Limited Area Modelling Activities in Slovenia

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Environmental Agency of the Republic of Slovenia is a partner in the international projects ALADIN and RC LACE. Our group is taking care that limited area numerical forecasts are prepared twice a day using ALADIN model. We have the leading role in the common ALADIN verification project for the objective verification on the synoptic scale.

The main research and development topics in last two years were devoted to introduce and test latent heat nudging in the model, to produce a physically consistent spatially complete climatological field of surface wind with numerical model initialised and driven by the ECMWF ERA-40 at the lateral boundaries. Quantile regression method was design for probability forecast of temperature.

**Operational ALADIN application** (neva.pristov@rzs-hm.si)

Our current ALADIN model configuration started in June 2003 on the new computer system which allowed increase of the computation domain.

Characteristics of the operational ALADIN/SI model configuration are:

*   spectral, elliptic truncation E89x84 (258*244 points, with extension zone 270*256)
*   Lambert projection,
*   9.5 km horizontal grid spacing on the collocation grid,
*   37 vertical model levels,
*   400 s time-step, range of forecast 54 hour,
*   initial and lateral boundary conditions from ARPEGE,
*   coupling at every 3 hours,
*   digital filter initialization,
*   integration twice per day.

Operational suite is running in Supervisor Monitor Scheduler, ECMWF product. Since end of July the whole cluster system and operational suite is controlled by NAGIOS supervision system and failures are reported to e-mails and via SMS messages to mobile phones. Required model products for PEPS project are sent to DWD. On the request of forecasters forecast length was increased up to 54h (20/07/2005).

The computer system is a cluster based on Intel Xeon processors, has 14 dual processor boxes with 2.4 GHz processors, 2 GB of memory per node (28 all together),300 GB primary disk space and additionally 3.5 TB external disks array. Processors are connected via gigabit fiber ethernet. It runs Linux OS enhanced by SCore software (www.pccluster.org). Queuing system, gang scheduling, check-pointing, parallel shell and simplified administration are available by SCore software. Lahey and Intel Fortran compilers, Totalview debugger are used.
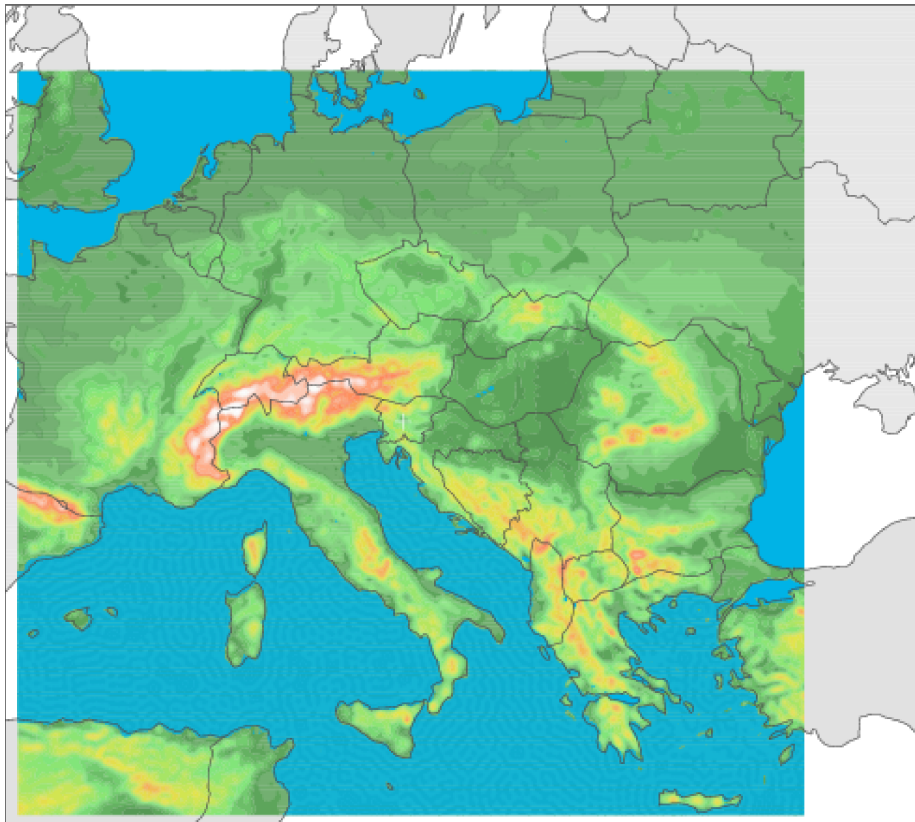
The domain of ALADIN/SI (colored) is smaller than the domain with initial and coupling fields prepared from ARPEGE model.

Latent Heat Nudging (jure.cedilnik@rzs-hm.si)

Latent Heat Nudging (LHN) is a method of forcing an NWP model with measured precipitation rate from radar with the aim to improve analysis and short range forecast of precipitation.

Model and measured precipitation rates are used to compute a weighted average according to the distance of measured point to the closest radar. This weighted average can be treated as a first approximation of analysis of precipitation. A ratio of this precipitation analysis and model precipitation is than used to rescale the latent heat cooling or heating part of temperature tendency profile in the model. Radar hourly accumulations is first interpolated into eight times more dense grid than the one of the model and then aggregated into the model grid. In case of no model precipitation, a climatological profile from model control run is used and rescaled according to radar measurement.

Results show that LHN improves model domain averaged precipitation bias. It successfully reposition precipitation systems from model's envelope orography ridges where they typically appear, but is not capable of altering the amount. In a case of only model precipitation and no precipitation measured, the LHN is trying to move the precipitation around instead of reducing the amount of it. However there are many cases of deterioration of the forecast (also) due to known problems of unrealistic model convection.

Impact of LHN after the end of nudging period lasts only up to a two or three hours ahead in time and is only positive when looking at statistical scores at a higher precipitation rate threshold.
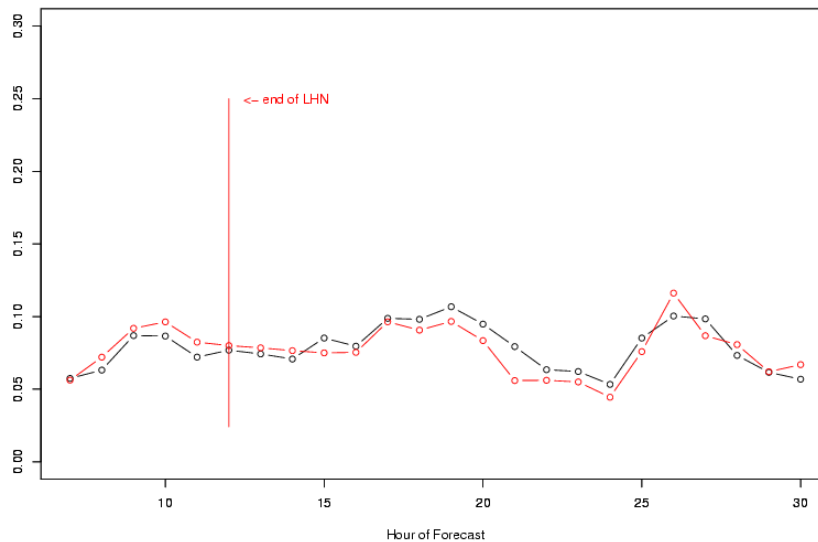
Equitable threat score with the threshold of 1 mm/h statistics for 2002. The red line is with LHN switched on till +12 hours of forecast and the black line is the control run.

Downscaling of the ERA40 data (mark.zagar@rzs-hm.si)

Downscaling of the ERA40 data for the 10-year period (1992-2001) was performed with a goal of obtaining a high-resolution wind climatology for the topographically diverse Slovenian territory. The NWP model ALADIN was used in three steps:

1. 60-hour simulations with 12-hour overlap, forced by the ERA40 fields at the lateral boundaries and with 30km horizontal resolution provided input for the second nest,
2. a 10km resolution run, again 60-hour long integration with 12-hour overlap.
3. In the final step, a 2.5km resolution ALADIN was run on each of 3-hourly output from the second nest and only until the wind field has adapted to the high-resolution orography, i.e. 30 minutes.
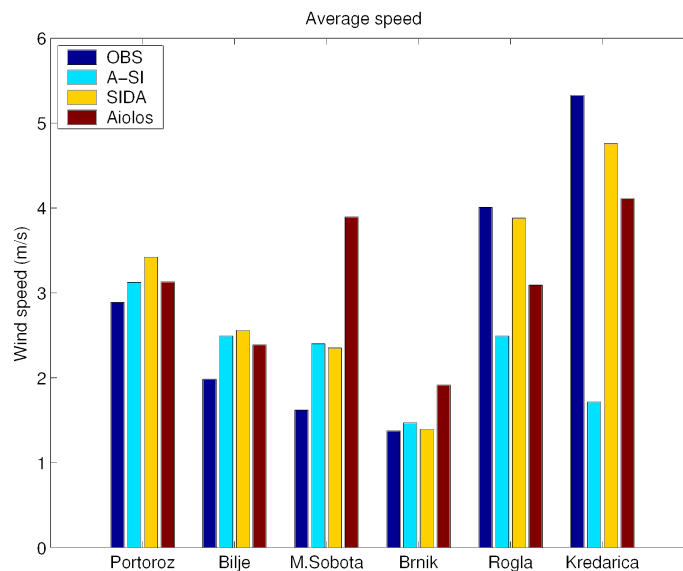

The average 10m wind speed at 6 station in Slovenia, as observed and modelled by two different ALADIN configurations (10km and 2.5km) and by one kinematic model with grid spacing of 1 km.

Probability forecast of temperature with quantile regression method (jasna.vehovar@rzs-hm.si)

Probability forecasting can also be done with a statistical model and not only with the ensembles. An advanced regression method, called quantile regression can be used as a statistical model. This method takes into account the true distribution of residuals, and combines probabilistic forecast and statistical adaptation of the NWP direct model output variables to the local conditions. The result is not only the forecast value, we also obtain the estimation of the accuracy of the forecast. This method allows us to produce probabilistic forecast not only for discrete but also for continuous variables. For development of such statistical model a learning data set is needed, sufficiently large to train the model.

The quantile regression method was tested on maximum and minimum daily temperature forecasts and 2 m temperature forecasts for different time ranges and for different locations in Slovenia. As predictors the observations and direct model output parameters from the operational ALADIN model were used. With comparison of verification scores for quantile regression and some other regression methods it was shown that the weighted local linear principle is the most privileged method among the tested.
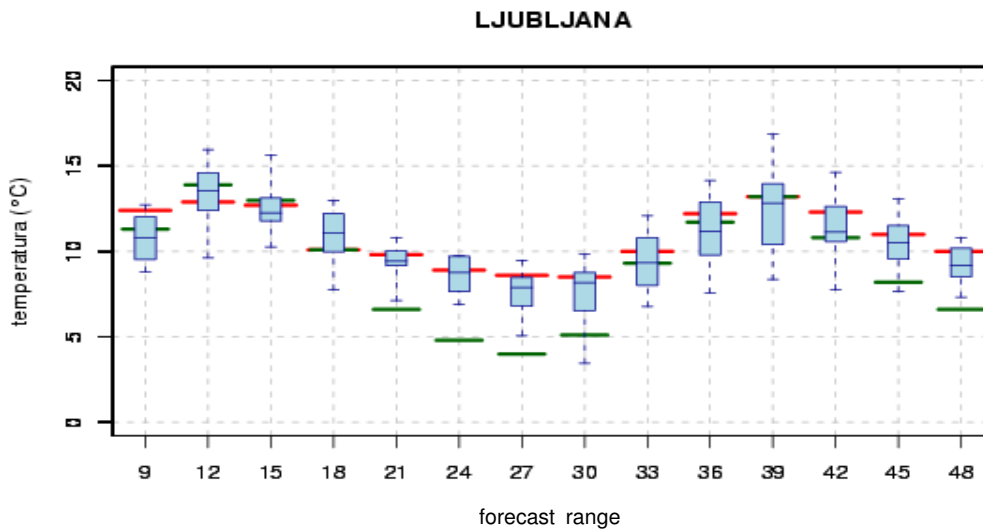
An example of 2m temperature forecast for up to 48 hours ahead, every three hours. Green dash denotes the direct model output, red dash the observed value and the box with handles the output of the quantile regression method (median, quartile and 95% confidence)

ALADIN Verification project (neva.pristov@rzs-hm.si)

The purpose of the common project for objective verification at the synoptic scale is to inter compare forecasts from the ALADIN models configurations and to easily produce various reports. Centralized procedure is prepared to produce time evolution and comparison of classical scores over various domains and for various model configurations. The application consists of collecting observations and forecast values from models (for selected meteorological variables and stations), storing them to a relational database (built in Ljubljana) and a web interface is used to get on-line verification products of interest. In the year 2005 application is in testing phase, 8 national meteorological services are daily sending data from operational models and parallel suites.