ALADIN LTM meeting
Tuesday 2 October 2018
16:00-18:00
Salzburg, Austria

Document for Item 3.a in
the agenda

Subject:	Progress and plans: • status of common IFS/Arpège/LAM cycles, • MF operational and R&D activities.
Summary:	Please see below, the detailed plans about the recent R&D code releases in MF's GIT repository, as well as the progress and plans at MF about e-suites and operational implementations.

Action(s) required:	• Take note of MF's plans for e-suites and operations in 2018 and 2019. Especially, please note the upcoming change of resolution of Arpège, planned for operations in the beginning of 2019 (first quarter).
	• 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.
	• For all LTMs and representatives, please check within your teams for potential candidates for the upcoming phasing exercises in Toulouse:
	    ○ CY47: **candidates for January-March 2019**, for the next joint IFS/Arpège/LAM.
	    ○ CY47T1: possible volunteers for **spring or autumn 2019** are welcome; details about the phasing work and the strategy of cycles will be sent in due time and until the next LTM meeting (April 2019).

Cycles, code releases and a few comments:

CY46T1: this cycle ideally should include all updated fixes enabling to run Arpège and LAM data assimilation systems [phasing up from CY43T2 – would include CANARI revival] + updates for Arpège-Surfex_v8 (adapted from CY42_op2 via CY43T2_bf) + any other fixes collected within [CY43-CY46].
Some additional new science will be added too.
Timing: Oct-Dec 2018. The deadline for contributions is Friday 28 September. Declaration to occur before X-mas.

Provisional 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, 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:
  - *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)*
  - visibility*; precipitation types; various flavours of snow cover height (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

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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.

- 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
- Arpège atmospheric physics:
  - *tunings and code adaptations needed for Arpège new resolution Tl1798C2.2L105 (??)*
  - *evolution of Lopez microphysics (Y. Bouteloup)*
  - interface to the IFS deep convection scheme (Y. Bouteloup)
  - interface to the ECRAD radiation 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)*
  - *other Arpège physics changes ??*
  - *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)
  - *other Arome physics changes ??*
- SURFEX based on v08 in [CY43-CY46T1] *or implementation of Surfex v8.1+* depending on results of testing in Arome (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.
  - linked with the previous bullet, a trial will be made for implementing V8.1 (with the help of S. Faroux)
- 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 LENSCV for EnVar (Y. Michel)
  - fix for reading FA files instead of GRIB in AEARP (B. Ménétrier)
- Observations:
  - Bator updates from CY43T2_bf (in coordinaiton with Aladin/Hirlam partners, after discussions in Toulouse in April 2018) (F. Guillaume)
  - *additional Bator updates by M. Martet and C. Payan*
  - *AMDAR humidity data: optimize QC and assimilation in ALARO or AROME 3D-VAR (P. Moll, A. Trojakova, F. Meier)*

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- *first codes for assimilating all-sky radiances using a Bayesian inversion method (P. Chambon)*
- *new satellites/instruments: 1) Aeolus L2 HLOS winds, 2) MTG-IRS, 3) IASI-NG, 4) winds from various scatterometers (GMAP/OBS)*
- *adapt codes for assimilating European radar data from OPERA (E. Wattrelot)*
- *preparations for assimilating radar dual-polarisation data (E. Wattrelot)*
- *use of infrared emissivity atlases for the use of IASI skin temperature retrievals (V. Guidard)*
- *first potential code adaptation of IFS/Arpège/LAM codes in order to test COPE3 pre-processing tools (E. Wattrelot, M. Dahlbom) tbc*

- 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)
  - improvements in ACRANEB2 (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.
  - 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
  - some CANARI fixes (A. Trojakova)
  - dynamics changes:
    - *implementation of the variables d5/W5 proposed by Fabrice Voitus (J. Vivoda, P. Smolikova in collaboration with Karim and Fabrice)*
    - dynamical switch-on/off P/C scheme for NH kernel of AAA models (J. Vivoda, P. Smolikova)
  - *Graupel code: requires a deeper restructuring (out of range for CY46T1). In the meanwhile, (IF LGRAPRO) statements need to be commented out in four subroutines in order to compile with Intel.*

- HIRLAM (in discussion between D. Santos and C. Fischer):
  - *Harmonie-Arome related physics, especially microphysics changes (and interface to radiation)*
  - *dynamics (one change in gnhd3.F90 originally from M. Hortal)*
  - *Bator and obs pre-processing (reviewed with F. Guillaume and E. Whelan)*
  - *assimilation: 4D-VAR/LAM and Jc-DFI fixes, MSGinit ???*
  - *system aspects (fixes and portability)*
  - *surface perturbation for EPS in pertsfc.F90*
  - *fixes required for Harmonie-Arome, re-phased from CY43T2_bf[04-08] or from CY43H2 into CY46*

- 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
  - *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 ?)*
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CY47: January-March 2019.

Provisional content:
- OOPS re-factoring in IFS FORTRAN codes:
  - VarBC tidy-up for OOPS-IFS, C-VarBC
  - VarQC, observation error correlations
  - adapted handling of time and time step variables for multiple MODEL instantiation - Step 2
  - 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)
- contents of CY46R1 and CY46T1

CY47T1: spring 2019 or autumn 2019 ??

Provisional content:
- System operational aspects (Météo-France o/e-suites):
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- System technical aspects:
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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)*
- 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)
- Arome 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

- 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*
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- ALADIN: to be discussed - see list below
- HIRLAM: to be discussed - see list below
- 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*

CY47T2: any time or good reason to do a T2 before end of 2019 ??

CY48: very open timing ! Could be a "quick" IFS/Arpège joint cycle before the end of 2019, or a late joint cycle after 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 end of March 2019).

Progress and plans of E-suites/O-suites 2018-2019:

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 spring 2018, for a switch foreseen in the first quarter of 2019. Expected content:

- Cycle version basis: **CY43T2_bf.08** (to become the **base for a CY43T2_op1**); the SURFEX version is V8+ (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 (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 changes (tbc):
  - Observation correlation errors taken into account for IASI and CRIS
  - Variational bias correction for GNSS observations
  - Assimilation of GNSS-RO on FY-3C
  - Assimilation of wind from ScatSat-1 (Ku band)
  - Assimilation of AMVs from GOES-R (16)
  - Monitoring of AMSR-2 from GCOM-W1 (7 channels)
  - Use of ATOVS, ATMS, MWHS-2 DBNet data
  - Monitoring/assimilation of Doppler winds and radar reflectivities (OPERA european radars)
  - Tuning in the dynamics (horizontal diffusion, SL iterations number)
  - Tuning of convection scheme in ARPEGE
  - Improved version of AROME microphysics scheme
  - Initialization of CMO-1D in AROME-Overseas with Mercator 4x per day

- Improvements in AROME surface analysis
- Graupels in ARPEGE microphysics
- New aerosols climatology originating from ARPEGE-Climat model
- New diagnostics: visibility, etc.

An executive outlook of MF's R2O plans on 2018-2019, reflected with respect to code cycles, could read as follows:

- CY43T2:
  - baseline validated end of April;
  - build e-suite version CY43T2_op1 (May-June-July);
  - port to Operations as e-suite (July-September);
  - switch to operations in Q1/2019;
- CY46:
  - IFS/Arpège joint cycle declaration on 10 April 2018;
  - requires phasing of fixes for assimilation in summer-autumn 2018;
  - build a CY46T1 in October-December;
  - start preparing a Research e-suite version beginning of 2019;
  - port e-suite to operations by end of 2019;
  - operational switch end of 2019 or Jan-Feb 2020;
  - note: if CY46T1 would prove more difficult to validate than expected for now, then the back-up cycles for the S1/2019 e-suite would be either CY46_main (+ fixes for the assimilation) or CY43T2_opNN.
- Build CY47 over January-March 2019 (with ECMWF).
- build CY47T1 either as a bugfix and completion cycle for OOPS in CY47 (Arpège, LAMs), or as an R&D version including developments (from MF, Aladin, Hirlam etc.). tbc.
- Migration to new HPC: mirror suite to start latest on 1 May 2020 (tbc), based on the operational code version of April 2020. However, this timing may still slip by about 6 months. Porting of a CY47 version to Operations before migration is quite unlikely.