

**ALADIN LTM meeting  
Tuesday 4 April 2017  
16:10-18:10  
Helsinki, Finland**



**Document for Item 4.c in  
the agenda**

<b>Subject:</b>	Progress and plans: <ul style="list-style-type: none"><li>• status of common IFS/Arpège/LAM cycles,</li><li>• MF operational and R&amp;D activities.</li></ul>
<b>Summary:</b>	Please see below, the detailed plans about the forthcoming R&D code releases in MF's GIT repository, as well as the progress and plans at MF about E-suite/operational implementations.
<b>Action(s) required:</b>	<ul style="list-style-type: none"><li>• Take note of MF's plans for operations and e-suites in 2017 and first half of 2018. Especially, please note the upcoming resolution change of Arpège, planned for operations in 2018.</li><li>• take note of the content and timing of IFS/Arpège cycles.</li><li>• 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"><li>◦ CY45T1: mid-Sept until mid-Nov 2017</li><li>◦ CY46: Dec 2017 until February 2018</li><li>◦ we are also interested to get information about candidates for March-June 2018, in case a CY46T1 would be possible over that period</li></ul></li></ul>

## Cycles, code releases and a few comments:

**CY43T1: Deadline for code commitments in MF's GIT repository was set to Monday 18 April 2016. First libraries were created on 21 April (CY43\_t1.01). Declaration in GIT was confirmed on 30 June 2016.**

Content:

- System:
  - Support and debug for GRIB1 encoding in FA files (R. El Khatib)
  - Encoding with GRIB2 using the GRIB\_API library in FA files (P. Marguinaud)
  - Post-processing server coupled with the forecast model (P. Marguinaud)
  - Memory and CPU optimization of the computation of filtering matrices for Full-POS Arpège (R. El Khatib)
  - Various pre-OOPS modifications in Full-POS - configuration 903 -<sup>1</sup> (R. El Khatib)
  - Removal of ISP (aka "movies") (R. El Khatib)
  - Open-MP compatible DDH-flexible (F. Voitus)
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- Assimilation and use of observations:
  - "quick and dirty" fix for running APACHE & ACHMT (USE hybrid-level vertical A and B's below HOP / awaiting for a clean solution in CY44) (P. Moll)
  - Option for anti-aliasing in the computation of  $\sigma_b$  (L. Berre, G. Desroziers, V. Chabot).
  - Option for the normalization of wavelet covariances (L. Berre, G. Desroziers, V. Chabot).
  - Option for taking into account the relaxation of balances in the stratosphere, when computing wavelet covariances or local  $\sigma_b$ 's (L. Berre, G. Desroziers, V. Chabot).
  - Restructure SUJBVARENS (computation of  $\sigma_b$  from the Arpège EDA) in order to make it LAM-compatible and enable objective filtering of tensor components/lengthscales (Y. Michel).
  - New code for EDA with AROME: inflation, modification to the stochastic perturbation scheme, merge of covariance matrices, etc. (Y. Michel)
  - Update of the code for the recursive filters (to make it match the development made for EnVAR with OOPS) and for the perturbation of the SST (Y. Michel).
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- ARPEGE forecast model:
  - Changes for the new convection scheme PCMT (JM Piriou)
  - Make SURFEX work for ARPEGE (F. Taillefer, Y. Bouteloup)
- AROME forecast model:
  - ORORAD impact of subgrid orography parameters on the surface radiation budget (A. Mary, Y. Seity, ZAMG/C. Wastl, Hirlam)

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1 - support for interoperability in Full-POS : EC GRIB2 to FA global or LAM ; FA global to GRIB2 with EC grib\_api interface (both to be still scientifically validated)  
- computation of Full-POS norms out of I/Os, re-enabling Full-POS norms for EC-Full-POS  
- option NFPWRITE=0/1 in NAMFPIOS to disable or not the I/Os of Full-POS, preserving the computation of the norms in the current listing  
- enhancements in the flexibility of the post-processing server facility in the configuration 903  
- preliminary cleaning to prepare OOPS-oriented re-factoring

- Necessary updates in “mse” in order to switch Surfex V8
- Surface schemes:
  - Version 8 of SURFEX (P. Marguinaud, Y. Seity)
- ALADIN/ALARO (R. Brozkova, J. Masek, L. Gérard):
  - Radiation code ACRANE2:
    - Sunshine duration computation also for ACRANE2 (complete a missing code);
    - Fix in APL\_AROME of the ACRANE2 call (to initialize a field needed by SURFEX with TEB);
    - Introduction of the exponent-random overlap in ACRANE2;
    - Improvement of the bracketing weights computations in ACRANE2 (long wave part).
  - Turbulence scheme TOUCANS:
    - New shallow convection;
    - Some cleanings.
    - Computation of T2m improved
  - Microphysics improvements (downdrafts, ...)
  - Add a new variable in Full-POS: ventilation index (tbc)
- HIRLAM (highlights)
  - Upper air assimilation:
    - Corrections to run 4DVAR in AROME (Jan Barkmeijer KNMI, Magnus Lindskog SMHI)
    - Scheme for generation of random perturbations with structure of B-matrix covariance (Jelena Bojarova, Met Norway)
    - GNSS, observation perturbation method etc.
  - Numerical aspects:
    - Application of Davies relaxation at the upper boundary LUNBC (Mariano Hortal AEMET, left over from CY41T1, code phased by Toon Moene KNMI)
    - Changes related to running with cubic grid (Mariano Hortal AEMET)
      - First order in time scheme (avoiding time extrapolations) during the first few time steps.
      - Introduce a threshold in order to limit the value of the computed 3-dimensional divergence in the model to half the inverse of the time step. This limit is chosen because it is the limit of convergence of the trajectory computation in the semi-Lagrangian method.
  - Physics aspects:
    - Optional RACMO/HARATU turbulence formulations in AROME (Wim De Rooy, KNMI)
    - Changes in coefficients and default settings for radiation (Christian Pagh Nielsen DMI, Laura Rontu FMI, Emily Gleeson Met Eirann) See note sent to MF/ECMWF
    - CA resolution dependent changes (ALARO) (Lisa Bengtsson SMHI)
    - Correction and cleaning of cloud overlap calculations (ALARO/AROME) (Lisa Bengtsson SMHI)
  - Technical aspects: cleaning, porting, fixes, ODB etc.
- Wrap-up of late changes of the ARPEGE and AROME-France operational versions of CY41T1\_op1 or CY42\_op1 (operational since 8 Dec, 2015) (GCO team)

Note that the reference version for validation of Arpège global configurations shall be CY41T1\_op1 and/or CY42\_op1.xx with xx<='09' (the latter is the CY42-phased version of the former, in rough words). For the LAM adiabatic “mitraille” tests (Aladin H/NH dynamics), the same reference applies. For the Arome-France CMC, the reference shall be CY41T1\_op1 + the additional plug-in and testing of SURFEX Version 8. A complete overhaul of the “mitraille” test of Arome-France has been implemented in GIT as well (new Ecoclimap files matching Surfex/V8, new PGD and test coupling files, updates for ORORAD).

**CY43T2:** this is a short-term update cycle, for fixes and code finalization on top of CY43T1. It contains only bugfixes and updates found during the build of the Arpège and Arome E-suite configurations (CY42\_op1) and any potential fix for Harmonie or Alaro. The cycle will not become a new scientific version (with respect to T1). Deadline for contributions was Tuesday 27 September. CY43T2 is the reference version at MF for (1) validation of the assimilation instead of T1 and for (2) building CY44. The reference validation version will be CY42\_op1 at MF.

Content:

- Fixes and code finalization from the Arpège and Arome E-suite versions CY42\_op1/op2
- Code updates for Full-POS (halo management, conf 903), Arpège optimization and Arpège single-precision forecasts
- Potential fixes for the Harmonie and Alaro forecast model configurations

CY43T2 was declared on 14 November 2016.

**CY44: mid-November 2016 until end of February 2017.**

Content:

- Code re-factoring for OOPS:
  - phase 2 re-factoring of observation operator codes (EC)
  - new version of trajectory code for OOPS-IFS VAR (O. Marsden)
  - updated GMV/GFL structures in order to match requirements for the OOPS INCREMENT and FIELDS objects (M. Hamrud)
  - other re-factoring aspects: fixes to run single-resolution adiabatic 4D-VAR OOPS-IFS (D. Salmond, T. Wilhelmsson, others)
- Pruning of obsolete options in the dynamics (K. Yessad):
  - The old code for the sponge
  - LRNHC1+LSLINLC1
  - LRETCFOU+LWRTCFOU (specific handling of radiation coefficients for the simplified radiation scheme of Arpège 4D-VAR)
  - The NH code for GEO-GW (coded in 2007, never used nor fully validated)
  - Note: in this process, some specific Aladin/LAM code will be removed
- Scientific inputs from CY43T1/T2 and CY43R1/R2/R3.

CY44 was declared on 15 March 2017.

**CY45: March-April 2017. This is a pure technical cycle immediately following upon CY44.**

Expected content:

- OOPS re-factoring:
  - adapted trajectory codes for simplified physics (D. Salmond)
  - first bits and pieces for VarBC (R. Stappers, A. Geer)
  - fixes and updates to enable multi-incremental IFS 4D-VAR from OOPS-IFS (M. Hamrud, D. Salmond)
  - adapted codes to redirect code printouts from std.out to listing (NULOUT) (M. Hamrud)
  - an updated version of Full-POS changes towards OOPS and conf 903 (R. El Khatib, E. Arbogast)
  - [Major change in the model codes:] pass by arguments MODEL variables and parameters (aka SPAMing). Partially remove global variables and pass all fields and parameters as arguments via Fortran structures. SPAMing is implemented via a Python script followed by some necessary manual intervention (O. Marsden for the IFS/Arpège codes, in coordination with A. Mary)
  - The SPAM re-factoring also applies to relevant LAM codes and variables (A. Mary, W. Khalfaoui)
- a few technical adaptations of the codes, outside the scope of OOPS re-factoring:

CY45 was declared on XX April 2017.

**CY45T1: Sept-Nov 2017 (precise dates yet to be confirmed)**

Provisional input:

- System aspects:
  - PREP with FA file formats, deactivate default use of LFI format (Ph. Marguinaud)
  - FA file format support in FESTAT (R. El Khatib)
  - fixes for LAM+SURFEX and MPI in order to enable MPI tasks running in E-zone regions only (REK)
  - optimizations for Full-POS; important updates for Full-POS in OOPS (configuration 903 for Arpège and Arome, and PostProcessor object in OOPS) (REK)
  - alternative MPI communicator in DrHOOK (REK, following S. Faroux)
  - pruning of FEMARS in CNT3/IFS code (REK)
  - enable NPROMA loops beyond the minimum length of MPI slices; code changes to alleviate reproducibility problems with Intel compiler version 17; miscellaneous other code optimizations for Arome (REK)
- Arpège and Arome model dynamics:
  - first codes for implementing the Quasi-Elastic NH equations in global and LAM (for finite differences at least) (K. Yessad, F. Voitus)
  - vertically variable SITRA in SI operator (K. Yessad)
  - more flexible filtering of orography for PGD files (KY)

- simplifications in the code of LASCAW when interpolating half-level fields (KY)
- if ready: enable to only switch on higher-order interpolations in the last iteration of P/C scheme (could be numerically cost-effective when LPC\_FULL, KY)
- Arome physics:
  - add a term of deposition for the microphysics (Y. Seity)
  - a significant rewrite of the ICE3 microphysics code in order to reduce the dependency upon the time step value (Note: some bugs fixed while rewriting) (S. Riette)
  - add surface fields to DDH diagnostics (Y. Seity)
  - recent updates for computing gust winds, from the CY42 e-suite (enable to compute gust winds over a different time range than the forecast range of the output file) (Y. Seity)
  - *implement SURFEX V8.1 ? Tbc* (Y. Seity)
- Assimilation methods:
  - updates for Ensemble Data Assimilation (EDA) and for using grid point  $\sigma$ 's in AROME. This contribution includes a significant rewrite of LSPFCE=.FALSE. For LAM (Y. Michel)
  - enable to diagnose the content of one column of B; enable a specific REDNMC value for Q (specific humidity); implement a tuning  $\sigma$  coefficient for GPSSOL in Bator (Y. Michel)
  - optimization of code for filtering B matrix structures and for computing the inflation factor for AROME EDA (previous codes already in CY43T1) (Y. Michel)
- Observations:
  - enable monitoring of data from the MTVZAGY microwave radiometer on board METEOR (Russia) (Ph. Chambon, F. Suzat)
  - enable monitoring, possibly assimilation, of data from the AMSR2 microwave radiometer on board GCOM-W1 (Japan) (P. Chambon, F. Suzat)
  - implement monthly varying versions of microwave surface emission atlases (F. Suzat)
- ALADIN, HIRLAM: Tbd ...
- OOPS re-factoring:
  - further reorganization, encapsulation and passing-by-arguments of the LBC code for LAMs (B. Bochenek, A. Mary, K. Yessad)
  - finalize the adaptation of Arpège options to the re-factored observation operator codes of phase 2: APACHE, ACHMTTL/AD (MF/ OBS team)

**CY46: middle or end of Nov 2017 through February 2018, precise timing and content yet open to discussion with ECMWF. This cycle will contain several new stages of the FORTRAN re-factoring of the IFS for OOPS.**

Provisional content:

- OOPS re-factoring:
  - final part of VarBC for OOPS-IFS
  - LTOVSCV
  - code adaptation for multi-incremental (multiple resolution) IFS 4D-VAR

- removing/pruning many of the global model variables references in USE statements (duplicated with passing by arguments of CY45)
- scientific contents of CY45T1 and CY45R2

Note: CY46 shall be built in a two stage process, with first the merge of the more scientific oriented interim cycles CY45T1 and CY45R2, followed by a final merge of the OOPS re-factoring items (those will be managed as a specific OOPS branch on top of CY45 first). Expected time of final declaration of CY46 is end of February 2018.

## Progress and plans of E-suites/O-suites:

### Progress and plans for MF's NWP suites in 2016:

The 2016 important scientific targets concern the implementation of new applications:

- **Arome-Nowcasting (“Arome-PI”)**: operational since 8 December 2015;
- **Arome-airport** application (for SESAR production). The operational implementation is to be discussed between Research, Production and IT Depts (not yet done);
- **Arome EPS (“PEARO”)**: porting to operational environment was completed in summer 2016, and since then daily production runs are performed twice per day;
- **Arome Overseas**: five domains in dynamical adaptation from the IFS (except La Réunion – 3D-VAR and Arpège coupling). In operations since 11 February 2016.

### HPC aspects at MF in 2016:

Here is the status of the porting to BULL and the upgrades of MF's HPC configuration for the end of 2016:

- The first Phase 2 BULL Cluster (new “prolix”) was declared operational in the beginning of July 2016.
- The second Phase 2 cluster (new “beaufix”) was fully validated in October 2016.

The following main items have entered the MF E-suite of the 2<sup>nd</sup> semester of 2016:

- **CY42\_op1/op2**
- Arpège/Aladin physics:
  - new convection scheme “PCMT” in Arpège
  - SURFEX in Arpège
- Arome physics: modified cloud optical properties, changed threshold value for liquid rain auto-conversion rate
- Improvements in the assimilation of satellite radiance: MWHS2 on FY3-C (Chinese satellite), GMI on GPM-Core (US satellite)
- Arome-Overseas: activated the 1D ocean mixing model CMO, implemented Incremental Update Analysis using a short term (6h) forecast as “first guess” and a IFS-forecast minus IFS-analysis via ee927 as increment (IAU enables to remove some spin-up while relaxing towards the latest IFS analysis in production mode)

The evaluation and improvements of this e-suite have lasted until the first quarter of 2017. Therefore, the switch to operations is for the time being expected for end of May, or possibly June, 2017.

### Plans for MF's NWP suites in 2017-2018. A new e-suite is scheduled to be implemented in September 2017, for a switch foreseen in spring 2018. Among its potential content:

- Cycle version basis: CY43T2 or CY44 in discussion (under evaluation); if so, the SURFEX version would become V8+

- 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 (model geometry) based on IFS official GRIB\_API library
- New horizontal resolutions for global systems (deterministic, EDA, EPS):
  - ARPEGE: ~5km over France (T11598c2.4L105 or T11798c2.2L105)
  - 4D-VAR: 2 minimisations in T1224c1L105 and T1499c1L105
  - EPS: 35 members (unchanged) at ~7.5 over France (~T11198c2.2L90) and four times per day
  - EDA: 50 members in T1499c1L105
- Modifications in the physics: tunings in PCMT convection scheme, inclusion of prognostic graupel in Arpège's microphysics, revision of surface evaporation over sea, 1D version of GELATO sea ice scheme, Flake lake model, etc.
- European radar data in Arome, Humidity observations from aircraft, variational bias correction for aircraft data, observation correlation between infra-red channels, 2D obs operator for GPS RO data, etc.

Other potential changes, or R&D work in progress, concern the following items:

- PEARP (global EPS) : 4 runs/day, test stochastic (model) parameter perturbations (SPP) instead of or in addition to SPPT
- Arome-France, other Arome models :
  - progress on forecasting low level clouds and fog,
  - test the new microphysics scheme LIMA in R&D mode only for the time being,
  - diagnose visibility and cloud bottom height,
- PEARO (convection-permitting EPS) : 4 runs/day, increase ensemble size ?