

Working Area Physics

Progress Report

Prepared by:	Project Manager Martina Tudor
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1 Progress summary

This report gives an overview of the progress of research and development in the first six (up to eight) months in 2019. The following can be pointed out:

Developments on the turbulence scheme TOUCANS are progressing well, included shallow convection scheme is completed and already used in the operational application at CHMI. Study of the stability of the solver inside TOMs part and research on mixing length computation have continued.

Work on coupling ALARO-1 with the SURFEX scheme has continued. In order to ensure the ascending operational compatibility with using the ISBA scheme, many problems were identified (surface roughness, drag coefficients treatment) and solved.

ALARO-1 bug fixes were prepared for the export version cy43t2 and new contributions were phased into cy46t1. The most advanced ALARO-1 version is used at CHMI (cy43t2, shallow convection) where new suite at 2.3 km horizontal resolution was prepared for parallel testing at the end of the 2018.

1.1 Code contributions for phasing

Decision is to pass two modsets:

The first modset will be prepared by Bogdan Bochenek, containing debugged prognostic graupel code. This time we hope for smooth phasing.

The second modset will be prepared by me, containing several contributions:

- 1) DDH budgets for prognostic TKE and TTE (in TOUCANS) added by Mario Hrastinski.
- 2) New cloudiness treatment in vertical diffusion by Radmila (introducing new options NDIFFNEB=4 and 5).
- 3) Fixes in adjustment and microphysics by Luc Gerard. These will be deactivated by local key, since they require more extensive validation.
- 4) TOMS (3rd order moments in TOUCANS) fixes by Peter Smerkol. These will be deactivated by local key as well.
- 5) Further modularization and optimization of ACRANEB2. Exact content depends on how much will I manage to implement until deadline.

6) Fixes of blend utility (new FA date structure, split of ECHIEN to ERIEN, reintroduction of Z_NSIGN, making official version working). Recently, Jan Masek found that blend utility in cy47t0 is crashing, the problem might be related to xrd adaptation for single/double precision. He is trying to make it working again.

The ALARO1 working days

1.1.1 ALARO-1 working days, SHMI, Bratislava, 11-13 March 2019

<http://www.rlace.eu/?page=197>

Piet Termonia: [Introduction](#)

Neva Pristov: [Introduction to Working Days and short overview of last 2.5 years](#)

Radiation

Ján Mašek: [ACRANEB2 - current status and plan](#)

Ján Mašek: [3D radiation - why, when and how?](#)

Turbulence-Diffusion TOUCANS

Ivan Bašták Ďurán: [A two-energies turbulence scheme](#)

Radmila Brožková: [Shallow convection closure using mass-flux type approach](#)

Mario Hrastinski: [TKE-based mixing length in TOUCANS](#)

Peter Smerkol: [TOUCANS: Issues with computations in TOMs](#)

Precipitations aspects (microphysics)

Bogdan Bochanek: [Prognostic graupel in ALARO](#)

Clouds

Radmila Brožková, Ján Mašek: [Cloudiness: status, unification attempts and perspectives](#)

Luc Gerard: [Cloud reunification in the CSD context](#)

Deep convection: complementary subgrid drafts; stochastic components

Luc Gerard: [Status overview of the CSD adaptive convection scheme](#)

ISBA, SURFEX:

Martina Tudor: [The quality of physiography data in clim files](#)

Ján Mašek: [New roughness treatment in ISBA scheme](#)

Martin Dian: [ALARO-1 with SURFEX - current status and plan](#)

Ján Mašek(Rafiq Hamdi): [ALARO-1 with SURFEX - some interfacing issues](#)

High resolution

Petra Smoliková: [NH dynamics at high resolution - setup and results](#)

Radmila Brožková: [ALARO at high resolution - setup and results](#)

EPS

Martin Belluš: [Uncertainty simulation in ALADIN-LAEF](#)

Geert Smet: [ALARO performance in the prototype convection-permitting RMI-EPS](#)

Michiel Van Genderachter: [A new methodology for physics perturbations](#)

Pau Escriba: [ALARO in the Spanish AEMET-gSREPS](#) (video conference)

Climate - Piet Termonia: [ALARO climate and the CORDEX.be project](#)

ALARO status in the national operational applications: Daan Degrauwe ([Belgium](#)), Martina

Tudor [Croatia](#), Radmila Brožková [Czech Republic](#), Piotr Sekula [Poland](#), Maria Derková

[Slovakia](#), Neva Pristov [Slovenia](#), Duygu Aktas [Turkey](#)

2 Scientific and technical main activities and achievements, major events

Action/Subject: **Turbulence scheme TOUCANS**

Description and objectives:

The turbulence scheme TOUCANS is integrated into ALARO-1 version. This scheme has many modern options for computation of turbulent fluxes of momentum, heat, water vapour and cloud condensed water. It includes also the description of shallow convection (non-precipitating) (available in the newest version ALARO-1vB). Further validation is still needed to profit from many available options and to update the selected set-up used the operational applications (some options remained the same as in ALARO-0).

Research and developments continue on mixing length computation, some improvements are possible in the shallow convection closure. Verification of wind forecast quality and the improvement wind gust diagnostics are also possible tasks.

Actions in the first half of 2019:

- shallow convection closure: tuning, possible improvement in the vertical profile definition and with new fit to a function;
- check and examine coding of some parts of TOUCANS (still in TOMs part, after reorganization);

- study and test mixing length computation;
- include TOUCANS into DDH (new)

Sub-action: Shallow convection**Contributors:** R. Brožková (Cz)**Efforts:** 1.5 person months**Documentation, deliverable:** ALADIN-HIRLAM Newsletter 11, ALADIN code cy43t2_bf.08**Status:**

The shallow convection scheme is handled as a part of the turbulence scheme TOUCANS. The effects of water phase changes, causing density fluctuations, are taken into account by a parameterization of the moist buoyancy flux, equations of the scheme are now published in the recent paper by Bašták et al., 2018.

Scheme is now completed, few more simplifications and regarding the determination of one of the key parameters of the scheme were introduced. Arbitrary thresholds, influencing feedbacks in an incorrect way, were removed. Recent modifications led to further improvement of results. In summer season the interaction with moist convection scheme is changed (confirmed with the DDH diagnostics). Transport of heat and water is improved by reducing warm and dry bias at the top of boundary layer. Precipitation location gets also better.

The shallow convection modifications became operational at CHMI on 10 July 2018 and entered cy43t2_bf.08 with other ALARO bug fixes.

Sub-action: Mixing length computation**Contributors:** M. Hraštinski (Hr), J. Mašek (Cz)**Efforts:** 4.5 person months, LACE stay (1 month)**Documentation, deliverable:** stay report**Status:**

Mario Hraštinski proceeded with his work on implementation of TKE-based mixing length in TOUCANS. The code is reorganized to enable full moist treatment of stability-dependent convection (SDC) from BL89 method output (L_{TKE}) to Prandtl type mixing length (l_m). As part of reorganization the moist gustiness correction was moved from ACMRIP to ACMIXELEN

subroutine. Tests of these modifications showed that mixing length is generally comparable to the reference (l_{gc}), i. e. it is not underestimated as previously.

After further inspection of the literature, with emphasis on length scale properties, it is found that the output of BL89 method can't be directly related to any of the TKE-based scales used in the code (L , L_K or L_{eps}), as it violates the Monin-Obukhov similarity theory even for weak deviations from neutrality. However, it can be related to Prandtl type mixing length (l_m), where proper solution for achieving the near surface kz limit and transition to pure LTKE formulation aloft needs to be found. The impact of used averaging operators on l_m is showed to be small.

During additional code validation a problem related to discretization of BL89 integral was found. This bug results in overestimation of mixing in stable stratification, while in unstable stratification it leads to slower accumulation of available energy. Since the original TOUCANS method of discretization is valid with the assumption of a constant Brunt-Väisälä frequency profile during integration path, another method (theta2) was implemented that is more general and consistent with original proposal by Bougeault and Lacarrere. This new computation (2nd order accuracy), based on virtual potential temperature (VPT), is implemented and tested against both "dry" and moist Brunt-Väisälä frequency (BVF) approach available in the current code. The diagnostics was performed within the reference mixing length formulation. As expected, the new VPT approach significantly affects vertical displacement near the surface, where distribution of model levels is denser and integration path may cover several model levels. In the cloud layer, new VPT and "dry" BVF approach produce similar displacement, while the effect of phase changes through the moist BVF starts to dominate. This results in increasing the vertical displacement up to an order of magnitude, which leads to instability when used in the prognostic mode. However, the problem of excessive mixing after abandoning the SDC approach is not necessarily related only to moist effects, but to limitation of the original version of BL89 method near the neutrality. With inclusion of global κ scaling, which is an equivalent of multiplying the LTKE solution (where it prevails) with some constant, the results are much better and near the surface even overcome the reference (for the winter case and partly for the summer). However, this should be avoided and other, more physical, approach to reduce mixing should be adopted.

For this reason, more general version of the BL89 formulation following Rodier et al. (2017) was applied. It includes the shear effects on ascending/descending parcel, which results in vertical decoupling of turbulent eddies, i.e. decreasing of displacement when local shear is strong (near neutrality and mainly near the surface). Initial tests showed that this method significantly reduces mixing above the kz layer, as well as up to the level where maximum of mixing occurs. This results in improvement of verification scores when desired local κ scaling is applied. However, there is almost no impact above the PBL, where spurious and unrealistic

peaks of both I_m and TKE appear. The sensitivity tests (based on cut-off of I_m above the PBL on certain value; e. g. asymptotic limit of I_{gc} formulation) showed that solving the problem of excessive mixing above the PBL should lead to further improving of verification scores and overcoming the reference.

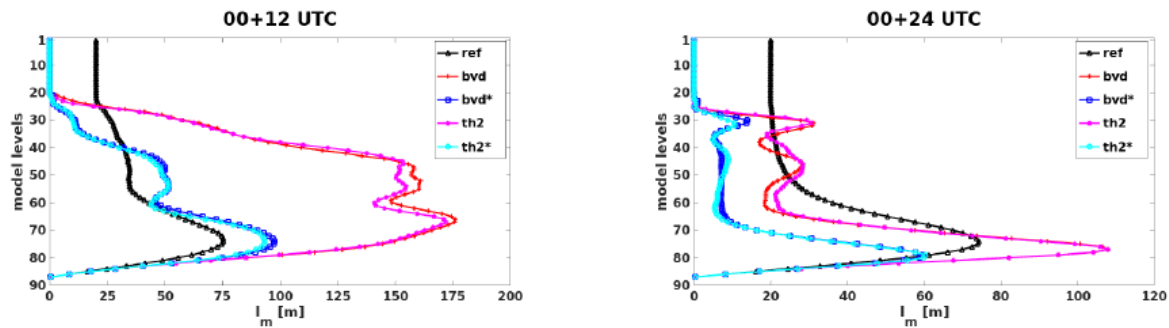


Figure 1: Comparison of the reference I_m and those obtained by combination of two averaging operators and two discretization methods for a summer day. Notice a different scale on the x-axis. See report for more information.

The work will continue in the second half of 2019 and 2020 with further testing of generalized BL89 method and an attempt to find a physical solution to reduce mixing above the PBL in near neutral conditions.

Sub-action: The code check

Contributors: P. Smerkol (Si), J. Mašek (Cz), R. Brožková (Cz)

Efforts: 1.75 pm, 0.5 pm LACE stay

Documentation, deliverable: code modification, stay report

Status:

Peter Smerkol has proceeded with checking the code that calculates the Third order moments corrections to the turbulent heat and moisture fluxes (acdivf3.F90). In 2017, he confirmed with a careful work (code of routine was written into mathematical expression) that the proposed correction (auxiliary variable ZZZ) from the documentation was correct. However, with this correction, the code becomes numerically unstable. It means that all known TOMS related bugs can be fixed except from ZZZ one. We would like to submit the fixes to cy47t1

Code checking has proceed with the analysis of numerical protection algorithm for the equation solver as it is suspected that the problem could be there. This algorithm was written with the previous (wrong) expression in mind, and should therefore be changed to make the code numerically stable again. During the study of this algorithm, determination of

few variables at the lowest vertical level was corrected. This improved the stability of the solver algorithm, however the system still crashed after few time steps. Analyses of the significance of all variables that enter the algorithm on the numerical stability of the solver system is ongoing. A new instability protection algorithm should be devised if source of instability is not corrected.

Luc Gerard identified short scale noise in turbulent fluxes and other fields, Jan Mašek analyzed the problem, trying to find a cure. Problem is specific to the use of two prognostic turbulent energies (case of ALARO-1). Mechanism producing 2.dt oscillations (unrelated to classical fibrillations) is connected to temporal discretization of TKE/TTE relaxation term, more specifically to overshoots of flux Richardson number over its critical value when the timestep is long. Use of extremely short timestep helps (typical behaviour of stiff systems), but it is unfeasible. Jan Mašek tried to implement substepping for relaxation term alone which is cheap, but still without success. During the work, sign error in diagnostics of flux Richardson number was identified and fixed, and related numerical protections were improved.

Sub-action: DDH for TOUCANS

Contributors: M. Hrastinski (Hr)

Efforts: 2.0 person months

Documentation, deliverable:

Status:

The diagnostics on horizontal domains (DDH) is a tool which can provide the budget of prognostic variables of ARPEGE/ALARO/AROME models (momentum, temperature, water vapour, etc) on user defined domains. The DDH tool is used by researchers and model developers to understand the model's dynamical and physical interactions, thus contributing to the parametrization development process. It should be easy to apply when new equations or terms of equations are added.

Related to TKE-based mixing length development, there is an ongoing work on extension of ALARO related part of DDH. The basic data flow from TKE/TTE solver to DDH input structure is completed and successfully tested with uniform input fields. During the process, a bug related to number of dynamical fluxes and tendencies for water related quantities (q_l , q_i , q_r and q_s) was found in `sunddh.F90` (instead of 4, they were both set to 2). The bug resulted in horizontal and vertical dynamical fluxes of rain and snow being overwritten with first next group of fields, i.e. horizontal dynamical fluxes (of rain and snow) by vertical dynamical fluxes of pressure and specific water vapor content (q_v), and vertical dynamical fluxes (of

rain and snow) by first two fluxes coming from physics. Among other, removing this bug was also crucial for setting the data flow of TKE/TTE, whose terms follow after those of water related quantities. Postprocessing of TKE/TTE budget fields is completed as well, i.e. the budget and conversion_list for computation of budgets are prepared (ddhb).

However, an error occurred (seen in final plot) when trying to fill DDH input structure with “proper” fields. It is suspected that physical fluxes from acptke.F90 are not treated properly, i.e. are multiplied with wrong factor (different types of terms are multiplied with different factor). Terms coming from dynamics are checked and it is confirmed that they are consistent with those for other equations. Along with removing of this latest bug, there is an ongoing work on phasing this development within the next common cycle (Jan Mašek).

There is a short term plan to further extend ALARO related part of DDH, including the prognostic equation for graupel (together with Bogdan Bochenek). After that, all development mentioned here should be rewritten into flexible framework.

Mario Hrastinski continued the work of Tomislav Kovačić. A solution is to introduce an array that contains all terms from both turbulence energy equations and to transfer it to DDH subroutines in the old fashioned way. Modifications are done in cy43t2 and are not yet ready for compilation. Work is continuing in the second half of 2019.

At the code training in Toulouse, it was demonstrated how to use the new data structures in DDH in CY36T1.

Action/Subject: **Radiation scheme**

Description and objectives:

The work on the radiation scheme can be extended to 3D (see presentation from Jan Mašek from ALARO1 working days). Radiation scheme ACRANEB2 is integrated into ALARO-1 versions. Climatological aerosol optical properties can be replaced with those (daily) provided by Copernicus Atmosphere Monitoring Service (CAMS MACC products). Improvements in the cloud-radiation interaction are planned by taking into account better information on cloud cover (see under “Cloud scheme”) and (in future) by getting microphysical cloud condensates into radiation scheme.

Parameterization of an impact of cloudiness on broadband surface albedo, which is an important issue for the schemes using single SW interval, can be prepared.

Adaptations to improve also climate simulations can be studied. First step is more efficient computation of clear sky fluxes.

Actions in 2019:

- *parameterization of an impact of cloudiness on broadband surface albedo*
(suitable/waiting for a newcomer)

Contributors: J. Mašek (Cz)

Efforts: 0.0 person month

Documentation, deliverable: code

Status:

Modularization of the computation of clear sky fluxes, optimized intermittent storage and further improvement in calculation of direct solar flux is planned to be done in 2019.

Action/Subject: **Cloud scheme**

Description and objectives:

The objective is 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.

An issue is the harmonization of radiative cloud and condensates with the microphysical cloud fraction and prognostic condensates. Presently, the radiative condensates are re-estimated, the 'stratiform' part (contrary to the cloud scheme) does not include phase and mesh size dependencies, the convective condensates are re-estimated from the 'protected' historic convective cloud fraction.

At short term, cloud diagnostic in radiation should be re-tuned, in the spirit to reduce the difference with the thermodynamic adjustment. 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.

Recent case studies of winter-type stratocumulus (clouds are not kept) have shown a tendency of the model to remove the sharp gradient at the inversion top. It does not seem to be a priori a problem of the cloud scheme, e.g. when data assimilation restores the gradient, we get clouds. Therefore a more in depth analysis of the processes involved is needed.

Action in 2018:

- *analysis of the process involved in dissipation of low clouds in winter situations*
- unify the treatment of stratiform cloudiness in radiation and thermodynamic adjustment (modification and testing)
- *further steps will be defined according to the outcomes*

Contributors: R. Brožková (Cz), J. Mašek (Cz)

Efforts: 3 months

Documentation, deliverable: code modification, testing and validation

Status:

Profile of critical relative humidity was unified between ACNEBN (diagnostic cloud cover for radiation) and ACNEBCOND (thermodynamic adjustment). Critical relative humidity from ACNEBCOND was adopted, since it contains dependence on horizontal resolution which was missing in ACNEBN. Retunings of stratiform cloudiness on ACNEBN side were done with the aim to get similar results than before. The goal was to get rid of several heuristic treatments applied when diagnosing stratiform condensate and cloud fraction (QXRTGH, QSSUSV, QSSC, RPHI0), making the diagnostic and microphysical condensates and cloud fractions closer. This is indeed possible, but deactivation of ACNEBN treatments supporting sub-inversion clouds (QSSC, RPHI0) logically produces too little low clouds in winter. Preliminary outcome is that it should be possible to unify stratiform cloudiness between ACNEBCOND and ACNEBN, but cloudiness entering radiation must see additional contribution not only from deep, but also from shallow convection parameterization.

Developments should continue in 2019, for the time being they are not mature. Part concerning critical relative humidity was contributed by diploma student Filip Švábik, who is investigating different feedback mechanisms affecting 2m temperature.

Action/Subject: **Microphysics**

Description and objectives:

Current microphysics schemes in AROME are ICE3 and ICE4 (prognostic hail included but not in operational use). Evaluation LIMA scheme is ongoing in AROME. LIMA is a two-moment microphysics scheme, which treats the number concentration of cloud condensation nuclei prognostically, and thus permits a physically more realistic treatment of aerosol-cloud interactions. Scheme was developed within Meso-NH, research version is implemented in AROME.

The implementation of prognostic graupel was done by Michiel Van Ginderachter and Joris Van den Bergh few year ago (within cy38). Bogdan Bochenek phased it into ALADIN code cy43t2 and cy45/cy45t1, technical and scientific validation should continue and it is expected some tuning inside microphysics is needed.

Actions in 2019:

- *aerosol initialization in LIMA scheme* replaced with Testing LIMA scheme in AROME
- *hail diagnostic in ICE3*
- *validation of the modifications made in ICE3 for improving forecasts of super cooled rain in AROME*
- validation of prognostic graupel computation in ALARO-1

Sub-action: Implementation and validation of prognostic graupel computation

Contributors: B. Bochenek (PI), J. Mašek (Cz), O. Španiel (ASC)

Efforts: 1.25 person months (1 month OPLACE stay)

Documentation, deliverable:

Status:

The prognostic graupel code, updated by Bogdan Bochanek, was tried to be phased into ALADIN code cy43t2 and cy45/cy45t1. Changed code was successfully tested on Meteo-France computer prolix with set of mitraillette tests but later during official phasing some inconsistencies in computations (with graupel switch false) appeared, so the code did not enter cy43t2 export version, neither cy45t1, cy46t1. After extensive search for the source of differences it was found that this is caused by bug of intel compiler related to too deeply placed IF statements in combination with option -fast-transcendentals. To solve this problem the code has to be restructured.

Simulations with the new code with and without prognostic graupel were done with ALARO-1vB (cy43t2) in Prague. The differences in results between the reference and code with graupel but with graupel switched off are strictly numerical. But when graupel computation is used results are still suspicious. Possible inconsistency are searched at various places (collection, fall speed of snow and graupel, ...). Evaluation will continue in 2019.

Sub-action: Testing LIMA scheme in AROME

Contributors: V. Homonnai (Hu)

Efforts: 1 person month (LACE stay) in 2018, 1 pm stay planned before the end of 2019

Documentation, deliverable: testing and validation, stay report

Status (the stay from 22018, the stay in 2019 to be done):

The LIMA scheme has been updated with some novelties already used in Meso-NH version and with some changes in the radiation scheme. Code was modified and tested, lot of time was spent to spot and resolve an error in the output values of the cloud fraction and radiation liquid water. Finally, AROME with LIMA was run for one case with 1.25 km and 90 levels (not yet with 500 m with 156 vertical levels). Fog forecast from both model differ, simulation using ICE3 scheme gives fog while one with LIMA scheme gives much less fog probably because of the presence of more snow. Further validation will be focused on fog cases for longer winter period, with different horizontal and vertical resolution and on evaluation of different characteristics such as cloud base and top, mean cloud water in the fog.

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

Description and objectives:

Currently 3 versions of ALARO physics package are used in the operational applications in LACE countries. The experiences were reported during the ALARO1 working days in March in Bratislava (see above). Local teams are encouraged to replace the ALARO-0 baseline with the latest ALARO-1 version. Validation and tests of the newest ALARO-1vB version for the (pre-)operational will continue and experiments at resolutions around 2 km shall be performed to see benefits at higher resolutions. 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 ARPEGE and AROME. To profit from latest developments we decided to couple ALARO-1 with SURFEX version 8 which is implemented in the aladin code CY43T2. The export version of CY43T2 needed for this action is plan to be delivered in 2018.

In order to be able to use SURFEX with ALARO-1 physics package many issues have to be tackled. Modifications are needed in TOUCANS and SURFEX side (work of Rafiq Hamdi), scientifically consistent transition of ALARO from ISBA surface scheme to SURFEX should be also ensured. Attention must be paid not only to code differences, but also to different file formats and datasets used. Only after we can proceed to more advanced SURFEX options (3 layer scheme, tiling, TEB, ...).

SURFEX in ALARO-1 (MD, JM) have code with correct averaging of thermal and mechanical roughnesses. A problem was found and fixed with computation of Richardson number in SURFACE_CDCH_1DARP (routine in surfex code). After the stay another bug was found (missing C3TKE factor in the same routine SURFACE_CDCH_1DARP) in calculation of thermal exchange coefficient in neutrality. After fix this bug there were still fibrillations in exchange coefficients. The solution is switching off the antifibrillation treatment, which is not necessary running with Toucans.

When moving to higher horizontal resolution, the parameterization of orographic shadowing in radiation implemented inside SURFEX (used in AROME) become important. It can be coupled also with ALARO-1vB physics (TOUCANS, ACRANEB2). 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) effects has lower priority.

Actions in 2018:

- validation and operational use of ALARO-1vB in local applications;
- *validation of ALARO-1 coupled with SURFEX* ;
- preparations for the SURFEX usage in operational ALARO applications;
- propose a solution for a problem with screen level temperature above snow in ISBA;
- *simulations with the FLake model*;

Sub-action: Validation and operational use of ALARO-1vB/ALARO-1vA in local applications

Contributors: R. Brožkova (cz), D. Lancz (hu), S. Tascu (ro)

Efforts: 3.0 person months

Documentation, deliverable:

Status:

In Czech Republic, modification in shallow convection computation entered operational application in begin of July and the cy43t2 is used since 21 August. A new operational set-up with resolution of 2.3 km has been prepared, entering parallel suite in the beginning of 2019.

In Hungary, comparison of ALARO-1vA and ALARO-1vB was done. The impact is not really big and it is connected mainly to precipitation, slightly better in the first part of the forecast but slightly worse in the second part. At the end of 2018 the migration to new HPC has been started where cy40t2 and ALARO-1vB will be used in operational applications.

In Romania, the plan to increase the spatial resolution (around 5 km) and to use ALARO-1vB in the operational application was postponed due to technical problems connected to IBM.

Comparison of ALARO-0 and ALARO-1vB during the convective season was performed. Standard statistical scores showed some improvements (precipitation for first day) and some degradation (T 2m, wind 10m).

Nothing new to report from Croatia, Slovakia and Slovenia regarding ALARO physics in the operational suites.

AROME (cy40) is used in Austria and Hungary.

Sub-action: ALARO-1 coupling with SURFEX

Contributors: M. Dian (Sk), J. Mašek (Cz), R. Brožkova (Cz)

Efforts: 4.0 person months (LACE stay)

Documentation, deliverable: technical note, stay report in preparation

Status:

There was substantial progress in ISBA vs. SURFEX comparisons, revealing inconsistency in surface Richardson number (application of USURIC correction in SURFEX when there should be none). Another bug found by Martin after the stay was forgotten factor C3TKEFREE in evaluation of heat coefficient C_H under SURFEX. After fixing these bugs, correspondence between ISBA and SURFEX runs is much closer and can be attributed mainly to different physiographic datasets. Martin has not delivered report from the stay yet, he is about to start writing it now.

Martin noticed slight fibrillations in ALARO-1 runs with ISBA. Investigation revealed that they are caused by antifibrillation treatment applied on system with prognostic TKE. In this case antifibrillation treatment is not needed, as was confirmed by subsequent tests and also by MF, where antifibrillation treatment in ARPEGE was switched off with introduction of prognostic TKE. Switching off antifibrillation treatment in ALARO-1 with SURFEX removed wild oscillations seen in wind components. These were not fibrillations themselves, but the consequence of incomplete antifibrillation treatment, missing on surface drag and heat coefficients under SURFEX. Findings were reported to Rafiq and Suzana, implying the need of antifibrillation treatment in SURFEX only in the case when used with old Louis type turbulence.

In order to ensure the ascending operational compatibility with using the ISBA scheme, the question of surface roughness treatment was addressed at first. Still on the ISBA side the roughness computation in presence of snow revealed a rather complicated approach. A unification proposal has been formulated. Some preliminary tests, including an experiment with a full assimilation cycle, were done. New formulation helps to improve screen level

temperature and wind scores. The implementation is quite easy and is available in the code starting by the export version of CY43T2. The activation requires to re-compute climate files and set the relevant namelist switches, see the technical report for details.

The study of surface roughness and drag coefficients computation on the SURFEX side has continued. This includes to check of roughness usage in SURFEX (microphysical versus effective value) and to inspect roughness data flow from SURFEX to APLPAR (i.e. from surface scheme to atmospheric model) where the surface roughness is transferred not only directly, but also implicitly via drag and heat coefficients. It was found that in EBA (Bazile et al. 2001) snow scheme in SURFEX, the effective roughness passed to calculation of drag coefficient contains only micrometeorological value (i.e. contribution of subgrid scale orography is missing).

After fixing it, drag coefficient calculated in SURFEX tiles correspond to what is expected in ISBA. However, another problem was identified in SURFEX roughness averaging between patches, tiles, snow-nosnow and land-water, preventing averaged roughness values larger than height of the lowest model level. This comes from assumption z_0 (surface roughness) $\ll Z$ (height of the lowest model level), which does not hold for effective roughness over high mountains. On the other hand, averaging of drag and heat coefficients is OK.

All ~17 routines dealing with roughness averaging were corrected so that SURFEX is able to deal with effective roughness correctly. It was checked that roughness values passed to APLPAR are now consistent with values hidden in drag and heat coefficients. ALARO-1 with corrected SURFEX code was compared with reference non-SURFEX run (taking summer case to exclude snow issues). Differences in surface temperature reach 4-5K already after 1 hour integration. They cannot be explained only by different physiogeographic datasets in ISBA and SURFEX, but they point to some other problem.

There are also some remaining technical problems, e.g. the data flow of snow fraction from SURFEX to APLPAR from one time step to the next and its initialization in time step zero.

The preliminary working code was ready at the end of the year, but its finalization and some investigations are needed before it can be used by others for ALARO-1 tests with SURFEX.

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

Description and objectives:

The current well-tuned ALARO-1 version is ALARO-1vB (ALARO-1vA, plus modified screen-level interpolation, shallow convection scheme in TOUCANS, exponential-random cloud overlaps in radiation and cloud diagnostics, improved sunshine duration and direct solar flux at surface, 10m wind interpolation). This

is now the base for further developments. Next step is to assemble the unsaturated downdrafts (an extra extension for the 3MT scheme), prognostic graupel and improved description of cloud cover when available.

BB: Work on phasing prognostic graupel code to current model cycles was continued. Further test of ALARO in different configurations revealed several bugs in the code, that were responsible for non realistic results, especially in precipitation field in case of prognostic graupel switched on. The most important one was wrong sign in an equation for tendency of water vapour with addition of graupel. With bugfixes, results of ALARO runs gives more realistic precipitation field, with stronger orography effects. Further tests are planned with more detailed verification with HARP, both with point-based methods and SAL score.

In the second stage then all other planed developments; i.e. CSD, TOUCANS evolution, prognostic graupel, unified cloud treatment. 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 from 5 km down to 1 km. Suitable validation testbeds (common with AROME and ARPEGE) for facilitating cross testing of various parameterizations should be also prepared. Clean comparison of ALARO and AROME can be done with 1D model.

Actions in 2018:

- *testing and tuning of non-saturated down draft inside ALARO-1vB;*
- *code cleaning and reorganization, contribution for main code cycle;*
- *implementation and validation of 1D MUSC with ALARO;*
- *comparison AROME/ALARO in 1D model*

Sub-action: Maintaining of CMC ALARO

Contributors: R. Brožková (Cz), J. Mašek (Cz), M.Derkova (Sk)

Efforts: 3.5 person month

Documentation, deliverable: code, commented namelist of ALARO-1vB for cy43t2_bf.09_export

Status:

The contributions to the cy43t2_bf.08 , cy43t2_bf.10, with the commented namelist of ALARO-1vB for cy43t2_bf.09_export and cy46t1 were prepared in 2018.

Contribution to cy43t2_bf.08 with other ALARO bug fixes:

- Corrected roughness treatment for LZ0HSREL=T with TOUCANS, related mostly to snow scheme LVGSN=T (JM).
- Corrections in shallow convection (RB).
- Fixes in thermodynamic adjustment - deep convective condensates protection (RB).
- Fix to pass correctly the dummy argument of hail diagnostic field.
- Fix to pass correctly convective and resolved precipitation enthalpy diagnostics in DDH, which was swapped wrongly (RB).
- *Fix of using spectral Q background in 3DVAR minimisation (A. Trojakova).*
- *Fix of misplaced arguments of ACRANEB2 call in APL_AROME (E. Gleeson).*

Validation was done in Prague (where first three modifications were extensively tested) and Toulouse. This was included in the cy43t2_bf.09_export.

Contribution to cy43t2_bf.10 bug fixes (export version available in February 2019):

- Fixed CIN/CAPE calculated from most unstable layer (independent on NPROC).
- Fixed convective cloud cover (ACNPART).
- Fixed vectorization of ACCVUD with Intel compiler (module real variables used in IF conditions replaced by their local copies).
- MOCON computation available in off-line Full-Pos.

Contribution to cy46t1 ALARO-1 fixes:

- New fields introduced in Full-Pos:
 - o convective temperature,
 - o mean radiant temperature (one of the inputs needed for evaluating thermal comfort),
 - o global normal irradiance (required by some energy producers).

Sub-action: Computation of topographic characteristics from the new database (GMTED2010)

Contributors: R. Brozkova (Cz), S. Panežić

Efforts: 1.5 pm + 2 pm (0.75pm stay)

Documentation, deliverable:

Status:

Suzana Panežić created climmake to make new clim files from GMTED2010 database using the PGD files as the intermediate step. The procedure uses the new database for topography and land sea mask, while the other parameters related to topography are computed from the old database.

Radmila Brožková created a procedure where other topographic characteristics (variance, orientation, anisotropy and orographic roughness) are computed from GMTED2010. The first experiments with this new set of climate files are done but it is too preliminary for conclusions. It is considered as a "step in between" towards the use of SURFEX with ALARO.

Sub-action: 1-D model MUSC**Contributors:** B. Szintai (Hu)**Efforts:** 0.75 person month**Documentation, deliverable:****Status:**

In Hungary, MUSC in model cycle cy38 was installed. A 1D case for a measurement campaign (detailed PBL) in Szeged (Hungary) was prepared but after that the work stopped.

Action/Subject: Interfacing physics parameterizations**Description and objectives:**

Impact study and validation of the physics-dynamics interface has high priority in ALADIN community (CPDY4). 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.

Action in 2019: Support to phasing TOUCANS scheme will be available.

Proposed contributors: R. Brožková (Cz), P. Smerkol (Si)**Estimated efforts:** not planned

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 have been 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: visibility, precipitation type (also wet snow, freezing rain), icing parameter, UV index, snowfall line, computation of real snow height.

Actions in 2019:

- *implementation of precipitation type diagnostics (with freezing rain);*
- evaluation of lightening diagnostics;
- the visibility computation;
- hail probability calculation (new)

Contributors: V. Homonnai (hu), J. Cedilnik (Si), J. Kemetmüller (At), N. Pristov (Si), P. Sekula (Po), R. Brožková (cz)

Efforts: 3.5 person month (0.5 month LACE stay, 1 month flat-rate stay)

Documentation, deliverable: stay reports

Status:

A. Simon, SHMU The visibility parameter was originally coded at Meteo France (by Ingrid Etchevers-Dombrowski) for the AROME model and later implemented and tested in ALARO at CHMI (by Radmila Brožková) and at ARSO (by Piotr Sekula). The original code was modified at CHMI, a new routine (phys_dmn/acvisih.F90) has been created to calculate visibility. Output parameters (PVISICLD, PVISIHYP) are visibility with respect to cloud liquid water (fog) and visibility concerning precipitation, which units are meters. Another product (PMXCLWC) is related to cloud liquid water content (kg/kg) and it was created for verification purposes. The outputs refer to the height HVISI above the terrain, which cannot be lower than the lowest vertical level (KLEV). The minimum visibility and maximum of cloud liquid water content is determined for a chosen period, which is set as parameters NVISIPERIOD (default 3600s) or NVISIPERIOD2 (900s) in NAMXFU. The maximum value of

visibility is limited to 20 km. The direct inputs are hydrometeors (cloud liquid and solid water, rain, snow and graupel) and their mixing ratios, multiplied by air density (original units for hydrometeors are kg/kg but g/m³ is used in visibility formulas).

Radmila Brožkova worked on the technical phasing of the precipitation type code, to make it available for the others on the CY43T2 export (the code by Ingrid is in the Météo-France branch "op"). So this was a more technical work. Small errors were spotted and reported back to Claude and Ingrid. Jure Cedilnik tested the precipitation type with ALARO (code training presentation). Code was developed in MeteoFrance for AROME, ARPEGE, is already in their operational suite. Testing, validation, tuning is ongoing in Ljubljana by Piotr (midAug-midSep), main issue is to tune the limits for graupel/hail as graupel field differ from AROME one.

Pack for convective diagnostics fields (authors Jure Cedilnik, Christoph Wittmann available for cy38, cy40) has been adopted for cy43t2 and partly validated in Prague and Ljubljana. Problems are still in computation of lightning (adaptation of the code provided by Christoph Wittmann). Accumulated lightning which gives better time distribution through forecast than instantaneous type is working only for AROME; is already implemented in AROME at ZAMG and used by forecasters. The plan is to prepare a "convective" pack based on model cycle cy46t1.

Few new diagnostic fields were coded in Prague (phased into cy46t1): convective temperature (the approximate temperature that air near the surface must reach for cloud formation without mechanical lift); mean radiant temperature (one of the inputs needed for evaluating thermal comfort) and global normal irradiance (required by some energy producers).

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).

Few teams have started experiments at higher horizontal resolutions with AROME or 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) will continue. The modification of shallow convection parameterization in AROME allows now to compute the turbulence parametrization scale-adaptively, the subgrid turbulent flux is extinguishing with higher horizontal resolution (100 – 1000 m) as the resolved turbulent flux increases. The effect of this modification is visible but is small and can be only part of final solution for the turbulence treatment in grey zone. Study will continue in direction of quasi 3D turbulence.

Actions in 2019:

- continuation of research on turbulence in the grey zone has been stopped for manpower reasons
- preparation and validation of VHR model set-up, comparison ALARO-1 (4 km -2 km -1 km), AROME;
- *tuning of TOUCANS for the dynamical adaptation for wind*

Sub-action: Turbulence in grey zone**Contributor:** D. Lancz (Hu)**Efforts:** stay cancelled**Documentation, deliverable:** stay report**Status (from previous work):**

The Hgrad is a turbulence parameterization which uses the horizontal gradients and showed promising results in the treatment of turbulence inside convective clouds (Moeng 2014, Verrelle et al. 2017). The Hgrad parameterization uses the horizontal gradients and is an alternative approach to more common Kgrad method where parameterization of the vertical turbulent fluxes are computed from the vertical gradients.

The aim of the Hgrad parameterization is to better treat the mixing inside the deep convection, thus it is used in grid-boxes where the altitude and the mixing ratio both reach the given threshold values.

Hgrad parameterization is implemented in the MesoNH. David Lancz (stay in Toulouse) has implemented it into the AROME model, taking into account the differences of both models (different type of vertical coordinate systems, spectral/grid-mesh model grid-mesh,...). Main modifications were made in `mf_phys_prep.F90`, `aro_turb_mnh.F90` and `turb_ver_thermo_flux.F90`, while in few other routines only minimal changes were needed. By the end of the stay, the code was not yet ready yet. Work will continue in 2019.

Sub-action: Preparation steps in direction of VHR**Contributor:** R. Brožková (Cz), P. Scheffknecht (at), M. Dian (sk), J. Cedilnik (si)**Efforts:** 1.5pm (cz), 0 pm (at), 1pm (sk), 0.75 pm (si)**Documentation, deliverable:****Status:**

A new operational model set-up at 2.3 km resolution has been prepared in Czech Republic. Firstly, a lot of the work was related to dynamical core (non-hydrostatic), after was proceeded with physics schemes validation. Few tunings were necessary: in connection to the new computation of surface roughness, a slight retuning of gravity wave drag and also it was necessary to retune cloudiness for radiation which changed the vertical distribution of cloudiness and improved radiative answer of it. The 3MT parameterization of still unresolved drafts is still the use and cannot be abandoned. A question was about the use or not of gravity wave drag (parameterizations of still unresolved orography). Tests have shown that it is still necessary and some modifications were done, the so-called form drag was reduced and the lift which parameterizes the effect of Coriolis force and influence wind direction as well.

Preliminary validations of the high-resolution setup were done for winter 2017 and late spring 2018, covering various weather regimes. For moist deep convection the specific period of June-July 2009 was used as a complementary test-bed. As expected, higher resolution improves namely scores of screen level parameters. Additional validations were done, such as the verification of global solar radiation, which helps to verify indirectly cloudiness. The validation of downward solar flux hourly sum (Fig 2), where for the high-resolution model version we reduce the bias below 5%.

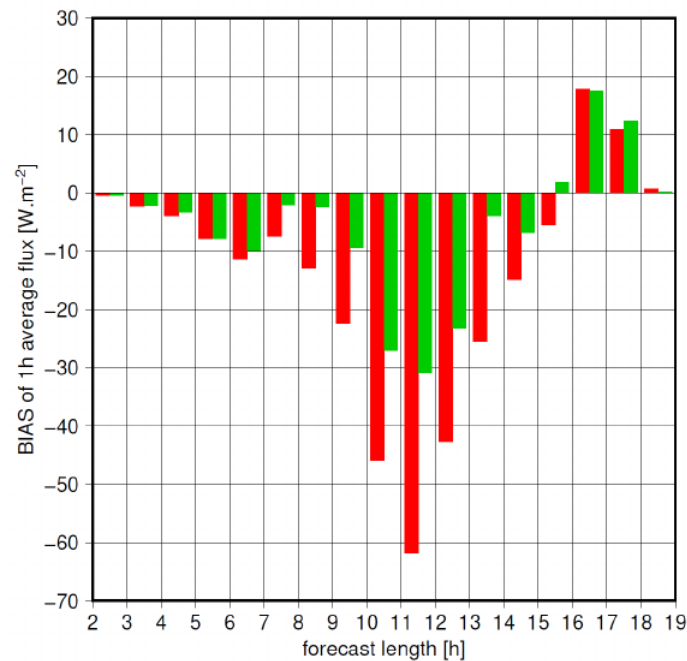


Figure2: Bias of hourly surface downward solar flux with respect to 19 stations, for the period from 14 May to 31 May 2018. Red bars denote the reference at 4.7km and green bars denote the high-resolution model version at 2.3km.

For the time being most of the work on this topic is not really related to physics in other countries.

In Austria, P. Scheffknecht is testing 500 - 1.2km - 2.5km AROME currently mainly dealing with assimilation of Austrian Mode-S Data.

In Slovenia, various possibilities to define the domain with resolution between 1 and 2 km (size and geographical position) were investigated. Due to limited computation resources the size of the domain has to be a compromise. However, according to the study of the propagation of variability of meteorological information from the LBCs into region in SE of the Alps, which is rather slow, a smaller domain is still believed to be adequate. The information from the initial condition is rather persistent compared to regions north of the Alps.

High resolution studies in Slovakia continue with testing two possible configurations of the convection-permitting non-hydrostatic. AROME and ALARO (same domain, 2 km horizontal resolution, 73 vertical levels, cy40t1, dynamical adaptation mode, twice per day) are coupled to the ALADIN/SHMU system (4.5 km/L63) with hourly coupling frequency. Simulations for longer periods and for individual case studies are performed. Evaluation is ongoing.

Dynamic adaptation of wind will be addressed in Croatia in 2019.

Action: Usage of off-line SURFEX**Sub-action: Improve quality of surface characterization****Contributors:** S. Penezić (hr)**Efforts:** 1.5 person month**Documentation, deliverable:** ALADIN-HIRLAM Newsletter 12**Status:**

In preparation for the use of SURFEX, the quality check of ECOCLIMAP v2.2 cover types over the Croatia has started in Croatia. Correction will be needed for the usage in the SURFEX.

Sub-action: ISBA-Ags**Contributors:** B.Szintai (hu)**Efforts:** 2.5 person month**Documentation, deliverable:** ALADIN-HIRLAM Newsletter 12**Status:**

The plan is to couple ImagineS system with the operational AROME model with respect to leaf area index (LAI). The ImagineS system is based on offline Surfex with ISBA-Ags and is currently assimilating LAI from the Proba-V satellite and ASCAT soil moisture. ImagineS is running offline and with a time lag of approximately 10 days (this is due to the timeliness of the Proba-V_LAI). The plan is to include the ImagineS LAI analysis in the operational AROME model on a daily basis. This will be done by integrating every day the offline Surfex ISBA-Ags from the last LAI observation (T-10days) until the current day and put this LAI into AROME.

A program is prepared to aggregate LAI (satellite data LAI and SWI) to grid (the same domain as in AROME (Lambert projection) Hungary). Simulations are done with SURFEXv7.3 on the period February- May 2018 in OpenLoop (no assimilation) with atmospheric forcing calculated from operational AROME forecasts. The positive anomaly (earlier start of vegetation in 2018 compared to climatology) over croplands is well simulated by ISBA-Ags, but over forests ISBA-Ags seriously underestimates the growth of vegetation.

Sub-action: CROCUS snow model

Contributors: M. Ličar (si)

Efforts: 2.5 person month

Documentation, deliverable: ALADIN-HIRLAM Newsletter 12

Status:

Snow simulations were performed during the 2017/18 winter season using the Crocus snow pack model. Crocus is integrated as a snow scheme in the ISBA land surface model, which is part of the SURFEX surface modeling platform. The SURFEX simulations were performed in offline mode, where meteorological forcing at the surface level is provided.

The simulations were performed daily in a semi-operational manner. The meteorological forcing was based on INCA analysis. A restart file containing the model state is generated after each daily simulation and is used as an initial condition for the simulation for the following day.

SURFEX requires also the longwave downward radiation (DLW) to be provided as meteorological forcing. Since this data is not available in INCA analysis, it is obtained from ALADIN forecast. The DLW data is then corrected using the insolation fraction from INCA analysis.

The system runs in an operational mode since the beginning of the 2018/19 winter season, simulation of the last 24 h is performed on daily basis to obtain hourly analysis. A forecast simulation based on ALADIN forecasts was added at the end of December. Hourly analysis and forecast of snow depth, snow melt, liquid water content and rams are available, besides snow profiles and snow cover characteristics (depth, density, lwc) are daily updated for selected locations.

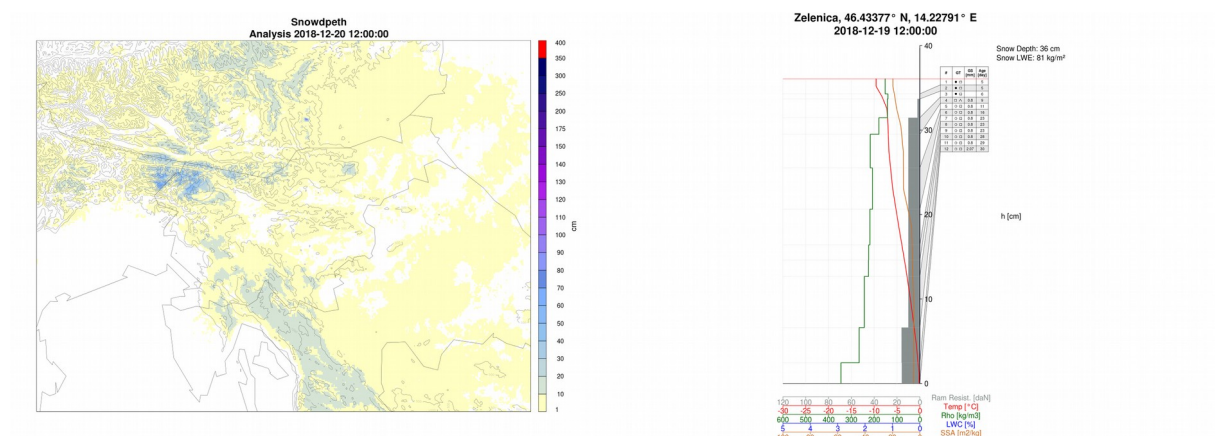


Figure3: Simulated snow depth on INCA domain (left) and simulated snow profile at mountain station Zelenica (right).

Sub-action: Off-line SURFEX as a downscaling tool**Contributors:** M. Ličar (si)**Efforts:** 1.5 person month**Documentation, deliverable:****Status:**

Test runs of SURFEX v8.1 were performed where both ISBA (for land surface) and TEB (for urban areas) schemes were activated. One motivation for these simulations is to obtain a better estimation of temperature at 2m for ALADIN and ECMWF forecasts. The simulations were performed in offline mode on the domain with 1 km resolution, meteorological forcing at the surface level is provided by both models.

The simulations were performed for 3 winter and the other for 3 summer months, evaluations is ongoing. Test cases showed a slight increase of the maximum 2m temperature in urban areas, due to more detailed physics in the TEB scheme.

Similar application is also in use in Slovakia. Off-line SURFEX in off-line mode is getting forcing from different sources (ALADIN, INCA, AROME). Aim is better representation of a surface and surface boundary layer (below lowest model level) and to get more accurate analysis and forecast of soil and screen-level variables.

Action: Coupling with sea surface / ocean**Contributors:** Croatia, Slovenia**Efforts:** 6 + 6 person months**Documentation, deliverable:** scientific papers**Status:**

Croatia:

Wind Wave Model III was implemented as operational wave model in the Adriatic Sea. Model has unstructured grid. Wind forcing comes from dynamical adaptation of wind to 2km grid spacing over the 3-day forecast range (DADA). The boundary condition at the Otranto Strait are obtained from WAM model forecasts from ECMWF.

Verification results showed underestimate of significant wave height by 8 cm, an absolute error of 21 cm and a correlation of 91 % when comparing with the altimeter of the SARAL satellite. More details can be found in paper (Sikirić et al, 2018)

Slovenia:

Study of the impact of Two-way Coupling and Sea-surface Temperature on Precipitation Forecast in Regional Atmosphere (ocean model POM and atmospheric model ALADIN) has continued. Main focus in 2018 was verification of sea surface temperature (SST).

Research on the impact of SST information in Adriatic Sea on forecast along its eastern coast was continued by performing further verification analysis and comparisons with satellite data. Experiments included different SST products (ECMWF, MFS, operational POM) and two-way real time coupling between ALADIN and POM (either in production cycle only, assimilation cycle or both). It is concluded from satellite verification that for the ocean model POM, the two-way coupling always improves SST. However, in ALADIN, high-resolution SST from POM (which has no ocean data assimilation) degrades the forecast with respect to ECMWF (daily analysis) and MFS (weekly analysis). Although the two-way coupling improves the forecast, it is not able to outperform the low resolution ECMWF product which benefits from frequent update with observations.

The operational implementation of NEMO ocean model (as replacement for POM) continued by replacing sigma with z-levels. Operational ALADIN is used as meteorological forcing. Additionally, a separate NEMO-based storm surge ensemble modeling system has been set up, employing TPX08 tides at the lateral boundary and ECMWF ensemble as meteorological surface forcing.

3 List of actions, deliverables including status

Subject: Turbulence scheme TOUCANS

Deliverables: paper published, shallow convection completed available in export cy43t2

Status: ONGOING

Subject: Radiation scheme

Deliverables:

Status: PENDING

Subject: Cloud scheme

Deliverables:

Status: ONGOING

Subject: 1D2D turbulence scheme

Deliverables: -

Status: POSTPONED

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

Deliverables:

Status: PERMANENT

Subject: The ALARO-1 version

Deliverables: Configuration ALARO-1vB, bug fixes cy43t1, contribution to cy46t1

Status: ONGOING

Subject: Interfacing physics parameterizations

Deliverables: -

Status: PENDING

Subject: Various products for users (forecasters)

Deliverables:

Status: ONGOING

Subject: Very Fine Resolution experiments

Deliverables:

Status: ONGOING

4 Documents and publications

Scientific papers:

Strajnar, B., J. Cedilnik, A. Fettich, M. Ličer, N. Pristov, P. Smerkol and J. Jerman, 2018: Impact of Two-way Coupling and Sea-surface Temperature on Precipitation Forecast in Regional Atmosphere and Ocean Model, manuscript submitted to publication

List of reports:

Peter Smerkol: Debugging and testing TOMs subroutine in TOUCANS module for ALARO-1, RC LACE stay report, Prague 14th March - 30th March 2019

Ján Mašek and Marin Dian, 2019: Source of fibrillations in SURFEX, Preliminary report, June 2019 (e-mail with figures)

Mario Hrastinski: Generalized TKE-based mixing length formulation in TOUCANS, RC LACE stay report, Prague, (14.1-25.1.2019 and 18.2-1.3.2019)

Viktoria Homonnai: Testing new modifications in LIMA scheme, RC LACE stay report, Toulouse (4.-15.6.2018 and 26.11.7-12.2018)

Martin Dian: ALARO coupled with SURFEX, correct averaging enabling use of effective roughness RC LACE stay report, Prague, (4.-15.6.2018 and 26.11.7-12.2018)

Piotr Sekula: precipitation types (very preliminary version, in Polish), in preparation, OPLACE stay in Ljubljana (19.8.-13.9. 2019)

Contributions:

List of presentations:

29th ALADIN Workshop and & HIRLAM All Staff Meeting, 1-4 April 2019, Madrid, Spain

Radmila BROZKOVA: [ALARO CMC at high resolution](http://www.cnrm.meteo.fr/aladin/spip.php)

<http://www.cnrm.meteo.fr/aladin/spip.php>

41st EWGLAM & 26th SRNWP joined meetings, 30 Sep – 3 October 2019, Sofia, Bulgaria

[Martina Tudor: LACE physics overview](http://srnwp.met.hu/Annual_Meetings/2019/index.html)

http://srnwp.met.hu/Annual_Meetings/2019/index.html

5 Activities of management, coordination and communication

Meetings:

- 29th ALADIN Workshop and & HIRLAM All Staff Meeting, 1-4 April 2019, Madrid, Spain (Radmila BROZKOVA: [ALARO CMC at high resolution](http://www.cnrm.meteo.fr/aladin/spip.php))

- 41st EWGLAM & 26th SRNWP joined meetings, 30 Sep – 3 October 2019, Sofia, Bulgaria ([Martina Tudor: LACE physics overview](#))
- ALARO-1 WD, Bratislava, Slovakia, 11-13 March 2019
- SURFEX Users Workshop, Toulouse, 18-20 March 2019
- NWP Surface Working Week, Norrköping, Sweden, 25.2.-1.3. 2019

6 Summary of resources

Summary of resources for the year 2019 are presented in two type of tables. First one according to the RC LACE physics (+ for Poland) the second one is related to ALADIN/HIRLAM/LACE manpower reporting tool for 2019 (without Poland).

Subject/Action	Resource		LACE		ALADIN Flat-rate	
	planned	realized	planned	realized	planned	realized
TOUCANS		10	1.5	1.5		
Radiation		/				
Cloud scheme		2.5				
Microphysics		2+2	1	0	1 OPLACE	1
ALARO-0/ALARO-1/ SURFEX		5.25	1	0.5	0.75	0.75
ALARO-1 (incl WD)		4.25	1.5	1.75	0.25	0
Physics interface		-				
Additional fields		3+2			3	1
VFR Experiments		0	1	0		
SURFEX off-line		6.5				
Coupling with sea surface / ocean		2.5				

Total		36+4	6	3.75	3	2.75
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Summary of the reported manpower (in person months) on the ALADIN reporting tool for the first two quarters of 2019.

DIAN Martin	PH3: PH3.8 implementation, optimization, maintenance of par-suite alaro 2km non-hydrostatic	0.25
MASEK Jan	PH3: gravity wave drag - tuition of a newcomer	0.5
MASEK Jan	PH3: ALARO with SURFEX	0.25
DERKOVA Maria	PH3: organisation and participation at the ALARO-1 WD	0.25
SMERKOL Peter	PH3: TOUCANS - Debugging and testing TOUCANS (acdifv3.F90)	0.5
HRASTINSKI Mario	PH3: Mixing length subside the TOUCANS scheme	0.5
MASEK Jan	PH3: TOUCANS - numerical aspects	1.75
HRASTINSKI Mario	PH3: TKE based mixing length in TOUCANS	1
BROZKOVA Radmila	PH3: development of the cloud scheme	1
MASEK Jan	PH3: mixing length in TOUCANS	0.5
MASEK Jan	PH3: mixing length	0.25
DIAN Martin	PH3: PH3.8: mplementation, optimization, maintenance of par-suite alaro 2km non-hydrostatic	0.25
SMERKOL Peter	PH3: TOUCANS - Debugging and testing TOUCANS (acdifv3.F90)	0.25
NESTIAK Michal	PH3: participation at the ALARO-1 WD	0.25
SVABIK FILIP	PH3: impact of gravity wave drag on temperature	2
SMERKOL Peter	PH3: TOUCANS - Debugging and testing TOUCANS (acdifv3.F90)	1

MASEK Jan	PH3: impact of dry processes on temperature	0.25
DIAN Martin	PH3: PH3.7 continuation of RC LACE stay development and report (Investigating Surfex in ALARO-1 part 3)	1
DIAN Martin	PH3: PH3.7: continuation of RC LACE stay development and report (Investigating Surfex in ALARO-1 part 3)	1
SVABIK FILIP	PH3: impact of dry processes on temperature	1.5
BROZKOVA Radmila	PH3: impact of finer topographic databases - roughness	2.25
PANEZIC Suzana	SU3: Antifibrillation system in coupling ALARO1 with SURFEX	0.75
SCHNEIDER Stefan	SU3: AROME ISBA Diff tests	0.5
MASEK Jan	SU3: validation of roughness computation in SURFEX vs ISBA	0.5
PANEZIC Suzana	SU3: Test and validate behaviour of components in cy43/SURFEXv9.1	1
SCHNEIDER Stefan	SU3: Validation ISBA Diff within SURFEX	0.5
TARJANI Viktor	SU3: Evaluation of snow cover schemes within offline SURFEX (winter 2018/2019 reanalysis experiments)	0.75
PANEZIC Suzana	SU5: ECOCLIMAP cover map, corrections and studying the impact	0.75
PANEZIC Suzana	SU5: SU5.1 ECOCLIMAP cover map, corrections and studying the impact	0.25
PANEZIC Suzana	SU5: ECOCLIMAP cover map, corrections and studying the impact	0.5
FETTICH Anja	SU6: validation of WAM and NEMO model (higher resolution)	1.25
FETTICH Anja	SU6: updates and validation of WAM and NEMO model (higher resolution)	1

LACE scientific stays:

- **Done** Mario Hrastinski (hr), Generalized TKE-based mixing length formulation in TOUCANS, Prague, (14.1-25.1.2019 and 18.2-1.3.2019)
- **Done** Peter Smerkol (si), Debugging and testing TOMs subroutine in TOUCANS module for ALARO-1, Prague 14th March - 30th March 2019
- **ToDo** Viktoria Homonnai (hu), AROME microphysics: testing novelties in LIMA scheme, Toulouse, 4 weeks stays (11. 11. - 6.12. 2019)
- **ToDo** Martin Dian (sk), ALARO coupled with SURFEX, Prague, 2 weeks done 2 weeks to do
- **Cancelled** David Lancz (hu), Study of the turbulence grey zone: Hgrad parameterization in AROME, Toulouse, 4 weeks, 5.-30. 11. 2018

ALADIN Flat-Rates Stays:

- **ToDo** Luc Gerard: Convection, 1 week, Prague
- **ToDo** Piotr Sekula: Validation of precipitation type diagnostics pack in cy43t2, 19.8.-13.9, Ljubljana (planned subject "Validation of ALARO-SURFEX coupling" was changed)

Stay related to OPLACE:

- **ToDo** Bogdan Bochenek: Validation of prognostic graupel, 4 weeks, Prague

7 Problems and opportunities

Although the core team for the ALARO developments is rather small good results and model performance can be shown. Progress is not so fast but steady.

The SURFEX with new physiography datasets is going to be used in the future, more knowledge is needed for its proper usage.

Topics from this report are included in ALADIN/HIRLAM/LACE rolling work plan 2019 in various working packages. Initiative on a more coordinated effort on post-processing (additional diagnostic fields for the end-users) was well accepted on the consortia level and resulted in new working package WP PH5 led by ACNA (Maria Derkova).

ALARO is included into AEMET-gamma SREPS, support has been provided to replace basic version ALARO-0 with ALARO-1vB. Some feedback from their verification was reported during ALARO1 WD.

