Synthesis Report ALADIN activities

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Introduction

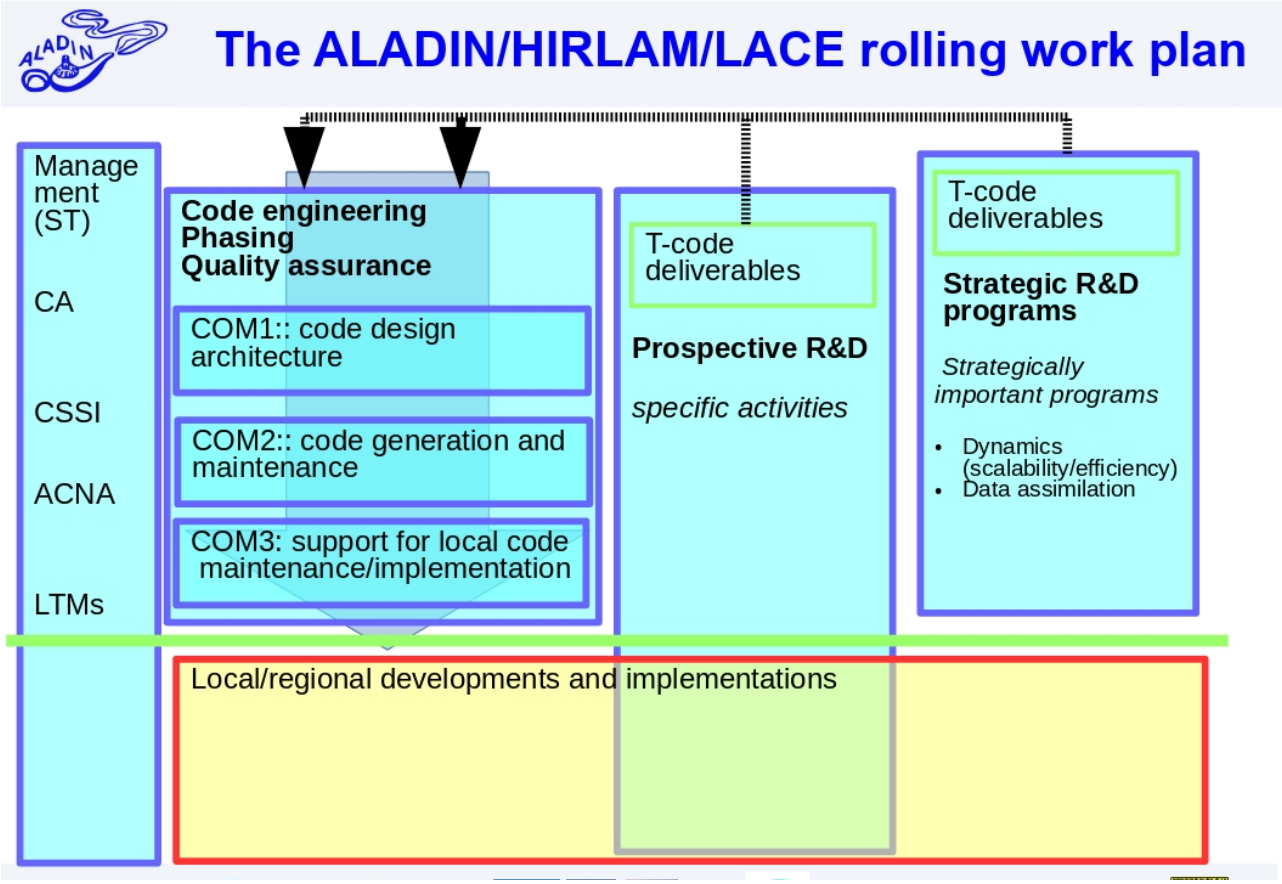

Figure 1: Structure of the ALADIN-HIRLAM RWP in relation to the ALADIN management structure, using the new terminology of the scope document.

A major step was taken in 2017 when the common ALADIN-HIRLAM work plan has been seriously restructured to make the code contributions, code engineering and the management of the codes more prominently visible (see Fig. 1). The result was the common ALADIN-HIRLAM Rolling work plan for 2018 (RWP2018) and it was approved by the ALADIN General Assembly and HIRLAM Council. A novelty was the introduction of the so-called t-code-deliverables being specified with respect to future Toulouse cycles of the code. Claude Fischer has made an effort to extract the expected code contribution from the text of the RWP2018 and to plan them with respect to the cycles calendar.

Here we report on the execution of the RWP2018. Last summer a first draft of this report was sent to the Local Team Managers. This document was updated with respect to the one sent to PAC last spring using their

input and using some additional inputs gathered from the recent DAsKIT meeting in Bucharest and the EWGLAM meeting. We report on the activities executed over the span of the last year.

MGMT1

All tasks have been executed as planned.
Regarding the flat-rate budget (MGMT1.3), we plan a meeting later for the data assimilation core program (as will be explained below) in September 2018 (the details are to be confirmed). There was less demand for stays this year, so finally we did not have to refuse demands as we had to do last year.

The ALADIN workshop was organized this year in Toulouse. Details can be found on the ALADIN website **http://www.umr-cnrm.fr/aladin/spip.php?article306&lang=en**

Several ALADIN colleagues attended the EWGLAM workshop (1-4 October 2018). I highlight two conclusion from his workshop:

- COSMO and the UK Met Office have “associate member”-type of code users. This can be split in NWP applications and academia (the latter mostly focused on regional climate).
- The MetOffice initiated a discussion session during the EWGLAM meeting on the topic of R2O (Research to Operations). Unfortunately this session coincided with the ALADIN LTM meeting, so many ALADIN people could not attend this meeting. This points out the fact that NWP developers increasingly have to pay more attention to the *code engineering issues*. We are currently trying to address this issue with HIRLAM through the notion of CMCs, the split in the different activities (Code Engineering, Prospective R&D, Strategic R&D) and the planning of the so-called code deliverables indicated in the RWP2019, Figure 1.

As requested by the ALADIN General Assembly and the HIRLAM Council, the reporting of the activities (MGMT1.5) is being recast in a new technical web interface developed by Patricia Pottier. The main goal of this is to make it possible to have a joint reporting together with HIRLAM. We took the opportunity to simplify the reporting for the ALADIN LTMs. The main changes from the current ALADIN manpower tool are: the same form is used for home work and stays; there is no longer an “in-kind” criteria and the criteria added 5 years ago (parallelization code design, ...) is also abandoned; a reference to the Work Package in the current RWP has been added. The biggest difference is that the LTMs register the work of their people wherever it is done (formerly called “stays” are non longer registered by the LTM who host the stay). Patricia has converted all former registered actions into the new database and the LTMs have access to the past data (since 1991). The LTMs were asked to perform their first reporting for the first and the second quarter of 2018. As a main outcome, it turned out that a lot of work was registered in the so-called “NoRef” category, i.e. as work that could not be fit into the tasks that were proposed last year when the plan was written. To this end two new tasks COM3.1.5 on “operational work” and COM3.1.6 “verification of operational suites” were included in the COM3 part (Maintenance and Partners' implementations of ALADIN system) of the work plan under the category (Code Engineering). It turns out almost all of the NoRef activities can be registered under these tasks. In HIRLAM this type of “System work” is reported as Prospective R&D activities. **It could be proposed that for the RWP2020, HIRLAM would also report their system work in the Code Engineering part.**

Two Newsletters were published (MGMT1.6):

- “Grand Tour” of ALADIN and HIRLAM and can be found on the ALADIN site: http://www.umr-cnrm.fr/aladin/IMG/pdf/nl10.pdf.
- And a second one mostly based on the outcomes of the ALADIN workshop/HIRLAM ASM: http://www.umr-cnrm.fr/aladin/meshtml/NL11.pdf

The Data Assimilation basic Kit (DasKIT) action was kicked off this year. The main event was the meeting held in Bucharest 19-21 September 2018.

These days there is a difference between LACE and non-LACE countries on the local implementation of operational Data Assimilation (DA) systems. The coordinated efforts of LACE countries as well as the development of a centralized preprocessing system (OPLACE) fostered the implementation of local DA systems in those countries.

For non-LACE countries (besides France) joining synergies in a coordinated way is the lesson to take from LACE experience. In this way, in 2017 a first joint effort was done in Lisbon during the 2017 DA Working Days: an exercise on preprocessing of conventional data, prepared by the LACE data manager Alena Trojakova (AT), was prepared and proposed; countries should be able to use the exercise as a reference in order to start implementation procedures in-doors. Meanwhile a new ALADIN strategic R&D project - the Data Assimilation basic KIT (DAsKIT, for simplicity) project, was established and its coordinator, Maria Monteiro (MM), was appointed at the beginning of 2018.

During the first quarter of 2018 a progress survey was done among DAsKIT countries, showing that they managed to preprocess GTS BUFR SYNOP data in-doors (or were able to manipulate OPLACE preprocessed data files for this type of observations); it showed also there was a concern on local surface DA.

The 2018DAsKIT Working Days (WD) were planned with support of LACE (AT) and HIRLAM (Roger Randriamampianina, RR) DA experts trying to fulfill the needs and expectations shown in the survey. Rafiq Hamdi (RH) and Alex Deckmyn (AD) expertises were also useful to support these WD. In order to optimize efforts, the 2018DAsKIT WD was jointly organized with LACE DA Working Days (DAWD) and the Romanian team took charge of the local organization.

Data Assimilation systems implementation requires a change in mentality (when compared to downscaling initialisation) since a cycling dependence has to exist between different model runs. Tools have been prepared to allow DAsKIT countries to implement a cycling system in-doors. In particular, a set of scripts to solve the basic surface DA steps on a particular cycling network was prepared. The usage of tools for local data monitoring (standalone OBSMON and MANDALAY) and data validation (HARP) was demonstrated and the experience with its local installation was exchanged.

The final joint discussion session was split in two parts a DAsKIT meeting and a LACE data asimilation working days meeting. For the DAsKIT part, a list of topics was prepared by PT and MM (see corresponding presentation). The main conclusions are:

1. some staffing issues were identified.

2. surface DA has a substantial impact on the model performance. The cycling is important to keep the memory of surface conditions at the small scales in our models. In fact, deep soil moisture is the memory for convection and keeping this memory in our models is crucial. Surface DA is a trackable tool, but the frequency of cycling as well as the density of surface observations are really important for the success of this tool. The choice to focus on surface DA first was a correct one.

3. to the question on which countries already have pre-operational/operational DA cycling, the countries replied:

ALADIN DAsKIT core programme: status on local DA systems

Different DA settings/models

Algeria	pre-oper ALADIN
Belgium	pre-oper AROME
Bulgaria	working days AROME exercise implementation is on-going
Morocco	pre-oper AROME
Poland	pre-oper AROME
Portugal	oper AROME (surface)
Tunisia	pre-oper AROME
Turkey	pre-oper AROME/ALARO

During discussion it was generally accepted the working days will help the countries to progress. Countries were tasked to cycle the 2018DAsKTWD surface DA exercise in order to share their problems. Moreover, participants were requested to ask their LTM's to put some man-power in the RWP2019.

4. Concerning SAPP, it was pointed out there are 3 countries which are not full or collaborating members of ECMWF and that may be an issue to solve in the near future (TODO@PM). Algeria was given as example: they asked access to SAPP and got a negative answer from ECMWF. For the time being those countries (as it is already the case of Poland and Tunisia) may get data already preprocessed from OPLACE; for the DA activities DAsKIT countries are doing locally SAPP is not needed, so one should take time to discuss the price to pay to go to SAPP. If Algeria is interested in OPLACE, it must make a request to the LACE management; the price is usually payed as man-power and LACE decision is taken case-by-case (the latest LACE payment requirement is one month of work and access to national data).

COM1.1

COM1.1.1: The implementation of the LAM components in the Atlas libraries has been finalized by Daan Degrauwe (ALADIN CA). This work is part of the ESCAPE project. ESCAPE will finish this year. This LAM code will be maintained in the future. ATLAS will become visible in IFS codes in CY47, but not compulsory for installation (protected by pre-compile directives)
COM1.1.2: A list was provided of the codes needed to run the three CMCs, AROME-Fr, ALARO and HARMONIE-AROME (as part of an effort requested by PAC and HAC on the list of the common ALADIN-HIRLAM codes). A Mitraillette test was added in Météo-France to test the HARMONIE-AROME configuration based on cy40 (**RWP2018 t-code-deliverable COM1.1.2**). Since there was no “parent” configuration present with the Toulouse repository, the codes had to be phased. This action is part of the convergence roadmap. This should now be carried over to a future next release (i.e. an export version). Some analysis has recently started on how to best do that. This procedure will be discussed with HIRLAM still before the summer break 2018. A goal would be to commonly test the HARMONIE-AROME-CMC in a cy46 release.
COM1.1.3: SURFEX has been technically implemented in the ALARO CMC. A first validation was carried out. While the outputs seem meteorologically reasonable, some fibrillations were observed. It is suspected

that they are partly the result of numerical non-linearities and partly of non-linear feedback of the physical processes. Some codes had to be modified in the SURFEX codes to compute the exchange coefficients in the surface scheme in a way that is consistent with the parameterizations of the TOUCANS turbulence scheme. The codes have been prepared for phasing and the code modifications have been documented which should lead to **t-code deliverable COM1.1.3** as in the RWP2018.
COM1.1.4: The ALADIN CA and/or the ALADIN PM assisted in the IFS/ARPEGE coordination meetings.

COM2

COM2.1: The current situation of the new IFS/ARPEGE/LAM common releases, as defined in the ECMWF/Météo-France common trunk:

- CY43T2: a baseline was validated at the end of April; Météo-France plans to use this for an e-suite version (April-May-June) and to port this to operations as e-suite (June); the switch to operations could be tentatively expected by end of 2018;
- CY46: the IFS/Arpège joint cycle has been declared on 10 April 2018; it is planned to build a CY46T0 or T1 in the autumn (t.b.c.), to start preparing a research e-suite version beginning of 2019; and an operational switch in the autumn 2019;
- The IFS/ARPEGE Build of CY47 could be expected over January-March 2019.

Météo-France plans a migration to a new HPC: the mirror suite would then start by about 1 May 2020 (t.b.c.), based on the operational code version of April 2020.
COM2.2: Regarding the creation of the export versions, the last issued export version is CY40T1_bf.07. Météo-France hopes to be able to install CY43T2_bf for the upcoming Arpège high-resolution e-suite. Technical testing is ongoing. Some local tests of an alpha-version CY43T2_bf.04 have started outside of Météo-France.
The usage of the LBC data from the ARPEGE with SURFEX suites has been validated in ALADIN/SHMU environment in the downscaling and in the assimilation (CANARI + blending) modes for various periods and in various setups, in order to prepare the switch for ALADIN Partners. The issue of the SURFEX -> ISBA conversion was addressed. A problem with soil frozen water and snow cover was identified and solved by D. Degrauwe and F. Bouyssel. It is shown that the e927 procedure works reasonably well and is ready for operational implementation.
COM2.3: The status of the tasks **COM2.1** and **COM2.2** has been communicated in great detail to the Local Team Managers recently during the ALADIN-HIRLAM workshop/ASM, see **COM3.1.3**.
COM2.4: The colleagues of HIRLAM have installed an “exportable” version of Mittraillette on their h-repository platform. **We propose that the ALADIN CA will provide some help for the future common testing of the HARMONIE-AROME CMC, see COM1.1.2.**

COM3.1

COM3.1.1: The progress of CY43T2 was communicated to the LTMs. It is planned to issue an export version based on CY43T2 only when the CMCs and AROME-FRANCE 3DVAR configurations are validated, in order to avoid many updates of the bugfixes. The details will be discussed on 9 May during the ACNA web conference.
COM3.2.1: Currently, the ALADIN Partners are encouraged to already start testing a version of CY43T2 and send bug reports to ACNA.
COM3.1.3: The LTM meeting took place on 17 April 2018. Preliminary minutes are available upon request.
COM3.1.4: As part of the operational coordination the following issues were addressed:

- An inquiry was launched by Maria Derkova (as ACNA) about the use of the CANARI configuration (used not only for surface data assimilation). It is expected that some options will not be maintained in the future after the re-coding needed for OOPS present in CY43-CY46. More details to be checked in the Minutes from the LTM meeting, Annex 2.
- ACNA has revitalized the discussion on the diagnostics parameters in and outside the ALADIN system. There is an increasing need for new diagnostics parameters out of NWP systems for many

applications such as aeronautics, green energy sector, automatic forecasting and for various end-users. Such work is ongoing at every NMS. To avoid possible work duplication it is suggested to - at least partially - coordinate activities on the diagnostics developments. M. Derkova prepared a summary of available diagnostics, either in fullpos, gl or in external tools (deterministic fields only).

CPDA1

Maria Monteiro started her job as the new ALADIN DA coordinator. She has made an extensive inquiry among the 8 Data Asssimilation starters kit (DasKIT) ALADIN Partners of this core program. The outcome is summarized in the attached presentation where a detailed status per task of the RWP2018 is given: CPDA1.1, …, CPDA1.5. The outcomes of the inquiry can be found on https://docs.google.com/spreadsheets/d/1REEsm5USxpE7gQrjzSZTDul3ieCKPVzvvHq1rf22vmA/edit#gid=0
All countries have available data to be assimilated in their local DA systems. The know-how to process conventional data using the ALADIN system already exists in all countries. Some countries already setup a DA cycling and there is a trend/common wish to invest on surface DA in this moment. Data Monitoring and validation tools know-how are missing.
As short-term actions, it is now proposed: (1) to establish regular video-conferences with DAsKIT countries, (2) to organize DAsKIT Working Days, possibly the week 17-21 September 2018.
The content of the WD is still opened (overview of the progress of the countries, more focused sessions on the topic of common needs : DA cycling, surface DA, overview with exercises if possible, some validation & verification tools, ...).
The inquiries, presentations at WD, minutes and list of actions can be found on the part of the ALADIN website dedicated to the DATA Assimilation Strategic Core Program.

CPDY

CPDY1: It has been demonstrated the quasi-elastic approximation is sufficiently accurate in a mass-based approach (to properly represent the Rossby wave). It is coded on the top of CY45T1 for both global and LAM models and, as a **CPDY1.1 t-code deliverable**, the code is expected to enter in CY46T1.
CPDY2: The advantage of gridpoint solvers (as opposed to spectral solvers) can be twofold: (1) they may yield better scalability properties and (2) they may be easier to implement a more accurate treatment of the orography. This can be an important issue for running the models over steep slopes (which becomes more stringent at higher resolutions). As a major milestone, it has been demonstrated by Fabrice Voitus that the orography can be treated with higher-order accuracy within our familiar mass-based spectral approach.

Regarding the scalability issue two approaches are followed:

1. Tests were performed in 2D academic context. Currently we are working on inserting solvers in the full AROME code.
2. The code for the solver is extracted from the full model code by Daan Degrauwe (this can be seen as a Canonical Weather and Climate Dwarf in the sense of the ESCAPE project) and the numerics is replaced by other non-spectral methods. Two gridpoint solvers have been implemented[1]. This allows for clean and flexible testing: (a) One can easily implement reference solutions, e.g. based on the methods developed by S. Caluwaerts to allow to control the accuracy of the solution (which is more problematic in the first solution) (b) one can test and select validated methods before starting the tedious coding in the full model and (c) since the dwarf is standalone, it is easier to port to other architectures than the full model.

As an outcome of this project one should consider the clean test in Fig. 2 where the lines “cross” and where the gridpoint methods starts to become better when increasing the number of nodes. This test is too simple to draw conclusions for the full code, but this is a new approach and should be followed for the further

1 based on the so-called Krylov method and one based on a mulitgrid algorithm.

developments.
CPDY3: The HEVI solution has been extensively studied in the PhD thesis of C. Colavolpe. His PhD was defended in December last year and the results are published. Currently the priority is given to CPDY1 (short term code deliverables) and CPDY2 (for the longer term).
CPDY4: No activities took place over the past year on the topic of the physics-dynamics interface.
CPDY5: For the LAM components in Atlas, see the descriptions of task COM1.1.1. There are no code-deliverables expected, but the contributions have been made to the ESCAPE git repository in the ECMWF.

DA1

DA1.2: Activities are reported here from Croatia , Portugal, Tunesia and Turkey:
A new B matrix was calculated in Croatia, and diagnostic comparison of B matrix properties was made. Three B matrices were computed with following methods/characteristics: NMC method, and two ensemble methods (using a local ALADIN-HR4 ensemble, 6 members, 6h cycle, upper air observation perturbation)with (a) operational ECMWF LBC same for all members ENS, or (b) LBCs from taken ECMWF global ensemble – ENS-LBC. Verification was done for May and June 2017; the tuning of the B matrix was performed over one month period. The resulting initial conditions produced small differences in surface scores, mainly visible in first 24 hours. Finally the ensemble method for estimation of background error covariance matrix was applied.
At IPMA (Portugal) a 3D-Var testbed (the LACE 3D-Var testbed) has been implemented on the actual operational HPC platform of IPMA, the IBM p7+, and a first B-matrix has been computed for an Iberian domain, by the ensemble method as a cold start from the Prevision d' Ensemble ARPege (PEARP). Furthermore, the collaboration with CHMI on pre-processing has progressed onto to the development of procedures for the ingestion of aviation observations under WMO BUFR (E-)AMDAR template.
At INM (Tunesia) a 3DVAR data assimilation configuration is being implemented on the local machine. The case study has been performed. Although both AROME-3DVAR and AROME Spin-up configurations predicted well the situation, AROME-3DVAR gave more accurate forecasts for the precipitation amount and the convective cell localization.
At MGM (Turkey) a new B Matrix was calculated using FESTAT and FEDIACOV from cy43t2. In the calculation 4 members, 4 runs (00,06,12,18) were used for 20180201-20180214 period from AEARP. Calculations were done alo for summer period. However winter period results show more accurate scores than the summer time. Also a verification was made to make a comparison between old B Matrix which was calculated by NMC method and new B Matrix. And promising results of ensemble B Matrix have led us to put it on operational cycle. Afterwards REDNMC value tuned by TuneBR tool and set to 0.6 after a 15 day test.
DA1.7: The Digital Filter Blending (DFB) method has been successfully exploited in the ALADIN operational suite of CHMI since 2001. To recall, ARPEGE 4D-VAR analysis is blended with ALADIN high resolution guess, taking advantage from the sophisticated 4D-VAR scheme, recently enhanced by the ensemble information on the structure functions of the day, and from the high resolution information contained in the ALADIN guess. Since 2015 the DFB method has been completed by a 3D-VAR step at high resolution to still improve the initial conditions; this combination is the so-called BlendVar scheme.
DA1.8: In 2017 CHMI (Czech Republic) has developed background error covariances adapted to the BlendVar scheme, with the goal to make the ALADIN 3D-VAR step working on finer scales while keeping the larger ones close to the result of the DFB algorithm. Comparison with background error covariances obtained by a more standard approach, including the impact on ensuing forecast has been published in Bučánek and Brožková, 2017. One of main conclusions is that DFB outperforms a classical 3D-VAR assimilation for forecast ranges longer than two hours about. The BlendVar scheme combines successfully DFB and 3D-VAR and yields better results than DFB or 3D-VAR used standalone, as expected. Using the newly proposed background error covariances in the BlendVar leads still to a slight forecast improvement visible also for forecast ranges longer than six hours.

DA2

DA2.1: The main developments of the **EnVar methods** in the LAM configurations (AROME) take place in Météo-France while relying on the OOPS framework. The En3DVar relies on the EDA AROME system, see task **D2.4.** To filter some of the sampling noise, localization techniques have been implemented according to Houtekamer and Mitchell (2001). Considering a 3.8 km horizontal resolution for both EDA and deterministic EnVar analyses: scores compared to 3DVar are clearly improved. The best configuration uses entirely sampled covariances that are homogeneously localized, considering objective length-scales derived from the EDA in a spatial localization scheme see presentation of Yann Michel during the ALADIN workshop.
DA2.4: A prototype of the **Ensemble Data Assimilation (EDA)** has been set up in Météo-France. Some aspects were tested: the impact of the resolutions, the tuning of the inflation factors on the spread/skill relation. The AROME Ensemble of Data Assimilations has been set up at Météo-France with 25 members, 3 hourly cycling and 3.25 km spatial resolution. The EDA brings significant performance improvements to both the 3DVar and the EPS. The first version of the EDA is planned for operations in May 2018, together with the new version of the EPS. The EDA will be a key component of the future EnVar scheme.
INM (Tunesia) is currently testing and EDA based on a 3Dvar with a 3-h cycling and Synop, Temp, Amdar, Buoy and Satellite data (Seviri, AMSU-A, AMSU-B, IASI) The B matrix is constructed in two different ways from the PEARP system and secondly from the AROME 3Dvar EDA of Météo-France. The validation has been carried out, see presentation of Wafa Khalfaoui on 16 April during the ALADIN workshop. It shows encouraging results with AROME-Tunisie 3Dvar. Despite the computational cost, B matrix with EDA is worth pursuing.

DA3

DA3.1: radar data assimilation.
The Moroccan Meteorologial Service (DMN) currenlty aims to improve QPE from moroccan radar by using rain gauge measurements. Thus the data from a C-band radar located at Khribga is first quality controlled to remove clutters and to correct the signal attenuation. The radar QPE shows an underestimation when compared to the rain gauges. In the next step, radar QPE is merged with 11 rain gauges measurement over an area of about 150 km radius. The validation of the adjusted radar QPE against CPC rain (Novella et al, 2012) shows a clear improvement.
First experimentation with radar data assimilation started by ARSO (Slovenia) in 2017. Technical steps were taken to read local and/or archived OPERA IOFS radar data in HDF5 format with BATOR decoder. The prepopera Python script was applied to reduce the number of pixels before loading data to ODB. ARSO managed to process numerous European radars except some with missing metadata (e.g. wavelength). The data assimilation procedure for radar technically works and produces reasonable analysis increments. Some efforts were devoted to radar QC as well. The QC modules developed earlier for INCA nowcasting software were applied to OIFS radar files and compared to the quality control in opera.
DA3.2: the use of mode-S data
Research was carried out on the quality and the preprocessing of mode-S data, see the presentation of Benedikt Strajnar of work with Alena Trojáková, Patrik Benáček, specifically on the need for whitelisting and thinning of the observations. This was found that these have only a neglibible impact.
MODE-S aircraft observations have been made available to CHMI by the Air Navigation Services of the Czech Republic since mid 2015. Both MRAR and EHS types are available. In June 2017 the MRAR observations were included into the operational data assimilation. Although the MRAR coverage is limited around the Czech Republic, there is a small positive impact on the forecast. In addition these data are used in the diagnostic analysis application called VarCanPack, leading to a better description of boundary layer, e.g. temperature inversions.
Since recently ZAMG also has access to mode-S in a national project and have started to validate this data see the presentation of Phillip Scheffknecht during the ALADIN workshop in Toulouse on 16 April 2018.
Météo-France started with the installation of 7 mode-S antennas over France to receive aircraft data from MODE-S interrogations and ADS-B transmissions (2017) and started collaborations with KNMI on data processing for the Toulouse antenna and BUFR encoding of uncorrected winds. It has started also impact

studies for the use of E-AMDAR data in AROME.

DA3.3: GNSS data

For the time being, the operational AROME data assimilation system of OMSZ (Hungary) includes only conventional observations. In order to extend the current observation set, the impact of Zenith Total Delay (ZTD) measurements of Global Navigation Satellite System (GNSS) are studied in the three hourly updated AROME 3DVAR system. During the OSEs, ZTD measurements from Hungarian(SGO1), Czech(GOP1) and Polish(WUEL) E-GVAP networks were pre-processed, pre-selected and studied providing dense ZTD observations over AROME/Hungary domain. Before the pre-selection procedure, the optimal thinning distance of ZTD stations was determined and a whitelist was generated according to the pre-selection criterias. During the impact studies both static and variational bias correction approaches were tested and compared on a summer and a winter period. The verification scores show a slight improvement for RH2m with respect to the operational configuration.

The GPS network of the Moroccan Meteorological Service (DMN) comprises ten permanent ground-based GPS stations. The NMS is currently putting efforts in the evaluation of the accuracy of ZTD. The accuracy is evaluated by comparison to equivalent values derived from radiosonde profiles. At this stage, the comparison of GPS ZTD and radiosondes ZTD time series over almost one year (2016) shows a good agreement and a seasonal signal with higher values of ZTD in summer and lower in winter.

At SHMI (Slovakia) a local near real-time processing of 59 GNSS stations is performed within a cooperation with the Slovak University of Technology, Department of Theoretical Geodesy (space.vm.stuba/pwvgraph). The station list comprises 40 stations from Euref network, 6 stations from IGS network and 13 from national permanent GNSS stations of AT, CZ, HU and SK. Technical 3DVAR runs over an AROME/HU domain using locally processed ZTD data look reasonable. Experiments are to be continued.

DA3.4: IPMA (Portugal) is performing sensitivity tests for for the assimilation of ocean wind data from ASCAT-coastal data in the HARMONIE-AROME configuration in close collaboration within a project with KNMI. They found that the model simulations using ASCAT DA present reduced (o-f) bias and stddev when compared with HSCAT and OSCAT observations. The ASCAT experiments show impact up to fc+09.

DA3.6: satellite data

MGM (Turkey) has been evaluating the impact of SEVIRI radiance and conventional observations on forecast. The assimilation system is run with 6 hour cycle. While 3DVAR method was applied for the upper air analysis, CANARI OI was used for the surface analysis. The first experiment (CONV) includes only conventional data: synop, amdar and temp observation. The second one (SEV70) includes conventional and SEVIRI data with 70 km thinning distance and the last one (SEV35) uses conventional and SEVIRI data with 35 km thinning distance. The current operational ALARO Turkey with no assimilation was used as a control experiment. In order to eliminate the negative effect of systematic errors on analysis in radiance data, the adaptive variational bias correction technique VarBC (Dee, 2005; Auligne et al. 2007) embedded within the system was utilized. The assimilation of seviri data improved the scores mostly for RH2m at the surface later in the foreacst (after 20-h forecast range).

DA3.8: Météo-France is currently extending the VarBC techniques for Ground-based GNSS, IASI channels over continents, inter-channel correlation errors for IR observations, radars from OPERA.

DA6: OOPS: OOPS-IFS 4D-VAR is expected to be fully available in research mode by the end of 2018, then have the staff test OOPS binaries for a long enough period in 2019 (**DA6.2**). E-suite and operations will happen possibly only after move of HPC Centre to Bologna (thus, rather S2/2020) unless this move slips in time. As regards the status of the FORTRAN code re-factoring (**DA6.1**):

- Significant code overhaul over [CY43-CY46], fairly welcomed by all involved developers and scientists;
- Remaining issues after CY46 : VarQC, all-sky radiances, c-VarBC, restart, time handling step 2 (EC); complete plug-in of FP in OOPS (**DA6.4**: MF) ; DFI (**DA6.6**: Aladin)

As a contribution to the project activities, Portugal has hosted at its headquarters in Lisbon, the ”ALADIN Data Assimilation basic kit Working Days” as the kick-off meeting to the ALADIN Core Program ”basic DA kit”, on 22-23 March 2017. It included 19 data assimilation new-comers and experts from many countries of the ALADIN, LACE and HIRLAM consortia. At the same time, the collaboration with CHMI has given rise to a new code source which should be available from CY42T1, the AMDARWMO procedure, which allows the ingestion by the upper-air assimilation of WMO BUFR E-AMDAR data as described by Monteiro

(2017). And finally, it was possible to install in the local HPC IBM p7+ the LACE 3D-Var testbed which can now be adapted to the local domain, taking advantage of the first B-Matrix recently computed from a downscaling of PEARP.

DY

DY1: Martina Tudor made, during the ALADIN workshop, a review of the possibilities to use IFS model outputs as LBC files for the ALADIN-HIRLAM System LAM configurations. She compared the data from the IFS disseminations to the one from the MARS archive and considered option for interpolating the data on the octahedral grid to the familiar conformal Lambert project of the LAM configurations. An open question remains what needs to be done to adapt the so-called 901 configuration of our model code to make it possible to perform these interpolations.
DY2: LACE dynamics experts have drawn conclusions from an intercomparison of different temporal interpolations schemes: in that is potentially unstable but less accurate (so-called SETTLS) and the other less accurate but more stable (the so-called NESC scheme) to use SETTLS whenever possible, and switch to NESC if needed. The dynamic choice of the predictor used (SETTLS/NESC) and of the number of correctors applied may be an efficient answer to stability/accuracy trade-off.
DY3: Recently some codes are phased to CY45T1 as a t-code-deliverable to rationalize the choice of the various parameter and the computation of the vertical discretization coefficients.
DY4: Some work is ongoing on the reiteration of the calculation of the SL trajectory in the predictor corrector scheme varying the number of reiterations. This work is not conclusive as yet.

PH: Physics

PH1: AROME

PH1.1: A new version of ICE3 has been released in CY45T1 and CY43T2_op. The main features are: a complete rewriting of rain_ice was done in order to reduce time step length sensitivity and some code optimizations. The ICE4 scheme has been further developed to reduce strong hail accumulations over orography. According to the tests it performs not better than ICE3 for hail diagnostics (with nevertheless a +6 % CPU time) so it did not become operational (in MF) as yet.
PH1.2: AROME can use the LIMA scheme (present since CY42 and will be present in CY45+). LIMA has a two-moment scheme and allows for interactions wih Aerosols. Recent work concentrated on improving the snow diagnostics in deep convection, and the diagnostics for fog in valleys, and initialization of the aerosol concentrations using MACC and MOCAGE analyses. An intercomparison with ICE3 scores for precipitation does not show a substantial improvement.
PH1.3: Some parameterizations of the turbulent fluxes are being reassessed. Verrelle A., Ricard D. et Lac C. (2017) tested a resolution-dependent parameterization of the vertical heat fluxes, which leads to better heat and moisture fluxes within the cloud of deep convection. Honnert and Lancz (PhD work) tested a vertical resolution dependent mitigation of the vertical mass flux scheme to control shallow convection. They found that it is not enough alone to treat the shallow convection gray zone problem, but a part of a final solution, which includes further developments like 3D turbulence and a more suitable set of mass flux equations for high resolution.
PH1.6: Some diagnostics was tested for visibility forecasting based on AROME outputs based on work of Niemela (2014) and some diagnostics of the ECMWF were introduced to estimate the precipitation types.

PH3: ALARO

Deliverables:

- **t-code-deliverables** in CY43T2, back-phased to cy40t1.bf7 (January 2017): shallow convection closure, exponential-random cloud overlaps in radiation and cloud diagnostics, improved sunshine duration and direct solar flux at surface

- **documentation**: describing namelist modifications.

PH3.2: The mass-flux type of estimation if the closure of the of the moist buoyancy flux in a general partly saturated case, has reached a mature stage. This has been validated and led to a reduction of the biases fo T2m and RH2m.

PH3.2.1: Peter Smerkol has proceeded with checking the code that calculates the Third order moments corrections to the turbulent heat and moisture fluxes (acdifv3.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. Code checking will proceed with the analysis of numerical protection algorithm for the equation solver.

PH3.3: Luc Gerard homogeneized the cloudiness estimates as to make the coherent across the microphyics and the deep convection scheme CSD (see task **PH3.5**).

PH3.6: The research code for graupel treatment that was prepared in cy38 has been phased into cy43t2 and cy45. Technical problems have appeared during the phasing, linked to the Intel compiler directives and optimization options. Preliminary runs were realized using the ALADIN/Poland configuration, running in Krakow (dynamical adaptation on the 7.4 km resolution grid, done for the period of the year of 2013). For scientific validation the code is planned to be phased in a research branch of CY43T2 (not an export version, but available later on request).

PH3.7: ALARO in CY4T2 is technically working with SURFEX(v8). There was a detection of surface temperature numerical fibrillations in the SURFEX run with TOUCANS. Recent tests have shown that the use of the implicit option in the surface-atmosphere coupling can solve this problem, but this will be tested further in 2018.

SU: surface developments

SU1.2: Some tests were preformed while using structure function for T2m of the MESCAN scheme in the AROME surface data assimilation. This led to some realistic increments of moutain regions.

At IPMA (Portugal) local progress has been noticeable in data assimilation: the AROME surface data assimilation cycling by the formalism OI_MAIN (Giard and Bazile, 2000) locally implemented according to a more recent description in Monteiro et al. (2017) was validated for the Iberian domain with a clear positive impact on the screen level parameters forecasts up to a 24-hour range; these short-range forecasts are now feeding a pre-operational hourly CANARI surface analysis. The verification showed a positive impact for T2m and RH2m.

SU2.2: Currently in the operational applications only T2m and RH2m are assimilated. Nevertheless quite some efforts are being made to assimilated satellite derived surface variables (e.g. the leaf-area index and surface soil moisture estimates). These activities mostly take place in Météo-France (see e.g. Albergel, C., et al. 2017), IPMA and ZAMG.

SU1.3: Snow analysis over plains is necessary to correct for insufficient snow melt in the AROME model. Last year efforts were made to extract more data over France. The snow analysis is done relying on codes from the CANARI scheme while transferring the increments to SURFEX in AROME. A French case study (12/2/2018) showed some slight improvements. This work has to continue.

SU3.1 The performance of the snow model Crocus (offline SURFEX) was evaluated by ARSO (Slovenia) over the winter 2016/2017. This included two versions of Crocus, one coupled to ALADIN forecast and another with INCA analysis. In both cases snow analysis and forecast was produced for each grid point of those models. Results are generally encouraging. The model will be used primarily as a snow product for hydrology and as a tool in snow avalanche risk diagnosis and forecasting, but could be later also used as snow analysis for ALADIN.

SU5.1: In order to take advantage of the most recent surface knowledge available, the Alqueva physiography was locally introduced and tested in IPMA (Portugal) on the latest available version of ECOCLIMAP_II_v2.3 [b] and the lake orography in GMTED2010_30. From the first part of our study it was possible to conclude that: i) the AROME2017 version provided fore casts more consistent with the observations than any other available; ii) the version of AROME with ECOCLIMAP_I_GLOBAL_v1.5 provided forecasts closer to the observations than with ECOCLIMAP_II _EUROPE_v2.3.

SU5.4: In 2017 the new version of ECOCLIMAP database, called ECOCLIMAP Second Generation, has

been realized. It is a global data set at 300m-resolution, with LATLON geographic projection. 1 pixel coorsponds 1 type (surface type or vegetation type). It is based on ESA-CCI Land Cover version 1.6.1 (2016), epoch 2008-2012, satellites MERIS FR && RR et SPOT/VGT. Some first tests have been performed in AROME-France for 2 months in 2016 showing encouraging improvements but more tests are needed to understand the sensitivities (to tree heights and roughness lengths).

E: EPS developments

These activities are mostly carried out by specific groups with the ALADIN consortium: at least Météo-France, ZAMG, OMSZ, RMI are developing convection permitting EPSes. RWP2018 is organized according to these groups. LACE develops a common system called LAEF (see the LACE work plans and **E3** in RWP2018). Some work is ongoing on methods to perturb the EPSes,
Since there is not so much direct impact of the these developments on the **t-code-deliverables.** I will not go into detail here but I refer to a few presentations during the ALADIN workshop/HIRLAM ASM.

QA: Quality assessment

This work package has been created in the past by HIRLAM in line with its old HIRLAM practice. As said in the MTGM above, the quality assurance in ALADIN takes place as part of the **code engineering, phasing and quality assurance** activities. There are nevertheless activities to develop new verification methods and software to apply them which would go under the Prospective R&D activities chapter. The most conspicuous one, that is organized across the two consortia, is the HARP verification tool, see below.

QA1: development of HARP

HARP is a good example of a joint development of ALADIN-HIRLAM Common Codes! Version 2 has been officially released recently, see presentation of Christoph Zingerle. The developers of HARP propose to put it under an open source license.

F.T.E. committed in RWP2018 and realized during the first semester of 2018

(ALADIN only)