# NWP activities at ARSO (Slovenia)

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**ARSO** METEO
Slovenian Environment Agency

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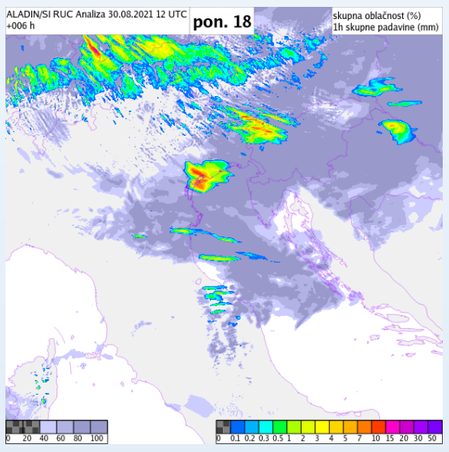
**RUC for Nowcasting**

- status: pre-operational since July 021
- 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 SIS4,+ radar
- output every 5 min, plots and movies available for subjective validation




Objective validation and impact of radar DA
4 experiments – 1 winter and summer month
4.4km OPER (default obs.), 4.4km OPER + radar refl.
1.3 km NWCRUC (default obs.),1.3 km NWCRUC + radar refl.
DA settings:
1.3 km: 1h cycle, thinning 10 km;4.4 km: 3h cycle, thinning 25 km

Technical issues:

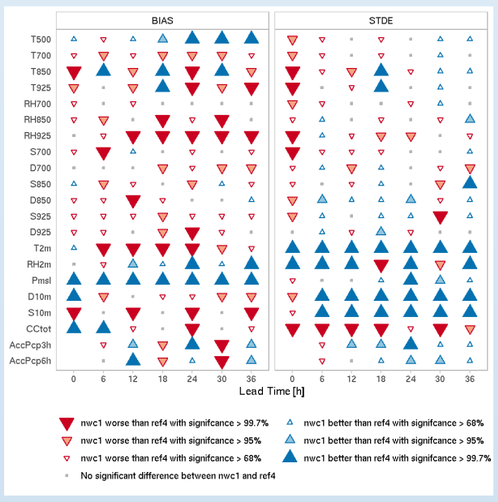
- timeliness of radar OPERA data (solved),
- radar data homogenization (HOOF)
  wind dealiasing using of the torus method and super observation to be tested

Scientific issues (subjective):

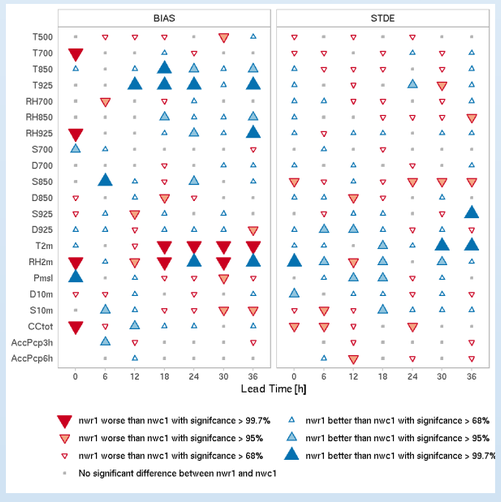
- light orographic precipitation over pronounced,
- convection well simulated,
- improvement of near surface feature (wind, temperature at 2m
- net drying observed by the reflectivity assimilation:
  important convective cases missed/damped
  spurious precipitation successfully removed from first guess
- model physiography to be improved.

Validation and evaluation still ongoing.

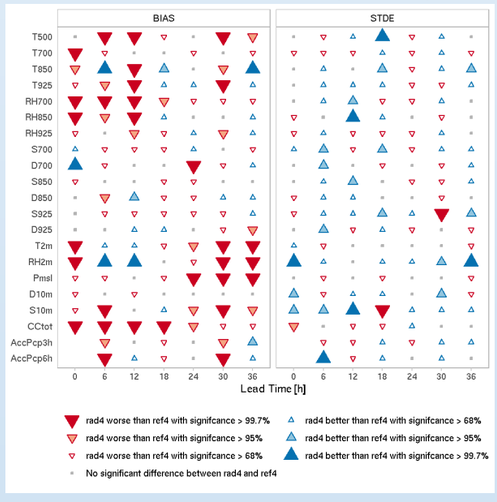
RUC (1.3 km) vs. OPER (4.4 km)

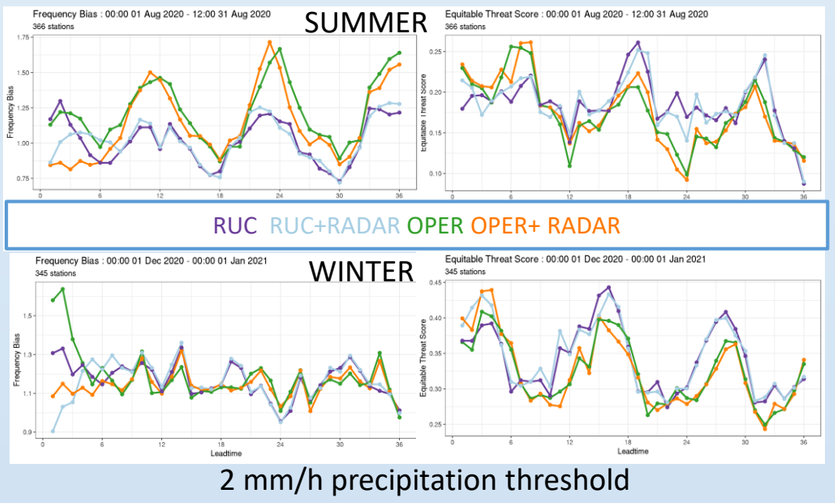



RADAR DA vs. REF RUC (1.3 km)




RADAR DA vs. REF OPER (4.4 km)




2 mm/h precipitation threshold

**HPC system**

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),
- 80 TB beegfs file system,
- 300TB ceph file system (new),
- robot tape libraries upgraded (new).

Software:

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

**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.

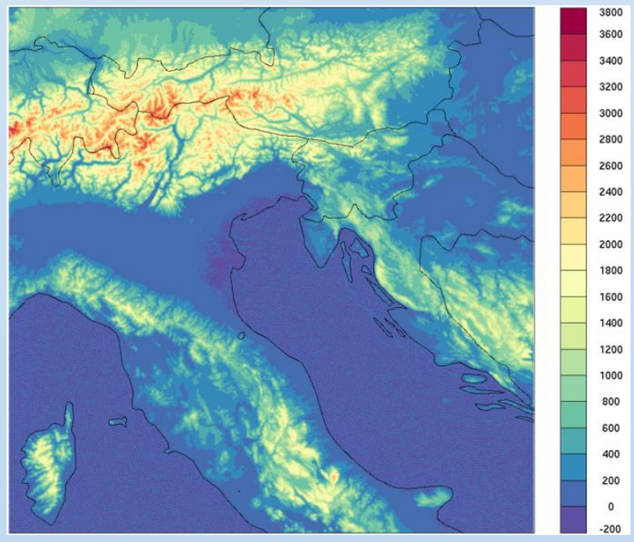
Data assimilation:

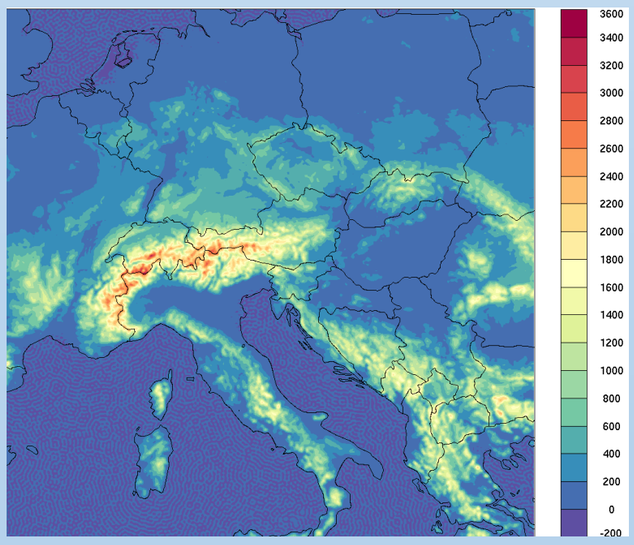
- 3h 3D-Var for atmosphere, OI for soil,
- static downscaled ensemble B-matrix,
- observations (mostly from the OPLACE system): SYNOP, AMV, HR-AMV, TEMP, AMSU&MHS, SEVIRI, IASI, ASCAT, OSCAT, Mode-S MRAR SI/CZ, MUAC EHS, ZTD (passive).

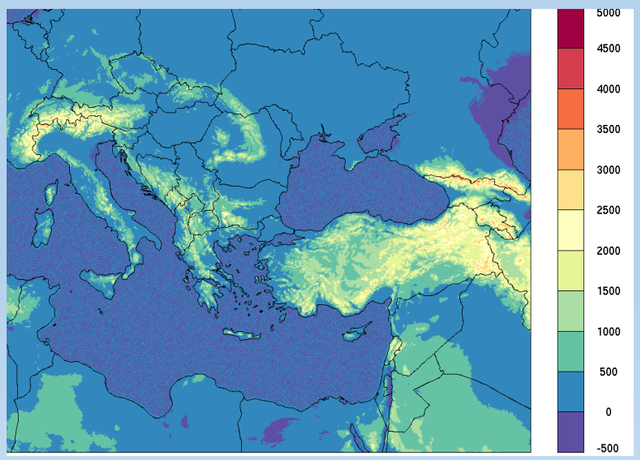
**Model system SEEMHEWS**

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

- setup 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.







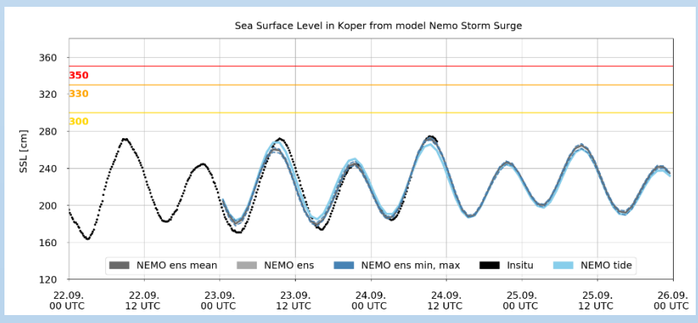
**Ocean modeling**

The operational ocean system 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,
- lateral boundary conditions from CMEMS MFS,
- 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.




HIDRA Deep Learning Ensemble (collaboration with Lojze Žust and Matej Kristan from FRI UL):

- trained on 2006-2016 ECMWF ensembles and Sea Level data from Koper tide-gauge,
- Deep Residual Convolutional Neural Network (based on ResNet20),
- spatial and temporal attention mechanisms,
- comparable performance to NEMO ensemble at 1e-6 numerical cost,
- fusion of atmospheric and oceanic features,
- fully operational at ARSO, with public operational results at https://lojzezust.github.io/hidra-visualization/en/
- more info: https://gmd.copernicus.org/articles/14/2057/2021/gmd-14-2057-2021.pdf