

## Working Area Physics

# Work Plan

<b>Prepared by:</b>	Area Leader Neva Pristov
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## 1 Introduction and background

Already for some years, the focus of the research and developing activities inside LACE is to achieve a scale-independent ALARO physics package which allows us to produce operational forecast at the resolution between 10 and 2 km mesh-size. A baseline version of the ALARO-0, available in December 2012, is used in the operational at resolutions down to 4 km.

Radiation and turbulence scheme, developed in last years, are now integrated together with some improvements in the cloud and precipitation microphysics into the first version of new physical package named ALARO-1 (version A). Extended validation of this version is ongoing. Same time developments of enhanced description of convective and other processes will continue and will be assembled step by step into next versions.

## 2 Goals

The highest priority is to optimize the performance of the LAM for resolutions in the 2 to 5 km range. First version of ALARO-1 is prepared for testing and preparations for the next version are on a way. Unsaturated downdraft parameterization for 3MT is ready to be implemented and validated, some developments in radiation, shallow convection inside turbulence scheme, some enhancement of the 3MT draft and steps towards the unification of cloud cover representations in various processes are the most important topics. Besides enhanced description of atmosphere-surface link available in SURFEX should be implemented. Better description of the (stable) boundary layer behaviour, daily cycle of precipitation and convection under unstable circumstances are one of the most wished improvements.

Research will continue to enhance the description of physical processes also at sub-km resolutions. Experiments in very fine resolution (with ALARO and AROME) will indicate the problems which should be tackled.

It will be encouraged (as always so far) and supported that novelties enter the operational applications. ALARO physics package is already used regional climate simulations, in LAEF and GlamEPS ensemble system and is tested in a convection-permitting ensemble system.

### 3 Main R&D activities

**Action/Subject:** Turbulence scheme TOUCANS

**Description and objectives:**

The turbulence scheme TOUCANS is integrated into ALARO-1 version. The selected set-up for the pre-operational is conservative; some options remained the same as in ALARO-0. Further validation is needed to profit from other available important novelties. The important task is verification of wind forecast quality and the improvement wind gust diagnostics.

Research and developments continue on prognostic mixing length and computation of shallow convection cloudiness. A target is to obtain a complete scheme with many modern options for computation of turbulent fluxes of momentum, heat, water vapour and cloud condensed water.

**Proposed contributors, Estimated efforts:** I. Bašták Ďurán(Cz), R. Brožková (Cz), P.Smerkol (Si), 8 months

**Planned timeframe:** whole year

**Planned deliverable:** code modification, regular documentation updates, second scientific paper

**Action/Subject:** Radiation scheme

**Description and objectives:**

Radiation scheme ACRANEB2 is integrated into ALARO-1 version. Its validation will continue in 2015, some fine tuning and code optimization is planed. Improvements in the cloud-radiation interaction are planed by taking into account better information on cloud cover (especially shallow convection cloudiness from turbulence scheme) and by getting microphysical cloud condensates into radiation scheme. Adaptation of NER statistical model for cloudy case has very low priority, since usage of intermittent exact computation of bracketing weights has good results. Some additional tests are foreseen while preparing a scientific paper on the long wave radiation part of ACRANEB2.

The ACRANEB2 scheme is part of the HARMONIE radiation comparison. Adaptations to improve also climate simulations will be studied.

**Proposed contributors, Estimated efforts:** J. Mašek (Cz), P. Kuma (Sk), 7 months

**Planned timeframe:** whole year

**Planned deliverable:** code modifications, theoretical and technical documentation, scientific paper on long wave radiation part

**Action/Subject:** Cloud scheme

**Description and objectives:**

The objective is an unification of the cloud-cover concept within ALARO-1. After careful analysis, it was decided not to aim at a single computation of cloudiness, like for instance in Tompkins (2002), but go for an alternative approach, to build bilateral correspondences and/or combinations for all cases where two parameterisations interact at the level of the cloud-cover definition. For example, in precipitation process combination of stratiform and deep convective cloudiness is used.

Relatively small upgrades with respect to current ALARO-1 version are needed. This transversal change is touching many feed-back loops, hence its practical consequences is quite unpredictable.

**Proposed contributors, Estimated efforts:** I. Bašták Ďurán(Cz), R. Brožková (Cz), J. Mašek (Cz), N. Pristov (Si), 3 months

**Planned timeframe:** whole year

**Planned deliverable:** code modification, testing and validation

**Action/Subject:** 1D2D turbulence scheme

**Description and objectives:**

The aim is to simulate the 3D effects of turbulence in the model. This can be achieved with the extension of vertical turbulence scheme TOUCANS by consistent components for horizontal part obtained from SL interpolation stencil.

A first version of this 2D extension of the present 1D turbulence scheme is available in the model. However the experience from running any such 3D-like schemes of turbulence in typical NWP resolutions between 100 m and 3 km (where the horizontal eddies should already play a role) and highly anisotropic grid with vertical

resolution being fairly finer compared to the horizontal one is rather minimal. So first task is validation of the existing code and inter-comparison with some LES and/or academic simulations to get experience how the TOUCANS and 3D extension behaves. Later real case high resolution simulations with full 3D environment (convection, radiation and good surface parameterization) can follow. The aim would be to study the effects of transition from turbulence to (deep) convection and its role to the realistic shallow and deep convections simulation.

**Proposed contributors, Estimated efforts:** I. Bašták Ďurán (Cz), 0.5 months

**Planned timeframe:** low priority

**Planned deliverable:** scientific validation, academic case

**Action/Subject:** Operational applications: from ALARO-0 to ALARO-1, SURFEX

**Description and objectives:**

The ALARO-0 baseline version is used in operational or pre-operational applications in all LACE countries. Its evaluation by the users shows strength and weaknesses of the model simulations. Some weaknesses (diurnal cycle of precipitation, light precipitation pattern) are improved in the first version of ALARO-1. Local teams will validate and test ALARO-1 version for the (pre-)operational use and also perform experiments at resolutions around 2 km. Support will be available.

For the model description of the surface/canopy layer and below, the externalized SURFEX framework of coupled models (for snow and ice, lake and sea, urban environment, forest and vegetation, heat and moisture fluxes in the soil etc.) is used ALADIN/AROME. As the first version of ALARO-1 is now available some effort should be put to SURFEX implementation. Link between ALARO-1 and SURFEX should be checked, some adaptations are probably needed, after validations should start.

Validation and sensitivity study of the parameterization of orographic shadowing in radiation with respect to the primary (radiation fluxes, temperature) and secondary (convection, low stratus in valleys, local circulation) will be done.

**Proposed contributors, Estimated efforts:** R. Brožková (Cz), N. Pristov (Si), C. Wittmann (At), M. Derkova (Sk), ? (hu), M.Tudor (hr), D.Banciu (ro), 8 months, C. Wastl (At) 1 months, M. Dian (Sk) 1 month LACE stay

**Planned timeframe:** whole year

**Planned deliverable:** report

**Action/Subject:** The ALARO-1 version

**Description and objectives:**

The first ALARO-1 version (ALARO-0, ACRANEB2, TOUCANS, some updates in microphysics) is available for validation and pre-operational testing. Next step is to assemble the unsaturated downdrafts (an extra extension for the 3MT scheme), and if developments are ready also improved description of cloud cover and prognostic graupl.

In the second stage then all other planned developments; i.e. CSD, TOUCANS evolution, prognostic graupl, thermodynamic adjustment, unified cloud treatment (in radiation, shallow convection, thermodynamic adjustment and 3MT). CSD stands for the complementary sub-grid draft (research work of Luc Gerard, including both up- and down- drafts) scheme which enable a more realistic transition from parameterized to explicit convection when going to higher resolutions. Tuning of this scheme in the ALARO-1 environment will be needed.

The validation will be in the range 5 km to 2 km and suitable validation testbeds (common with AROME and ARPEGE) for facilitating cross testing of various parameterizations should be also prepared.

**Proposed contributors, Estimated efforts:** R. Brožková (Cz), I. Bašták Ďurán(Cz), D.Banciu (Ro), ?, 6 months (1 month LACE stay)

**Planned timeframe:** whole year

**Planned deliverable:** code, validation environment, documentation

**Action/Subject:** Interfacing physics parameterizations

**Description and objectives:**

Impact study and validation of the physics-dynamics interface has high priority in HARMONIE community. Scientific and practical constrains for redesign of physics interfaces (APL\_AROME and APLPAR), which should enable the various physics packages (and also to exchange their individual parameterization schemes) are proposed. Actions are spread among many people, LACE contribution is to adopt ALARO part of computations in APLPAR routine. Radiation scheme is already in

proper shape, code linked to turbulence and shallow convection should be analyzed and adopted, Very demanding part on 3MT will follow after.

**Proposed contributors, Estimated efforts:** R. Brožková (Cz), I. Bašták Ďurán(Cz), 1 month

**Planned timeframe:** whole year

**Planned deliverable:** code, documentation

**Action/Subject:** Various products for users (forecasters)

**Description and objectives:**

Many requests from the user side, mainly forecasters, asking for additional forecast parameters has arrived. For this new features should be coded in post-processing part which would enable output of model fields. Continuation of this topic is foreseen on the base of good experience with enlarged convection diagnostics. The methods for lightening diagnostics have still to be evaluated and final solution should be proposed. Additional diagnostic meteorological parameters can be added: UV index, icing parameter, freezing rain, snowfall line, computation of real snow height.

**Proposed contributors, Estimated efforts:** J. Cedilnik (Si), C. Wittmann (At), 1 month (0.5 month LACE stay)

**Planned timeframe:** second half of the year

**Planned deliverable:** code, documentation

**Action/Subject:** Very Fine Resolution Experiments

**Description and objectives:**

More and more teams are now able to perform VFR experiments with ALADIN NH-based models (with AROME and ALARO physics, within or without HARMONIE framework).

Some teams have started experiments at higher horizontal resolutions with AROME, experiments can be done now also ALARO-1 package (to be used also at the kilometric and hectometric scales). Several aspects on high resolution should be investigated (low stratus in valleys, initiation of convection over orography, etc.).

Study of the turbulence in the grey zone (resolved and parameterized description of eddies) is performed as part of PhD work of David Lancz. The aim is to modify the EDKF scheme used AROME in such way that parametrization of non-local eddies in the planetary boundary layer extinguish with higher horizontal model resolution and are handled by the model's dynamics.

The influence of orographic shadowing in radiation can be evaluated also at higher resolutions.

**Proposed contributors, Estimated efforts:** D. Lancz (Hu), N.Awan (At), M. Pietrisi (Ro), J.Cedilnik (Si), 8 months (1 month LACE stay)

**Planned timeframe:** whole year

**Planned deliverable:** report, diagnostics tools

#### 4 Summary of resources

Subject	Manpower	LACE	ALADIN
TOUCANS	8	0.5	
Radiation	7	0.5*	
Cloud scheme	3	0.25	
1D2D turbulence	0.5		
ALARO-0/ALARO-1/SURFEX	10	1	0.5
ALARO-1	6	1*	1.25
Physics interface	1		
Additional fields	1	0.5	
VFR Experiments	8	1	
<b>Total:</b>	<b>39</b>	<b>3.25+1.5</b>	<b>1.75</b>



## 5 Meetings and events

LACE scientific stays:

Dávid Lancz: Study of the turbulence grey zone (AROME 1km runs), Toulouse, 1 month

Martin Dian: Validation of orographic radiation parameterization, Vienna, 1 month

Ivan Bašták Ďurán : Discussion related to turbulence description in ALARO/AROME, Budapest, 0.5 month

Christoph Wittmann: Additional forecast weather parameters, Ljubljana, 0.5 month

Neva Pristov: ALARO-1 related issues, Prague, 1 week

\*Open

?: ALARO-1: assembling of complementary sub-grid drafts (CSD), Prague, 1 month

Peter Kuma: ACRANEB2 related issues, Prague, 0.5 month

ALADIN Flat-Rates Stays

Michiel Van Ginderachter: Micro-physics in ALARO, Prague, 1 month

Luc Gerard: Convection, Prague, 0.25 month

Rafiq Hamdi: SURFEX in ALARO, Prague, 0.5 month

Meetings:

- 1) 25st ALADIN Workshop and & HIRLAM All Staff Meeting, 2015, Denmark (participation of Neva Pristov).
- 2) 37th EWGLAM & 22nd SRNWP joined meetings, 2015, Serbia (participation of Neva Pristov).
- 3) Working week(s) organized by ALADIN/HIRLAM community  
SURFACE validation WW in Brussels is planed
- 4) Web meetings  
physics-dynamics interface (participation of Radmila Brožkova, Neva Pristov, other related developers) ; geospatial data in NWP;

## 6 Risk and constrain

The message from previous year(s) remains the same.

The research part of ALARO is ongoing only in two groups (Czech Republic, Belgium), other services contribute with one or two persons mainly on validation and application part. The new contributors are needed, especially someone who would follow CSD developments of Luc Gerard and help with its incorporation into ALARO1 and its validation.

It is crucial to continue good collaboration with other ALADIN/HIRLAM partners. Good examples are small working groups on parameterization of orographic effects on radiation into SURFEX and HIRLAM radiation group.