LACE Working Group for Physics
Research progress summary for 2004

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Contents

1 Introduction

Short overview of research and developments in the frame of LACE working group for physics in the year 2004 is presented. Work on various physical parameterization is described, work on topics connected with systematic errors in the current operational forecast systems is summarized and information on validation of ALARO prototype is included. In third part training information on learning Meso-NH physics and surface scheme can be found. Short information about training course and working group on physical/dynamical interfacing is also added.

2 Progress in research topics

2.1 Shallow convection and PBL cloudiness

Cloudiness parameterization

By applying acnebn to radiosonde data over a multi-year period it was found that the critical relative humidity for onset of cloudiness in ALADIN as used at ZAMG was too low, especially at mid-levels. The new values proposed by MF were found too high, leading to a too strong switch on / switch off behavior. An intermediate solution was found and put into operations. It reduces some of the negative bias in T2m during the day in the summer season.
Slightly different modifications were performed and put into operation in Prague. Improvements can be very easily noticed in distribution of forecasted amount of cloudiness.

Efforts: 3 person x month
Contribution: T. Haiden (At), R. Brožkova (Cz)
Documentation: presentation at 14th ALADIN workshop, mail information

Stratus prediction

The Seidl-Kann scheme has been further improved and optimized. Best results in terms of stratus coverage are obtained when the horizontal diffusion of temperature is switched off or made very small, like a tenth of its normal value. Then we can obtain realistic stratus even in Alpine basins, such as the Klagenfurt basin. However, before we can put into operations the reduced T horizontal diffusion we must check for possible negative effects in dynamically active weather situations (e.g. frontal passages). It was also found that an increase in horizontal resolution from 9.6 to 2.3 km does not give a significant improvement of the stratus prediction.

Efforts: 6 person x month
Contribution: A. Kann (At), H. Seidl (At)
Documentation: poster at 14th ALADIN workshop

2.2 CAPE and deep convection triggering

ALADIN produces light to moderate convective rainfall on many days when none (or much less) was observed. It was presumed that a change from envelope to non-envelope might have a beneficial effect on this over-prediction of convective rainfall in the mountain areas. It was found that with the non-envelope the convective triggering was reduced or delayed as expected, but the grid-scale rainfall increased. A change in the vertical resolution from 37 to 45 levels similarly had a beneficial effect

on convective triggering but also led to compensating effects in the grid-scale rainfall. Increasing the horizontal resolution from 9.6 to 7 km did not have a significant effect.

Efforts: 1 person x month
Contribution: F. Wimmer (At)
Documentation: presentation at 14th ALADIN workshop

2.3 Orographic drag

Many efforts were done to suppress the envelope topography, which finally does not allow using it in the model.

- A new approach for calculating semienvelope orography was tested. The idea was to keep the envelope for greater wave numbers and to suppress it for smaller ones with direct modification of spectral coefficients. Also with this method problem of low model topography values over sea remains.

- Testing and tuning of the new version of acdrag parameterization scheme by observing vertical impact on u wind speed and checking scores on the set of ten 4-days forecasts

- Results from a 1-month parallel run (non-envelope, new acdrag scheme) show neutral to slightly negative scores in terms of 10 m wind at valley stations.

- Results from some other parallel suites show positive impact (more realistic flow around mountain ranges, less upwind exaggerated precipitation on mountain flanks, better wind scores at 850 hPa and around) and some negative (too weak 10 m wind near mountains, decreased foehn effect).

Efforts: 5 person x month
Contribution: J. Cedilnik (Si), A. Kann (At), K. Stadlbacher (At), R. Brožkova (Cz), R. Mladek (Cz)
Documentation: Some details about physics in cycle 28T1 (ALADIN newsletter 26), report available on ALADIN web page

2.4 Other parameterization

Radiation parameterization

Some validation work was performed on the new developments in the radiation scheme. Possible way of parameterization weighting factors needed in the new scheme was investigated.
The new version of the radiation scheme requires more CPU time, but has also better results and is already used in operational version in Prague.

Efforts: 1 person x month (0.5 month stay in Prague)
Contribution: N. Pristov (Si)
Documentation: few slides in J.-F. Geleyn presentation at 14th ALADIN workshop

Parameterization of turbulent fluxes

Influence of the parameterization of turbulent fluxes and friction on cyclogenesis and anticyclogenesis in academic experiments and in realistic simulations with ARPÈGE/ALADIN models was studied. The result of the academic tests showed a

high overestimation of the friction force effect and non-realistic shape of the friction force hodograph in lowest layers of the PBL in comparison to Ekman spiral. Further studies showed that mixing length should depend on latitude and wind shear in the model parameterizations. Experiments with so modified parameterization of friction show decrease in the pressure gradients and damping of rapid cyclones.

Efforts: 2 person x month (2 months stay in Toulouse)
Contribution: A. Simon (Sk)
Documentation: powerpoint presentation available on ALADIN web side

2.5 Validation, case studies, sensitivity studies

Soil moisture sensitivity

Summer 2004 in Austria was characterized by negative ALADIN T2m bias during daytime on sunny days. Analysis of the problem revealed initial soil moisture field as a major cause of the problem. Sensitivity experiments with different soil moisture values were carried out and the effect on T2m and precipitation documented.

Efforts: 1 person x month
Contribution: H. Seidl (At)
Documentation: -

Orographic precipitation

The performance of ALADIN during strong southern alpine upslope precipitation cases was studied using data from a dense network of hydrological stations. Specifically it was investigated whether (a) ALADIN can distinguish cases where the rainfall intrudes into the inner alpine areas versus cases where it stays in Slovenia and Italy, and (b) cases where the rainfall covers even the low-lying areas to the east (Klagenfurt basin) from those where it remains in the west. It was found that the model produces realistic patterns and amounts as long as the front is to the West of the area, but strongly underestimates rainfall during the frontal passage, most likely due to exaggerated drying in the downward motion on the leeside of the mountains. It is concluded that prognostic cloud water very likely would improve forecasts in such situations/areas.

Efforts: 6 person x month
Contribution: C. Wittmann (At)
Documentation: presentation at 14th ALADIN workshop

Evaluation of ALARO prototype

In the ALARO prototype Meso-NH physics is imported in very robust/raw way. In the tests the amount of precipitation was very poorly predicted and they were dependent on integration time step.

Dependency of precipitation on time step length was examined. Tests were done on 10 km resolution, for two cases (Gard floods, MCS over west part of Czech Republic).
Experiments showed that with longer integration time steps precipitation are less intensive.
To cure this time splitting for microphysics during one integration time step was introduced and tested on Gard case. For all time steps used, precipitation amount is converging to final value as time step for microphysics is decreasing. This limiting

value for precipitation can be also dependant on time step. Conclusions are still not final.

Efforts: 4 person x month (2.5 months stays in Toulouse)
Contribution: T. Kovačić (Hr)
Documentation: reports available on ALADIN web side

Validation of ALARO prototype at resolutions 5 and 7 km, with or without the parameterization of subgrid convection was performed for two cases (Gard floods, MCS over west part of Czech Republic). Generally, results of runs without the parameterization of convection are better than with the convection scheme switched on. Especially the amount of precipitation with switched on convection is much too low for the Gard case (and also in the MSC case). The amount of precipitation with different resolutions used is more or less comparable.

Efforts: 2 person x month (1.5 month stay in Toulouse)
Contribution: J. Cedilnik (Si)
Documentation: report available on ALADIN web side

3 Training

Training on AROME physics *(organized by GMME team in Meteo-France)*

The upper air physics of Meso-NH model, which are implemented into the model, Arome with the addition convection was studied and is described in the report (vertical levels, calling tree of the upper air physics subroutines and their short description, description of additional routines). Some tests for numerical stability were performed.

Contribution: M. Tudor (Hr)
Efforts: 2 person x month (1.5 month stay in Toulouse)
Documentation: report available on ALADIN web side

Externalized surface scheme *(organized by GMME team in Meteo-France)*

During stay in Toulouse Laszlo Kullmann got familiar with the surface scheme and learned how to use it. The sensitivity of scheme on the forcing time step, behavior of different snow schemes, the impact of number of layers in ISBA scheme were studied. Later he installed the externalized surface scheme locally at service in Budapest.

Efforts: 2 person x month (1 month stay in Toulouse)
Contribution: L. Kullmann (Hu)
Documentation: report available on ALADIN web side

Training course and working group on physical/dynamical interfacing

The training course and working group on physical/dynamical interfacing was organized in Prague from 22 to 26 November 2004 by J.-F. Geleyn (ALADIN-2 coordinator) with help of CHMI.

Besides 28 participants from ALADIN countries (19 from LACE countries) were 6 from HIRLAM and one from ECMWF. Teaching part was devoted to presentations on equations, stability and reliability of physical schemes, code architectures and organization of the time step.

During working group part constraints from various models IFS, HIRLAM, ARPEGE, ALARO, AROME-Meso/NH were presented and discussed. The physics-dynamics interface choices were discussed without common agreement for working plan at the end of the workshop.
A small group of ALADIN-2 and HIRLAM people was asked to produce a document about goals and means of the proposed physics-dynamics interfacing strategy. This document was later useful in further discussions and decisions taken in January 2005.

4 Summary of means

The following table is a short overview of the report above concentrating on the used manpower for each research topic. All together 14 scientists contributed to 39 working months. In year 2004 LACE supported training of 7 participants at the training course and working group on physical/dynamical interfacing (TCWGPDI).

Table 1: Overview of the realized effort in 2004.

Topic	**Realized effort** (person x month)	**LACE support**
Cloudiness parameterization	3	-
Stratus prediction	6	-
Deep convection triggering	1	-
Orographic forcing parameterization	5	-
Radiation parameterization	1	-
Parameterization of turbulent fluxes	2	-
Soil moisture sensitivity	1	-
Orographic precipitation	6	-
Evaluation of ALARO prototype	6	-
Training on AROME physics	2	-
Externalized surface scheme	2	-
TCWGPDI	4 (19 participants)	For 7 part.
Total	**39 p x m**	