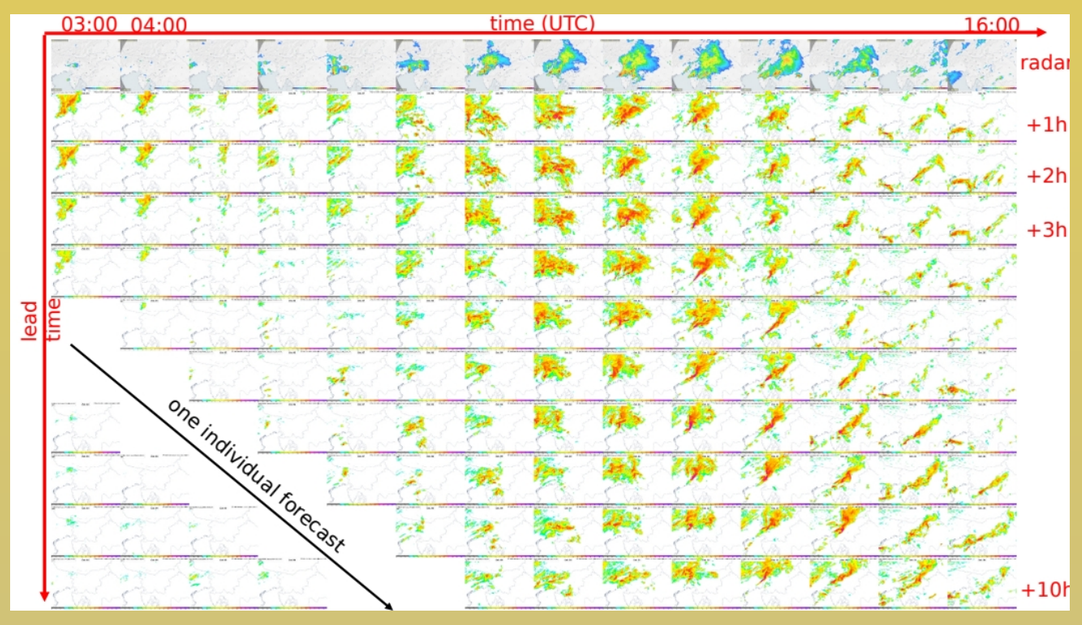


Operational ALARO 4.4 km/87L model domain.

Model system SEEMHEWS
One of the NWP models within the South-East European Multi-Hazard Early Warning Advisory System project:
- runs at ECMWF infrastructure (cca/ccb),
- 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.

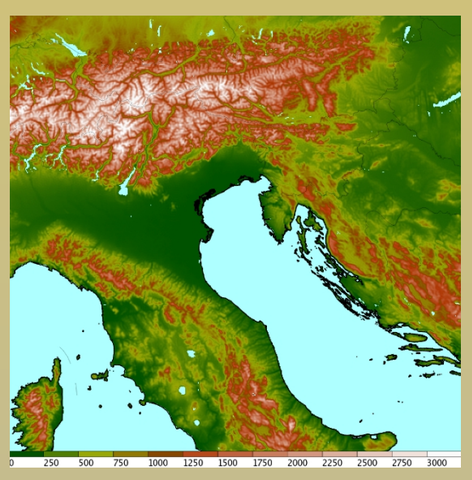


Model domain of SEEMHEWS 2.5 km/87L model domain, run daily at ECMWF HPC.

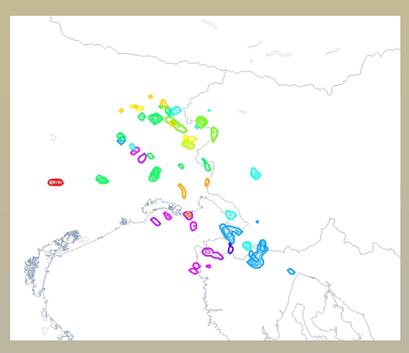


RUC validation: poststamp visualisation plot to investigate the abilty to simulate convective activity in progress (first two rows) and model consistency from run to run (differences in each column).

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,
- output every 5 min, plots and movies available for subjective validation.



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

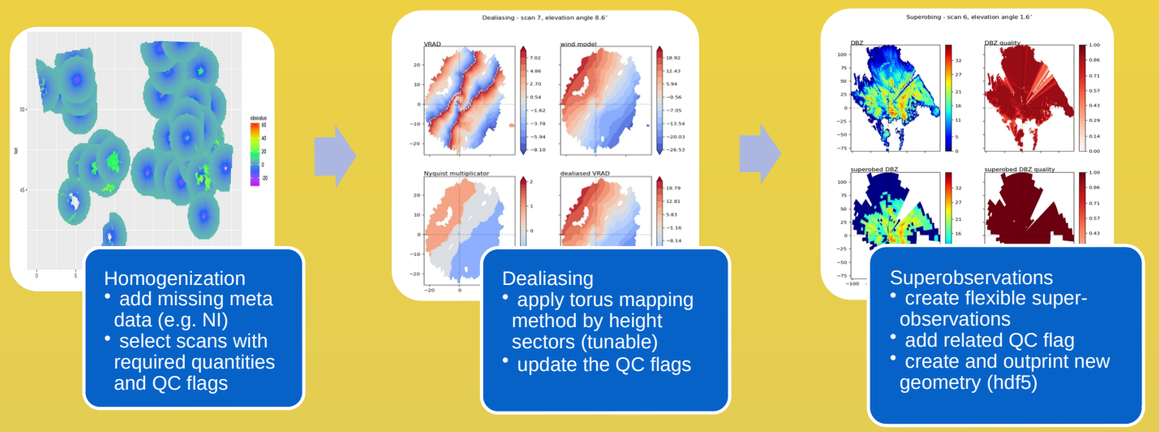


Severe convection associated with advancing cold front in the N-Adriatic. Left: RUC lagged ensemble (only isolines of 45 dBz simulated reflectivity and above are shown) with rainbow color determining lead time (violet shortest, red longest). Right: observed radar reflectivity.

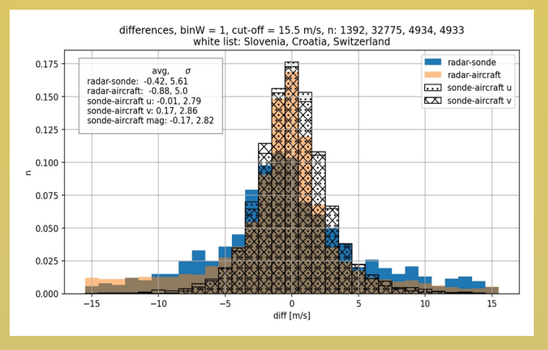
HPC system at ARSO
Technical characteristics (SGI ICE X):
- 205 Intel Sandy Bridge compute nodes (3280 cores, E5-2670 @ 2.6 GHz) - each with 64 GB of memory,
- 11 Intel Broadwell compute nodes (308 cores),
- two Infiniband FDR networks,
- 500 TB of disk space (HA NFS),
- 500 TB of disk space (HA NFS),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

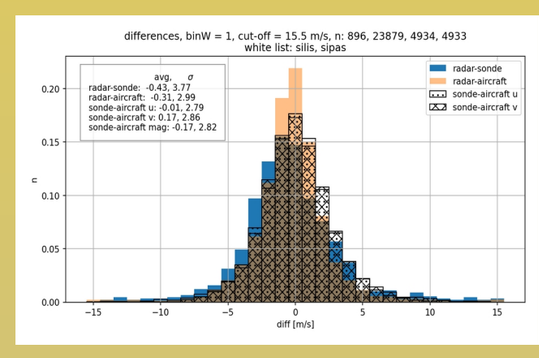
HOOF tool
A new version of the Homogenization Of OPERA Files (HOOF2) now implements additional functionalities:
- Homogenization of radar OPERA hdf5 data,
- Radial wind dealiasing using the torus mapping method,
- creation of super observations.

The Python-based system is flexible and namelist-driven and now also includes a GUI to easily check and plot the contents of output radar files.



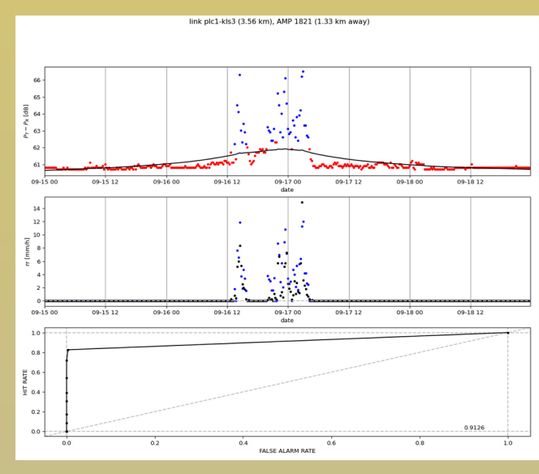
Validation of wind dealiasing
- Dealiasing method from HOOF evaluated over year 2021:
  - Inter comparison of collocated observations: aircraft, radiosondes,
  - Comparison of (passive) first guess departures.
- „Radial winds“ computed for aircraft, sondes,
- Low NI radars in the ALARO-SI domain: Switzerland, Croatia, Slovenia,
- Dealiasing introduced tails in difference distributions, 15 m/s background rejection limit reduces this,
- Improvements to dealiasing procedure implemented – to limit unsuccessful fits.





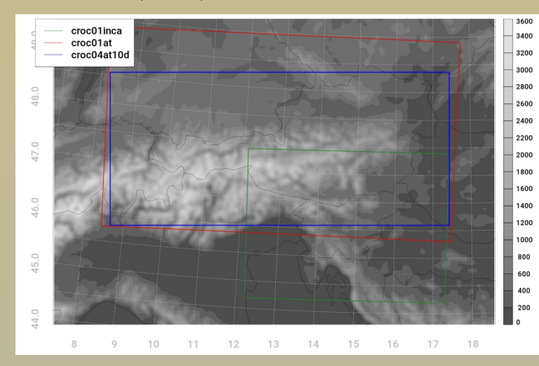
Distribution of differences for various observations. Left: for all low NI radars. Right: only 2 Slovenian radars, lower tails indicate less noise in data.

Rain rates from microlinks – new preprocessing
- rain rate observations from attenuation of microwave signals,
- 3 months of transmitted/received power data (1700 links on 15min intervals),
- attenuation expressed by Mie scattering calculations (Hergert et al.),
- main challenge: determining the baseline attenuation A_B – independent of rain rate. Baseline determined by factor graph algorithm (Loeliger et al., Reller et al.). Processing of time series of attenuation data implemented in Python and C++.



Example for one data link. Top: wet (blue),dry (red) points, calculated baseline (black line). Middle: rain rate (blue), measuring station (black). Bottom: ROC curve.

Snowpack modeling with SURFEX/Crocus
- Daily runs of the SURFEX land surface platform using the Crocus snowpack model are run on several domains. The system is run in offline mode with prescribed atmospheric forcing:
- 1km INCA-SI domain: 24h analysis with INCA-SI forcing, forecast +68h ALARO-4.4km forcing
- 1km INCA-AT domain: 24h analysis with INCA-AT forcing, forecasts +56h with AROME-AT forcing
- 4km domain: 24h analysis with INCA-AT forcing, forecast +236h with ECMWF forcing



The different domains for the SURFEX/Crocus snowpack model

Ocean modeling
The operational ocean system includes the following components:
- NEMO ocean circulation model
- WAM wave model
- ensemble of NEMO used for storm surge
- ocean particle tracking (OpenDrift).

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.