

ALADIN LTM meeting
Monday 1 April 2019
16:00-18:00
Madrid, Spain



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">• CY47 is now in build process with EC• perhaps only a fairly “quick” CY47T1 in the autumn• two scenarios for CY48: early (start build in Dec’19) or later (start build around Feb’20) => we think that we need to be prepared for the early scenario Operations in MF: <ul style="list-style-type: none">• CY43T2 Arpège high resolution E-suite foreseen to switch to operations in beginning of June 2019• MF hope to be able to start another e-suite based on CY46T1 (this is pending on timeliness of the switch of CY43T2 and precise calendar of arrival of next HPC)• in 2020: installation of next HPC in MF (still with an uncertainty of about 6 months on the precise calendar); decision to become official in July 2019.
Action(s) required:	<ul style="list-style-type: none">• Take note of MF’s plans for e-suites and operations in 2019 & outlook beyond.• Take note of the content and timing of IFS/Arpège cycles.• CY43T2_bf.08 was used as base version for MF’s e-suite; 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">◦ CY47T1: candidates for October-November 2019◦ CY48 possible volunteers for December 2019 and first quarter of 2020 are welcome.

Cycles, code releases and a few comments:

CY46T1: this cycle includes many known & updated fixes enabling to run Arpège and LAM data assimilation systems [phasing up from CY43T2 – including the revival of CANARI] + updates for Arpège-Surfex_v8 (adapted from CY42_op2 via CY43T2_bf) + any other fixes collected within [CY43-CY46].

Some additional new science was added too.

The deadline for contributions was Friday 28 September 2018. Declaration of the “main” branch in MF’s GIT repository occurred on 28 February 2019.

Overview of content:

- System operational aspects (Météo-France o/e-suites):
 - adapted fixes for Arpège+Surfex_v8 (from testing CY43T2_bf and comparison with CY42_op2) [*all contributors to CY43T2_bf.04-08*]
 - adapted updates from CY42_op3 suite (i.e. for AEARO) [Yann Michel]
 - any fix needed to run Arpège 4D-VAR or LAM 3D-VAR as tested in CY43T2_bf, and possible extra re-phasing with respect to CY45-CY46 [Florian, Camille, Patrick, Thibaut, Dominique R., Etienne etc.]
 - re-phased fixes and recoding necessary to revive CANARI at MF and by Aladin partners (included in previous item) [Camille, Alena]
- System technical aspects:
 - reminder: GRIB2 facility enabled using ecCodes software (mandatory for compiling CY46)
 - fix in FASGRA/FAIGRA to avoid warning messages with GRIB2/LAM geometry (R. El Khatib, based on former change by P. Marguinaud)
 - enable saving SURFEX surface fields states at each step of a model integration, in order to enable a reinitialization of SURFEX for a restart (P. Marguinaud)
 - remove Fortran version of LFI routines and keep only C code version (P. Marguinaud)¹
 - implement an LBC file re-reading mechanism (P. Marguinaud)
- Full-POS software:
 - several fixes or minor developments (R. El Khatib)
 - new diagnostic fields (see list in the Aladin partners’ bullet below)
- Diagnostics and specific post-processing:
 - visibility (I. Etchevers)
 - for aeronautics: convective cloud top and bottom pressure, Clear Air Turbulence (CAT) (O. Jaron)
- Arpège and Arome model dynamics:
 - various dynamics updates and cleaning by Karim (K. Yessad & F. Voitus):
 - several fixes for the treatment of the NL Laplacian term in NH-QE (note: the NH-QE version coded in CY46 is unstable)
 - alternative, simpler version of the SI term coded for NH-EE
 - the possibility to define the vertical divergence using moist R instead of dry R (note: the default choice in the code will not be changed though)
 - the possibility to control the increase of horizontal spectral diffusion by passing a ratio by namelist (in NAMDYN), rather than the resolution-depending parameter NSREFDH

¹ The LFI file content and structure is identical using either the Fortran or the C low-level routines. From CY41T1 through CY46_main, users can test and switch from the one version to the other using the environmental variable « export LFI_HNDL_SPEC=:1 ». A technical note by P. Marguinaud is available.

- Arpège atmospheric physics:
 - tunings and code adaptations needed for Arpège new resolution T11798C2.2L105
 - interface to the ECRAD radiation scheme (Y. Bouteloup)
 - Climate group updates (in liaison with GMAP/PROC):
 - Bugfixes and add-ups in the atmospheric physics codes of Arpège (non-orographic waves, PCMT convection scheme in climate mode etc.)
 - additional options for atmospheric components and aerosols
 - various other fixes, key-protected
 - key-protected developments for the single-column model MUSC
- Arome atmospheric physics:
 - interface to the ECRAD radiation scheme (Y. Bouteloup)
- SURFEX **based on v8.0+** as in [CY43T1-CY46_main] (Y. Seity):
 - bf for TEB when garden not activated (wrong calculations of vertical/horizontal fractions)
 - bf for 1D-ocean mixing layer model CMO (used in AROME-Overseas)
 - in parallel, GMAP will re-phase all recent MF NWP changes required for Arpège and Arome-France (from CY43T2) on top of Surfex V8.1, in the context of the build process of V9 of Surfex at GMME (Y. Seity, S. Faroux). These changes include ORORAD, single precision, Arpège assimilation etc.
 - *note: the validation of SURFEX v8.1 in Arome-France was not advanced enough to consider this version for CY46T1 (no test done in Arpège either btw)*
- Assimilation methods:
 - improvements on EDA for AROME (reporting from CY43T2_op1), use of EDA information in AROME-France 3D-VAR (Y. Michel, P. Brousseau, L. Berre, B. Ménétrier)
 - technical developments preparing LAM EnVar, including adjoint tests; parallel version of the recursive filters for filtering in LAM ; extension of control variable under key LENSVCV for EnVar (Y. Michel)
 - fix for reading FA files instead of GRIB in AEARP (B. Ménétrier)
- Observations:
 - Bator updates from CY43T2_bf (in coordination with Aladin/Hirlam partners, after discussions in Toulouse in April 2018) (F. Guillaume)
 - Modifications to enable the monitoring of FY-3C and Megha-Tropiques radio-occultation data (D. Raspaud)
 - Preparation for the assimilation of METOP-C radio-occultation measurements (D. Raspaud)
 - Update of the list of the GPSRO satellites for the JO-table (D. Raspaud)
 - Various updates for AMV data, mainly at the level of ODB content (C. Payan)
 - Pre-merging of an EC branch, the so-called “4newSCATT” dev, provided by GDC, with miscellaneous improvements (C. Payan)
 - allow the all-sky assimilation of microwave observations using a Bayesian inversion of brightness temperatures, with the same methodology than for radar reflectivities (F. Duruisseau & P. Chambon)
 - new satellites/instruments: 1) Aeolus L2 HLOS winds, 2) MTG-IRS, 3) IASI-NG, (GMAP/OBS)
 - use of infrared emissivity atlases for the use of IASI skin temperature retrievals (V. Guidard)
- ALADIN:
 - transfer of ALARO-1 fixes that entered CY43T2_bf.08 (J. Masek) – note: those fixes that entered CY43T2_bf.04 already are in CY45T1

- fix in ACNPART for convective cloud cover (J. Masek)
- fix for CAPE computation starting from most unstable level – make the computation independent of number of processor (R. Brozkova)
- some CANARI fixes (A. Trojakova)
- dynamics changes:
 - dynamical switch-on/off P/C scheme for NH kernel of AAA models (J. Vivoda, P. Smolikova)
- HIRLAM (in close coordination between D. Santos and C. Fischer):
 - *dynamics (one change in gnhd3.F90 originally from M. Hortal)*
 - *system aspects (fixes and portability, Bert van Uft)*
 - *fixes required for Harmonie-Arome, re-phased from CY43T2_bf[04-08] or from CY43H2 into CY46 (EDMF, shallow convection) (W. de Rooy, L. Bengtsson)*
 - *note: after a coordination discussion in April 2018 in Toulouse, “Bator” code changes are now being discussed and coordinated between F. Guillaume and E. Whelan. Implementation of changes in T-cycles by the LAM partners need to be agreed under this governance first (contacts include C. Fischer, J.-F. Mahfouf, R. Randriamampianina, A. Trojakova, M. Monteiro)*
- OOPS re-factoring:
 - Adaptations of ARPEGE forecast + finalize Fullpos in-line for OOPS (E. Arbogast & R. El Khatib) :
 - OOPS unit tests for observations operators, model, TL/AD model and change of resolution with fullpos
 - Remove the obsolete oops directory in the MF repository
 - Fix surface fields use in TL/AD model for OOPS
 - Encapsulate global variables NGP5_OOPS, NTRAJ_CST_OOPS in YRSURF
 - Fix GFL use in TL/AD model for OOPS

The declaration of CY46T1_main in MF’s GIT repository occurred on 28 February 2019. More validation now takes place in order to fully validate the Arpège and Arome assimilation cycles. We stress however that many “mitraille” model and FP configurations have been validated, as well as components of data assimilation using the OOPS objects (this part of technical validation is a real novelty!).

CY46T1 will have to be complemented by wrap-ups from the late source code changes from the CY43T2 e-suite (CY43T2_op1 version from November 2018 onwards), including fixes for GRIB2 or new model output diagnostics (visibility, types of precipitation at ground etc.).

An evolved version of a CY46T1 (CY46T1_bf or CY46T1_op1) could be considered for an export version (to be confirmed yet).

CY47: March-May 2019.

Provisional content:

- OOPS re-factoring in IFS FORTRAN codes:
 - VarBC works
 - final work for Full-POS as PostProcessor object (MF/REK)
 - any required fix in order to run OOPS-IFS in a full PrepIFS experiment (CY46R1). *NOTE: as of end of March 2019, ECMWF signalled that OOPS-IFS 4D-VAR was providing wrong*

results with CY46R1, and this problem was still under investigation

- contents of CY46R1 and CY46T1

CY47T1: autumn 2019. The precise timing of CY47T1 will depend on the final decision of the timing of CY48. The latter is pending decisions on the choices and installation of the next HPCs in both MF and EC.

In the case of an early installation of the next HPC at MF, an “early CY48 scenario” would mean that to start building CY48 as early as December 2019. In that case, CY47T1 will have to be a short, scientifically reduced cycle mostly devoted to technical updates and contributions well validated on the basis of CY47 by September 2018.

Provisional content:

- System operational aspects (Météo-France o/e-suites):
 - wrap-up of MF's e-suites based on CY43T2_op1 and a hypothetical CY46T1_op1 (all GMAP staff)
- System technical aspects:
 - direct reading of NetCDF file formats in c931 and c932 (J.-M. Piriou)
- 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)
- 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:
 - various dynamics updates and cleaning by Karim (K. Yessad & 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)*
 - *first rewrites of PCMT code (J.-M. Piriou, Y. Bouteloup)*

- *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)*
-
- **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: to be discussed - see list below**
 - *improvements in ACRANE2 (J. Masek): optimized version enabling cheap diagnostics of clear sky fluxes and reducing memory needed for LW intermittent storage. Possibly, there can be further improvements in calculation of direct solar flux.*
 - *Graupel code: requires a deeper restructuring (with respect to what’s coded in CY45T1). In the meanwhile, (IF LGRAPRO) statements need to be commented out in four subroutines in order to compile with Intel.*
 - **Dynamics:**
 - *implementation of the variables d5/W5 proposed by Fabrice Voitius (J. Vivoda, P. Smolikova in collaboration with Karim and Fabrice)*
- **HIRLAM: to be discussed - see list below**
 - *Harmonie-Arome related physics, especially microphysics changes (and interface to radiation) (T. Moene, K.-I. Ivarsson, W. de Rooy)*
 - *agree on final shape of the contribution for the assimilation of Mode-S data (V. Pourret, KNMI contacts)*
 - *assimilation: 4D-VAR/LAM and Jc-DFI fixes, MSGinit ???*
 - *surface perturbation for EPS in pertsfc.F90*
- **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*
 - *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 ?)

CY48: open timing still ! Could be a “quick” IFS/Arpège joint cycle before the end of 2019, or a late joint cycle in parallel or after the migration to the new HPCs (and move to Bologna for EC Data & Computer centre).

Note: there was a strong recommendation not to let more than 1 year between two joint cycles (eg. CY47 to be declared around mid-May 2019).

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
 - 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

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

Plans for MF's NWP suites in 2018 and 2019.

Specific changes in suites, or new applications, not requiring a new cycle version (base: **CY42_op2**):

- Extension of some Arome forecast ranges. On 14 March 2018, the following extensions have been implemented: Arome-France [43 → 48h for 00 UTC; 40 → 45h for 03 UTC; 37 → 42h for 06 UTC], Arome-IFS [43 → 48h for 00 UTC], Arome-EPS (PEARO) [46 → 51h for 21 UTC].
- A second set of extension and additional production became operational on 29 March: Arome-France [43 → 48h for 12 UTC; 37 → 42h for 18 UTC], PEARO [46 → 51h for 09 UTC], new production instances of PEARP [0 → 48h for 00 and 12 UTC] and PEARO [0 → 45h for 03 and 15 UTC]. Note that MF will then operate 4 EPS runs per day for both global and LAM EPS.

A “mini” e-suite was implemented in order to port the Arome ensemble data assimilation system (AEARO) to operations (April-June):

- code basis: **CY42_op3**
- main characteristics: 3.8km/90 levels, 25 members coupled with the AEARP (Arpège EDA) members, hydrostatic dynamics, perturbation of SST, inflation based on a spread-to-skill diagnostic, 3h cycling 3D-VAR with perturbed observations

This Arome-EDA e-suite became operational on 10 July 2018.

A new scientific e-suite started to be implemented in September 2018. Its complete installation in the MF operational context proved to be very long, and is not yet fully completed at the time of writing this note. Listed content:

- Cycle version basis: **CY43T2_op1** (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 (Tl1798c2.2L105)
 - 4D-VAR: 2 minimisations in Tl224c1L105 (90km) and Tl499c1L105 (40km)
 - EPS: 35 members (unchanged) at ~7.5km over France (~Tl1198c2.2L90)
 - EDA: 50 members in Tl499c1L105 => 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 is expected for the beginning of June 2019.

A specific 2019 scientific e-suite is in discussion, with a provisional content as listed hereafter:

- **CY46T1**
- Snow analysis in Arpège and Arome
- Tuning of observation error stdev
- Assimilation of GNSS-RO from FY3-C, MWRI, AMSR-2
- Winds from AEOLUS, winds and radiances from GOES-16 and GOES-17
- Assimilation of NOAA-20 (CrIS and ATMS) and Metop-C (IASI, AMSU-A, MHS, ASCAT, GRAS) data
- Assimilation of scatterometer winds from ScatSat-1, CFOSAT and possibly HY-2B
- Assimilation of « all-sky » microwave radiances from MHS (in the Tropics)
- Model output : CAT index, ice crystals index (for aviation purpose)
- *Note : work on IFS convection and radiation schemes will be continued, though probably not for this e-suite (Tiedtke-Bechtold, ECRAD)*
- Arome aspects :
 - Monitoring and/or assimilation of OPERA radar data ; monitoring of Mode-S winds
 - Coupling EDA and 3D-VAR
 - Switch to ECRAD ?
 - Extension of new model outputs from CY43T2_op1 to PEARO (EPS)
 - Renovated coupling procedure for Arome-IFS and Overseas models (conf 903)
- PEARP (global EPS) : adaptation to new model outputs (from CY43T2_op1), first use of SPP for model error if ready

Its implementation to the operational context should start not much later than September 2019, in order to meet a target timing for a switch to Operations by February 2020.

Outlook to MF plans for 2020-2024:

- 2020-2021: migration to next HPC

- 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 ?