ALADIN in Slovenia - 2014

Neva Pristov, Benedikt Strajnar, Jure Cedilnik, Marko Rus, Jure Jerman, Peter Smerkol, Ivan Bašták-Ďurán (visitor) - Slovenian Environment Agency

New 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 suites

Operational suites are unchanged compared to previous year, and will be replaced by new model setup (to become operational in spring 2014).

New 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.
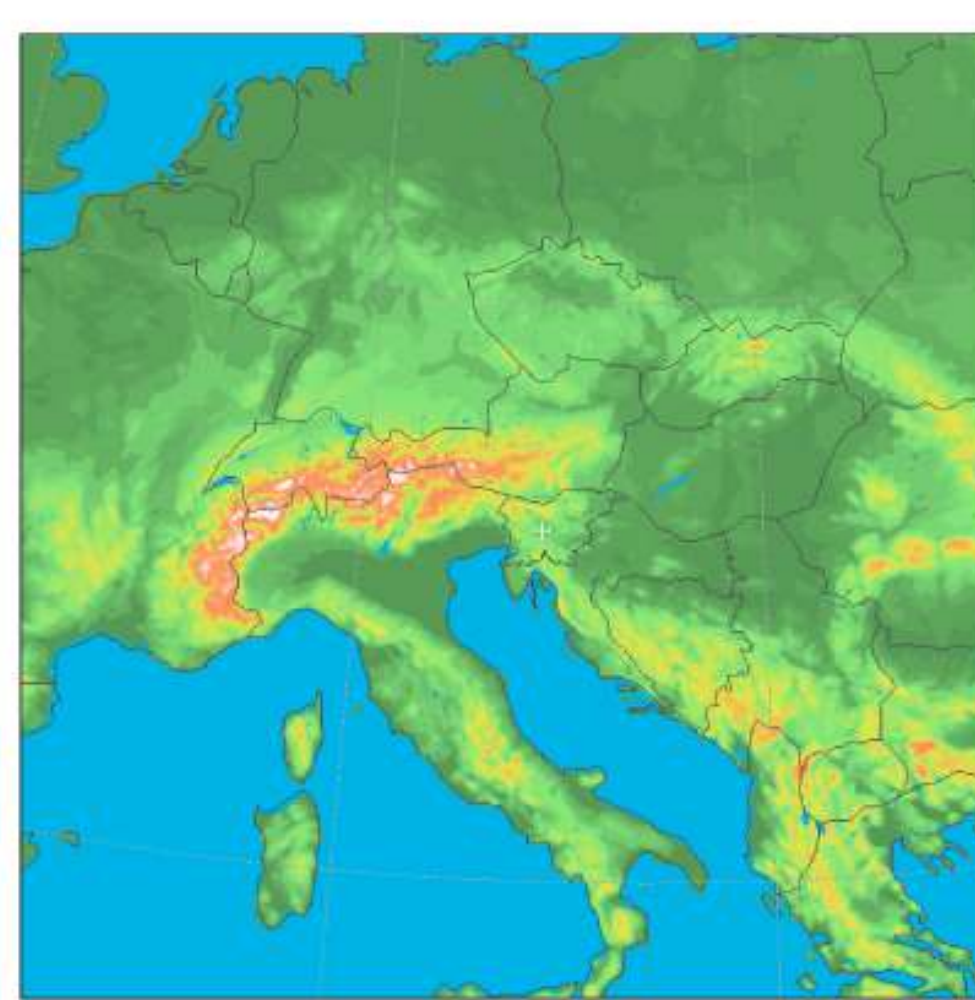
*New slightly modified model domain.*

Data assimilation cycle features:

- 3-hourly assimilation cycle,
- B matrix produced by downscaling ECMWF ensembles – created at ECMWF with Harmonie scripting system,
- 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 data and local observations (SYNOP, soon Mode-S),
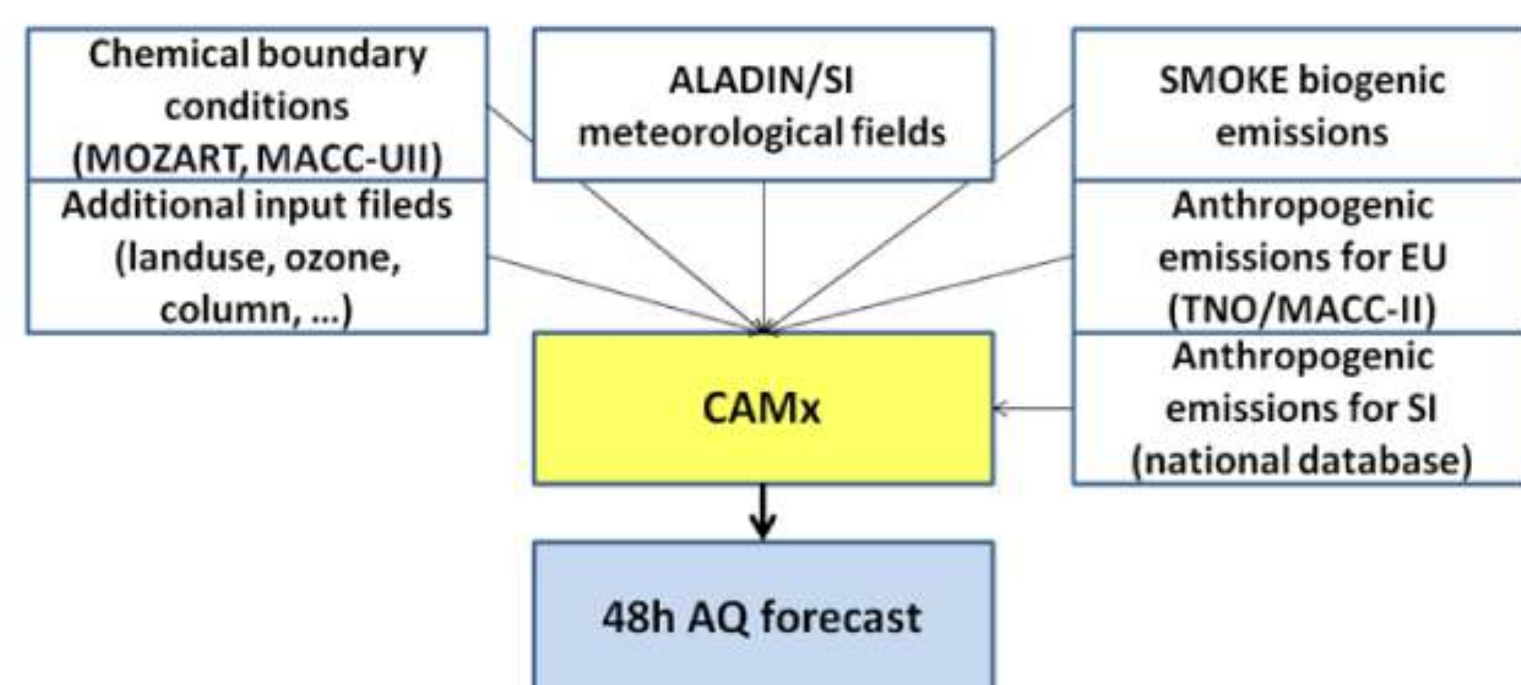
Modeling system ALADIN-CAMx

Photochemical dispersion model CAMx (version 6.00) coupled offline with ALADIN is used for air pollution simulations:

- Lambert projection,
- coarse grid: 145x135 points, 13.2 km horizontal grid spacing,
- fine grid: 185x167 points, 4.4 km horizontal grid spacing,
- 34 vertical levels up to 14 km in the troposphere,
- initial chemical conditions from the previous model run,
- chemical boundary conditions from global 3h MOZART forecast (MACC-II project),
- emissions: highly resolved emission database for Slovenia region, emission database (MACC-II project) for the areas outside of Slovenia,
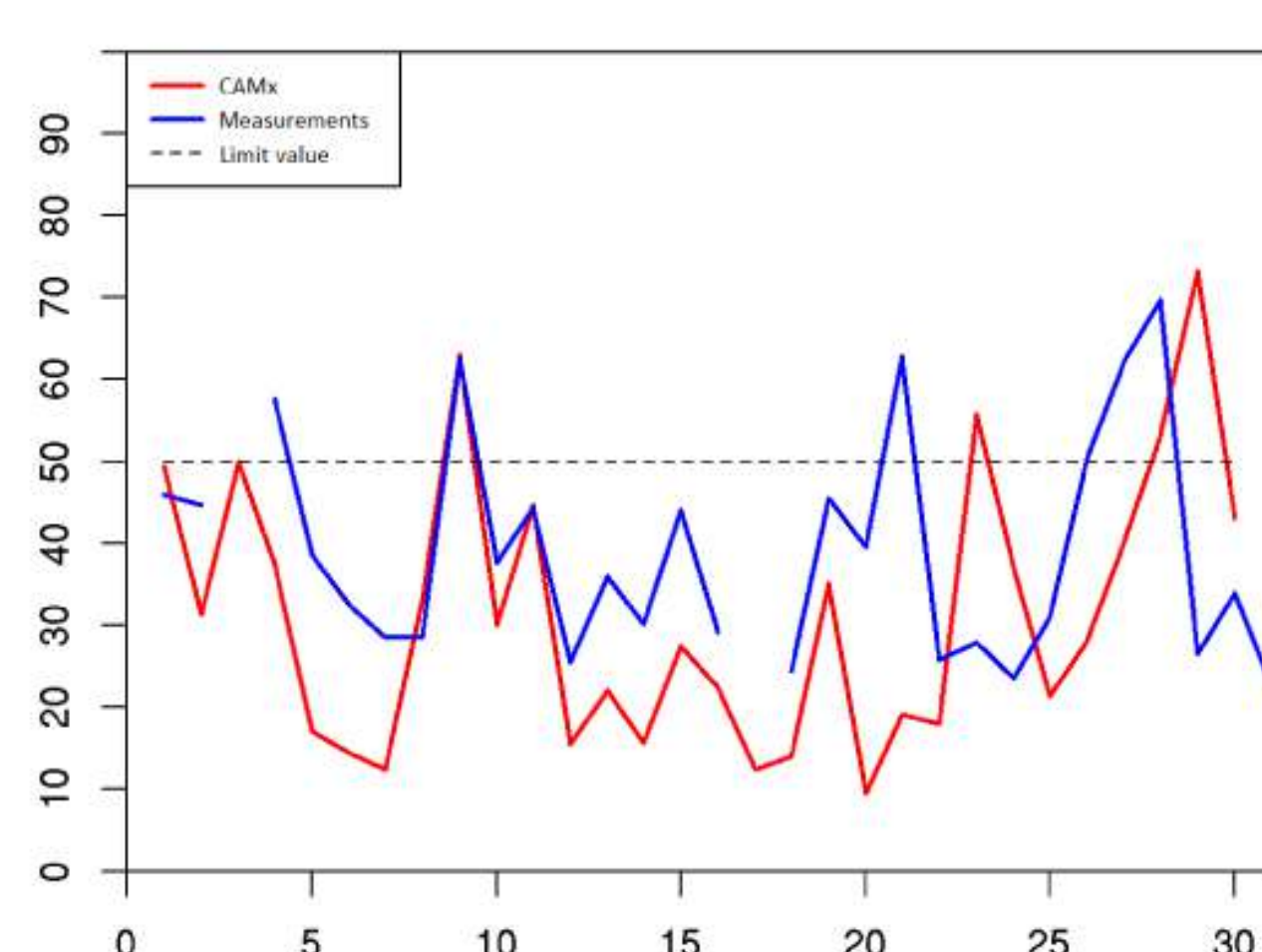 biogenic emission using emission model SMOKE.
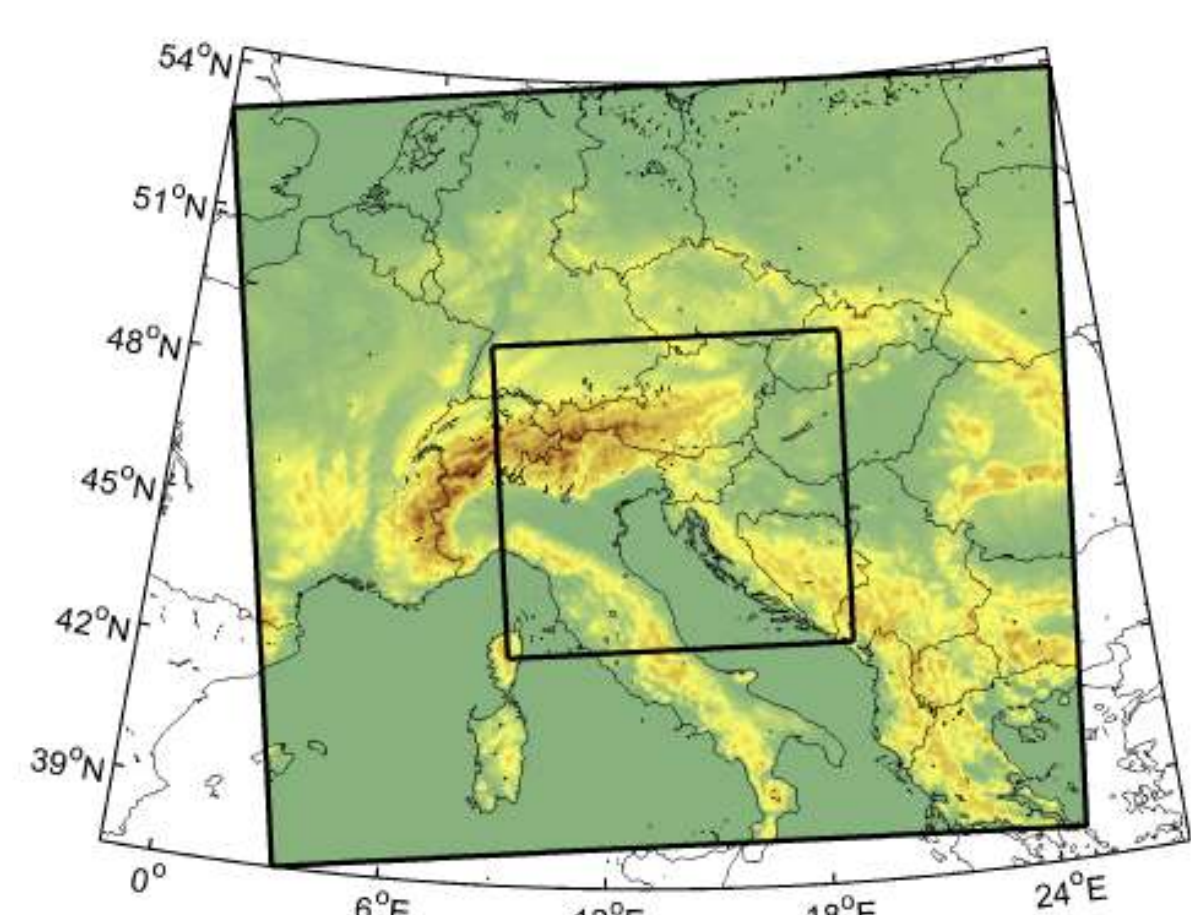
Modeling domains used in operational ALADIN-CAMx model configurations.

ALADIN-CAMx modeling system and data flow.
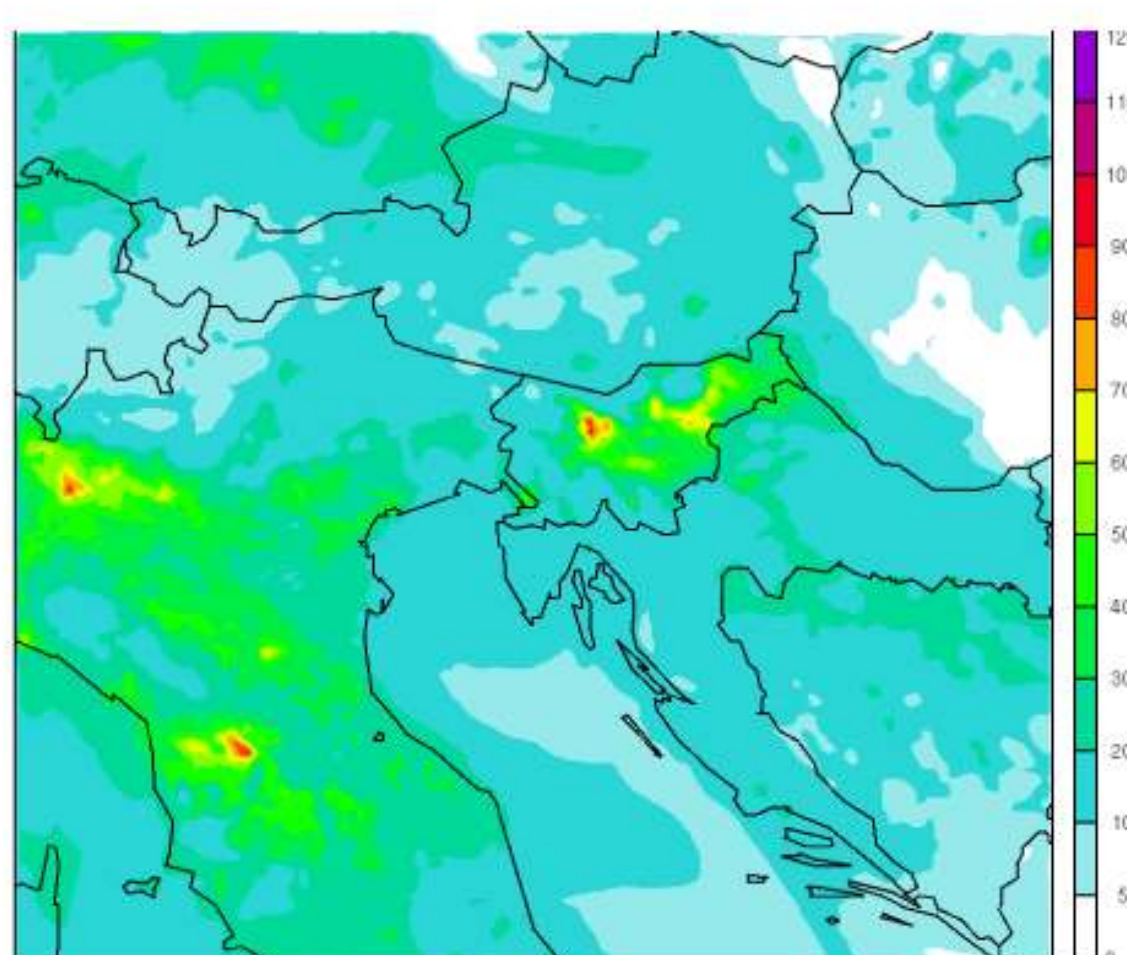
Hourly PM10 concentrations (in μgm^{-3}) at lowest model level as simulated by ALADIN-CAMx for January 9, 2013 14 UTC. Shown are concentrations in the inner domain.

*Daily PM10 concentrations (in μgm-3) at lowest model level as simulated by ALADIN-CAMx modeling system (red) and measurements (blue) for January, 2013. Shown are concentrations in Ljubljana city.*

Testing options in turbulence scheme

Influence of mixing length on quality of wind forecast was tested:

- predicted SW wind in NE of Slovenia in situations with stable stratification near the surface is often too strong,
- the usage of mixing length based on TKE qualitatively improves the forecast (wind speed reduced),
- the TKE based mixing length produces less mixing (than the current scheme) near the surface, The problem originates in diagnostic of PBL height which depends on Richardson number and is very inaccurate, leading to erroneous vertical profiles of mixing length. Too strong mixing causes too strong downward transport of momentum.
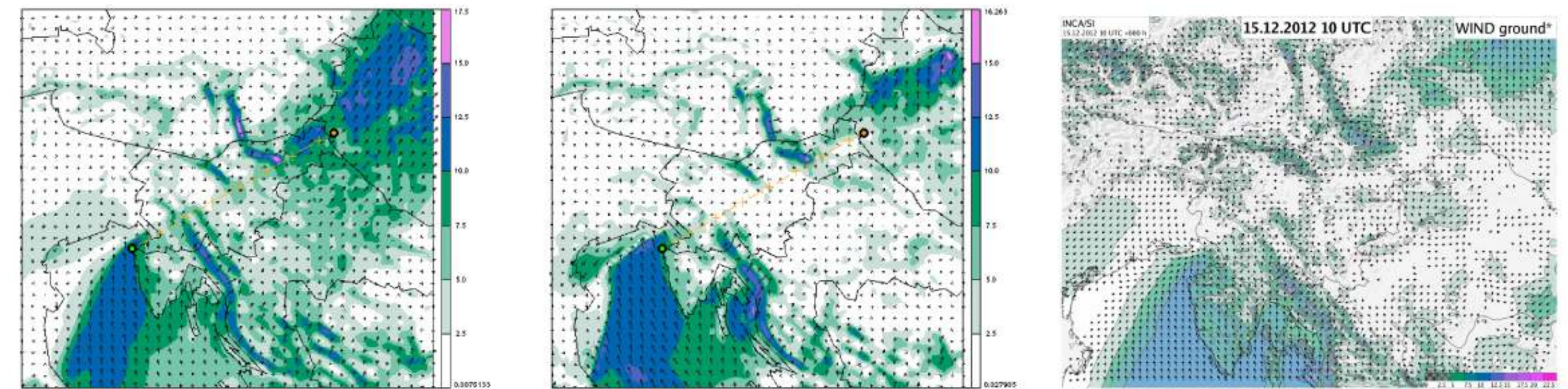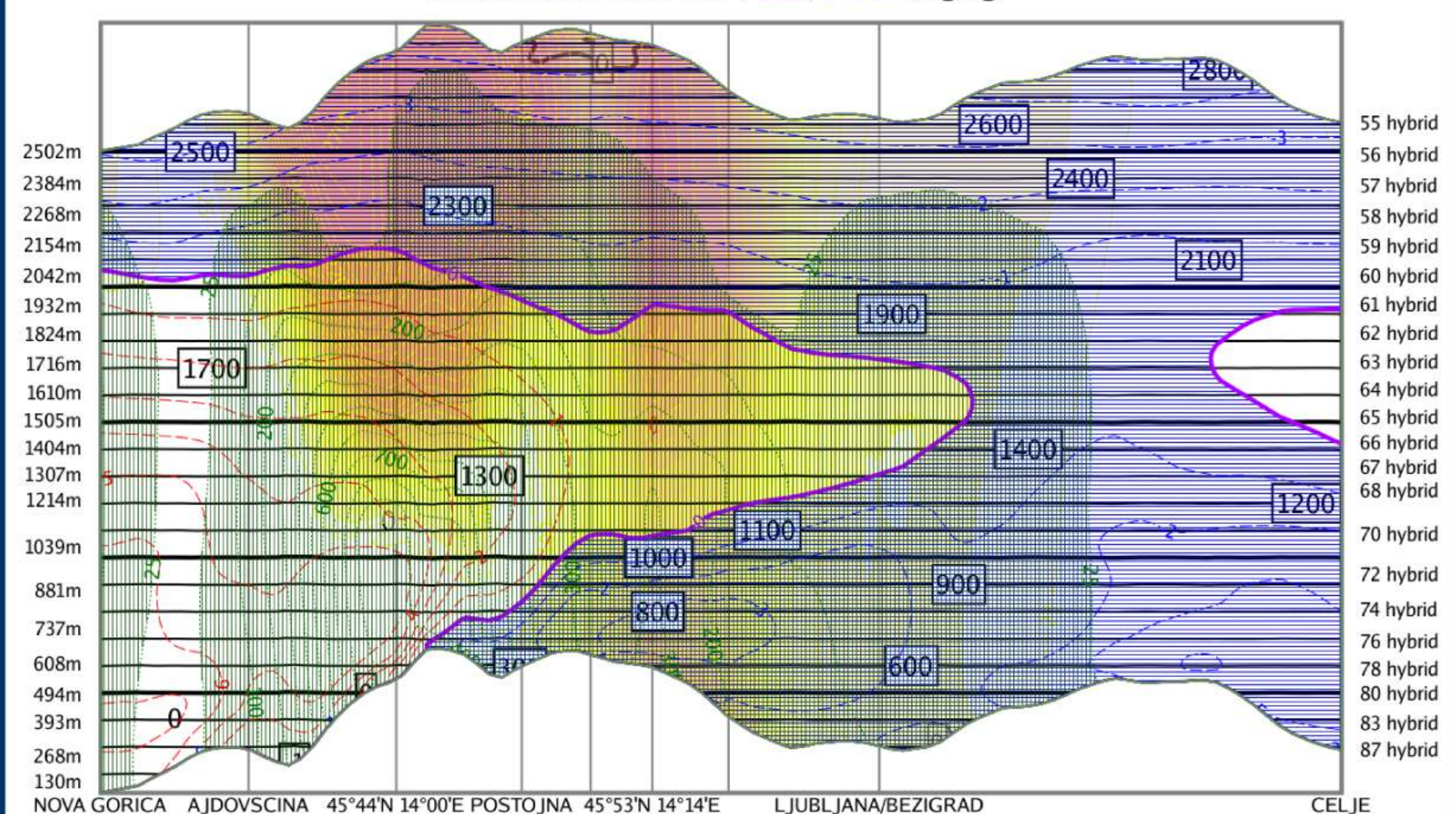

Wind forecast for 14.12.2012 00:00 + 34h with current computation of mixing length (left), and TKE-based mixing length (middle). Reference INCA 10 m wind analysis for 15.12.2913 at 10 UTC (right).

Freezing rain/ice case

Slovenia experienced extreme weather conditions in the end of January and beginning of February 2014. ALADIN model served as a good input for warnings.

Horizontal cross-section of temperature and hydrometeors over Slovenia on 31th January 2014 16 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.

Atmosphere-ocean coupling

A prototype of a coupled atmosphere-ocean modeling system is under development at ARSO:

- coupling of ALADIN at 4.4 km and Princeton Ocean Model (POM) at 3.6 km covering Adriatic Sea and Mediterranean Forecasting System (MFS) outside Adriatic,
- OASIS3 MCT coupler implemented in the code,
- real time two-way coupling for Adriatic region, one way for rest of Mediterranean,
- SST provided to the ALADIN every time step,
- wind, air temperature, humidity and fluxes provided to POM over Adriatic,
- ongoing project, no results yet.

SST over model domains of Mediterranean Forecasting System (top), POM (middle) and ALADIN (bottom, only southern part of model domain is shown).