# LACE project
# Operational ALARO at 5km mesh-size

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first version: March 2008
update: December 2008

## General info

Project name: **Operational ALARO configuration at scales around 5km mesh-size**
Responsible person: **Neva Pristov, Area leader for Physics**
Responsible Center: **CHMI**
Project duration: **2008-2010**

## Background

For the quality of the model results the description of the processes is crucial. In a NWP application a stable (longer time steps) and cost-efficient algorithmic solution is also very important. For these reasons the ALARO-0 physical package has been developed for some years and has been declared as working physics package in March 2008. This code contents various physical schemes which are designed to be used on wide range of model resolutions.
The use of ALARO-0 physical package at the present operational resolution (around 9 km of mesh-size) has improved the model performance. New prognostic variables (such as hydro meteors and turbulent kinetic energy) have improved realism and are available for the users.
Our interest is to increase the resolution of operational models. Considering the computer resources of the services inside RC LACE it is foreseen for the next few years that the highest affordable resolution will be between 4 and 9 km. To achieve this goal (resolutions around 4-5 km) further tests and improvements of ALARO physical package are needed.

## Objectives and benefits

The main objective of the project is to provide good quality of model forecast at the scales around 5km mesh-size and still requiring reasonable amount of computation time.
At this mesh-size many physical processes are still partly resolved and partly parameterized. Especially important is the treatment of deep convection. 3MT was designed for this but behaviour at higher resolution has to be examined (first tests show promising results). Improvements of other schemes (not so scale-dependent) are also important.
During the model validation and evaluation weaknesses and their causes will be identified. Some effort will be devoted to the code stabilization and modularization to create a good basis for further improvements and sophistications. In such a way the scientific and technical maintenance capacity will increase inside LACE countries.
The improvements of the model system at scales at around 5km mesh-size are expected for the prediction of local phenomena, such as precipitation (convective, extreme precipitation, distinction between snow and rain), fog and low clouds, low level winds (wind storms, sea or mountain breeze, wind gusts). Also low level temperatures are expected to be improved.

## Organization

The work can be split into three working packages:

- WP 1: Research - development of the schemes
- WP 2: Scientific maintenance
- WP 3: Operational implementation

WP1 Research - development of the schemes

Task 1.1: Turbulent scheme

Description: Further sophistication of the current turbulent scheme (pTKE) is planed. Among various formulations of the mixing length computation the best one should be found. After coding some variants for emulating full TKE scheme, tests and comparisons will follow. According to the results the optimal solution will be selected.
Resources: 6.5 pm
Contributors: F. Váňa (Cz), I. Bašták (Sk)
Schedule: March 2008 - 2009

Task 1.2: Radiation scheme

Description: Our aim is still to use current radiation scheme with a low computational cost. Scheme performance can be improved with the new fits of gaseous broad band transmission functions for thermal band. Some improvements are proposed in the aerosol's optical properties.
Resources: 8 pm
Contributors: T. Kral (Cz)
Schedule: March 2008 - 2009

Task 1.3: Cloudiness scheme

Description: The prognostic water species are now available in the model and the description of cloudiness should take this into account. Method should be revised, also link between clouds and radiation. Maybe unified cloud scheme can be proposed, find out if same clouds can used in the radiation scheme or not.
Resources: 5 pm
Contributors: J. Rio (Pt), N.Pristov (Si)
Schedule: November 2008 - 2009

WP2: Scientific maintenance

Task 2.1: Code optimization

Description: It is important and useful to have well organized code and is worth to invest into code modularization, stabilization and cleaning. The following is planed: optimization of the modularized version of ACRANEB, modularisation of the updraft and downdraft computation, to allow use of other microphysical processes (from ICE3). Additional some other unexpected work can appear. The validated developments (e.g. 3MT), done by other ALADIN and HIRLAM partners, should be also regularly implemented.
Resources: 7.5 pm
Contributors: T. Kral (Cz), R. Brožková (Cz), D. Banciu (Ro), C. Wittmann (At), B. Catry (Be)
Schedule: 2008-2009

Task 2.2: Validation, tuning

Description: Validation of the historic entrainment formulation and the retuning the 3 coefficients of the scheme. Study of other variants of prognostic entrainment, which is foreseen/anticipated to be needed at higher resolutions.
Resources: 5 pm
Contributors: D. Banciu (Ro)
Schedule: August 2008 - 2009
Description: Retuning Xu-Randall cloudiness scheme in 3MT framework taking into account also radiation feedback.
Resources: 1 pm
Contributors: J. Mašek (Sk)
Schedule: 2009

Task 2.3: Evaluation

Description: Evaluation of the model can start already with the current operational configuration at the scale around 10 km. First model environment on target resolutions has to be prepared locally with decisions about domain size, resolution, suitable number of vertical levels, a way of the initialisation of prognostic variables. Model behaviour and performance can be studied with case studies and parallel suites. Some of the proposed subjects are to study the position and the amount of (convective) precipitation, life cycle of convection (diurnal cycle), triggering of the convection.
In the last part (when a guidance will be available) also teams not active before are invited to implement and to test according to their needs.
Contributors: C. Wittman (At), R. Brožková (Cz), M. Žagar (Si), N. Pristov (Si), D. Banciu (Ro), M. Tudor (Hr), J. Mašek (Sk), N. Lopez (Pt), Hu team
Resources: 18.5 pm
Schedule: 2008-2010

WP3: Operational implementation

Task 3.1: Operational model at CHMI

Description: The model can become operational when the model forecast fields have such a quality that can be offered to the forecasters. According to the possibilities and interest the regular daily computations can start also in other services.
Resources: 1 pm
Contributors: R. Brožková (Cz), local operational team
Schedule: first quarter 2010

Task 3.2: Guidance and recommendations

Description: For the implementation of the model with adequate physics packet (and NH dynamics) the instructions will be prepared.
Resources: 1 pm
Contributors: R. Brožková (Cz), N. Pristov (Si)
Schedule: first quarter 2010

## Time table

The project is designed for the period of 2 years, starting in 2008 finishing in first quarter of 2010.

## Deliverables

WP 1: Development of the schemes
**D1:** improvements in the TKE scheme ready for inclusion into ALADIN library (mid 2009)
**D2:** improvements in the radiation scheme ready for inclusion into ALADIN library (mid 2009)
**D3:** code related to unification of cloudiness ready for inclusion into ALADIN library (end of 2009)

WP 2: Scientific maintenance
**D4:** modularized version of the radiation scheme (ACRANEB) (mid 2009)
**D5:** stabilization, modularisation and cleaning of the 3MT code (2009)
**D6:** the entrainment rate formulation and its tuning parameters (2009)
**D7:** regular implementations of validated 3MT code including the latest developments (2009)
**D8:** local configuration of the model setup at scale around 5 km at services (2008-2010)
**D9:** list of weaknesses of the model performance (3MT scheme) around and beyond 5 km resolution (regular updates, 2009)

WP 3: Operational implementation
**D10:** operational model at CHMI with NH dynamics and ALARO physics (begin 2010)
**D11:** guidance with the recommendations for the operational use (begin 2010)

## Links to other projects

Collaboration inside ALADIN project with non LACE countries is essential, in particular for 3MT developments. Some tasks are in the project "Toward an operational implementation of the NH dynamics", while operational implementation (tasks in project for dynamics and physics) is complementary and will be done simultaneously.

## Resources overview

Scientists: Doina Banciu (DB), Ivan Bašták (IB), Radmila Brožková (RB), Tomas Kral (TK), Jan Mašek (JM), Neva Pristov (NP), Martina Tudor (MT), Filip Váňa (FV), Christoph Wittmann (CW), Mark Žagar (MŽ)
Scientists from non-LACE countries: Bart Catry (BC), Joao Rio (JR), Nuno Lopez (NL)

Total means overview for the period **2008-2010** (person.months)

| | | At | Cz | Hr | Hu | Ro | Si | Sk | flat rate | total |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | |
| WP1 | Turbulent scheme | | 3 | | | | | 3.5 | | 6.5 |
| | Radiation scheme | | 8 | | | | | | | 8 |
| | Cloudiness scheme | | | | | | 3 | | 2 | 5 |
| | | | | | | | | | | |
| WP2 | Code optimization | 2 | 3.5 | | | 1 | | | 1 | 7.5 |
| | Validation | | | | | 5 | | 1 | | 6 |
| | Evaluation | 3 | 2.5 | 2 | 1 | 2.5 | 4.5 | 2 | 1 | 18.5 |
| | | | | | | | | | | |
| WP3 | Operational | | 1 | | | | | | | 1 |
| | Guidance | | 0.5 | | | | 0.5 | | | 1 |
| | | | | | | | | | | |
| WP 1 | | 0 | 11 | 0 | 0 | 0 | 3 | 3.5 | 2 | 19.5 |
| WP 2 | | 5 | 6 | 2 | 1 | 8.5 | 4.5 | 3 | 2 | 32 |
| WP 3 | | | 1.5 | | | | 0.5 | | | 2 |
| | | | | | | | | | | |
| Total | | 5 | 18.5 | 2 | 1 | 8.5 | 8.0 | 6.5 | 4 | 53.5 |

Yearly means overview for the **year 2008** (person.months)

| | | At | Cz | Hr | Hu | Ro | Si | Sk | flat rate | total |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | |
| WP1 | Turbulent scheme | | FV 2 | | | | | IB 2.5 | | 4.5 |
| | Radiation scheme | | TK 3.5 | | | | | | | 3.5 |
| | Cloudiness scheme | | | | | | | | JR 1 | 1 |
| | | | | | | | | | | |
| WP2 | Code optimization | | RB 0.5 | | | | | | | 0.5 |
| | Validation | | | | | DB 2 | | | | 2 |
| | Evaluation | CW 0.5 | RB 0.5 | | | DB 0.5 | MŽ 1<br>NP0.5 | | NL 1 | 4 |
| | | | | | | | | | | |
| WP3 | Operational | | | | | | | | | |
| | Guidance | | | | | | | | | |
| | | | | | | | | | | |
| WP 1 | | 0 | 5.5 | 0 | 0 | 0 | 0 | 2.5 | 1 | 9 |
| WP 2 | | 0.5 | 1 | 0 | 0 | 2.5 | 1.5 | 0 | 1 | 6.5 |
| WP 3 | | | | | | | | | | |
| | | | | | | | | | | |
| Total | | 0.5 | 6.5 | 0 | 0 | 2.5 | 1.5 | 2.5 | 2 | 15.5 |

Yearly means overview for the **year 2009** (person.months)

| | | At | Cz | Hr | Hu | Ro | Si | Sk | flat rate | total |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | |
| WP1 | Turbulent scheme | | FV 1 | | | | | IB 1 | | 2 |
| | Radiation scheme | | TK 4.5 | | | | | | | 4.5 |
| | Cloudiness scheme | | | | | | NP 3 | | 1 | 4 |
| | | | | | | | | | | |
| WP2 | Code optimization | CW 2 | RB 1<br>TK 1 | | | DB 1 | | | BC 1 | 6 |
| | Validation | | | | | DB 3 | | JM 1 | | 4 |
| | Evaluation | CW 1.5 | RB 1 | MT 1 | | DB 1 | NP 2 | JM 1 | | 7.5 |
| | | | | | | | | | | |
| WP3 | Operational | | | | | | | | | |
| | Guidance | | | | | | | | | |
| | | | | | | | | | | |
| WP 1 | | 0 | 5.5 | 0 | 0 | 0 | 3 | 1 | 1 | 10.5 |
| WP 2 | | 3.5 | 3 | 1 | 0 | 5 | 2 | 2 | 1 | 17.5 |
| WP 3 | | | | | | | | | | |
| | | | | | | | | | | |
| Total | | 3.5 | 8.5 | 1 | 0 | 5 | 5 | 3 | 2 | 28 |

Yearly means overview for the **year 2010** (person.months)

| | | At | Cz | Hr | Hu | Ro | Si | Sk | flat rate | total |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | |
| WP1 | Turbulent scheme | | | | | | | | | |
| | Radiation scheme | | | | | | | | | |
| | Cloudiness scheme | | | | | | | | | |
| | | | | | | | | | | |
| WP2 | Code optimization | | 1 | | | | | | | 1 |
| | Validation | | | | | | | | | |
| | Evaluation | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | 7 |
| | | | | | | | | | | |
| WP3 | Operational | | RB 1 | | | | | | | 1 |
| | Guidance | | RB 0.5 | | | | NP 0.5 | | | 1 |
| | | | | | | | | | | |
| WP 1 | | | | | | | | | | |
| WP 2 | | 1 | 2 | 1 | 1 | 1 | 1 | 1 | | 8 |
| WP 3 | | | 1.5 | | | | 0.5 | | | 2 |
| | | | | | | | | | | |
| Total | | 1 | 3.5 | 1 | 1 | 1 | 1.5 | 1 | | 10 |