

RC LACE Status Report 2004-2005

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Introduction

Regional Cooperation for Limited Area modeling in Central Europe (RC LACE) has gathered the meteorological services of Austria, Czech Republic, Croatia, Hungary, Slovakia and Slovenia under the common goal to coordinate operational ALADIN applications development and to optimize the research with common human and budget resources. LACE Memorandum of Understanding defines the relations between LACE Council, LACE Steering Committee and LACE Management Group. Since year 2003, operative ALADIN applications and R&D have been organized at decentralized mode, at each Member service.

1 Life of the Project

The main highlights of LACE project in 2004-2005 period were:

- coordination of ALADIN and HIRLAM actives toward the future common-code development
- development and harmonization of **AAAA** (ARPEGE/ALADIN/ALARO/AROME) chain of models.

The LACE R&D affords for 2004 has reached 100 person/months, and actions at 2005 would fulfill 110 person/months of coordinated research. LACE Budget has financed the mobility of the scientists with the funds for the 15 person/months missions and workshops.

2 Operational Applications

ALADIN applications are operative at all LACE services. ALADIN has been coupled with ARPEGE LBC with 3h coupling frequency. 00 and 12 UTC runs are standard while 06 and 18 runs are started on demands. Dynamical adaptation initialization has been replaced with 3DVAR initialization at Hungary, while CHMI has running a blending type of initialization. Standard horizontal resolutions are 12-7km , while some services also run a separate small domains with dynamical adaptations up to 2.5 km for high-resolution wind fields.

3 Research activities

Working group on Dynamics and Coupling

ALADIN Non-Hydrostatic dynamic is in the scope of interest. The stability of the ALADIN NH has been tested on 10, 5, 2 and 1 km resolutions. The further code cleaning and tests have been performed. The Semi Lagrangian Horizontal Diffusion (SLHD) system has been documented, tuned and tested at various cases.

- Iterative schemes for non-hydrostatic ALADIN

The further development of NH ALADIN system has been performed. After the main iterative 2TL SL P/C (ICI) development, the 3TL Eulerian ICI scheme has been phased into the CY29T2. Its existence allows inter-comparison between semi-Lagrangian (SL) and Eulerian version of time stepping procedures. The 3D ALPHA tests with physical forcing has been performed at 4km resolution. The implementation of SLHD into 3TL Eulerian scheme is planned.

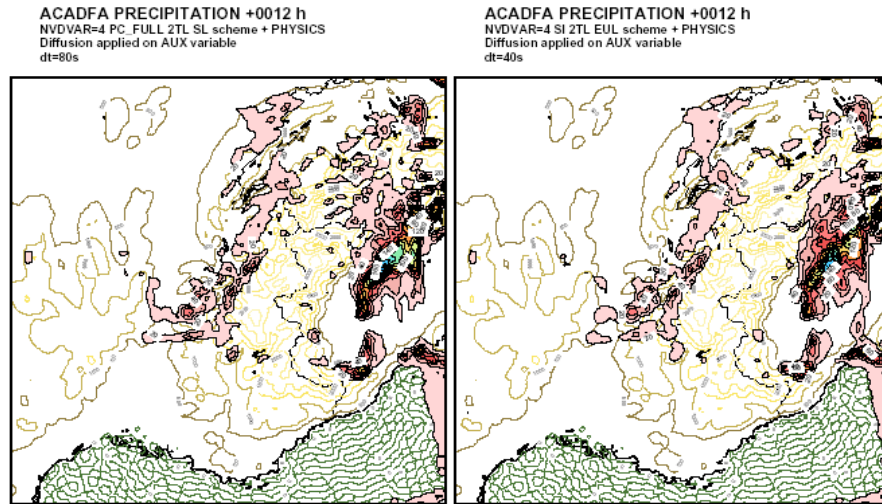


Fig. 1: ALADIN NH at 4km resolution, Alpine reagia, +12h precipitation forecast, left: 2TSL, $\Delta t = 80s$; right: 3TL Eulerian $\Delta t = 40s$.

- Bottom boundary condition (BBC) tests in the academic environment

The exact treatment of BBC formulation and origin of diffusive chimney has been examined. The horizontal diffusion numerical filtering has been replaced with SLHD.

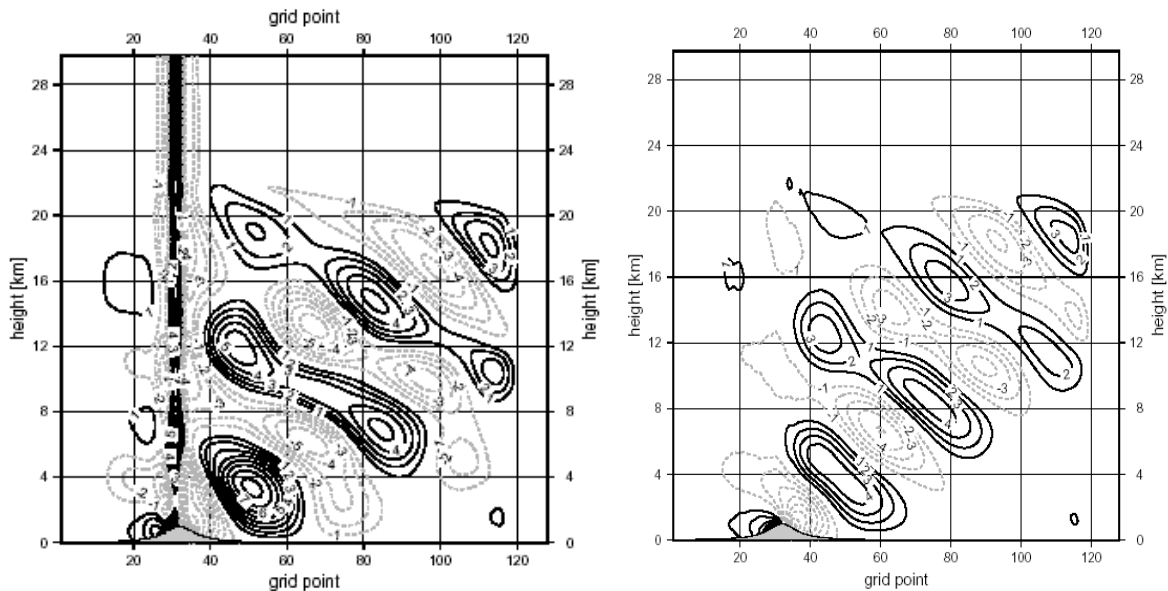


Fig.2 : NH vertical velocities, Bell-shaped 2D tests, left: Horizontal diffusion, right: SLHD.

Working group on Physics

The developments in physics has been targeting to the sustain improvements of ARPEGE/ALADIN physics, as well toward the development of the new physics for the 10-5km scales.

- PBL Cloudiness - Convergence Xu-Randall and Seidl-Kann scheme

The problem of too strong 2m temperature diurnal cycle during a winter anti-cyclonic conditions has been studied in Prague. The problems were detected by large errors in 2m temperature forecasts. Method based on diagnostic of temperature inversion layers and temperature vertical gradients has been applied. «Critical Humidity Profile” computation has been modified by lower values for computation for saturation for cloud. The new cloudiness geometry has been applied.

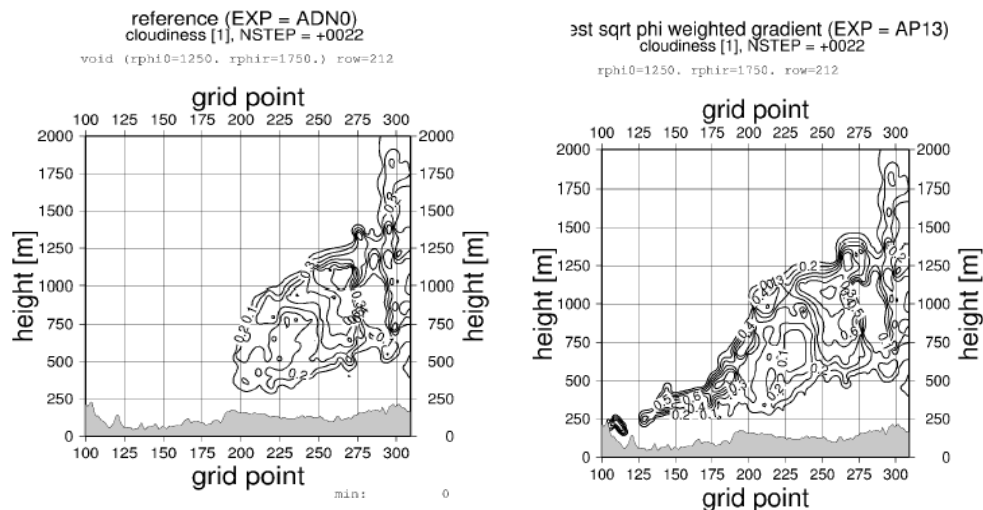


Fig.3: Vertical cross sections of cloudiness: left reference, right with the modifications

- ALARO prototype development

ALARO application (10km model) tend to bridge the ALADIN(10km) and AROME(3km) models by harmonizing the system of equations and variables at the closest possible way. The physical parameterizations would be tailed for 10 km horizontal resolution scale, with the further developments toward the parameterization for 4-5 km scale. The highlights of ALARO developments are:

- gravity wave drag parametrization down to the 5km sub-grid effects
- improvements of thermal radiative fluxes
- semi-prognostic treatment of TKE
- prognostic treatment of liquid and solid cloud water and precipitation
- simplified microphysic scheme
- Bulk Convective Condensation approach

The work is in progress, final tests are planned for the end of 2005.

Working Group on Data Assimilation and Predictability

ALADIN Data Assimilation R&D were focused on theoretical methods and observations. The influence of non-classical observations (MSG/AMV, AMDAR, wind profilers, radar radiances) at the performance of meso-scale 3DVAR has been studied. The core of the activities were

performed in HMS-Budapest, where the first operational ALADIN 3DVAR has started at May 2005.

- 3d VAR ALADIN e-suites and comparisons vs. Dynamical adaptation initialization

Since 2002 a development of 3DVAR has been in the scope of HMS activities. 6-hour assimilation cycle has been based on SYNOP, TEMP, ATOVS/AMSU-A satellite data observations. The subjective and objective scores have shown the positive impact of 3DVAR system in the first 12 hours of model integration. At several cases the forecast based on 3DVAR provided the more reliable precipitation fields in the comparison with precipitation forecast based on dynamical adaptation initialization (see more details at HMS report).

- Tuning of the multivariate humidity formulation of the B matrix

The tuning of the humidity error variances for stratosphere and troposphere levels was performed. The tests aimed to examine the negative impact of the multivariate humidity formulation to the humidity 3DVAR analysis. While the single observation experiments show encouraging results, the full observation assimilation cycle experiments (TEMP, SYNOP, AMDAR, ATOVS data) tend to have a small impact on the humidity analysis.

- Assimilation of 10 m wind

The impact of 10m wind assimilation has been studied. with the goal to improve 10m wind assimilation over the land. The impact of “black-list” due to the difference between model orography and the surface stations altitudes has been tested. Even when “black-list” approach has been applied on stations with $RMSE > 2.5$, the 10m wind assimilation showed the almost neutral impact. The further studies would be performed with “no-envelope” orography.

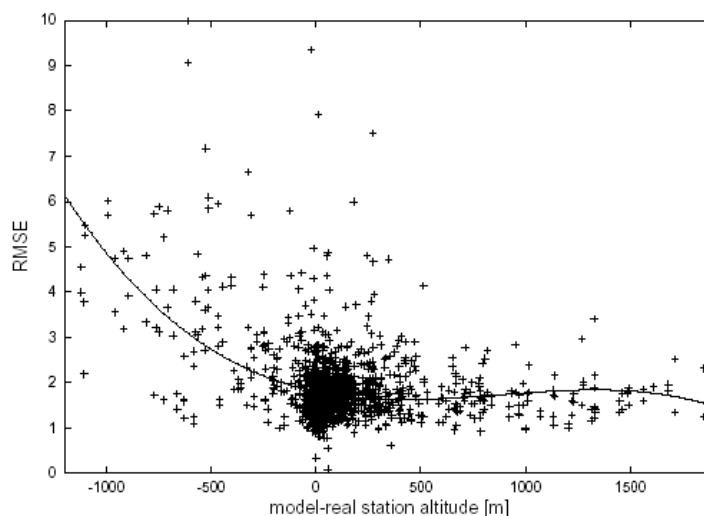
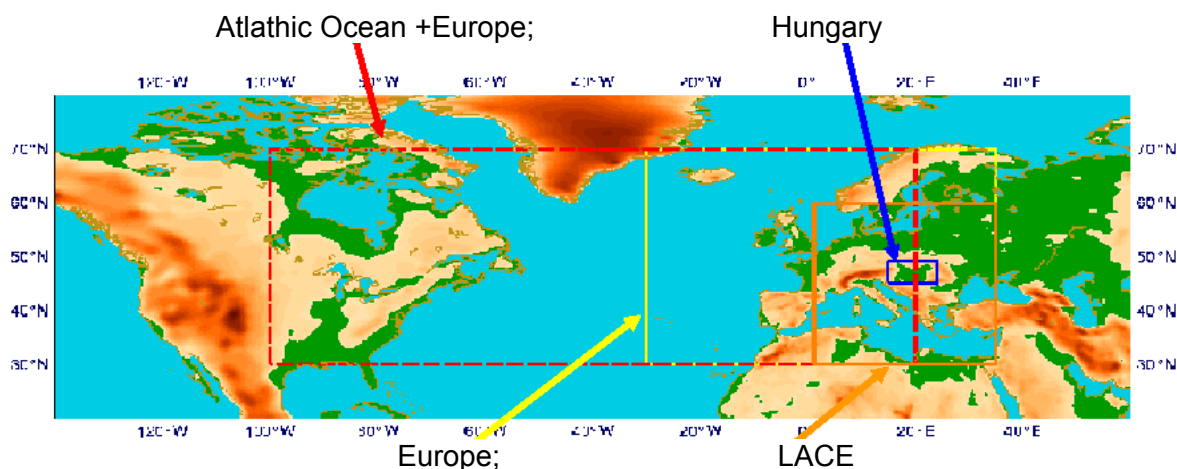


Fig. 4: Relation between 10m wind RMSE and model orography altitude – station altitude, fitted by polynomial function of degree 5 and 3.

Predictability targeting LAM-EPS has been studied at Austria, Hungary at Croatia. The different EPS approaches has been studied: ALADIN EPS based on ARPEGE SV perturbations; Breeding techniques, ETKF -Ensemble Transformed Kalman Filter methods; ALADIN EPS based on the ECMWF EPS system. The diagnostic tools (ROC, Talagrand) for EPS system has been developed at HMS-Budapest.

- ALADIN EPS sensitivity experiments at 4 domains for singular vector (SV) computation



- ALADIN EPS based on downscaling of ECMWF EPS
 At Hungary and Croatia, ECMWF EPS products have been applied as the initial conditions for ALADIN EPS computation. Members of ECMWF/ EPS products have been chosen by clustering methods and downscaled to meso-scale resolution. Impact of ECMWF/ EPS initial conditions has been studied on the severe weather events.

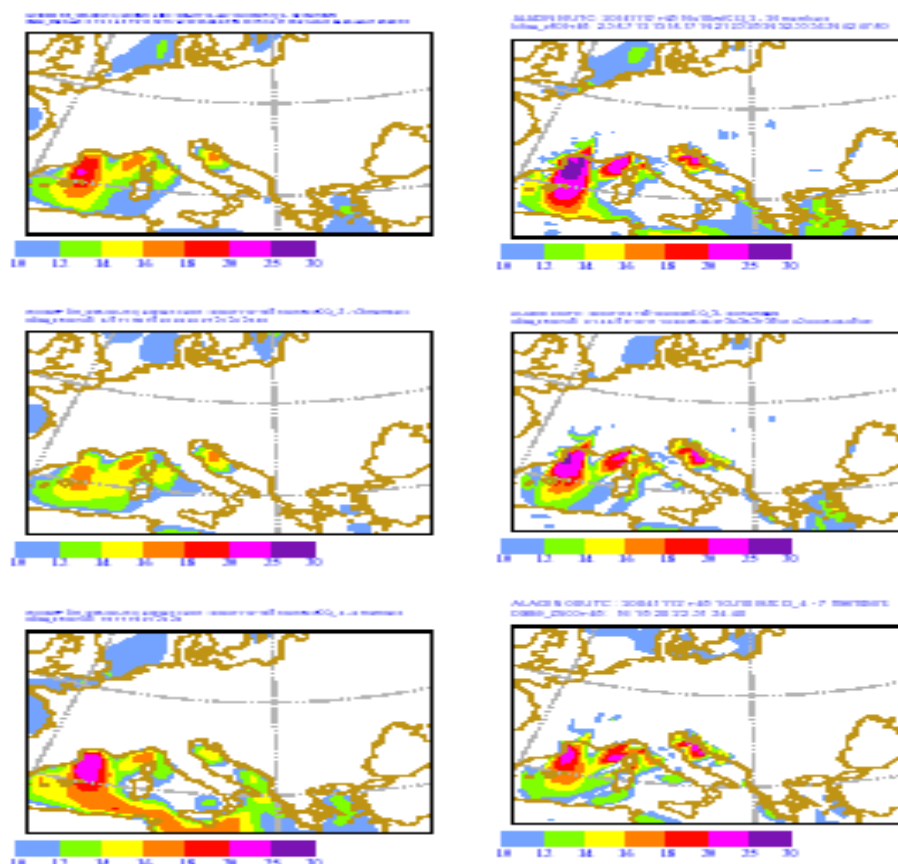


Fig.5: 10m wind forecast for 14 November 2004, measurements of wind velocities over 25m/s, left column: 3 clusters of ECMWF/ EPS +48h forecast downscaled to 12km, right column: ALADIN +48 forecasts based on ECMWF/ EPS clusters.

4 Plans and Goals 2005-2007

At the recent LACE Steering Committee Meeting, September 2005, the enlargement of R&D has been proposed in the form of the new working group for predictability. In the 2006 LACE project would dedicate the new funds for LAM EPS workshops and research stays. The kick-off ALADIN/EPS workshop is planned for the beginning of 2006, as part of the LACE – HIRLAM cooperation.

Research and development targeted for the new models: ALARO(10km), AROME(3km) would continue. The work would be organized under the common ALADIN-LACE coordination. The first AROME training is planned for November 2005 in Romania. One-month phasing for ALARO prototype development would be organized at Jan/Feb 2006 in Brussels. The porting and validation of ALARO model at LACE member services would be in the scope of the actions at the first half of 2006. The several tests would be performed (stability, objective and subjective verification, case studies, e-suites vs. ALADIN model)

The members of LACE Project have decided to put the last 10 years of LACE Project under the external evaluation procedure. The Evaluation Team has been hired under the leadership of Prof Peter Lynch. The evaluation should be finished till the mid of 2006. LACE partners decided to prolong the current LACE MoU till the end 2007, with the ambition to apply the evaluation recommendations into the LACE structure till the end of the same period.