Limited Area Modeling in Slovenia - 2015

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HPC 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).

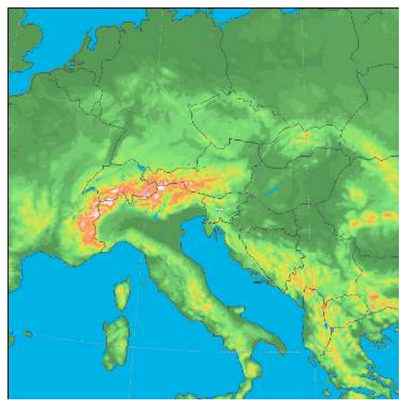
Software:

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

Operational suite

Model characteristics:

- 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 ECMWF Boundary Conditions Optional project (time lagged coupling).



ALADIN-Slovenia model domain.

Assimilation cycle:

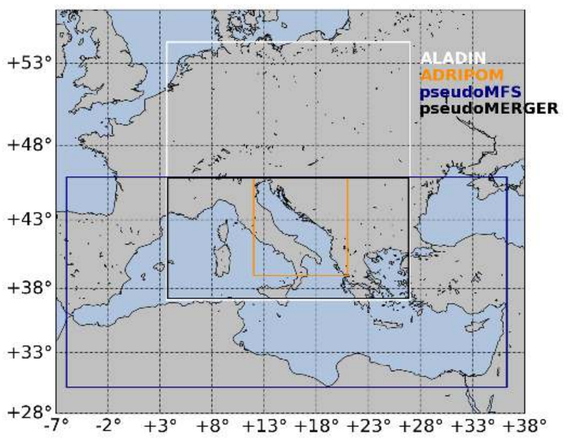
- 3-hourly 3D-Var assimilation cycle (RUC),
- B-matrix sampled from downscaled ECMWF ensemble members,
- CANARI surface analysis using surface observations (T and RH at 2 m),
- coupling frequency 1 hour,
- space consistent coupling, no digital filter initialization,
- observations: OPLACE data and local observations (SYNOP, Mode-S MRAR).

Two-way atmosphere-ocean coupling

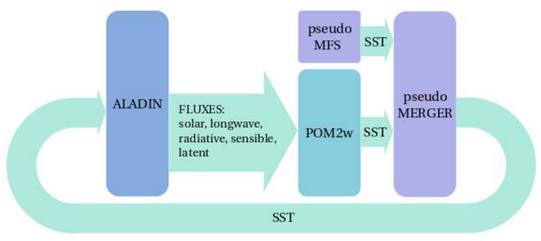
A coupled atmosphere-ocean modeling system is being developed:

- coupling of ALADIN at 4.4 km with ADRIPOM (Princeton Ocean Model for Adriatic Sea) at 3.6 km using OASIS3-MCT coupler,
- real time two-way coupling for the Adriatic Sea region, quantities are exchanged every model time step (see figure),
- daily initial and boundary conditions for ADRIPOM are obtained from MyOcean MFS model,
- ADRIPOM model results: heat fluxes in coupled scheme are smaller (see figure), resulting in smaller bias in sea temperature (see figure),
- ALADIN model results are being validated: validation is focusing mainly on convection triggering, coastal winds and precipitation.

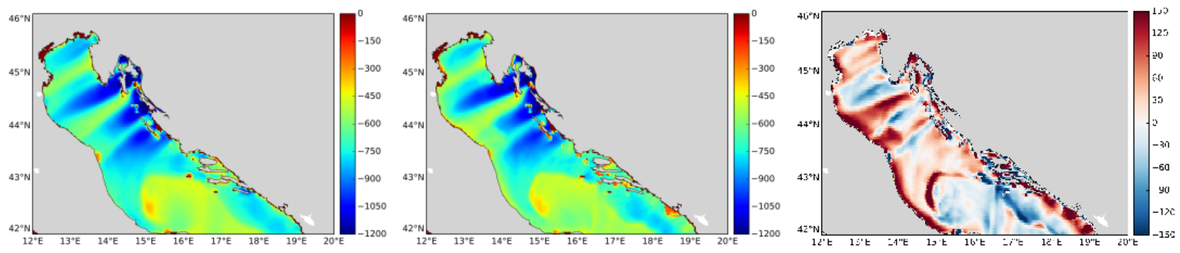
Further plan is to add the ECMWF wave model (WAM) at 1.5 km for a 3-way coupled system.



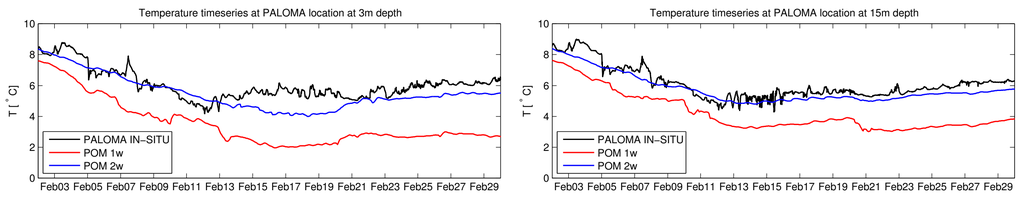
Domains of the coupled models.



Coupling scheme for one timestep in the 2-way coupled models.



Total exchanged heat fluxes in uncoupled and coupled models and its total heat flux difference. Strong bora case on 10th February 2012 after 23 hours.



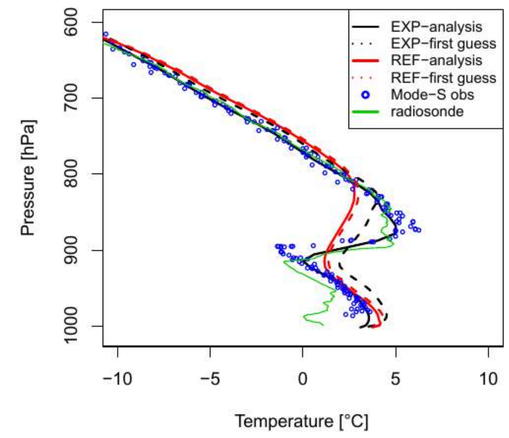
Sea temperature at depth of 3 m (top) and 15 m (bottom) at Paloma buoy in February 2012: in-situ data, uncoupled (1w) and coupled (2w) ADRIPOM model output. Paloma data courtesy of CNR-ISMAR Trieste, Italy.

M. Ličer et al., Ocean Science, 2015 in review

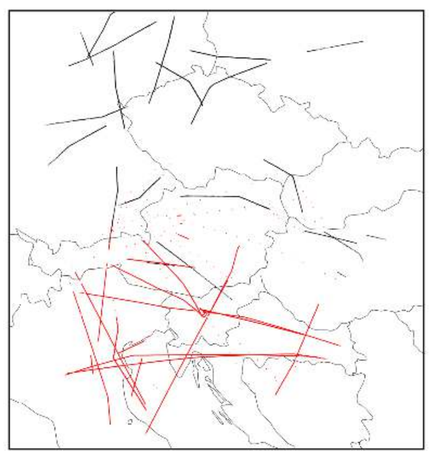
Usage of Mode-S MRAR observations in Central Europe

Mode-S MRAR are aircraft-derived observations:

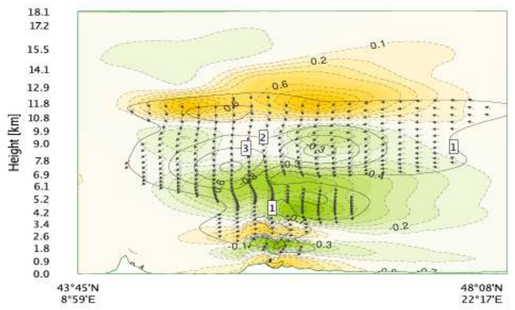
- a promising source of upper-air temperature and wind information from some aircraft, quality is similar to AMDAR,
- data from two air-traffic control radars in Slovenia are already assimilated in ALADIN-Slovenia,
- positive impact on short-range forecasts shown for periods and cases,
- recently extended to Czech Republic (3 radars) and experimental in Austria (1 radar).



Vertical temperature profile for 11 December 2013 21 UTC. Analysis is improved due to Mode-S.



Mode-S observations in Central Europe over 15 min time interval (6 radars).

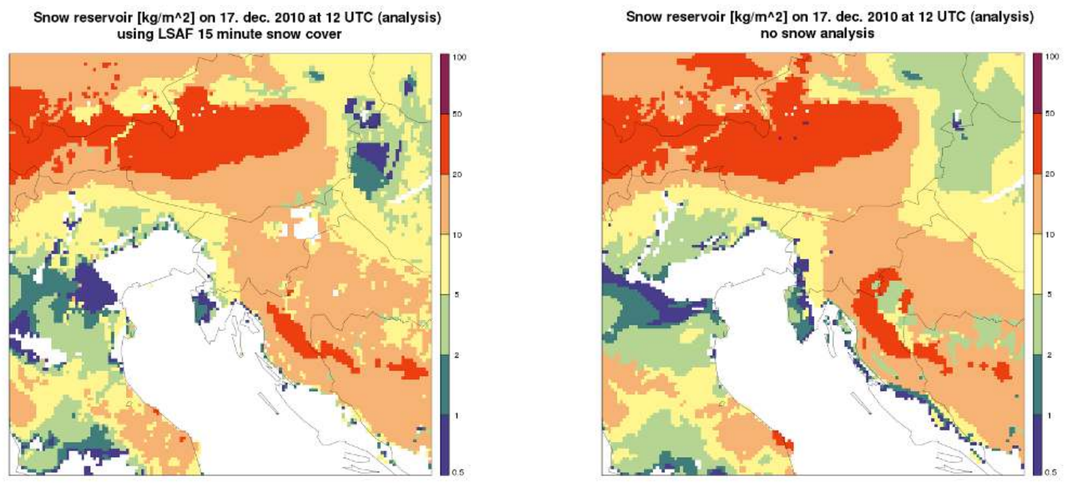


Cross-section of analysis increment of temperature (colors) and wind (arrows ans isolines) from Bay of Genoa to eastern Hungary using Mode-S data for 21 June 2013 18 UTC. Approximately 300 wind and temperature observations are assimilated.

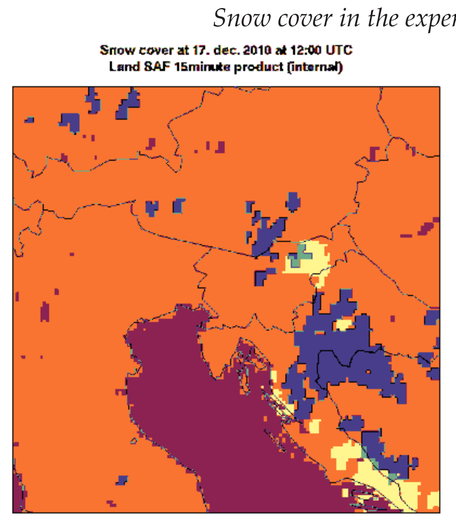
LandSAF snow cover assimilation

An experimental assimilation of LandSAF snow cover has the following characteristics:

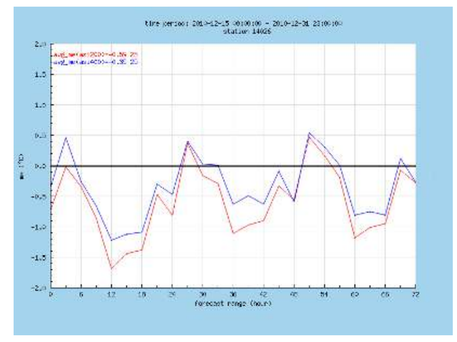
- a simple snow cover assimilation is used to modify snow cover extent after the last stage of RUC 3D-Var,
- snow is either removed or added (10 kg/m2) depending on value of the satellite product,
- input data is 15 minute LSAF snow cover - not the standard daily product which is unusable for NWP due to 1 day collection window,
- results show large differences in snow accumulations and extent compared to simple cycling of snow (ref.),
- little impact on objective scores, on average, but in some locations it can be quite significant.



Snow cover in the experiment (left) and in reference (right).



Snow data from LSAF 15 min snow cover product, yellow - snowfree, blue - snow cover, others - sea/lake or obstructed by clouds.



Improvement of temperature bias at 2 m for station in Maribor (EXP in blue, REF in red).