

Working Area Physics

Work Plan

Prepared by:	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 of the ALARO-0 version has been prepared in December 2012, it serves as a base for further developments and is recommended to be implemented into the operational use at resolutions down to 4 km. Significant progress was achieved in the description of turbulence, radiation and convective processes during previous year therefore it is foreseen that selection of the parameterizations schemes will be assembled into the first version of new physical package named ALARO-1.

2 Goals

The highest priority is to optimize the performance of the LAM for resolutions in the 2 to 5 km range; this means that various physics parameterization schemes recently developed should be integrated together and tested. 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, but in longer time-term and with lower priority.

It will be encouraged (as always so far) and supported that novelties enter the operational applications. ALARO physics package is already used in LAEF and can be also important part in a convection-permitting ensemble system.

3 Main R&D activities

Action/Subject: Turbulence scheme TOUCANS

Description and objectives:

The turbulence scheme TOUCANS is in validation process where an optimal set-up for the operational use has to be proposed. Scheme is also ready to be integrated into ALARO-1 version. The important task is verification of wind forecast quality.

In parallel, research and developments continue with new options and features, like prognostic mixing length, prognostic shallow convection cloudiness, introduction of the turbulence energy and flux budget (EFB, Zilitinkevich et al.). The interface with

SURFEX has to be readdressed, coupling with SURFEX should be consistent with the underlying hypotheses of TOUCANS.

Collaboration with HIRLAM developers who will perform single-column sensitivity studies (test the EFB in the AROME/MUSC framework) is also planned. Maybe experiments inside the GEWEX atmospheric boundary layer model inter-comparison study over Antarctic, GABLS4.

Proposed contributors, Estimated efforts: I. Bašták Ďurán(Cz), R. Brožková (Cz), J. Cedilnik (Si), 5 months

Planned timeframe: whole year

Planned deliverable: code modification, ALARO-1, regular documentation updates, publication

Action/Subject: Radiation scheme

Description and objectives:

Radiation scheme (new name ACRANEB2 due to many modifications) will obtain the expected final version. During 2012, substantial progress with the new gaseous transmissions was achieved. In this year, scheme will be finalized and statistical model will be retuned. It will be integrated together with other schemes into ALARO-1 and validation in 3D environment will be performed. Effect of spectral overlap between clouds and gases has to be estimated. Besides, optimization of the code computation part is planned.

The new version of ACRANEB code will be included in the HARMONIE radiation comparison. Adaptations to improve also climate simulations will be studied.

Proposed contributors, Estimated efforts: J. Mašek (Cz), R. Brožková (Cz), P. Kuma (Sk), 4 months

Planned timeframe: first half of the year

Planned deliverable: code ACRANEB2, ALARO-1, theoretical and technical documentation, publication

Action/Subject: Cloud scheme

Description and objectives:

Sub-grid scale cloud treatment is essential to achieve the necessary harmony between physical parameterization schemes (convection, turbulence and radiation). The aim is to arrive to a unified cloud scheme. Tasks will be addressed to the computation of cloudiness and cloud water content needed in the radiation scheme and deep and shallow convective cloud-covered parts in 3MT and TOUCANS. The physical properties of the cloud scheme and the microphysical properties need to be harmonized, contributions from turbulence and convection have to be taken into account.

Proposed contributors, Estimated efforts: I. Bašták Ďurán(Cz), R. Brožková (Cz), N. Pristov (Si), 2 months

Planned timeframe: whole year

Planned deliverable: problem analysis code modification, testing

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), 2 months

Planned timeframe: second half 2013, common action with Dynamics&Coupling

Planned deliverable: preparation of a testing environment, scientific validation, academic case studies

Action/Subject: Baseline of the ALARO-0 version

Description and objectives:

A baseline of the ALARO-0 version has been prepared in December 2012, it serves as a base for further developments and is recommended to be implemented into the operational use at resolutions down to 4 km. Support will be available to local teams. Additional effort is needed to find good settings for the screen level diagnostics, here a coordinated tuning action is planned.

Proposed contributors & Estimated efforts: R. Brožková (Cz), N. Pristov (Si), M.Tudor (Hr), D. Banciu (Ro), C. Wittmann (At), M. Sucs (Hu), M. Derkova (Sk), 3 months

Planned timeframe:

Planned deliverable: report

Action/Subject: The ALARO-1 version

Description and objectives:

Significant progress was achieved in the description of turbulence, radiation and convective processes during previous year. Besides developments inside LACE, there is Luc Gerard's work in Belgium on the unsaturated downdrafts (an extra extension for the 3MT scheme) and the complementary sub-grid updraft (CSU) scheme which enable a more realistic transition from parameterized to explicit convection when going to higher resolutions.

Integration and testing will be done in two steps, during first stage TOUCANS, ACRANEB2 and the unsaturated downdrafts. In the second stage then rest planned developments; i.e. CSU, TOUCANS evolution, prognostic graupel, thermodynamic adjustment, unified cloud treatment in radiation, shallow convection, thermodynamic adjustment and 3MT.

In 2013 the first assembling step is planned and can start when radiation scheme ACRANEB2 is ready. The validation will be in the range 5km 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), D. Banciu (Ro), I. Bašták
Řurán(Sk) 4 months (1 month LACE stay)

Planned timeframe:

Planned deliverable: code, validation environment, documentation

Action/Subject: SURFEX in ALARO

Description and objectives:

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. In term of coding Surfex, having been designed by a non-NWP community, does not yet fit in optimally with other parts of the NWP system. Adaptation of the SURFEX code for the operational use with ALADIN/AROME is ongoing inside ALADIN/HARMONIE programme. When code is available, validations and preparation for an operational use should start.

Proposed contributors, Estimated efforts: J. Cedilnik (Si), S. Schneider (At), S. Ivatek-Sahdan
(Hr), M. Pietrisi (Ro), 4 months

Planned timeframe:

Planned deliverable: reports

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. The current list of proposed post-processed fields which can be enlarged: temperature lapse rate, improved, simulated radar reflectivity, mixed layer CAPE, helicity, UV index, lightning.

Proposed contributors, Estimated efforts: J. Cedilnik (Si), C. Wittmann (At), 2 months, (1.5 month LACE stay)

Planned timeframe:

Planned deliverable: code, documentation

Action/Subject: List of cases suitable for validation of schemes

Description and objectives:

During the validation process one usually needs to select suitable meteorological situation and prepare various sort of data. The idea is to prepare an environment with many relevant information. First attempt is only to prepare a demo environment for few pre-selected cases (list of input files, information, ...).

Proposed contributors, Estimated efforts: O. Spaniel (ASC), N. Pristov (Si), C. Wittmann (At), 1 month

Planned timeframe:

Planned deliverable: demo environment, report

4 Summary of resources

Subject	Manpower	LACE	ALADIN	Other
TOUCANS	5	1	0.5	
Radiation	4			
Cloud scheme	2			
1D2D turbulence	2			
ALARO-0	3			
ALARO-1	4	1	1.75	
SURFEX	4			

Additional fields	2	1,5		
List of cases	1			
Total:	27	3.5	2.25	

5 Meetings and events

LACE scientific stays:

Ivan Bašták Ďurán: TOUCANS, Ljubljana, 1 month

Doina Banciu: ALARO-1 assembling step 1, Prague, 1 month

Peter Kuma: Radiation, Prague, 0.5 month (optional, from 2012)

Christoph Wittman: Additional post-processed products, Ljubljana, 1 month

Jure Cedilnik: Additional post-processed products, Vienna, 0.5 month

ALADIN Flat-Rates Stays

Michiel Vanginderachter: Cleaning of 3MT routines, replacement of the use of moist static energy in convective computations, Prague, 1 month

Joris Van der Bergh: Microphysics – aspects of cloud and precipitation geometry – a sensitivity study, Prague, 0.5 month

Luc Gerard: Further consolidation of new developments in convection, Prague, 0.25 month

Rafiq Hamdi: TOUCANS with SURFEX, Prague, 0.5 month

Meetings:

- 1) 23st ALADIN Workshop and & HIRLAM All Staff Meeting 2013, 15-19 April, 2013, Reykjavik, Iceland (participation of Neva Pristov).

- 2) Joint SRNWP Workshop on Model Physics and Ensemble Prediction Systems Madrid, 18 to 20 June 2013, AEMET (participation of Christoph Wittmann, Jean-Francois Geleyn, Neva Pristov).
- 3) 35th EWGLAM & 20th SRNWP joined meetings, 30 September - 3 October, 2013, Antalya, Turkey (participation of Neva Pristov).

Possible events: working weeks organized by ALADIN/HIRLAM community (list is not available yet)

Project complement to LACE research:

COST Activity ES0905 "Basic concepts for convection parameterization in weather forecast and climate models" (CHMI and HMS are among project parties)

6 Risk and constrain

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. It is expected that number will be even reduced during this year, so new contributors are needed. It is also crucial to continue good collaboration with other ALADIN/HIRLAM partners.

Quite some effort has been invested in the ALARO physics package and this needs wide recognition and publicity. Preparation of scientific papers would be very much appreciated. One opportunity is also to promote ALARO in the EPS world and participating on the SRNWP workshop.