Limited Area Modeling in Slovenia - 2014

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Computer system

Technical characteristics (SGI ICE X):

- 62 compute nodes installed in two racks, every compute node has 32 GB of memory and 2 eight core Sandy Bridge processors(E5-2670 @ 2.6 GHz) (992 cores)
- two Infiniband FDR networks,
- 150 TB of disk space (HA NFS).

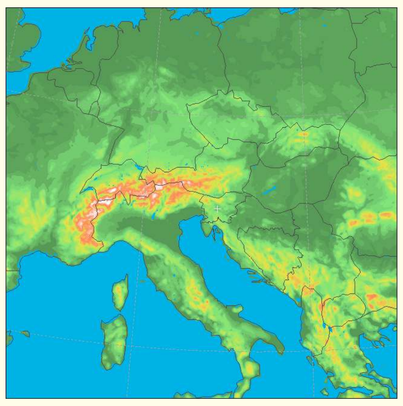
Programs:

- OS: SGI ProPack on top of Suse Entreprise Server,
- SGI MPI,
- Intel Fortran compiler, SGI mpt
- Altair PBS job queueing system,
- TotalView debugger.

Operational suite NEW

New operational 4.4 km RUC data assimilation suite:

- CY38T1, ALARO-0 baseline,
- 4.4 km horizontal grid spacing, 87 model levels,
- linear spectral elliptic truncation,
- Lambert projection,
- 421x421 points, (with extension zone 432x432), E215x215,
- 180 s time-step,
- four production runs per day:
  00, 06, 12, 18, forecast up to 72 hours,
  additionally four runs 03, 09, 15, 21 up to 36 hours,
- coupling at every 3 hours, LBC from IFS model (time lagged coupling),
- data assimilation.



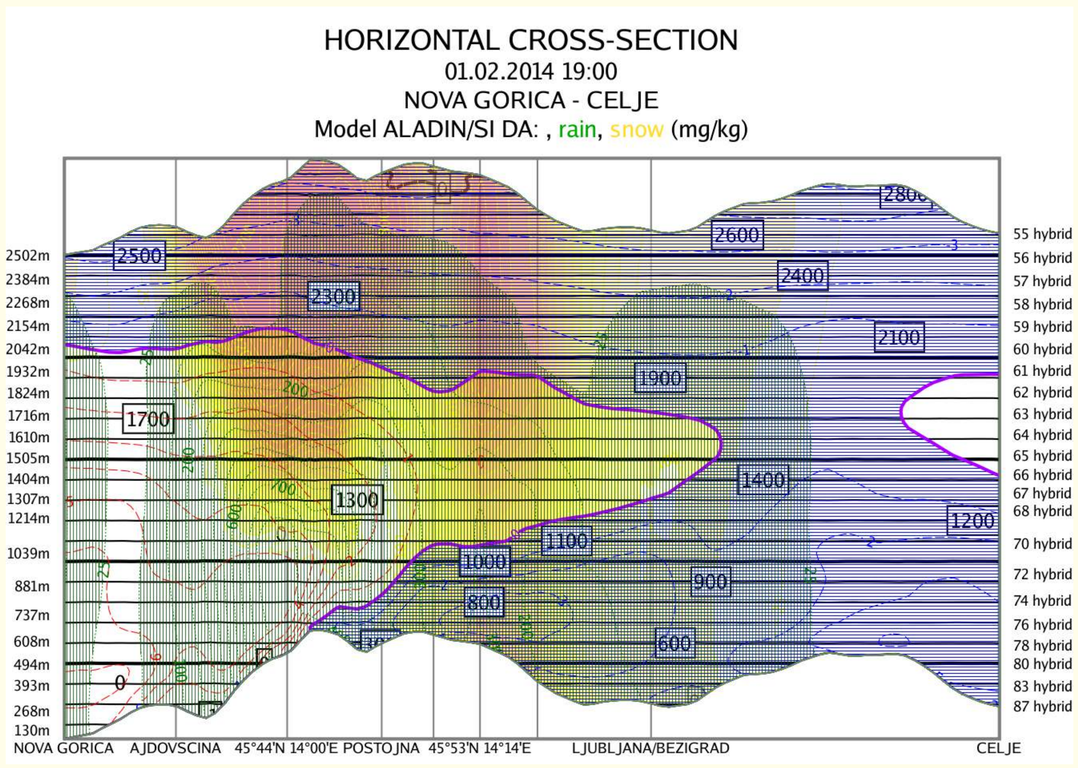
New slightly modified model domain.

Data assimilation cycle features:

- 3-hourly assimilation cycle,
- B matrix produced by downscaling ECMWF ensembles,
- CANARI surface analysis using surface observations (T and RH at 2 m),
- 3d-Var upper air assimilation,
- coupling at every 1 hour, lateral boundary conditions from IFS model,
- space consistent coupling, no digital filter initialization,
- observations: OPLACE pre-processed data (SYNOP, AMDAR, SATOB, TEMP, WINDPROFILER, NOAA and METOP: AMSU-A,AMSU-B, METEOSAT SEVIRI) and local observations (automatic stations, Mode-S MRAR from Ljubljana airport).

Freezing rain/ice case

Slovenia experienced extreme weather conditions in the end of January and beginning of February 2014. Situation with warm and moist south westerlies aloft and cold easterlies below persisted for unusually long time (4 days). In combination with large amount of precipitation the result was one of the most severe icing events ever recorded over a relatively large portion of the country. The estimated damage was around 430 mEUR.
ALADIN model served as a good input for warnings.



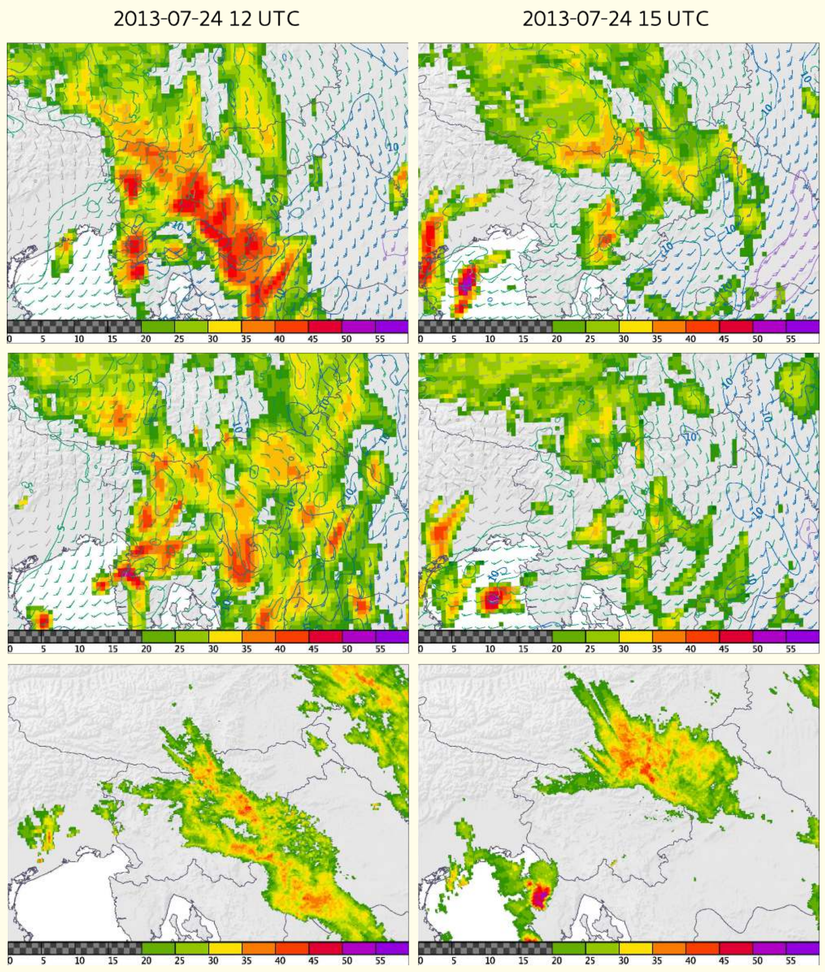
Horizontal cross-section of temperature and hydrometeors over Slovenia on 31th January 2014 18 UTC - new model setup with 87 vertical levels and local Mode-S observations. Thick warm layer over colder air near the surface can be observed. Snow is plotted in yellow, rain with green vertical lines, and negative temperatures with blue horizontal lines. Greatest chance of freezing rain and ice is where green and blue lines intersect.

Damage caused by severe freezing rain and ice.

Assimilation of Mode-S MRAR observations in ALADIN

Locally received Mode-S MRAR (Meteorological Routine Air Report) aircraft wind and temperature observations are assimilated in the operational data assimilation cycle with ALADIN 3-hourly RUC from 19 June 2014:

- Mode-S significantly improves local upper-air observational coverage,
- systematically positive impact on wind forecasts till around T+3 hours of the forecast in all seasons,
- complicated impact on humidity analysis during summer, potentially problematic if little humidity observations available,
- visible impact on selected cases (see figure).



Simulated radar reflectivity (dBZ) and model winds at 600 hPa. Experiment with assimilated Mode-S (top), reference without Mode-S (middle) and verifying radar observation (bottom) for analysis time (left) and subsequent 3-hourly forecast (right).

3-way Atmosphere Ocean Wave Coupling

A coupled atmosphere-ocean-wave modeling system is under development:

- coupling of ALADIN at 4.4 km, Princeton Ocean Model (POM) at 3.6 km and WAM (ECMWF WAve Model) at 1.5 km resolution,
- OASIS3 MCT coupler implemented in each model code,
- real time three-way coupling over Adriatic Sea region,
- quantities exchanged every model time-step (3 minutes),
- ongoing validation focusing mainly on convection triggering, coastal winds and precipitation,
- first preliminary results.

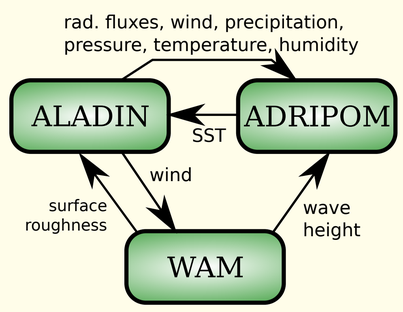
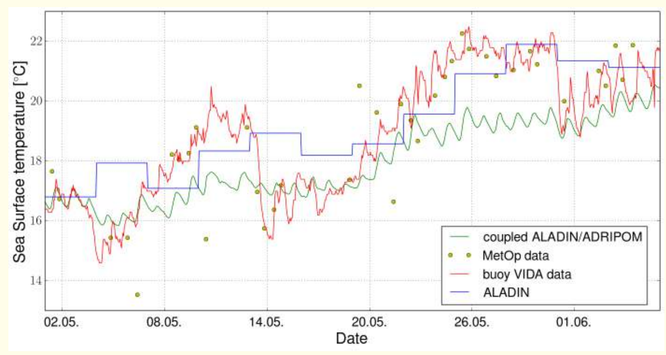
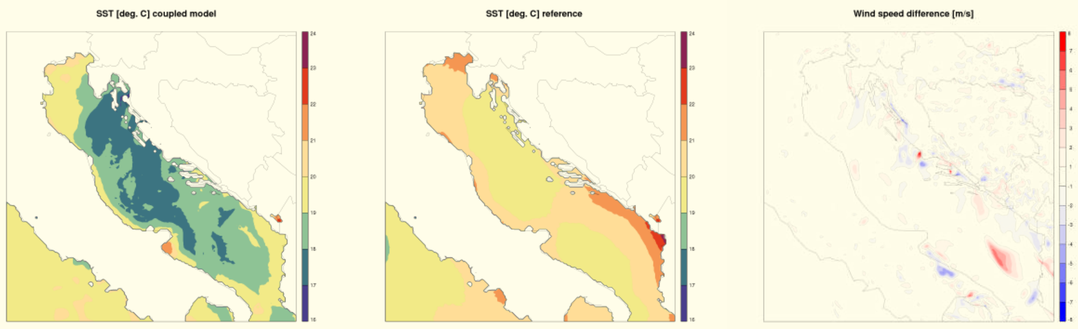


Diagram of the coupling mechanism



Sea surface temperature (SST) time series (consequent 3-day forecasts) for 3-way coupled simulation (green) and ALADIN reference without ocean model (blue) compared to MetOp satellite (circles) and buoy (red) measurements at the buoy location in the gulf of Trieste.



Sea surface temperature (SST) from ALADIN 3-way coupled simulation on the Adriatic sea domain (left), ALADIN reference without ocean model (middle), where SST is constant during integration, and wind speed difference between both simulations (right) on 31.5.2014, for run 00, +36 h forecast. Much colder SST in the coupled simulation is attributed to enhanced mixing in the upper layers of the sea due to bora wind; this further influences the wind field.