Draft minutes of the IFS/ARP tech' videoconf meeting of 26 Sept 2017:

0. participants:

Deborah, Olivier, Tomas (EC),
Claude, Alexandre, Ryad, Karim, Etienne (MF),
Daniel, Roel (Aemet/Hirlam),
Daan (RMI/Aladin)

1. OOPS re-factoring progress post-CY45

Status of tests with OOPS-IFS:

EC manage to run a multi-incremental OOPS-IFS 4D-VAR with the same resolution for two inner loops (two T255 TRAJ steps followed each by a T159 minimization), with acceptable results with respect to IFS 4D-VAR run in degraded mode (i.e. with certain switches disabled that are not available in OOPS yet – e.g. LVARQC). These tests still use a reduced set of the observations (ATOVS, ATMS, Conventional without AIREP) also no LTOVSCV, no VARQC, no Jc.
For two different horizontal resolutions, the OOPS 4D-VAR does work technically but the result of the final analysis increment significantly diverges from the IFS result. The likely guilty part is in the way the change of resolution of the increment is being done in the OOPS inner loops. Basically, in OOPS, the χ-variable is handed over from one minimization to the next, while in the SIM4D algorithm, there are steps of application of SQRT(B) added in between. The application of SQRT(B) seems to definitely have a numerical impact, and the inner loops solution does not converge to an acceptably close result between OOPS and standard 4D-VAR. EC intend therefore to implement the SQRT(B) object and the preconditioning in OOPS, for the purpose of complete validation. Marcin Chrust is writing a technical note about this finding. EC will send it to MF once completed.

Re-factoring items in progress or planned:

- split of namelists (Mats): scripts will generate several namelist blocks, that will be recognized in the OOPS-IFS interfaces. Mats has sorted the namelist blocks between resolution-depending and resolution-independent blocks. For standard IFS, the changes are neutral and the classical “fort.4” file is read. The split namelist facility will enter CY46.
- evolution of json for OOPS (EC): “json” will be used in the C++ in order to handle the complete tree of namelist blocks, and make the link with the several MODEL objects.
- handling of time variable in IFS (Mats/Olivier/Deborah): Olivier has started to draft a code proposal in order to handle timing and time step information with respect to a MODEL instance (each MODEL object should be able to have its own time and time step values). Olivier will continue to work on this in liaison with Mats and Karim. Code and a short note will be sent to MF once the proposal is (pretty) ready.
- Full-POS (Ryad): Ryad presented a few slides on his progress with Full-POS for OOPS (slides can be obtained from Ryad or Claude). The re-factoring as ready this autumn will enter CY45T1 in MF, and Ryad will send the code to EC for scrutiny and possibly for inclusion in the CY45_OOPS branch.
- any other news about re-factoring ongoing or planned (EC, MF):
  - VarBC: the big class that exists now will probably have to be split later, but this is not a priority action for now. So likely to happen after CY46 (this will reduce potential

memory over-consumption in OOPS).
- Duplicated routines for OOPS in CY45: Deborah has pruned a large number of the duplicated codes for CY46. The expectation is that only the STEPO[.,TL,AD]_OOPS and the new/old TRAJ routines will have to be maintained in parallel after CY46, and for as long as both OOPS-IFS and standard IFS will be maintained.
- VarQC: Lars Isaksen will adapt this code for OOPS as soon as he is available for this task (the re-factoring method has been decided though).
- LTOVSCV: Olivier will adapt this piece of code, for CY46 (with help by Tony McNally).
- Olivier has prepared TL/AD tests for the model. Etienne already has TL/AD test for the obs operators. Action on Etienne to send his tests to Olivier.
- Observation error correlation code (for IASI, CriSP): Peter Lean is going to look into this code for OOPS-IFS. He will write a note about his proposal of re-factoring (note by Claude: this was perhaps an area where the definition of the object for the obs error covariances “R” wasn’t fully understood at the time of the 2015 workshop in Toulouse, was it ?).
- Jo-table: Peter Lean has a code to generate the Jo-table, available in the CY45_OOPS branch.
- LBC code for LAM (H. Dhouioui – Tunisia -, Alexandre, Karim)

2. OOPS code exchanges in GIT manner

EC have created a _OOPS branch in their GIT repository, on top of CY45. Various re-factoring elements already have been implemented there (split of namelists, Jo-table, etc.). MF will send further codes, for Full-POS in OOPS and later specific scientific codes for OOPS assimilation prototypes (localization codes) as agreed with Sébastien Massart.

EC will continue to use this branch for testing progress with OOPS-IFS 4D-VAR. MF will use it for code exchanges only *for the time being*, as they are not yet ready to test CY45 assimilation (note by Claude: MF are still busy with updating codes for CY43T2, and in parallel updates are being prepared for CY45T1).

OOPS re-factoring items will generally be implemented in parallel in both CY45_OOPS and in the EC/MF interim cycles (CY45T1, CY45R1, CY45R2). It is expected to only merge CY45T1 and CY45R2 when building CY46, plus extra re-factoring stuff if ready in the course of the construction of CY46. After CY46, the definition of a new _OOPS branch based on that cycle will be evaluated.

EC informed that they had to define a specific IFS-OOPS C++ version, in order to make progress with implementing the tests of OOPS-IFS (the full 4D-VAR under OOPS). Indeed, the MODEL object actually is necessary for a few operations, such as the construction of a STATE. This type of dependency however was initially not desired in the design of objects of the abstract OOPS layer, which should enable definition of more model-independent objects. An alternative solution, namely to stick to MODEL-unaware definitions of other objects, would require a much deeper recoding of the IFS than the already ongoing re-factoring, and would be a very complex and long effort probably out of range for the OOPS Project. Discussion with the OOPS master administrator at EC is taking place, in order to decide how these dependencies eventually can be designed for future master releases.
MF asked whether this MODEL object dependency could hamper the implementation of new

assimilation algorithms in the OOPS/C++ layer. EC thought this would not be a problem; the point rather would be that other model types (eg. the toy models, NEMOVar) would have useless dependencies.

3. Content of CY45T1 (MF/Claude)

Provisional list in Appendix 1, for information to all participants.

4. Preparation of CY45R1 (EC)

Content of CY45R1: refer to list from the 12 June coordination meeting in Toulouse. This cycle is now almost completed in Reading. It has been recently validated with respect to a meteorological validation over the summer 2017 period, as well as for the EPS system (Tomas). In Nov/Dec, EC will produce CY45R2, and the start of build of CY46 is scheduled for mid-January 2018.

5. AOB & next meetings

next videoconference IFS/Arpège coordination meeting on Thursday 28 September 14h30 CET / 1.30pm UK

next technical videoconference on Thursday 7 December 2017 14h30 CET / 1.30pm UK

next physical IFS/Arpège coordination meeting on Monday 19 March 2018 in Toulouse

End note: list of actions of this technical meeting:

1. EC to send MF Marcin's note about the SQRT(B) in OOPS and impact of preconditioning
2. MF (Ryad) to send EC the state-of-art Full-POS code based on CY45_main, for scrutiny and feedback about the interfacing with OOPS (this code can enter the CY45_OOPS branch once ready, or at any suitable time)
3. EC (Olivier) to send note about the proposed handling of time and time step in OOPS-IFS, and associated IFS re-factoring
4. MF (Etienne) to send EC (Olivier) the code of the obs operators tests (TL, AD etc.)
5. EC to send MF Peter's note about the code re-factoring for obs error correlations in OOPS-IFS

Claude.

APPENDIX 1: Content of CY45T1

CY45T1: Oct-Dec 2017. Deadline for contributions Thursday 28 September, 23:59 CET.

Provisional input:

- System operational aspects (Météo-France o/e-suites):
  - Fixes phased on top of CY45, for enabling to run screening and minimization in Arpège 4D-VAR and Arome 3D-VAR ***in CY43T2*** (P. Moll, F. Suzat, C. Payan, P. Brousseau, E. Arbogast)
  - *Fixes for CANARI in CY43T2, tbc* ()
  - Phased contributions to MF's Arpège+Surfex e-suite based on CY42_op2 (GMAP staff)
- System technical 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)
  - pruning of FEMARS in CNT3/IFS code (REK)
  - drHack: a runtime profiling facility to dynamically generate call tree information for any configuration (F. Suzat)
- Diagnostics and specific post-processing:
  - add surface fields to DDH diagnostics (Y. Seity)
  - Flexible DDH OpenMP debugging (F. Voitus):
    - Introduction of a new DDH type devoted to the DDH bugdet in APL_AROME
    - Fix for storing and cleaning the DDH structure when KSTEP=0
- 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)
  - 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)*
  - first version of the LIMA two-moment microphysics scheme (Y. Seity, B. Vié)

- Assimilation methods:
  - updates for Ensemble Data Assimilation (EDA) and for using grid point σb'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 NETCDF I/O of LAM stabal and stabcv files for the B-Matrix (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)
  - monitoring and potential use of scatterometer winds from the Indian satellite ScatSat-1 (tbc, C. Payan in coordination with ECMWF/G. De Chiara)
- ALADIN:
  - fix for quadratic/cubic coupling (Jan, following Jozef and Alexandre)
  - fixes for ALARO-1 (Jan Masek)
  - combination of SURFEX with TOUCANS (D. Degrauwe and R. Hamdi)
  - *prognostic graupel scheme "LGRAPRO" (B. Bochenek) tbc*
  - phasing of VFE work for NH dynamics (Petra Smolikova)
  - note: a fix for writing out spectral orography in e923 clim files was added as well, already in CY45_main (originally fix by F. Taillefer)
- HIRLAM: final list is under discussion
  - observation pre-treatment aspects, Bator/Oulan (mostly E. Whelan)
  - microphysics and radiation ()
  - Surfex changes
  - assimilation code (M. Lindskog, others) – Jb, Jk, … -
  - miscellaneous cleaning and fixing (U. Andrae)
- OOPS re-factoring:
  - further reorganization, encapsulation and passing-by-arguments of the LBC code for LAMs (H. Dhouioui, A. Mary, K. Yessad, B. Bochenek)
  - remove the Tomas' trick for YOMPHY* variables. Proper handling of the MODEL parameters inside calls to MF obs operators (A. Mary)
  - more generally, finalize the adaptation of Arpège options to the re-factored observation operator codes of phase 2: APACHE, ACHMTTL/AD (MF/ OBS team)

Expected timing for declaring CY45T1 in MF's GIT repository is in December 2017.