ALADIN in Slovenia - 2020

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ARSO METEO
Slovenian Environment Agency

HPC system

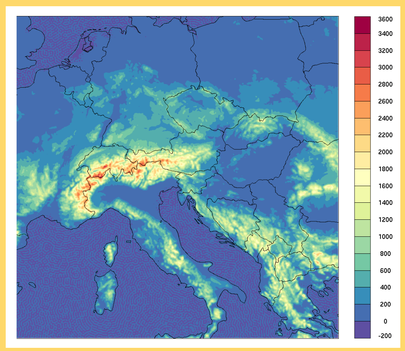
Technical characteristics (SGI ICE X):

- 61 Intel Sandy Bridge compute nodes (976 cores, E5-2670 @ 2.6 GHz) - each with 64 GB of memory,
- 11 Intel Broadwell compute nodes (308 cores),
- New in 2020: 108 Intel Sandy Bridge compute nodes (976 cores, E5-2670 @ 2.6 GHz) - each with 64 GB of memory,
- two Infiniband FDR networks,
- 500 TB of disk space (HA NFS),
- robot tape libraries.

Software:

- OS: SGI ProPack on top of Suse Entreprise Server,
- Intel Fortran compiler v16, openMPI,
- Altair PBS job queueing system,
- EcFlow suite management.

Operational suite (ALADIN-SI)



Model domain and orography of operational ALADIN-SI.

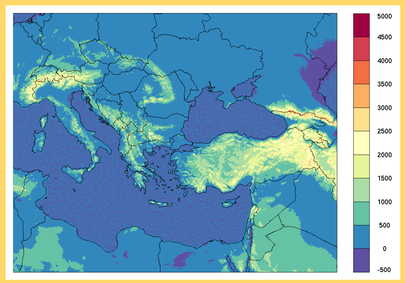
Model characteristics:

- 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, no initialization,
- 4 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.

ALADIN for SEE-MHEWS-A



Model domain of ALADIN-SEE-MHEWS.

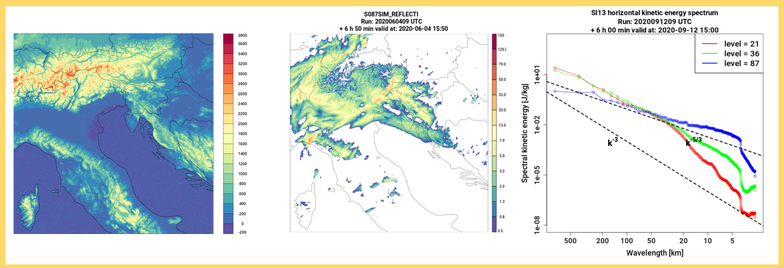
Within the South-East European Multi-Hazard Early Warning Advisory System (SEE-MHEWS-A) project, ARSO provides ALADIN results as one of NWP inputs:

- a dedicated setup at ECMWF infrastructure (c1a),
- 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,
- coupling with ECMWF, 1h (assim. cycle) / 3h (forecast),
- observations from OPLACE preprocessing system.

ALADIN for nowcasting

A prototype of a NWP-based hourly nowcasting system (NWCRUC) centered over North Adriatic is under development with the following characteristics:

- same model version as operational ALADIN-SI,
- 1.3 km horizontal resolution, 87 vertical levels, 589 x 589 horizontal grid points,
- 60 s time step,
- hourly assimilation cycle with 3D-VAR + OI,
- all observations + radar,
- regular runs, outputs available for evaluation.

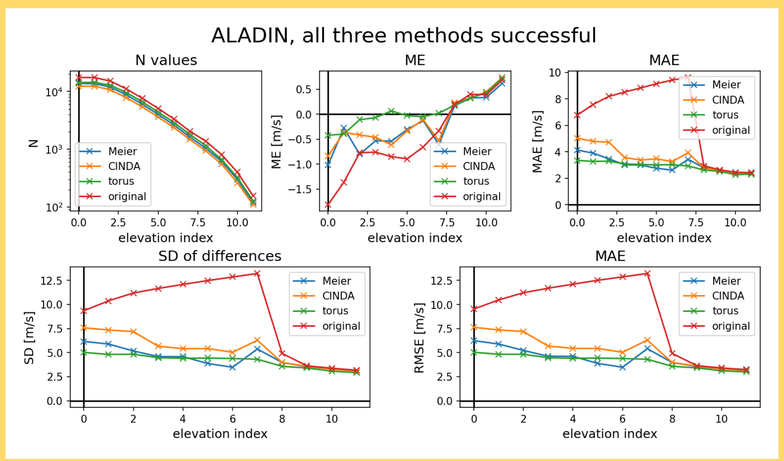


ALADIN-NWCRUC model domain (left), an example of simulated radar reflectivity field (middle) and kinetic energy spectra at several model levels (right).

Data assimilation

Test of method for Radar dealiasing:
In Slovenia, both radars provide Doppler wind measurements with Nyquist velocity of 8 m/s. Methods for wind dealiasing are investigated in order to be able to use winds for assimilation – dealiasing proved partly successful (on Slovenian radars):

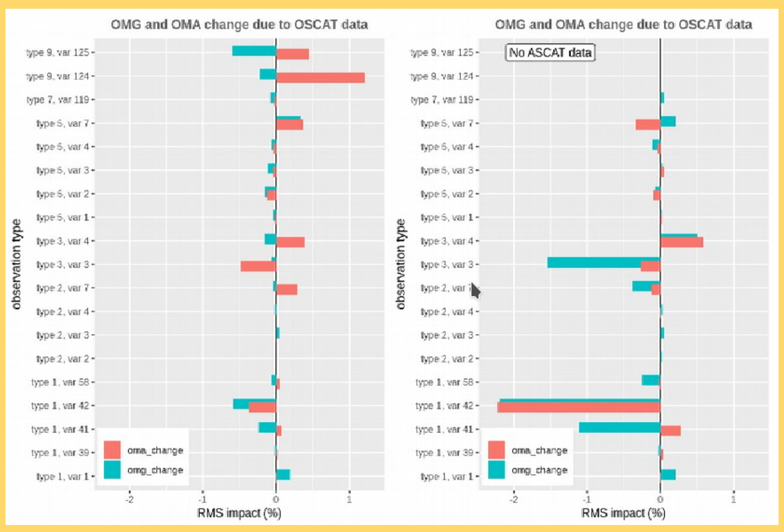
- 3 methods implemented (torus mapping, CINDA, method applied by ZAMG),
- verified for precipitation cases over 2 years,
- methods generally successful but robustness needs to be increased.



Statistics of Doppler wind departures wrt. ALADIN first guess for original (aliased) winds (red line) and 3 dealiased solutions. The uppermost 4 radar elevations are not aliased.

Assimilation of OSCAT scatterometer:
In order to better initialize wind over the Adriatic and Tyrrhenian Sea, scatterometer data from ScatSat-1 (India) was evalauted:

- 25 km resolution,
- available at 9 and 21 UTC, close to Metop-B,
- significant reduction of obs-minus-guess departures for surface wind,
- neutral impact on forecast scores.

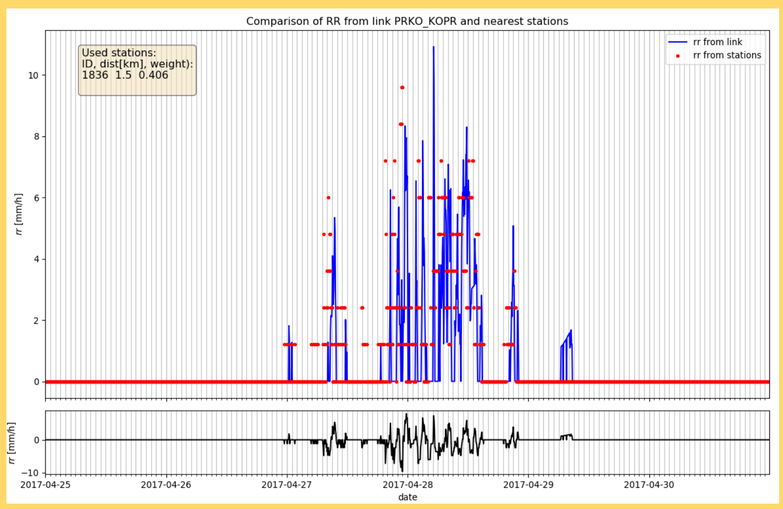


Obs-minus-guess departure change due to assimilated OSCAT in the case when ASCAT is used (left) or not used (right).

Attenuation of microwave links

Attenuation in microwave telecommunication links are interesting novel source of low level moisture information. A feasibility study with a sample data set from 600 data links in Slovenia was carried out:

- first challenge was to efficiently separate attenuation data in rainy and dry conditions,
- wet/dry period and attenuation dynamically modeled by factor graph approach,
- relation between attenuation and rain modeled as a power law.



Inter-comparison of rain estimates from microwave links (blue) and nearby station measurements (red dots).

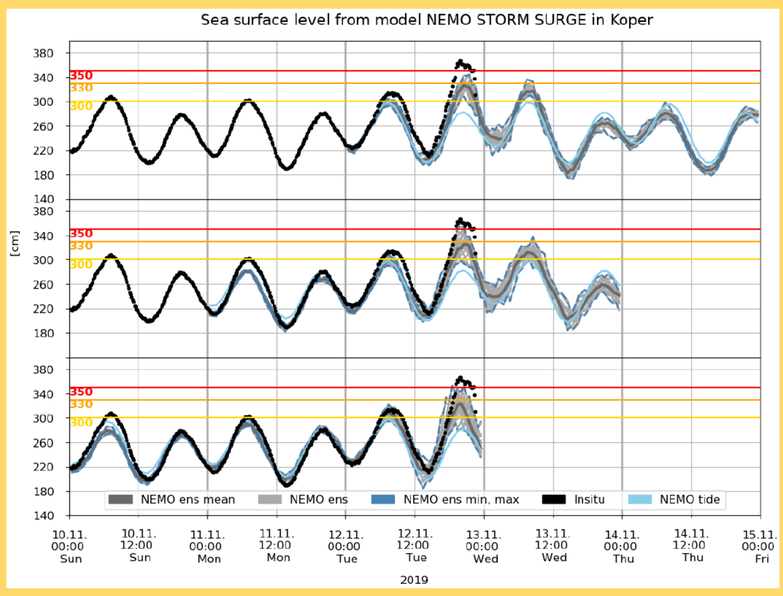
Operational ocean model

The operational ocean model includes the following components:

- NEMO ocean circulation model,
- WAM wave model,
- ensemble of NEMO used for storm surge,
- Shyfem ensemble used for storm surge,
- ocean particle tracking (OpenDrift).

NEMO STORM SURGE is an operational ensemble version of the NEMO ocean model, adapted to predict storm surges in the Gulf of Trieste:

- model domain is the Adriatic Sea,
- model resolution 1/72 degrees, 31 horizontal partial-step vertical z levels,
- lateral boundary conditions from CMEMS MFS,
- river runoffs of Soča (from the MIKE hydrological model) and Po (ARPAE measurements), climatological values for all the other rivers,
- surface conditions are obtained from ECMWF ensemble forecast,
- forecast is performed for 17 subseted members of the ECMWF ensembles,
- two runs per day, 72 h forecast,
- bias correction added every hour (according to the latest available measurements),
- a deep learning approach is also under development.



Sea surface level as predicted by NEMO STORM SURGE system.