Working Area Physics

Work Plan

Prepared by:	Area Leader Neva Pristov
Period:	2014
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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 years therefore it is foreseen that selection of the parameterizations schemes will be assembled into the first version of new physical package named ALARO-1 during the first months of year 2014, extended validation will follow.

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. Experiments in very fine resolution 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 in LAEF and can be also important part in a convection-permitting ensemble system.

ALARO-1 working days will be organized in 2014. After two years it is time to gather again, prepare an overview and spread knowledge to wider community.

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, computation of shallow convection cloudiness, introduction

of the turbulence energy and flux budget (EFB, Zilitinkevich et al.), the interface with SURFEX, and some other ideas can arrive during development. Work on these topics is at various progress level (theoretical study, coding, validation) and will continue with the target to obtain a scheme with many modern options for computation of turbulent fluxes of momentum, heat, water vapour and cloud condensed water.

Collaboration with HIRLAM developers who will perform single-column sensitivity studies (test the EFB in the AROME/MUSC framework) is also planed.

Proposed contributors, Estimated efforts: I. Bašták Ďurán(Cz), R. Brožková (Cz), J. Cedilnik (Si), 6 months

Planned timeframe: whole year

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

Action/Subject: Radiation scheme

Description and objectives:

Radiation scheme (named ACRANEB2 due to many modifications) obtain the complete baseline version in the end of 2013. Its validation in 3D environment will continue in 2014 and will be integrated together with other schemes into ALARO-1.

Some improvements are planed by taking into account also information on clouds (NER statistical model in cloudy case, further improvement of cloud optical properties). Expensive computation (high CPU demands) can be reduced by including intermittency in the computation also in solar part. Study how to include the effect of orographic shadowing in radiation will be done.

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), C. Wastl (At), 6 months

Planned timeframe: whole year

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

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. Upgrades with respect to ALARO-0+ACRANEB2+TOUCANS needed for getting a first version of this unification are in fact relatively small. So testing of this transversal change, obviously touching many feed-back loops and hence unpredictable in its practical consequences, may start mid-2014.

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: low priority

Planned deliverable: scientific validation, academic case

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 those local teams who plan its implementation. Additional effort is needed to find good settings for the screen level diagnostics, here a coordinated tuning action is planed.

Proposed contributors & Estimated efforts: R. Brožková (Cz), N. Pristov (Si), M.Tudor (Hr), A. Craciun (Ro), C. Wittmann (At), M. Sucs (Hu), B. Brajnovits (Hu), M. Derkova (Sk), 4 months

Planned timeframe: permanent

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 years. Besides developments inside LACE, there is research work of Luc Gerard on the unsaturated downdrafts (an extra extension for the 3MT scheme) and the complementary sub-grid draft (including now both up- and down- drafts, CSD) 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 are going to be assembled. In the second stage then all other planed developments; i.e. CSD, TOUCANS evolution, prognostic graupl, thermodynamic adjustment, unified cloud treatment in radiation, shallow convection, thermodynamic adjustment and 3MT.

The first assembling step will start already in the first months of 2014 after 3D validation of radiation scheme ACRANEB2. 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(Sk), ?, 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. The aim is to find scientific and practical constrains for redesign of physics interfaces (APL_AROME and APLPAR) and make few proposals for an interface which enables the various physics packages (schemes) to use same underlying data flow. Actions are spread among many people, LACE contribution is to adopt APLPAR routine.

Proposed contributors, Estimated efforts: R. Brožková (Cz), 1 months

Planned timeframe: first half of the year

Planned deliverable: code, documentation

Action/Subject: SURFEX issues

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.

Implementation of orographic effecfs on radiation into SURFEX is planed with the aim to provide improved temperature and radiation forecast in the complex terrain.

Proposed contributors, Estimated efforts: local teams, 3 months; C. Wastl (At), C.Wittmann(At), 5 months (1 month LACE stay)

Planned timeframe: whole year

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. In 2013 work started to enlarge convection diagnostics. Mixed layer CAPE, storm motion vector, vertical wind shear, relative helicity and lightning diagnostics, where coded, but evaluation is still needed. Besides additional diagnostic can be added: temperature lapse rate, improved simulated radar reflectivity, UV index, icing parameter, computation of real snow height, etc.

Proposed contributors, Estimated efforts: J. Cedilnik (Si), C. Wittmann (At), 1 months, (0.5 month LACE stay from 2013)

Planned timeframe: first 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).

Besides developing physics schemes inside ALARO1 package (to be used also at the kilometric and hectometric scales) some teams have started experiments with AROME model. 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) will be performed as part of PhD work of David Lancz. His aim is first to diagnose deficiencies of the AROME turbulence scheme at 1 km resolution (compared to 2.5 km) and later to improve the scheme.

Proposed contributors, Estimated efforts: D. Lancz (Hu), B.Szintai (Hu), F.Meier (At), C.Wastl (At), M. Pietrisi (Ro), 8 month (1 month LACE stay)

Planned timeframe: whole year

Planned deliverable: report, diagnostics tools

4 Summary of resources

Subject	Manpower	LACE	ALADIN	From 2013
TOUCANS	**6**	**1?**		
Radiation	**6**			
Cloud scheme	**2**			
1D2D turbulence	**2**			
ALARO-0	**4**			
ALARO-1	**6**	**1?**	**0.25**	
Physics interface	**1**		**1**	
SURFEX	**8**	**1**	**0.5**	
Additional fields	**1**			**0.5**
VFR Experiments	**8**	**1**		
Total:	**44**	**3 (+1)**	**1.75**	

5 Meetings and events

LACE scientific stays:

?: ALARO-1 assembling step 1 or 2 (complementary sub-grid drafts CSD), Prague, 1 month, Candidate not found

Dávid Lancz: Study of the turbulence grey zone (AROME 1km runs), Toulouse, 1 month (0.5 in March)

Clemens Wastl: Orographic shadowing in radiation (AROME, ALARO), Toulouse, 1 month (September)

Ivan Bašták Ďurán : TOCANS related topic, Bratislava, 1 month

ALADIN Flat-Rates Stays

Michiel Vanginderachter: Validation, Prague, 1 month

Luc Gerard: Convection, Prague, 0.25 month

Rafiq Hamdi: ALARO/SURFACE issues and/or climate, Prague, 0.5 month

Meetings:

1) 24st ALADIN Workshop and & HIRLAM All Staff Meeting 2014, Romania (participation of Neva Pristov).
2) 36th EWGLAM & 21st SRNWP joined meetings, 2014, (participation of Neva Pristov).
3) ALARO-1 Working days, Vienna, Austria, 12-14 May 2014 (participation of one person per country, 1-2 lectures, Neva Pristov).
4) Working week(s) organized by ALADIN/HIRLAM community (whole list is not available yet):
   - working week on radiation, Prague, 10-12 March 2014
5) Web meetings on physics-dynamics interface (participation of Radmila Brožkova, Neva Pristov, Jan Mašek)
6) Web meetings on Implementation of orographic effects on radiation into SURFEX (participation of Christoph Wittmann, Clemns Wastl, Neva Pristov)

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. 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 two small groups created recently on the physics-dynamics interface subject and on parameterization of orographic effects on radiation into SURFEX.