Working Area Physics

Progress report

Prepared by:	Area Leader Neva Pristov
Period:	2016
Date:	8 March 2017

1 Progress summary

This report gives an overview of the progress of research and development in the year 2016. The following can be pointed out:

Turbulence scheme TOUCANS in now completed with the last renewed part, namely the new shallow convection closure which uses a mass-flux type of computation.

New diagnostics of sunshine duration removed strong overestimation of sunshine duration in situation with partial cloud cover, also a direct solar flux at the surface is now more consistent with instrumental measurements.

Exponential-random cloud overlap is available in radiation and diagnostic cloudiness and is consistent with cloud-precipitation geometry in microphysics.

The new interpolation method from model levels to screen level for temperature and relative humidity removed oscillations noticed in stable weather situations (calm, clear sky conditions at night) and entered into ALARO-1 code immediately.

These new developments were included in the second well-tuned version of ALARO-1 physics package named ALARO-1vB, which is already in the operational use at CHMI. ALARO-1vA with new 2m diagnostics entered the operational 8km applications (deterministic and EPS) in Hungary, while in other services validation of ALARO-1 is on-going with the aim to replace ALARO-0 version.

New researchers has started to learn more about TOUCANS and saturated downdraft inside convection. LACE research stays were good starting point to get familiar with these schemes.

ALARO developers and users gathered at ALARO-1 Working Days in Brussels for three days in mid September 2016. Developments during the last two years and users experiences were presented.

The paper about long wave radiation part of ACRANEB2 scheme was finalized and accepted in QJRMS. NER approach is now presented to the scientific community in a clear way. It closes impressive work of Jean-Francois on radiation, starting nearly four decades ago. Jan Mašek gained an excellent understanding and competence in this field.

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

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

Actions in 2016:
- tests with new computation of shallow convection;
- check and examine coding of some part of TOUCANS (TOMs, ...);
- test available options for mixing length computation and continue developments on prognostic mixing length;

Ivan Bašták Ďurán gave an initiative to write a paper on the moist prognostic TTE implementation where the reservoir of moist TPE is a second prognostic variable.

Sub-action: Shallow convection

Contributors: R. Brožková (Cz),

Efforts: 3 person months

Documentation, deliverable: code modification, presentation at ALADIN workshop

Status:

Proposed description of shallow convection uses a mass-flux type of computation and is based on the recent work (Geleyn and Marquet, 2013 and Lewellen & Lewellen, 2004). One of main ingredients is the computation of a ratio between dry and saturated atmospheric conditions, on which bases shallow convection cloud vertical profile can be obtained. Method is similar to the one for moist deep convection in 3MT, but with a lot of simplification as shallow convection is not producing precipitation. The algorithm to compute mass-flux type shallow convection profile was coded and tested, namely with respect to the choices of aborting the cloud and with respect to the lateral mixing formulation. One of the tested

possibility was to stop the cloud at low values of TKE, however, this choice turned to be too rough, as it is preventing creation of turbulence (too big negative feedback). The threshold is now based on a very low value of the moist TTE (Total Turbulent Energy), however it could be considered to be removed completely. The lateral mixing is not applied within the cloud, which is in agreement with L&L2004 proposal. On the other hand there is a mechanism of preventing to start a new cloud above a rather thick stable layer, by applying a strong mixing above the cloud top (bottom of the stable layer). These two algorithms (aborting the cloud and preventing its restart above a thick stable layer) could be still revisited and/or completely abandoned. The results of the new shallow convection scheme are more realistic compared to the current one based on usage of modified Richardson number, since the diagnosed shallow convection cloudiness compares much better with the observed cloud scene. Although this cloudiness is detected at half-model levels can in principle mimic cloudiness computed by other schemes (adjustment, deep convection). Therefore it is not used as an input to the radiation. Nevertheless the improved shallow convection scheme transports moisture in a better way and thus it contributes to the cloudiness indirectly. Since new shallow convection scheme increases amount of the cloudiness in general, especially in summer, the retuning of the clouds coming to the radiation became necessary. New scheme helps reducing the bias of precipitation, temperature and humidity at screen level. Precipitation structure also becomes better, especially the reduction of weak precipitation spread is quite noticeable on the precipitation charts (Figure 1). Upper air scores are neutral in RMSE.

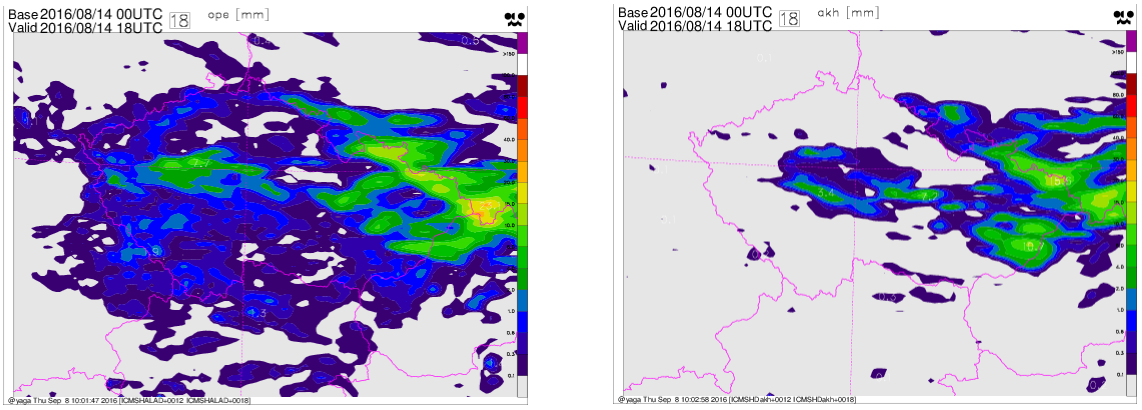

Figure 1: 6 hour precipitation amounts, 14.8.2016 00 run at +18 UTC, ALARO-1vA (at that time operational) run (left) and ALARO-1vB (at that time e-suite), where new shallow convection is the main ingredient (right).

Development is part of ALARO-1vB, is already phased into cy43t2 and is back phased into cy40t1, code is also in the local CHMI branch cy38t1op5. Before entering into the operational suite at CHMI it was validated for the convection period in summer 2009 (become new control run) and in their e-suite.

Sub-action: Mixing length computation

Contributors: M. Hrastinski (Hr)

Efforts: 3 person months, LACE stay

Documentation, deliverable: stay reports

Status:

Mario Hrastinski has started to study TOUCANS scheme. His first task was to check the code versus TOUCANS documentation and literature linked to the methods of mixing length definitions and computations as it has been noticed that all TKE-based mixing lengths and their combinations produce too small near surface mixing. Consequently, forecast is deteriorated when compared to the one on Prandtl type still used in the operational set-up. The review and some optimization of the code (acmixelen.F90) was done, minor bugs were corrected, conversion factor from TKE-based length scale to Prandtl-type mixing-length was carefully checked and tested as Ivan Bašták Ďurán mentioned that there can be misinterpretation. First tests were made on single forecast of summer convection on June 29th 2009 and on two weeks period (June 21th – July 5th 2009) of intensive summer convection over central Europe. Verification scores were produced and seems reasonable. The modification in the scale conversion, which results in decreasing the mixing length six times, reduces the BIAS of temperature and relative humidity and improves the simulation of 10 m wind. Testing has continued also with different formulations of Bougeault-Lacarerre main length scale available in the TOUCANS scheme. Studies are continuing, beside suitable validation strategy is needed.

Sub-action: The code check

Contributors: P. Smerkol (Si)

Efforts: 2.5 person months, LACE stay

Documentation, deliverable: code modification, stay report

Status:

Peter Smerkol has focused on the code that calculates the Third order moments corrections to heat and moisture fluxes (acdifv3.F90). He cleaned the code, corrected known bugs listed in TOUCANS documentation by Ivan Bašták Ďurán and the one he found. All of the bug corrections except one produce the negligible differences in norms and in the contributions within DDH. Code debugging is still in process.

Action/Subject: Radiation scheme

Description and objectives:

Radiation scheme ACRANEB2 is integrated into ALARO-1 version. Its validation will continue in 2016, some fine tuning and code optimization is planned. Improvements in the cloud-radiation interaction are planned by taking into account better information on cloud cover (especially shallow convection cloudiness from turbulence scheme) and (in future) by getting microphysical cloud condensates into radiation scheme. Adaptation of NER statistical model for cloudy case has very low priority, since usage of intermittent exact computation of bracketing weights has good results. Some additional tests are foreseen while preparing a scientific paper on the long wave radiation part of ACRANEB2. Parameterization of an impact of cloudiness on broadband surface albedo, which is an important issue for the schemes using single SW interval, will be prepared.

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

Actions in 2016:
- *more realistic cloud inputs (topic is moved under cloud scheme);*
- preparing a paper on long-wave radiation part with additional tests (revision of the bracketing method inside NER when clouds are included, ...);
- validation of delta-scaled and true direct fluxes, study whether observation operator is needed for verification against measurements
- parameterization of an impact of cloudiness on broadband surface albedo;

Contributors: J. Mašek (Cz)

Efforts: 4.5 person months

Documentation, deliverable: code modification, presentation at ALADIN workshop, scientific paper on long wave radiation part

Status:

The paper about long wave part of ACRANEB2 scheme was finalized, revised and accepted to QJRMS. As the part of the work, optimal tuning of bracketing was obtained. New tuning gives more accurate long wave heating rates with respect to narrowband reference, but in 3D simulations it increased warm temperature bias around 700 hPa level. Modification is therefore not used yet, its reactivation will require further retuning elsewhere.

In order to validate the NER concept with bracketing, an independent narrowband reference was developed in the long wave part of spectrum. It was validated against CIRC (Continuous

Intercomparison of Radiation Codes) line by line benchmark results and so can be used as a reference for any real case profile. Figure 2 shows ACRANEB2 long wave heating rate error with respect to narrowband reference, confirming accuracy several tenths of K/day in clear sky cases, while the error inside clouds usually remains within 1 K/day.

Exponential-random cloud overlap method is now available for cloud cover computation inside radiation scheme. Preliminary tuning of decorrelation depth performs well in radiation, in summer it reduces so called veils sometimes produced in high clouds and not confirmed by satellite.

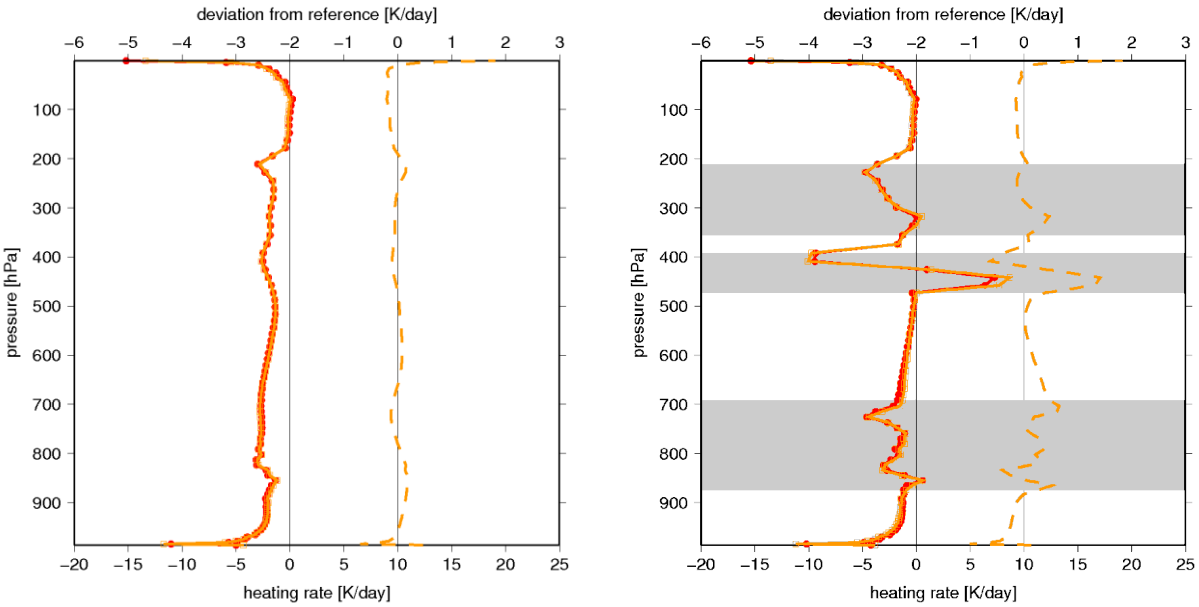

Figure 2: Long wave heating rates for a clear sky case (left) and cloudy case (right), red is the narrowband reference, yellow is the ACRANEB2, dashed line is difference and is linked with upper scale, grey shading notes cloud layers.

New diagnostics of sunshine duration was developed, taking into account variation of direct solar flux between clear sky and cloudy parts of grid-box. It removed strong overestimation of sunshine duration visible in situation with partial cloud cover, even when global radiation was unbiased. In connection to improved sunshine duration, a direct solar flux at the surface which is more consistent with instrumental measurements was derived. Delta-scaling is now applied only to clear sky part of the surface direct solar flux. Below cloud unscaled value is used, since it is more realistic when multiple scattering is present. MBIAS for sunshine duration and surface direct solar flux for current and new diagnostic is presented on figure 3.

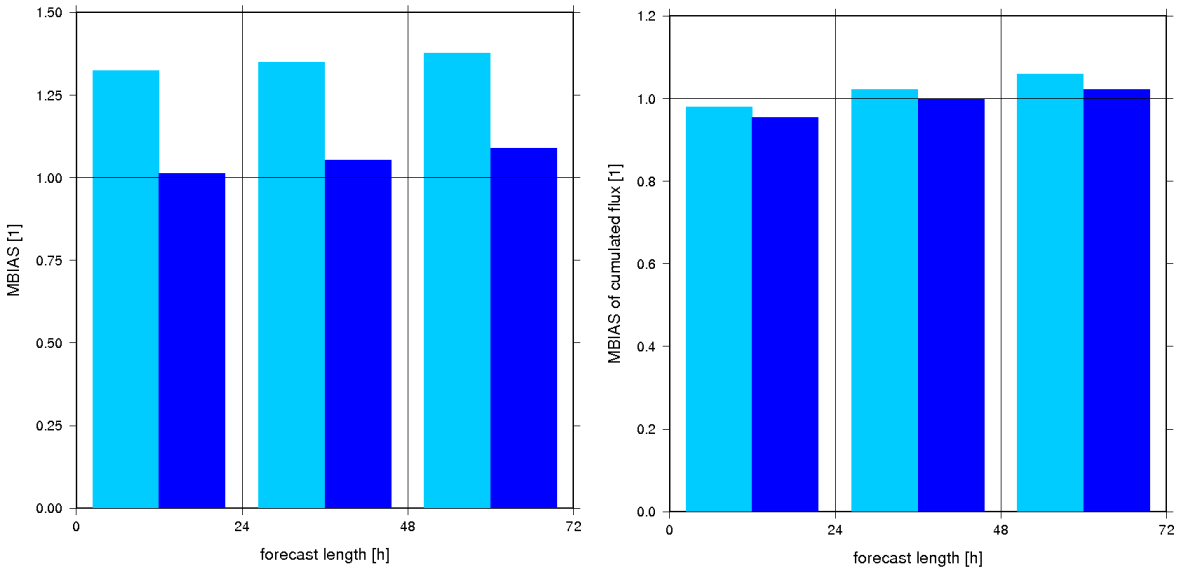

Figure 3: MBIAS (multiplicative BIAS), i.e. the ratio of model average to observation average, for sunshine duration and direct solar flux at surface for first second and third forecast day. Statistic is done for 19 stations for period 30.6.2016 to 7.9.2016. Light blue: CHMI operational suite (ALARO-1vA with new 2m diagnostics); dark blue: e-suite with new shallow convection, exponential-random cloud overlap and improved direct solar flux and sunshine duration.

Action/Subject: Cloud scheme

Description and objectives:

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

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

Action in 2016:
tests with usage of shallow convection cloudiness diagnosed in turbulence scheme as an input to radiation and microphysics

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

Efforts: 2 person months

Documentation, deliverable: code modification,

Status:

Exponential-random cloud overlap prepared at the end of 2015 is implemented in radiation and diagnostic cloudiness, consistently with cloud-precipitation geometry in microphysics. Dependence of decorrelation depth on latitude and season was introduced, inspired by the work of Oreopoulos et al. 2012. Preliminary tuning of decorrelation depth performs well in radiation and microphysics, but produce smaller total cloud cover in cloudiness diagnostics. Total cloud cover with respect to LACPANMX option is reduced and comparison against SYNOP shows prevailing negative bias. In order to mitigate the problem, decorrelation depth in diagnostic cloud cover is reduced by factor (currently 0.4 which means more random overlap). An example is seen on figure 4, exponential-random overlap does not remove the problem completely, but reduces it by roughly one half. The goal is to have the same diagnostic and radiative cloud cover, if possible. The problem will be further investigated when we inspect cloudiness in ALARO-1.

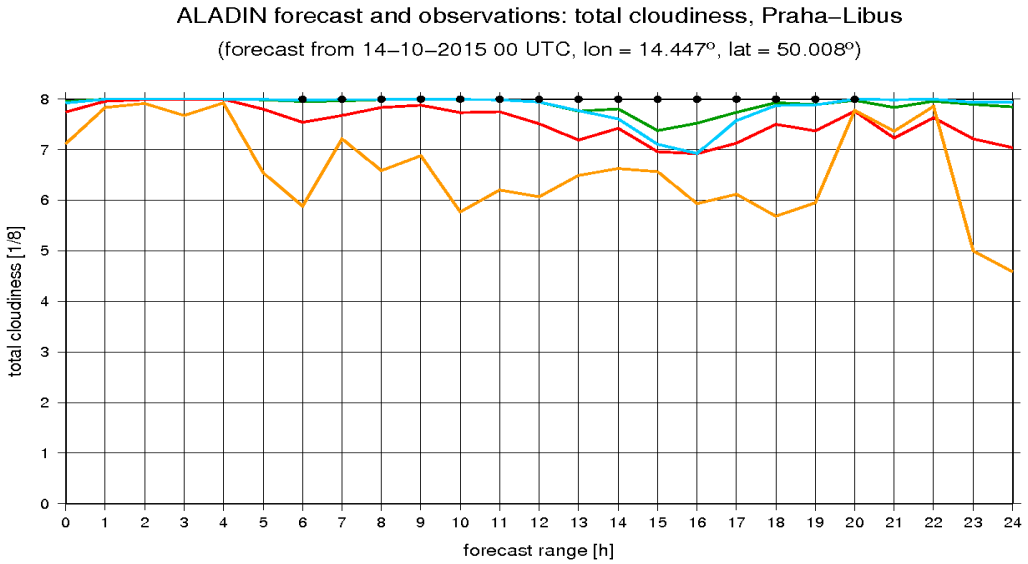

Figure 4: Cloud cover in Prague on 14.10.2015. Radiation cloud cover with exponential-random overlap (red) and maximum-random overlap (yellow), diagnostic cloud cover with exponential-random overlap (green) and nearly maximum-random overlap (blue). Black dots are measurements.

Action/Subject: Microphysics

Description and objectives:

Current microphysics schemes in AROME are ICE3 and ICE4. The ICE3 sensitivity to the time step length has been reduced recently, while ICE4 is under re-evaluating procedure as some bugs related to hail were fixed inside ICE4 in Meso-NH.

LIMA is a two-moment microphysics scheme, focusing on the aerosol-cloud interactions. At the moment is under validation process in Meso-NH, research version is going to be implemented in AROME, the operational application of the scheme at Météo-France is planned by the end of 2016. When a first working prototype in AROME is available, testing and further tuning can start.

Action in 2016:
Testing of LIMA scheme in the research version of AROME;

Contributors: V. Homonnai (Hu)

Efforts: 1.5 person months, 1 month LACE stay

Documentation, deliverable: stay report, presentations at CLOUD WD, set of python scripts to prepare initial fields for LIMA scheme in AROME

Status:

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 (cy42t1).

The procedure which prepare initial conditions for aerosols used in LIMA scheme in AROME from model MOCAGE (Meteo-France multi-scale Chemistry and Transport Model) was prepared. Both models has different horizontal and vertical resolution, different aerosol types and characteristics, description of size distribution also differ. All needed conversions and interpolations are included in the set of python scripts, using also epygram library. First case study to see the influence of the initial conditions was already done.

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

Description and objectives:

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

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

Validation and sensitivity study of the parameterization of orographic shadowing in radiation with respect to the primary (radiation fluxes, temperature) and secondary (convection, low stratus in valleys, local circulation) will continue. This parameterization will be tested also within ALARO-1vA physics coupled with SURFEX .

Actions in 2016:
- validation and operational use of ALARO-1vA in local applications;
- the interpolation method from model levels to screen level (2m temperature and rel. humidity) should be revised;
- preparations for the SURFEX usage with ALARO;
- implementation of the ororad scheme in the ALARO-1vA/SURFEX system;
- validation and sensitivity studies to understand better influence of ororad scheme on upper air atmosphere;

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

Contributors: R. Brožková (Cz), N. Pristov (Si), M. Derková (Sk), D. Lancz (Hu), M. Szucs (Hu), S. Tascu (Ro), M.Tudor (Hr)

Efforts: 6 person months

Documentation, deliverable: presentations at ALARO-1 WD

Status:

The first well-tuned version was ALARO-1vA available in February 2015 (export cy40t1, also modset for cy38t1), in May 2016 the improvement of the screen-level properties (modset for cy40t1 and cy38t1) was distributed. Now next well-tuned version named ALARO-1vB has been prepared. Its ingredients (in addition to ALARO-1vA, screen-level interpolation) are: mass flux type of shallow convection scheme in TOUCANS, exponential-random cloud overlaps in radiation and cloud diagnostics, improved diagnostics of sunshine duration, direct solar flux at surface and 10m wind interpolation in cases where lowest model level is below 10 m. This code is available in cy43t2 and a modset for cy40t1 is prepared (begin of 2017).

New diagnostics of 2m temperature and relative humidity entered the operational ALARO-1vA application at CHMI immediately after final testing. ALARO-1vB entered their

operational suite in September 2016. The verification scores of e-suite confirm improvements, it can be pointed out that BIAS for precipitation is reduced (its daily variation) and less small rain spread is observed.

ALARO-1vA and new diagnostics of 2m temperature and relative humidity have been tested in Hungary. ALARO-1vA replaced ALARO-0 baseline in the operational (8 km) model in August 2016. Moderate improvements were noticed in the precipitation-timing, in high-level temperature and 2 m dew point forecast. ALARO-v1A including new screen level diagnostic has pre-operational status in Slovakia since August. One of the problem is that wind speed around mountains is too low. In Slovenia, ALARO-1vA was used in 3-hour assimilation cycle to obtain re-analyses, which will be used to re-compute forecasts for the period of few years (2011-2016), their plan is to continue with ALARO-1vB. In Romania, case studies with ALARO-v1A and new larger domain with increased horizontal resolution (5 km) were done.

Few still remaining problems can be pointed out based on operational validation, low cloudiness in anticyclonic winter situations, minimum 2m temperature in stable winter conditions with or without snow cover. Part of the problem can be attributed to snow treatment in ISBA scheme.

Many case studies with low-cloudiness were studied to understand why low clouds gets dissolved. It seem this is not (only) problem of cloud scheme. A tendency of the model to remove the sharp gradient at the inversion top was noticed. When data assimilation restores the gradient, clouds appear again for a while.

Tuning of the wind gusts computations is also an issue. Each country try to adopt FACRAF factor to their local need, but its value is not optimal for all weather situations. These messages are valid for both ALARO and AROME operational models.

Sub-action: The interpolation method from model levels to screen level (2 m temperature and relative humidity)

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

Efforts: 3.5 person months

Documentation, deliverable: code modification, stay report

Status:

The interpolation of the temperature and humidity to 2m was studied in stable conditions. Solution of Geleyn 1988 is smooth but too cold in winter. Solution of Kullmann 2009 is

warmer, but follows lowest model level too closely and sometimes oscillated. Mixture of the two, implemented in the ALARO-1vA version, has smaller BIAS but suffers from 2m temperature oscillations especially in the calm, clear sky conditions at night, where the strong surface inversion builds up. It is switching abruptly between the too cold (Geleyn 1988) and too warm (Kullmann 2009) solutions.

The new interpolation method is revised Kullmann 2009 solution, obtained by consistent application of Geleyn 1988 methodology to simplified Gratchev et al. 2007 stability function. New solution is smooth (non-oscillating), with one tunable parameter. Interpolation in unstable conditions is not influenced, here the Geleyn 1988 solution seems satisfactory.

Figure 5 shows maps of 1 hour increment of 2m temperature forecast in the morning. Problem with temporal oscillations can be clearly identified in spatial structure of the increment, visible as a short scale noise. While the new formula gives a noise free field, reference solution is heavily contaminated.

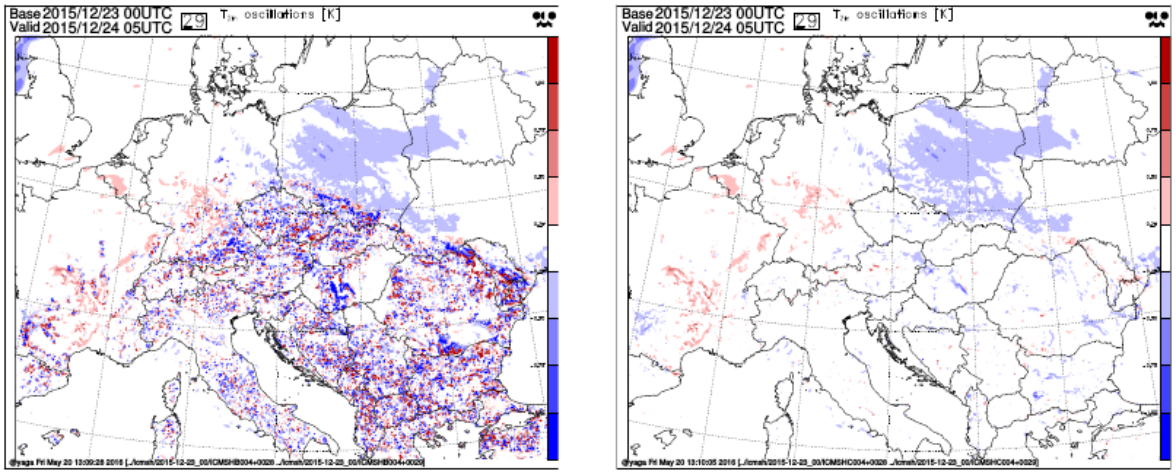

Figure 5: 1 hour 2 m temperature difference (23.12.2015 00+29) for the simulation using mixed solution (left) and one using new interpolation formula (right).

Method is already in the operational use. Code entered cycle cy43t1, the modset on cycle cy40t1 (last cycle, which can be compliable by Fortran90) and cy38t1 was also prepared and distributed. It is advised to use this new diagnostics in ALARO-1 and also in ALARO-0.

Sub-action: Parameterization of orographic shadowing on surface radiation

Status:

Implementation of the ororad scheme in the ALARO-1vA/SURFEX system is postponed. Very probably the author C. Wastl won't be available to continue work on this subject.

Sub-action: Coupling ALARO-1 with SURFEX

Contributors: R.Hamdi (Be)

Efforts: 0.5 person months

Documentation, deliverable: code modifications, stay report

Status:

The current code ALARO-1 in cy43t2 is a base for further developments and tunings, also for the coupling with SURFEX, so interface has to be rechecked with the newest code. Coupling of ALARO-1vA and SURFEX (v8) is based on the same method as it was done for ALARO-1vA in cy38t1 and SURFEX (v7.2) in 2015.

The interface between TOUCANS and SURFEX is done through drag turbulent coefficients. In TOCUCANS same stability functions are used for upper air and at surface and these functions has to be included also in SURFEX part of computation. Adaptations in the radiation part were not needed.

ALARO-1 coupled to SURFEX-8 is technically working using CY43T2. Code and scripts are at SHMU in Bratislava and at RMI in Brussels. Preparation of requested input files (climate and init file for SURFEX) and namelists definitions are done in same way as in Meteo-France.

Further scientific validation is needed to investigate more in detail the effect of the tiling approach inside SURFEX on the boundary layer when switching on the TOUCANS scheme.

Action/Subject: The ALARO-1 version

Description and objectives:

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

In the second stage then all other planed developments; i.e. CSD, TOUCANS evolution, prognostic graupl, thermodynamic adjustment, 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 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.

Actions in 2016:
- implementation of unsaturated down draft into ALARO-1;
- validation of prognostic graupl computations;
- preparations and validation of CSD;

Sub-action: Implementation of unsaturated down draft into ALARO-1

Contributors: S. Briceag (Ro), R. Brožková (Cz)

Efforts: 1.5 person months (1 month LACE stay)

Documentation, deliverable: stay report

Status:

Simona Briceag has started to get familiar with the code for unsaturated downdraft (acnsdo.F90). First she checked it against the documentation provided by the author Luc Gerard. Few corrections were introduced into code (cy38t1op5) and tests were done on the two cases. Results were compared with the operational set-up at CHMI (without unsaturated downdraft). There were no significant differences in the 10m wind or precipitation pattern, but the downdraft evaporation flux was too weak compared to the reference. The unsaturated downdraft mesh fraction had suitable values, while differences of the vertical velocity were larger, the experiment with unsaturated downdraft has a more realistic pattern located on the actual precipitation areas, but the values themselves were smaller. Work proceeded with the tuning of some parameters (TENTRD, TDDFR).

Action/Subject: Interfacing physics parameterizations

Description and objectives:

Impact study and validation of the physics-dynamics interface has high priority in ALADIN community. Scientific and practical constrains for redesign of physics interfaces (APL_AROME and APLPAR), which should enable the various physics packages (and also to exchange their individual parameterization schemes) are proposed. Actions are spread among many people, LACE contribution is to adopt ALARO part of computations in APLPAR routine. Radiation scheme in 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 2016: Support to phasing TOUCANS scheme will be available.

Proposed contributors, Estimated efforts: *R. Brožková (Cz), 0.5 month*

Status:

Nothing done as there was no request for support.

Action/Subject: Various products for users (forecasters)

Description and objectives:

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

Actions in 2016:
- evaluation of lightening diagnostics
- implementation of icing parameter and freezing rain

Contributors: J. Cedilnik (Si), C. Wittmann (At)

Efforts: 0.75 person months

Documentation, deliverable: stay report

Status:

Lightning diagnostic is used inside AROME model in Austria. Objective verification was not done yet, while forecasters gave a positive feedback. The quality of the wind forecast in the mountain areas has been tried to improve with more realistic roughness length field obtained from SURFEX. As those values are much smaller than those produced in climate files the adaptation of its usage should be done in the model (turbulence scheme), another approach could be to tune new roughness length field.

Action/Subject: Very Fine Resolution Experiments

Description and objectives:

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

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

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

Actions in 2016:
- preparing PhD thesis based on the experiments with modified EDKF scheme;
- preparation of VHR model set-up, comparison ALARO-1 (4 km -2 km -1 km), AROME;

Sub-action: Turbulence in grey zone

Contributor: D. Lancz (Hu)

Efforts: 4.5 person months

Documentation, deliverable:

Status:

The validation of modified shallow convection parametrization (EDKF modification) continued on real cases, additional to 1 km horizontal resolution also experiments in 500 m resolution were done. Some improvement due to the modification was detected in cloudiness, but deterioration was observed in the 2 m temperature and 10 m wind gust at 500 m. Unfortunately it seems that at 500 m horizontal resolution (independently from the modification) the precipitation forecast is worse than at 1 km. A case to study the convective cells (storm event with deep convection) was also done at various horizontal resolutions. The simulations at the 500 m and 1 km run produced more convective cells or merged big cells into even bigger cells, overestimated the precipitation (in greater measure

as the operational) and there are even more small convective cells (or merged big cells) when modified shallow convection parametrization was used. D. Lancz is writing a scientific paper on this subject to be submitted into Boundary-Layer Meteorology.

Sub-action: Preparation steps in direction of VHR

Contributor: C. Wittmann (At), M. Dian (Sk), J. Cedilnik (Si), M. Tudor (Hr)

Efforts: 0.5 pm (At), 1 pm (Sk), 0.5 pm (Si), 2.5 pm (Hr)

Documentation, deliverable:

Status:

Model set-up with AROME in horizontal resolution of 1.2 km is prepared in Austria, it is used for the simulation of selected cases (severe weather). AROME (2.5 km) simulation over Rio de Janeiro domain with Harmonie system at ECMWF were used during the Olympic Games in August 2016 in Slovenia. The wind forecast was very useful, also the squall line which appeared one day was well predicted. AROME (2.5 km) basic installation and model set-up in 1 km horizontal resolution with ALARO-1vA were prepared in Slovakia. The later one is in the experimental daily mode, focus is on weather in mountains.

In Croatia, in 2016 many cases with severe events of bora wind were identified, which were missed by hydrostatic run but correctly predicted by non-hydrostatic forecast at 4 km horizontal resolution. The simulation with non-hydrostatic model in 2 km resolution run is still superiour to both 4km runs due to better resolution of the coastal mountains that control the spatial variability of the wind field.

Wind speed in some locations in strong bora was still underestimated in simulations in 2 km resolution. After many experiment it was confirmed that good description of the surface is very important, especially surface roughness has significant influence on the wind field, more realistic surface roughness allow model dynamics to develop local features at appropriate place and time and produce correct forecast.

Impact of SST on heavy rainfall events on eastern Adriatic has been studied on selected HyMeX Special observing period (SOP1, 6 September to 5 November 2012). Forecast runs in 8 and 2 km resolutions were performed for the whole period using different SST fields prescribed at initial time and kept constant during the model forecast. The results show that the impact of introducing improved SST analysis varies for different cases and there is generally a larger sensitivity to the SST in high resolution than in the lower one, even for

the longer forecast period. Too high SST in the forecast lead to overestimated rainfall intensity on the coastal mountains. The 2 km resolution runs show substantial improvement in precipitation when realistic SST analysis is used.

3 List of actions, deliverables including status

Subject: Turbulence scheme TOUCANS

Deliverables:

Status: ONGOING

Subject: Radiation scheme

Deliverables: paper accepted into QJRMS

Status: ONGOING

Subject: Cloud scheme

Deliverables:

Status: ONGOING

Subject: 1D2D turbulence scheme

Deliverables: -

Status: POSTPONED

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

Deliverables: new interpolation method for temperature and relative humidity at 2m, ALARO-1vB in cy43t2

Status: PERMANENT

Subject: The ALARO-1 version

Deliverables:

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

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4 Documents and publications

Scientific papers:

J.-F. Geleyn, J. Mašek, R. Brožková, P. Kuma, D. Degrauwe, G. Hello and N. Pristov, 2017: Single interval longwave radiation scheme based on the net exchanged rate decomposition with bracketing, accepted into Quarterly Journal of the Royal Meteorological Society, DOI: 10.1002/qj.3006

List of reports:

Simona Briceag: The non-saturated downdraft in ALARO-1, Prague, 5 June – 3 July 2016

Jure Cedilnik: Wind forecast quality – impact of surface roughness, Vienna, August 16-26 2016

Martin Dian: Improving the computation of screen level fields (temperature, moisture), Prague, 1-29 April 2016

Rafiq Hamdi: Coupling SURFEX_V8 to ALARO-1 for CY43T2, Bratislava 5-16 December 2016

Viktória Homonnai: Initialization of aerosols in LIMA scheme for AROME, Toulouse, 2 – 30 November 2016

Mario Hrastinski: Mixing length computation in TOUCANS, Prague, 29 February – 24 March 2016

Peter Smerkol: Debugging and testing TOUCNAS, Prague, 6 – 19 March 2016

Contributions:

M. Tudor, S. Ivatek-Šahdan, A. Stanešič, 2017: Sea surface temperature in operational forecast (example of Adriatic Sea), ALADIN-HIRLAM Newsletter No.8

List of presentations:

Joint 26th ALADIN Workshop & HIRLAM All Staff Meeting, 4-8 April 2016, Lisbon, Portugal
http://www.cnrm.meteo.fr/aladin/spip.php?article287
Neva Pristov: ALARO status overview
Radmila Brožková: New shallow convection parameterization in ALARO-1

ALARO-1 working days http://www.rclace.eu/?page=163

Neva Pristov: ALARO Physics Developments, 38th EWGLAM & 23rd SRNWP joined meetings, 3-6 October 2016, Rome, Italy

5 Activities of management, coordination and communication

Meetings:

- 26st ALADIN Workshop and & HIRLAM All Staff Meeting, 2016, Lisbon, Portugal (participation of Neva Pristov).
- 38th EWGLAM & 23nd SRNWP joined meetings, 2016, Rome, Italia (participation of Neva Pristov).
- ALARO-1 Working Days, 12-14 September 2016 in Brussels (active in scientific part of organization)

6 Summary of resources/means

2016

Subject/Action	Resource		LACE		ALADIN Flat-rate	
	planned	realized	planned	realized	planned	realized
TOUCANS	6	8.5	1.5	1.5		
Radiation	6	4.5				
Cloud scheme	4	2				
Microphysics	7	1.5	1	1		
ALARO-0/ALARO-1/ SURFEX	11	9	1.25	0.75	0.5	0.5
ALARO-1	6	1.5	1	1	0.25	0.25
Physics interface	0.5	-				
Additional fields	2	0.75	0.5	0.5		
VFR Experiments	10	9				
Total	**52.5**	**36.75**	**5.25**	**4.75**	**0.75**	**0.75**

The total planned sum is quite high, this is comming out as some researchers (RB, JM, DL, VH) are working on physics topics for more than half of their working time. VH and SB were not able to work on physics topic in 2016 as it was planned.

LACE scientific stays:

- Clemens Wastl (at), Orographic radiation parameterization with ALARO, Prague, 2 weeks Cancelled
- Simona Briceag (ro), Unsaturated downdraft, Prague, 5 June – 3 July 2016
- Peter Smerkol (si), TOUCANS - code validation of TOMs, Prague, 6-19 March
- Jure Cedilnik (si), Wind forecast validation, Vienna, 6-26 August
- Viktoria Homonnai (hu), AROME microphysics (ICE4 and two-moment scheme), Toulouse, 2-30 November

- Martin Dian (sk), Improving the computation of screen level fields (temperature, moisture),Prague, 1-29 April
- Mario Hrastinski (hr): Turbulence related topic, Prague, 29 February - 24 March

ALADIN Flat-Rates Stays:

- Luc Gerard: Convection, Prague, 0.25 month
- Rafiq Hamdi: SURFEX in ALARO, Bratislava, 0.5 month