

ALADIN LTM meeting
Tuesday 1 October 2019
16:30-18:30
Sofia, Bulgaria



**Document for Item 3.a in
the agenda**

Subject:	Progress and plans: <ul style="list-style-type: none">• status of common IFS/Arpège/LAM cycles,• MF operational and R&D activities.
Summary:	Cycles: <ul style="list-style-type: none">• CY43T2_op2 operational in MF• CY43T2_op3 for limited changes in operations (November)• CY46T1_bf: updated CY46T1 w/r to CY43T2_op2• CY47_main joint cycle with ECMWF declared in August• CY47T0: technical interim cycle• CY47T1: build process to start on 8 October; declaration expected by end of November• CY48: build to start in December; declaration expected end of February• CY48T1: autumn 2020 (planned for now, precise timing to be confirmed) Operations in MF: <ul style="list-style-type: none">• limited updates planned in November 2019 (CY43T2_op3)• migration to new HPC (BULL Sequana) over March-June 2020• first scientific e-suite on the new HPC to start in September 2020; base cycle open (CY46T1_bf or CY47T1)
Action(s) required:	<ul style="list-style-type: none">• Take note of MF's plans for e-suites and operations in 2019, 2020 & outlook beyond.• Take note of the content and timing of IFS/Arpège cycles.• CY43T2_bf.08 was used as base version for MF's present operational cycle; CY43T2_bf.09 was used as base version for the Aladin export; CY43T2_bf.10 was an incremental update for the export; later two additional fixes had been reported by RMI• For all LTMs and representatives, please check within your teams for potential candidates for the upcoming phasing exercises in Toulouse:<ul style="list-style-type: none">◦ CY48 possible volunteers for December 2019 and first quarter of 2020 are still welcome◦ <i>spring phasing in 2020 is unlikely, but nevertheless</i> if specific staff from Aladin (or Hirlam) teams would be available and like to join GMAP work for technical tasks, then this could be addressed◦ CY48T1: autumn 2020 planned for now => call for phasers ~ open

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Cycles, code releases and a few comments:

CY46T1_main has been complemented by wrap-ups from the late source code changes from the CY43T2 e-suite (CY43T2_op1/op2 version from November 2018 onwards), including fixes for GRIB2 or new model output diagnostics (visibility, types of precipitation at ground etc.). This increased version has been tagged as **CY46T1_bf** in MF's GIT. CY46T1_bf.02 is the almost completed version with respect to the wrap-up of MF's CY43T2_op2, and was declared on 9 July 2019.

Validation of data assimilation (Arpège 4D-VAR, Arome 3D-VAR) is ongoing based on this CY46T1_bf.

CY46T1_bf could be considered for an export version (to be confirmed yet).

CY47: the main build process took place over March-May 2019. CY47_main was declared on 19 August 2019. MF has run the mitraillette validation tool on that version, and EC has technically run an IFS 4D-VAR suite.

Content:

- OOPS re-factoring in IFS FORTRAN codes:
 - VarBC works
 - final work for Full-POS as PostProcessor object (MF/REK)
 - other required fixes in order to run OOPS-IFS in a full PrepIFS experiment (CY46R1).
Note: recent code adaptations in order to run screening in OOPS-IFS are still missing in CY47, and will enter CY47R1.
- Scientific contents of CY46R1 and CY46T1

CY47T0: this is a technical quick cycle built in the end of August 2019. The goal was to enable the first early prototypes of tests based on the “davaï” concept and tools (for technical validation). Another goal was to enable to run the Fortran binary executable files using array bound check options throughout the code (this actually required a number of corrections and adaptations of interfaces, following a proposal made by Ryad).

Content:

- code changes enabling array bound check options throughout the code, for a number of Arpège and LAM configurations (R. El Khatib)
- Fortran/C++ interface codes adapted in order to enable OOPS unitary tests in the “davaï” framework for CY47 (E. Arbogast with A. Mary)
- bator change to enable the use of “one obs out of two” (useful for creating smaller obs databases for testing) (F. Guillaume following an idea by F. Suzat)
- miscellaneous other bug-fixes found in CY47_main or reported from earlier cycles, excluding those linked with reporting codes from CY43T2 (this is planned for CY47T1)

Declaration of CY47T0_main occurred on 3 September 2019.

CY47T1: October-November 2019. The timing of CY47T1 is very constrained, as MF and EC

will start building CY48 as early as December 2019. Contributions to CY47T1 will have to be prepared for Tue 8 October.

Provisional content: because of the timing constraints, delayed contributions will be avoided. Contributions edited in *italic* mode are pending a firm confirmation and commitment by the contributors (meaning here “to be confirmed by the time of the deadline”)

- System operational aspects (Météo-France o/e-suites):
 - wrap-up of MF’s e-suites based on **CY43T2 op1/op2** and **CY46T1 bf** (all GMAP staff) => finishing this wrap-up into the official trunk is a major goal of this cycle for GMAP
- System technical aspects:
 - *direct reading of NetCDF file formats in c931 and c932 (J.-M. Piriou)*
 - *inclusion of new configuration c933 aimed to replace c931 and c932 in some near future (A. Napoly, J.-M. Piriou)*
- Model algorithmic diagnostics:
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- Full-POS & Model output diagnostics:
 - *precipitation types; various flavours of snow cover height (I. Etchevers)*
 - *for aeronautics: pressure and flight level height of Tropopause and jet (O. Jaron)*
 - *new fields in Fullpos (CHMI & J. Cedilnik):*
 - *convective temperature,*
 - *mean radiant temperature (needed for evaluating thermal comfort),*
 - *global normal irradiance (for energy producers),*
 - *lightning diagnostics*
 - *vertical temperature gradient (aviation application)*
 - *MLCAPE*
 - *storm motion vector, storm relative helicity, vertical wind shear diagnostics*
- Arpège and Arome model dynamics:
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- Arpège atmospheric physics:
 - *updated interface to the IFS radiation scheme ECRAD (Y. Bouteloup, following work by M. Raouindi)*
 - *for Arpège-Climat: additional dry adjustment term; changes in the Lopez microphysics (R. Roehrig, A. Alias)*
- Arome atmospheric physics:
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- SURFEX codes in NWP repository:
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- Surface analysis & CANARI:
 - *snow analysis code (C. Birman)*
- Assimilation methods:
 - *fixes for trajectory handling in AEARO, for I/O of control vector initial condition slices (Y. Michel)*
 - *re-factoring of some control vector attributes, that are moved from the CV-level down to the levels of slices. Eg. `YDCV%ljbwavelet` => `YDCV%initcv%ljbwavelet`, `YDCV%lam1d` => `YDCV%initcv%lam1d` (Y. Michel). This will enable more flexibility in defining the spectral space components at slice-level. Pending a decision in liaison with ECMWF.*
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- Observations:
 - *GNSS ZTD horizontal gradients observation operator (P.Moll) tbc*
 - *AMDAR humidity data: optimize QC and assimilation in ALARO or AROME 3D-VAR (P. Moll, A. Trojakova, F. Meier)*
 - *final (and agreed) code for handling Mode-S data in the Arpège and LAM systems (V. Pourret, coordination MF-KNMI team)*
- ALADIN:
 - Graupel code: required a deeper restructuring (with respect to what's coded in CY45T1). In CY45T1, (IF LGRAPRO) statements were commented out in four subroutines in order to compile the codes with Intel. The debugged version of the graupel code is expected to enter in CY47T1 (B. Bochenek & J. Masek)
 - Miscellaneous ALARO physics aspects (J. Masek – 10 Sept. 2019):
 - DDH budgets for prognostic TKE and TTE (in TOUCANS) added by Mario Hrastinski.
 - New cloudiness treatment in vertical diffusion by Radmila (introducing new options NDIFFNEB=4 and 5).
 - Fixes in adjustment and microphysics by Luc Gerard. These will be deactivated by local key, since they require more extensive validation.
 - TOMS (3rd order moments in TOUCANS) fixes by Peter Smerkol. These will be deactivated by local key as well.
 - Further modularization and optimization of ACRANEB2. Exact content depends on how much will I (Jan) manage to implement until deadline.
 - Fixes of blend utility (new FA date structure, split of ECHIEN to ERIEN, reintroduction of Z_NSIGN, making official version working). Today I (Jan) found that blend utility in cy47t0 is crashing, the problem might be related to xrd adaptation for single/double precision. I am trying to make it working again.
 - Dynamics:
 - *implementation of the variables d5/W5 proposed by Fabrice Voitus (J. Vivoda, P. Smolikova in collaboration with Karim and Fabrice)*
- HIRLAM: to be confirmed (under discussion – likely that not all what's listed below will enter CY47T1)
 - *Harmonie-Arome related physics:*
 - *MUSC LFA: write model level data*
 - *microphysics changes (and interface to radiation) (T. Moene, K.-I. Ivarsson, W. de Rooy)*
 - *fixes for clouds – turb – convection (U. Andrae)*
 - *Assimilation aspects:*
 - *Bator changes for Ps/Pmsl from Synop & Buoy*
 - *Harmonie-Arome blacklist versions*
 - *Brand; hybrid EnVar*
 - *surface perturbation for EPS in pertsfc.F90*
 - *EPS aspects:*
 - *infrastructure for Harmonie-Arome SPP (based on IFS codes extended) (U. Andrae, I.-L. Frogner)*
 - *implement SPG based on Tsyrlunikov etal. (U. Andrae)*
 - *Technical changes: initialization, OpenMP, fixes etc.*
- OOPS re-factoring and prototypes:

- *in the FORTRAN code libraries: any potentially missing issue after CY47, or bug-fixes for running the OOPS binaries for standard configurations (4D-VAR Arpège, 3D-VAR Arome, Unit tests with Arpège or Arome data, Arpège and Arome forecast models etc.)*
- *first implementations in official SCR of OOPS/C++ towards FORTRAN/IFS interface codes, enabling the 4D-VAR and 3D-VAR prototypes to run*
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The declaration of CY47T1 is expected by the end of November.

CY48: December 2019 – end of February 2020. The timing is constrained by MF’s change of HPC, which will occur in spring 2020. Porting the operational NWP suites to the new (BULL-Sequana) HPC will take place from March onwards.

Provisional content:

- OOPS re-factoring in IFS FORTRAN codes:
 - adapted handling of time and time step variables for multiple MODEL instantiation - Step 2
 - VarBC tidy-up for OOPS-IFS, C-VarBC
 - VarQC, observation error correlations (already in CY47)
 - finalized OOPS/Fortran interfaces to run Screening and Continuous Data Assimilation with OOPS/IFS
 - any required fix in order to run OOPS-IFS in a full PrepIFS experiment (CY47R1)
 - fixes for OOPS/Arpège or OOPS/Arome
- scientific and technical contents of CY47R1 and CY47T1

Declaration of CY48 is expected by the end of February 2020.

CY48T1: provisional timing is autumn 2020.

Hypothetical content:

- System operational aspects (Météo-France o/e-suites):
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- System technical aspects:
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- Model algorithmic diagnostics:
 - *harmonize the names of fluxes and tendencies (3D and 2D) in ARPEGE and AROME (flexible DDH, F. Voitus),*
 - *finish the implementation of DDH terms from the dynamics (flexible DDH, F. Voitus)*
 - *new version of “W-term” for NH-EE (NVDVAR=14) (F. Voitus)*
 - *mass correction option from Arpège-Climat adapted to Arpège-NWP for the new cycles (CY47 and beyond, with the model objects) (H. Petithomme)*
- Full-POS & Model output diagnostics:
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- Arpège and Arome model dynamics:
 - *various dynamics updates and cleaning (F. Voitus):*
 - *NH-QE treatment of w improved*
 - *simplification of the spectral SI operator generalized to H and NH, global and LAM*

- *modified handling of bottom boundary condition for w: implement a modified W following the condition $W_{mod} = 0$ (proposal by L. Auger)*
 - *more proper use of R_dry (versus R_moist) in dynamics*
 - *3D grid point solver for SI hydrostatic model (research version) (L. Auger)*
- *Arpège atmospheric physics:*
 - *evolution of Lopez microphysics (Y. Bouteloup)*
 - *interface to the IFS deep convection scheme (Y. Bouteloup)*
 - *computation of the TKE production term from deep convection (Y. Bouteloup)*
 - *rewrite of PCMT code in order to make the Météo-France NWP and Arpège-climate versions converge (J.-M. Piriou, J.-F. Guérémy)*
 - *review stability functions for PBL with respect to consistency of energy cycle, potential impact of Lewis number # 1 (P. Marquet)*
 - *TL linear physics for 4D-VAR: updates in microphysics (C. Loo)*
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- *Arome atmospheric physics:*
 - *horizontal gradients and horizontal turbulent mixing treated within the Arpège/Arome code algorithm, probably building on available spectral/grid point arrays and SL stencil computations (R. Honnert) – for tests in sub-km Arome configurations*
- *SURFEX codes in NWP repository:*
 - *implement Surfex official code release v8.x or even v9 (Y. Seity)*
- *Surface analysis & CANARI:*
 - *snow analysis code (C. Birman)*
- *Assimilation methods:*
 - *first “official” codes for EnVar in ARPEGE or AROME implemented in common libraries, including interface codes to OOPS/C++ (E. Arbogast, Y. Michel, T. Montmerle)*
- *Observations:*
 - *GNSS ZTD horizontal gradients observation operator (P.Moll) tbc*
 - *AMDAR humidity data: optimize QC and assimilation in ALARO or AROME 3D-VAR (P. Moll, A. Trojakova, F. Meier)*
 - *final (and agreed) code for handling Mode-S data in the Arpège and LAM systems (V. Pourret, coordination MF-KNMI team)*
- *ALADIN:*
 - *ALARO physics:*
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 - *Dynamics:*
 - *implementation of the variables d5/W5 proposed by Fabrice Voitius (J. Vivoda, P. Smolikova in collaboration with Karim and Fabrice)*
- *HIRLAM:*
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- *OOPS re-factoring and prototypes:*
 - *in the FORTRAN code libraries: any potentially missing issue after CY47, or bug-fixes for running the OOPS binaries for standard configurations (4D-VAR Arpège, 3D-VAR Arome, Unit tests with Arpège or Arome data, Arpège and Arome forecast models etc.)*
 - *FORTRAN and interface codes for EnVar solutions as developed for ARPEGE and AROME*
 - *adaptation of LAM MODEL components, possibly DDH code, to OOPS (A. Mary)*
 - *remove the Tomas’ trick for YOMPHY* variables. Proper handling of the MODEL parameters inside calls to MF obs operators (A. Mary & OBS team ?)*

Progress and plans of E-suites/O-suites 2019-beyond:

A scientific e-suite started to be implemented in September 2018. Its complete installation in the MF operational context proved to be very long (almost one year). Listed content:

- Cycle version basis: **CY43T2_op2** (originally based on **CY43T2_bf.08**); the SURFEX version is V8.0+ (like in CY42_op2)
- Migration to VORTEX (Python toolbox) for ARPEGE 4D-Var, EDA and AROME 3D-Var
- Migration to GRIB2 format for post-processing (lat/lon) files and using GRIB2 encoding for historical files (only for global model geometry) based on the GRIB_API library included in the ecCodes package of ECMWF (note: otherwise, GRIB1 remains available as well via ecCodes)
- New horizontal resolutions for global systems (deterministic, EDA, EPS):
 - ARPEGE: ~5km over France (T11798c2.2L105)
 - 4D-VAR: 2 minimisations in T1224c1L105 (90km) and T1499c1L105 (40km)
 - EPS: 35 members (unchanged) at ~7.5km over France (~T1198c2.2L90)
 - EDA: 50 members in T1499c1L105 => will sample B-matrix from 3*50 instead of 6*25 as now
- Scientific content:
 - Tuning in the dynamics (horizontal diffusion, SL iterations number)
 - Tuning of convection scheme in ARPEGE
 - Improved version of AROME microphysics scheme
 - New roughness and emissivity for snow
 - Tuning of sigma_b for humidity in ARPEGE-EDA
 - Variational bias correction for GNSS observations
 - Assimilation of more IASI channels over land
 - Inter-channels observation error correlation for IASI and CRIS
 - New channels assimilated for geostationary CSR
 - Monitoring of new observations :
 - *GPSRO : GNOS/FY3-C, ROSA/MEGHA-T*
 - *Microwave : AMSR2/GCOM-W1, MWRI/FY3-C, ATOVS, ATMS, MWHS-2 Flux DbNet, AMSUA et MHS on METOP-C, ATMS on NOAA20*
 - *Scatterometer : OSCAT sur ScatSat-1*
 - *AMV wind : Goes-16, Goes-17, Metop-C*
 - *Doppler winds and radar reflectivities (European radars)*
 - Initialization of CMO-1D in AROME-Overseas with Mercator 4x per day
 - New structure functions for T2m and H2m analysis
 - News diagnostics: visibility, type of precipitations, ...
- PEARO: increase of the ensemble size to 16 members planned for mid-2019

The switch to Operations took place on 2 July 2019.

A renovated coupling procedure for Arome-IFS and Overseas models (**conf 903**) was implemented operationally at ECMWF in the beginning of September.

Specific changes to the CY43T2 operational suites are now under discussion between MF's Research and Operational Dpts. One important constraint is that most of the potential changes should not require

changes of the Arpège/Arome binary files. It is also not planned to implement a full e-suite context. The list of the potential changes is provided below.

List of operational changes for the autumn 2019 (still in preparation) :

- a kind of **CY43T2_op3**
- Snow analysis in Arome
- New satellites : GOES, NOAA-20, METOP-C, chinois, AEOLUS winds ...
- Arome aspects :
 - Monitoring and/or assimilation of more OPERA radar data
 - Extension of new model outputs from CY43T2_op2 to PEARO (EPS)
 - Renovated coupling procedure for Arome-IFS and Overseas models (conf 903)

Its implementation to the operational context should occur in November 2019, in order to meet a target timing for a switch to Operations by February 2020.

Plans for MF's NWP suites in 2020 and 2021.

Porting of the operational suites will take place in spring-summer 2020 (note: a first migration test computer should be available in MF in October 2019). The goal is to declare the new (BULL-Sequana) suites ready for operations by end of August 2020. The old BULL HPCs are to be switched off in 1 September 2020.

The first scientific e-suite on the new HPC is expected to be installed in the beginning of the autumn 2020. The precise content is under discussion. The code base version should be either CY47T1 or CY46T1_bf (the second probably is a more likely option?).

Provisional list of content:

- **CY46T1_bf or CY47T1**
- 2020 scientific changes *after HPC migration* :
- Monitoring of Mode-S
- Snow analysis in Arpège and Arome (if not in last e-suite of 2019)
- Tuning of observation error stdev
- Model output : CAT index, ice crystals index (for aviation purpose) (if not in last e-suite of 2019)
- *Note : work on IFS convection and radiation schemes will be continued, as well as on the IFS/ GWD scheme + revisited orography based on GMTED2010 (Tiedtke-Bechtold, ECRAD, GWD)*
- Arome aspects :
 - Revisited choices for diffusion
- EPS :
 - PEARP (global) : revisited multi-physics choices, research work on SPP
 - PEARO : research work on SPP, stochastic objects and post-processing

Outlook to MF plans for 2021-2024:

- S2/2020 - 2021 : Arome (PEARO) and Arpège (PEARP) EPS change of resolution in order to reach those of the deterministic models (will probably require single-precision) => first & important step towards a probabilistic production system
- 2022 : OOPS ported to operations, perhaps in association with implementing 3D-EnVar for Arome
- 2022+ : Renewed surface assimilation ?
- 2022+ : 4D-EnVar or hybrid 4DVAR/4D-EnVar in Arpège (perhaps only for the EDA part?)
- 2023 : Instances of Arome-500m become operational
- 2023 : 4D-EnVar in Arome ?