

NWP in Croatian Meteorological and Hydrological Service

presented on 27th EWGLAM & 12th SRNWP meetings
3rd - 5th October 2005, Ljubljana, Slovenia

Zoran Vakula, Lovro Kalin, Martina Tudor, Ivana Stiperski, Vlasta Tutiš, Dunja Drvar,
Lukša Kraljević, Kornelija Špoler Čanić, Branka Ivančan-Picek and Stjepan Ivatek-Šahdan
Meteorological and Hydrological Service, Grič 3, HR-10000 Zagreb, Croatia
for more information ivateks@cirus.dhz.hr

Current status of Operational NWP Suite

In the Croatian meteorological service ALADIN is operationally run twice a day, for 00 and 12 UTC. Coupling files are retrieved from ARPEGE (Meteo-France global model) via Internet and RETIM2000. The execution of the suite is controlled by the OpenPBS (Portable Batch System) as the queuing system. Horizontal resolution of the LACE domain is 12.2 km, 37 vertical η -levels, time-step 514 sec, 229x205 grid points (240x216 with extension zone). Horizontal resolution of Croatian domains is 8 km, 37 vertical η -levels, time-step 327 sec, 169x149 grid points (180x160). Initialisation of ALADIN on LACE domain is provided by Digital Filter Initialisation (DFI). Coupling frequency and frequency of output files for the LACE and Croatian domains are 3 hours. When the 48 hours forecast on LACE domain is finished 48 hours forecast for Croatian domain starts without initialisation with coupling files from LACE. 6 domains for the dynamical adaptation of the wind field in the lower troposphere to 2-km resolution orography for mountainous parts of Croatia. Dynamical adaptation is run sequentially for each output file, with 3 hour interval. In the dynamical adaptation meteorological fields are first interpolated from input 8-km resolution to the dynamical adaptation 2-km resolution. The same file is used as a initial file and as a coupling file that contains boundary conditions for the model.

Visualisation of numerous meteorological fields are done on LINUX PC. Comparison of forecasts with SINOP data are done hourly for today's and yesterday's forecast. The products are available on the Intranet & Internet. Internet address with some of the ALADIN products, total precipitation and 10 m wind: http://prognoza.hr/aladin_prognoza_e.html & http://www.dhmz.htnet.hr/prognoza/aladin_prognoza_e.html.

Operational forecasts verification

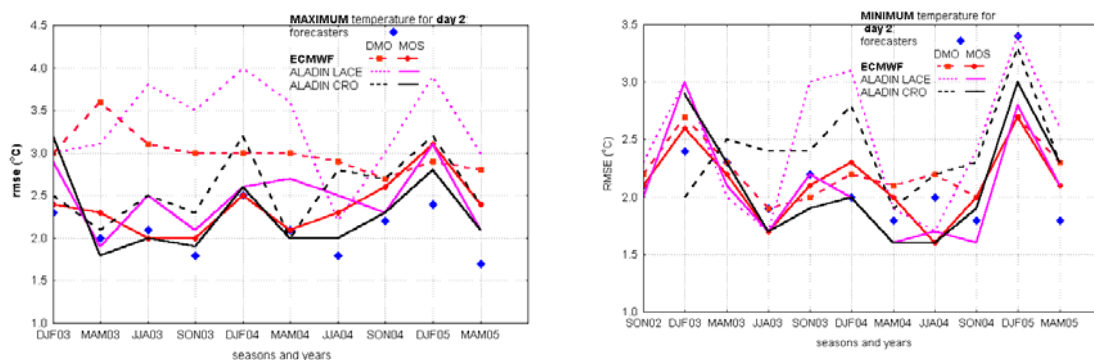


Figure 1. Root-mean-square errors of maximum temperature for day 2 (left) and minimum temperature for day 2 (right) forecast of forecasters and models: ECMWF, ALADIN LACE and CROATIA for direct model output and model output statistics, for Zagreb Maksimir (14240), from winter 2002/03 to spring 2005. MOS were done using regression equations ($y=ax+b$) which were calculated from historic data.

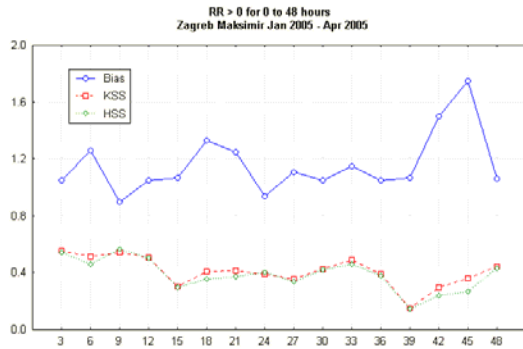


Figure 2. Precipitation verification for 3 hour periods for Zagreb Maksimir (14240), bias, Hansen-Kuipers Skill Score (KSS) and Heidke Skill Score (HSS) ALADIN CROATIA (8-km) were made from contingency table.

Changes in near future

Before the end of the year it is planned to make a lot of changes in operational suite simultaneously. At the time the new set-up is in parallel suite. Replace the operational model version 25T1 with 28T3 Prague version. Switch to a single big domain (one large 8km resolution domain in the place of the LACE and the current operational Croatian domain), no envelope, new physics package and SLHD. New climatological files are missing.

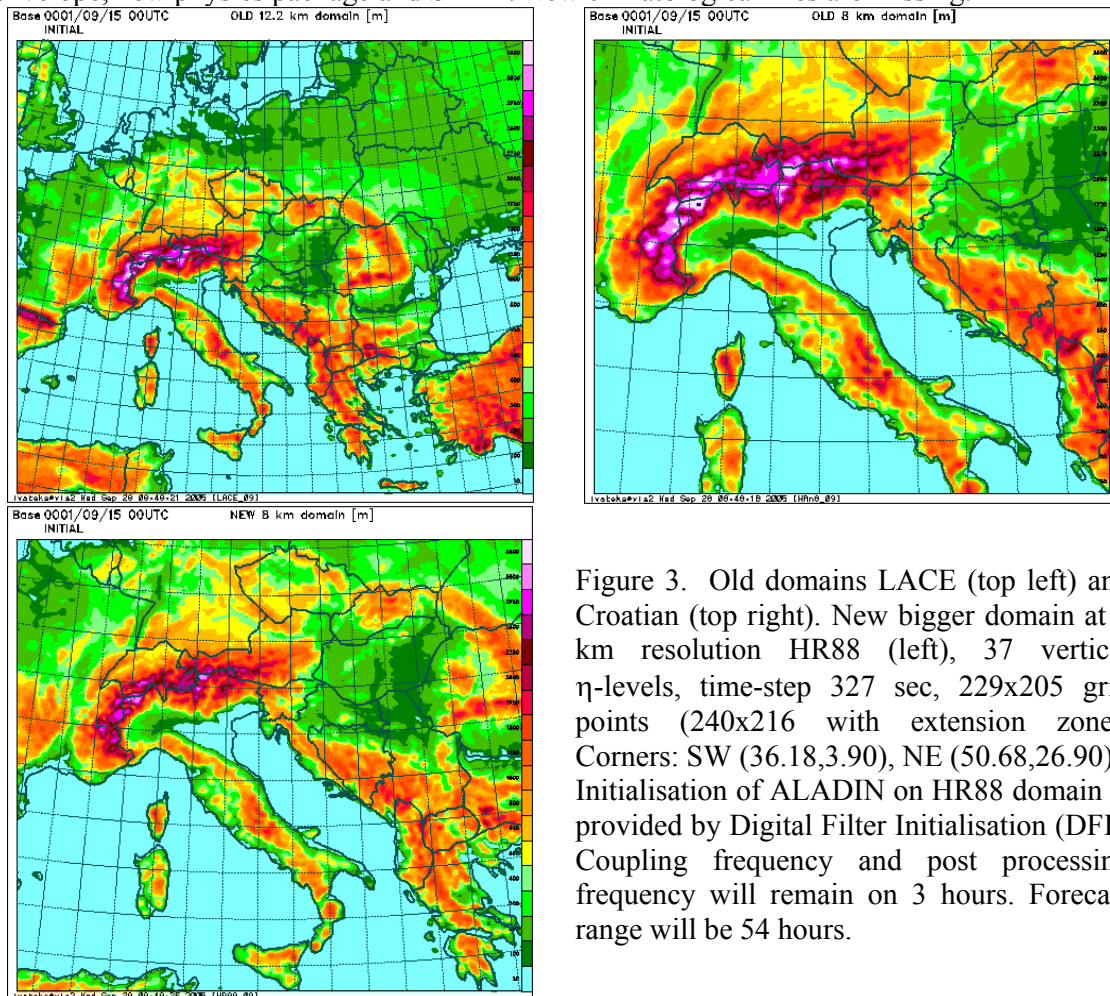


Figure 3. Old domains LACE (top left) and Croatian (top right). New bigger domain at 8 km resolution HR88 (left), 37 vertical η -levels, time-step 327 sec, 229x205 grid points (240x216 with extension zone). Corners: SW (36.18,3.90), NE (50.68,26.90). Initialisation of ALADIN on HR88 domain is provided by Digital Filter Initialisation (DFI). Coupling frequency and post processing frequency will remain on 3 hours. Forecast range will be 54 hours.

Research topics in 2005

SLHD: Semi-Lagrangian Horizontal Diffusion shows beneficial impact on the reduction of the overestimated cyclone intensity, correction of cyclone position while not altering a good intensity prediction and improvement of fog forecast in the valleys in an anticyclone.

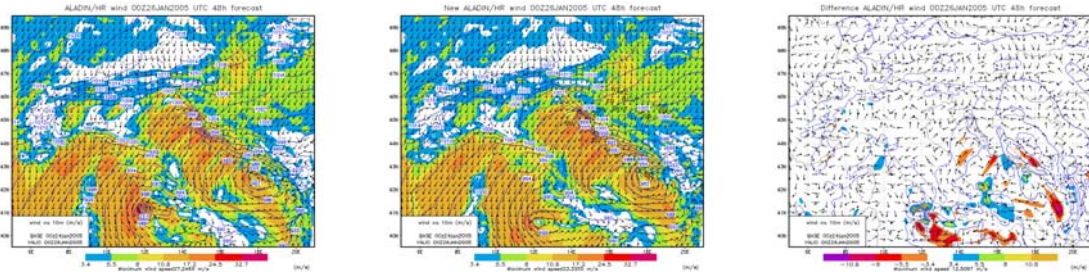


Figure 4. 10m wind and mean sea level pressure obtained with classical numerical diffusion (left), SLHD (centre) and their difference (right), 48hr fcast from 00 UTC 24th January 2005.

Radiation and cloudiness: Unsatisfactory model forecast in fog has encouraged a study of alternative radiation and cloudiness schemes combined with diff. cloud overlap assumptions.

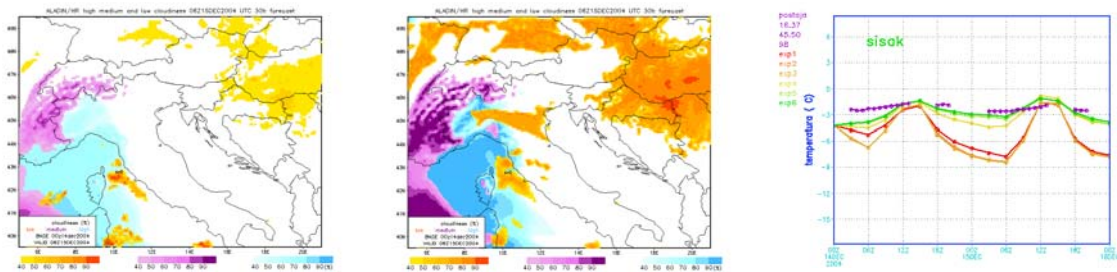


Figure 5. Low, medium and high cloudiness, 30 hour forecast starting at 00 UTC 14th December 2004, with the operational radiation scheme, operational critical relative humidity profile and operational cloudiness parametrization with random overlap (left) and Xu-Randall cloudiness scheme with random overlap (centre). Comparison of the modelled 2m temperature evolution (right) for same run with measured data from synoptic station with operational radiation scheme exp1-operational exp2-max. overlap in cloud scheme exp4-new vert. humidity profile Xu-Randall cloudiness scheme with max. overlap and exp6-operational vert. humidity profile Xu-Randall cloudiness scheme with random overlap (as in the centre).

Envelope or not?: Removal of envelope and changes in gravity wave drag parametrization result in stronger winds on the windward and generally weaker winds on the leeward side of the obstacles, as well as mountain wave amplitude reduction and smoothing.

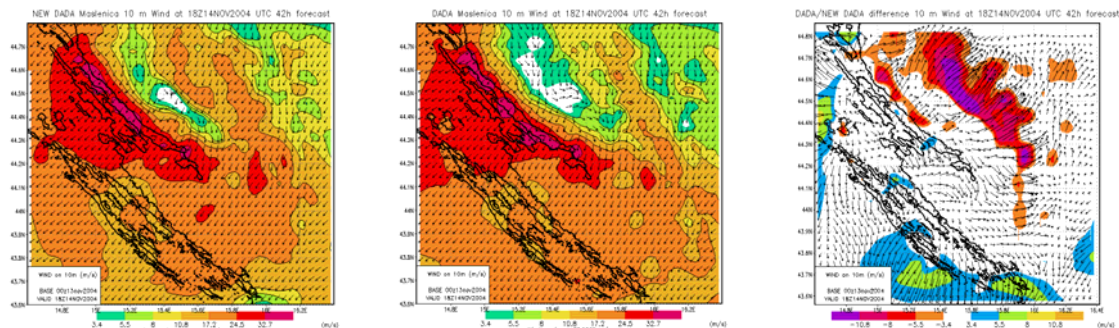


Figure 6. 10m wind in the operational (left) and mean orography (centre) model version, and difference (right), for the 2-km model resolution, 42hr fcast from 00 UTC 13th November 2004

Intercomparison of MM5 and Aladin: High resolution simulations of a severe Bura event from 22nd to 26th December 2003. The maximum measured wind gust was 62.7 m/s and the maximum 10-minute mean wind speed was 40.9 m/s, strongest during the winter 2003/04.

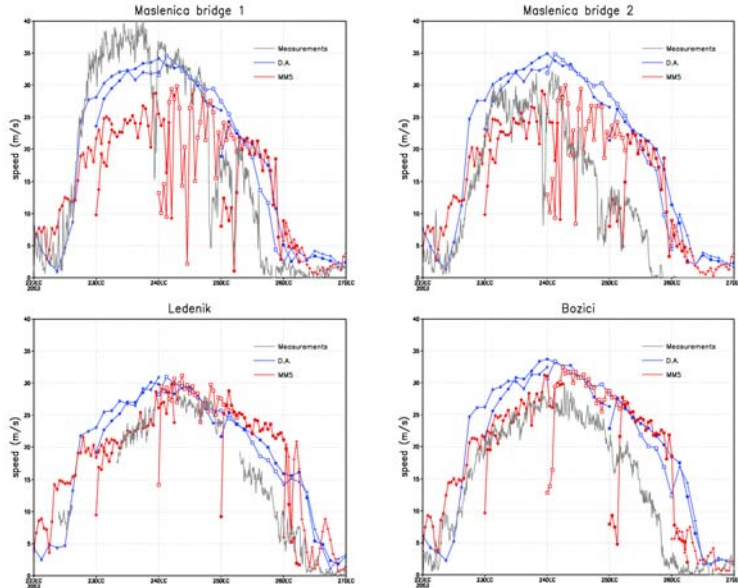


Figure 7. 10-m wind meas. and modeled for 4 stations on the new highway near Zadar, Maslenica bridge 1&2 and 2 stations upslope on the highway Ledenik & Bozic. The high resolution 1-km MM5 is computationally very expensive, while ALADIN dynamical adaptation on 2-km is computationally very cheap. Operational ALADIN/HR dynamical adaptation same as MM5 simulation are able to reproduce extreme variability of Bura.

Sensitivity to the initial conditions: Different initial and boundary conditions were used to run the ALADIN forecast: operational ARPEGE form 1999 and ECMWF MAP Re-Analysis from 2003. Results of the numerical experiments show the higher sensitivity to the initial conditions for the MAP IOP 5 heavy precipitation case, especially in Slovenian near Austrian and Italian border and on the Slovenian Croatian border. For MAP IOP 15, different initial conditions do not have a significant influence.

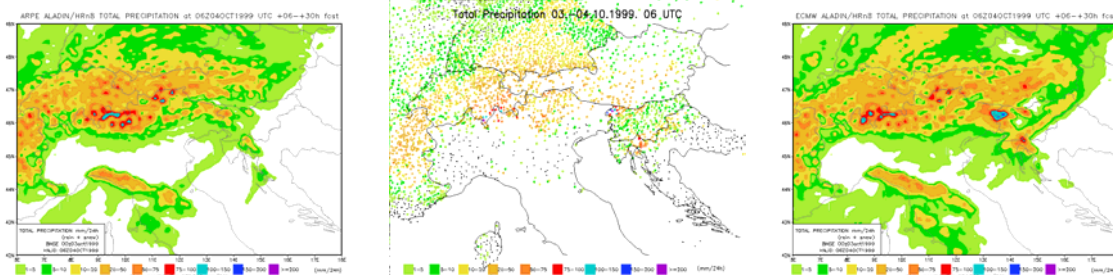


Figure 8. 24-hour accumulated precipitation (in mm) from 3rd October, 06 UTC to 4th October, 06 UTC for: ARPEGE (left) downscaled to ALADIN 8-km resolution, observations (center) and ECMWF MAP Re-Analysis (right) downscaled to ALADIN 8-km resolution.

Intercomparison of Coamps and Aladin: ALADIN 8-km and 2-km resolution Dynamical Adaptation forecasts and COAMPS NH 3-km resolution forecast are compared to the aircraft measurements (ELECTRA) showing that ALADIN is able to reproduce the structure of PV banners and good wind forecast especially the 2-km resolution run.

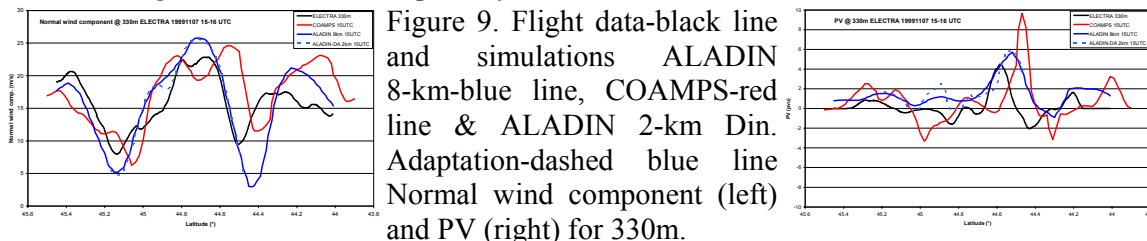


Figure 9. Flight data-black line and simulations ALADIN 8-km-blue line, COAMPS-red line & ALADIN 2-km Din. Adaptation-dashed blue line Normal wind component (left) and PV (right) for 330m.