

# IFS/Arpège Memorandum

**From:** Claude Fischer (Météo-France)

**To:** (ECMWF) DR, RD Division & Section Heads

**To:** (Météo-France) Arpège diffusion list

**To:** (ALADIN) Piet Termonia

**To:** (HIRLAM) Daniel Santos-Muñoz

**File:** RD18-xxx

**Subject:** Draft minutes of the IFS/Arpège coordination meeting held on 19 March 2018.

## **Participants:**

**Meeting room (Toulouse):** CNRM Committee Room F. Taillefer.

**Météo-France:** Alain Joly, François Bouyssel, Claude Fischer, Ryad El Khatib, Karim Yessad, Stéphane Martinez, Jean-François Mahfouf (all full day), Camille Birman, Florian Suzat, Etienne Arbogast (for Items 9.1-9.3), Dominique Puech (Item 9.1)

**ECMWF:** Stephen English, Deborah Salmond, Peter Lean (all full day), Olivier Marsden (afternoon)

**ALADIN:** Daan Degrauwe (full day), Piet Termonia (morning)

**HIRLAM:** Daniel Santos-Muñoz (full day)

## **1. Adoption of Agenda**

adopted

## **2. Approval of Minutes of meeting of 28 September 2017**

approved

## **3. Review of list of actions from last meeting**

1. Action on both MF (Claude, Ryad, Stéphane) and EC (Deborah, Tomas) to agree on the content of link and runtime information to be included in FLUBs (compilers tested, versions of libraries, extra data files etc.) => *this extra list was agreed in the tech videoconfs (list GRIB, ecCodes, ODB-API, OOPS/C++, RT-files, RTTOV-files etc. + info about which compilers and compiler versions had been used). Ryad pointed out that it could be useful to*

*have the information ready even a bit before starting to build a new joint cycle. Agreed.  
Action closed.*

2. Claude will check with Gérald/Loïk/Etienne as well as Sébastien, whether they intend to continue discussing the potential issues with the LSPRT option in the assimilation code. This includes exchanges about technical notes describing the bugs found on both sides, and a specific discussion when G/L/E visit Sébastien on 20-22 November. Claude will keep Steve informed => *exchange of information has started when Claude, then Gérald + Loïk + Etienne visited EC last autumn (discussed with Sébastien). However, it was felt that the codes for LSPRT still were unsafe, and both MF and EC will further investigate them. It was agreed to continue to exchange information and keep this action open.*
3. Claude to check with Philippe Marguinaud about potential GRIB2 features to enter the ECMWF ecCodes packages, and provide feedback to Deborah and Shahram Najm. => *the exchange of information and the exchange of code developments will continue through the normal channels. Claude explained that presently there was an open action between MF and WMO in order to fully accept the LAM bi-Fourier grid definitions as WMO standard for GRIB2. Completion of this task is pending confirmation by MF's IT Dept and by WMO contacts. One specific consequence is that when using LAM codes + ecCodes in CY46, ecCodes prompts a Warning message ("Lambert grid not found", roughly speaking). This message is however harmless as long as specific spectral fields compression options are not being asked (they are indeed not being asked in operational LAM configurations so far). Action as far as the IFS/Arpège coordination is concerned, is closed.*
4. Action on Steve and François: François to send details about the GNSS VarBC implementation in CY42\_op2 => *we agreed that we should exchange info about the assimilation of GNSS data in both systems. Action reformulated and reassigned (Lars Isaksen at EC and Patrick Moll at MF). Steve to send information about VarBC with AIREP in CY45R1 => done. Closed.*
5. EC (Steve) to send MF (François) information about the lightning parameterization in CY45R1 => *done. Closed.*
6. Action on EC, MF and LAM: contact appropriate teams and scientists active on the dynamics codes, and check whether the deep atmosphere option can be pruned from the shared codes => *inquiry done and all contacted scientists and groups gave green light for the pruning. The option for deep layer has indeed been pruned from IFS/Arpège/LAM codes in CY46. Closed.*

*Note: the slides by François (item 4), Steve (item 5) and Peter (item 9.1) can be obtained from the authors on request.*

#### **4. MF information about progress and plans of E-suites and cycles (François)**

François presented the recent evolutions of MF's operational NWP suites:

- mid 2017: new system Arome-IFS

- December 2017: operational switch to CY42\_op2 which is MF's latest scientific change with for instance the surface scheme Surfex in Arpège
- February 2018: migration from Meteosat-10 to Meteosat-11
- March 2018: increase maximum lead times of Arome systems by 6 hours
- April 2018: extend Arpège and Arome EPS systems to 4 runs per day

A “mini” e-suite based on a code version CY42\_op3 is in preparation in order to port the Arome EDA system to Operations (details in François' slides).

This suite would be followed by a new scientific e-suite based on CY43T2\_bf, whose major scientific change will be an increase of the horizontal resolution of the Arpège deterministic forecast (about 5km over France), the EPS forecasts (7.5km over France) as well as the 4D-VAR increments, and an increase of the number of members of the global EDA (from 25 to 50 members). A number of other scientific changes are presently under investigation. The detailed list of expected contributions reads:

- Cycle version basis: CY43T2 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 (T11798c2.2L105)
  - 4D-VAR: 2 minimisations in T1224c1L105 (90km) and T1499c1L105 (40km)
  - EPS: 35 members (unchanged) at ~7.5km over France (~T11198c2.2L90)
  - EDA: 50 members in T1499c1L105 => 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.

François stressed the efforts in MF to improve the Research-to-Operations procedure, with several aspects that are now being discussed and tested (collaborative tools, project-team approach, validation process, etc.).

Questions raised by EC or Aladin/Hirlam:

- the increase of CPU cost in the global systems is estimated to be about \*3 for the whole global suite, \*5 for the EPS alone, \*3.5 for the deterministic forecast, \*4 for the EDA

- a new operational layout on the HPC should however enable to keep the (real-)time production delays unchanged. Thus, downstream production times should not be affected (eg production of Aladin LBC files)
- the so-called Arome-IFS model version actually uses IFS atmospheric coupling fields, and Arpège surface fields (its naming is therefore slightly improper). This model system (2.5km resolution) was a request from MF's Operations Dept.

Claude presented a summary view of the expected planning of MF cycles in link with e-suites:

- CY43T2:
  - baseline validated end of March;
  - build e-suite version (April-May);
  - port to Operations as e-suite (June);
  - switch to operations by end of 2018;
- CY46 (or CY45T1 ?):
  - IFS/Arpège joint cycle declaration end of March 2018;
  - requires phasing of fixes for assimilation in summer-autumn 2018;
  - build a CY46T0 or T1 in the autumn (yet tbd);
  - start preparing a Research e-suite version beginning of 2019;
  - port e-suite to operations by mid-June 2019;
  - operational switch in the autumn 2019;
- Build CY47 either in autumn 2018 (early scenario) or Jan-March 2019 (late scenario): tbd at (this!) coord meeting of 19.03.2018 (*see item 10*)
- prepare an e-suite version based on CY47 and port to operations (summer-autumn 2019); switch to operations by March 2020 or so
- Migration to new HPC: mirror suite to start on 1 May 2020 (tbc), based on the operational code version of April 2020

## 5. EC information about progress and plans of E-suites and cycles (Steve)

Steve presented the progress and plans at EC.

CY45R1 high-level summary:

- Target implementation date: 5 June 2018
- Many strategically important science and technical changes
- Observations:
  - Increased satellite data usage (Infrared data over land, all sky microwave data over coastlines)
  - Update to latest Radiative Transfer model (RTTOV-12) used in the assimilation of all satellite radiance data
  - Better use of radiosondes including drift during ascent and improved aircraft bias correction
  - Ocean and dynamical sea-ice in HRES: this brings HRES consistent with ENS and SEAS5
  - Atmospheric model changes (warm-rain, convection, lightnings)
  - Model uncertainty: more 'physical' SPPT and SKEB deactivation (2.5% cost savings)
  - EDA: more reliable and consistent with ENS
  - New products: probability of lightning
  - Faster operational model+wave production: 15%
  - Scores: Mixed, some positive, some negative

More details: see for Steve's slides.

A summary of the scores and evaluations results is listed hereafter, along with other lessons learnt from the preparation and porting of CY45R1:

- **HRES:**
  - Scores indicate that overall the cycle is neutral/slightly positive

- The two main negative issues from the scorecard are:
- TP (~2% RMSE deterioration in summer): model changes improves the frequency biases but increases variability. Negative effect on RMS(TP) or CRPS scores but the SEEPS score is improved.
- WAVES (~10% deterioration in summer): degradation appears when fcs verified against analysis but not when compared against obs (discussion to follow)
- Significant timing improvement, ~15%
- **ENS:**
  - Scores indicate that overall the cycle is mixed, though monthly scores positive
  - The two main negative issues from the scorecard are:
  - TP CRPS (2-3% deterioration in summer): deterioration is linked to model and SPPT model error changes
  - WIND (1-3% deterioration in summer over extra-tropics): also linked to changes in the model and in SPPT
  - Significant timing improvement, > 15%
- **45r1 Lessons Learnt :**
  - Mixed results, especially for ENS, raised questions if 45r1 was a viable cycle
  - Earlier testing of EDA and ENS would have helped: some issues much clearer only in EDA, ENS testing, even if visible in HRES.
  - Care is needed interpreting score sheets: e.g. wave scores

The Research-to-Operations process was discussed. Steve introduced a few recent considerations developed at EC:

- Assessing the potential to use smaller ensemble sizes in testing
  - e.g. 8 instead of 50 members in ENS, plus question of sufficient resolution
  - “fair scores” when testing changes to the forecast system (accounting for ensemble size).
- For ENS, Martin Leutbecher is working on a paper that will describe the results in detail.
- By end of April, we expect to have a copy sufficiently mature to send to Météo-France for information but also for your comments.
- For EDA, Simon Lang is working with Massimo Bonavita on a similar concept.
  - It is being examined to see if issues found late in 45r1 testing could have been identified earlier.
  - This work is at an early stage, we are interested in Météo-France thinking in this area
- We are also interested to know whether Météo-France is either using or working on a method to represent observation uncertainty in the verification of ensemble forecasts. Have they documented what they are doing in this.

Next cycle CY46R1 planning:

- data assimilation:
  - 50 Member EDA (plus cheaper test configuration): *possible large impact*
  - Continuous DA: *possible large impact*
  - Reformulation of B matrix plus optimisation of calculations
  - Modified Cariolle ozone chemistry
  - Upgrade of the augmented control variable
  - EDA Jacobians for soil moisture
  - SMOS Neural Network
  - Weakly coupled SST in the tropics
  - ERA-5 contributions

- observations:
  - Improved and increased use of IR GEO radiances
  - Upgrade all IR coefficients to the latest spectroscopy
  - Retune background error for skin temperature (step towards full field T\* analysis in coupled system)
  - Microwave all sky improvements
  - Improved microwave observation usage
  - BUFR TEMP DROP and BUFR TEMP MOBILE
  - Aircraft obs errors
  - Ground based GPS
  - Surface pressure bias correction (external to IFS)
  - Huber norm for scatterometers
  - Ambiguity selection for scatterometers
- model:
  - Convection: alleviate biases in maritime continent (to active triggering in deep conv) + other small conv changes with expected positive impact **~ 2% in winds, temperature in the maritime continent area**
  - Microphysics: improvements to address the increase in precipitation bias in the E. Asia monsoon
  - Radiation: LW scattering - approx 1% improvement in T in the troposphere
  - Revision of aerosol climatology (3D) - small impact expected
  - Modification to Cariolle ozone chemistry scheme
  - Improved WAM physics: (i) new physics based on Ardhuin et al. 2010 (ii) new method to compute momentum and energy fluxes for NEMO (iii) fix for very shallow water wave breaking (iv) sea state dependent heat and moisture fluxes
  - New climate fields v16 with revised LSM lakes cover and depth
  - Revised coupling coefficient for wet skin tile (Tmax instability fix)
  - I/O server changes for WAM
  - NEMO V3.6 + SST partial coupling changes (passive)
  - 5-layer snow (passive)
  - Higher order wind component interpolation and polar spherical geometry improvements in SL advection (currently passive: to be activated subject to improving TL test results with physics and reducing cost)
  - SP fixes + other passive/bit-identical changes (modified continuity equation formulation under switch, idealised DCMIP cases, ICI bug fix)
  - 1-hour radiation timestep for the ensemble
  - Model timestep change from 720s to 600s
  - Optimise ENS for 50m EDA
  - Multiple grid in IFS (passive): Atlas based advection schemes running at multiple res grids / given directly to Tomas W for merging

Questions/items raised in the discussion:

- in the seamless system, the ocean model is fully coupled with the atmospheric model in the tropics (20S to 20N) and partially coupled in the extra tropics. For the partial coupling the OSTIA analysis is used in the first four days with an increment adding from NEMO, then from day 4 to day 8 the OSTIA component is progressively removed. MF asked EC about their future plans for SST, whether daily MERCATOR products for instance would be considered (HRES and ENS). ECMWF are considering assimilation of L3 products in NEMOVAR in the future in the coupled data assimilation system.

- Constrained VarBC (aka c-VarBC) adds an additional constraint on the size of the bias correction. This formulation is now being applied to AMSU-A channel 14 data. This allows inter-satellite biases to be removed successfully by VarBC.
- It was noted that EC were continuing to test in-depth the IFS behaviour with single-precision. Recent problems concerned SGEMM on CRAY and the set-up of constant values in the radiation scheme (ECRAD).
- MF asked about how EC were handling the drift information of dropsondes, whether this was handled the same way as for RS. ECMWF responded that the plan is to do so once dropsondes with navigation information become available.
- Which component of the HRES/ENS systems have been optimized for Open-MP in CY45R1 ?
- Steve explained how specific negative results seen on the scorecards had been studied. First, a 2% deterioration of total precipitation (TP) was noticed, which came from an increase of TP variability, while frequency biases were improved. The wave model showed a 10% deterioration when compared to analysis or buoy significant wave height observations. The distribution of height obs is however very sparse and localized in coastal areas. Comparisons with altimeter data provides a global validation and shows improvement from 45r1.
- EC spent a significant time in testing and evaluating the ENS and EDA systems. This has triggered motivation to study the relevance of testing and evaluating changes in a simplified framework, especially using a smaller ensemble size. Martin Leutbecher is preparing a paper on this topic. EC explained they were interested to get feedback from MF about this proposal.
- About introducing ATLAS in the IFS code: MF recalled that they wish the IFS/Arpège code to remain protected against a mandatory installation and use of the ATLAS library for the time being. EC confirmed that ATLAS interfaces were implemented using pre-compiler directives, thus they can be filtered and ignored already at compile time.

## 6. Status of merge of CY46 (Claude, Deborah)

Claude gave an overview of the steps of the build so far:

- CY45R1+OOPS received from EC around 15 January. MF and EC exchanged then about compile issues (on BULL, Stéphane) and about code compliance checks (several comments sent by Karim to EC).
- Several versions of pre-CY46 have been built since then: v01 (5/02); v02 (15/02) which was sent to EC; v03 (7/03)
- Known contributions for v04, to be build on Thursday 22 March PM:
  - necessary fixes to run all “mitraille” tests: "faigra.F90 (back to v02), wrsfp.F90, transinvh.F90, sudimf1.F90 "
  - pruning too much verbose for NODE file in “aplparr.F90”; corrected various comment lines; remove obsolete routines
  - replace LNHDYN by LNHEE and LNHQE
  - last update of Full-POS re-factoring (for OOPS)
  - fixes from ECMWF: YOMCVER, YOMTRAJ
  - updated version of “mitraille” technical benchmark data & scripts in GIT
  - new: will add the diagnostic evaluation tools for technical benchmarking in GIT (“checkpack”, “ciboulette”)
  - **note: v04 will be sent to EC for cross-check and testing**

- Remain to be finalized before declaring CY46:
  - with ECMWF: PPOBSAP (Deborah/Christophe/Alan), SUGOMS (handling of NOBSHOR, Mats/Claude/Deborah)
  - re-factored setup routine for VAR/LAM calculations (SUESCAL) (Abdenour & Claude)
  - any late fix ...

Deborah stressed that the feedback by MF had been very useful to improve the codes for CY46. The regular exchange of pre-versions and bug-fixes was appreciated on both sides, and coordination of updates had been very smooth. Both MF and EC found that the status and progress for CY46 was so far very satisfactory.

Claude showed the outcome (in graphical format) of the technical benchmark test (so-called “mitraille”<sup>1</sup>) performed in MF. Deborah asked to send one such example to EC for information<sup>1</sup>. EC have started to test the usual RD truncation 4D-VAR (Tco399), which was running with only very few extra fixes.

Declaration of CY46 was still expected for the end of March, possibly with a slight delay into the first week of April. A detailed content (with a focus on re-factoring items) is added in Appendix 1 of these minutes.

## **7. HIRLAM comments**

Questions were handled within each of the previous items, on-the-fly.

## **8. ALADIN comments**

Questions were handled within each of the previous items, on-the-fly.

## **9. Specific issues:**

### **9.1. Continuous data assimilation + COPE (Peter)**

Peter introduced the progress and planning for continuous data assimilation in operational IFS. The goal is to enable additional observations to enter assimilation in each outer loop of 4D-VAR. This means also to rerun observation screening at each Traj step. In total, however, timing can be saved since the first cut-off times could be earlier than today, and trajectories would still be updated at each loop. The early delivery assimilation window could be extended from 6h to 8h. The goal is to implement continuous DA for CY46R1 in June.

Conversely, the timing of COPE is being delayed, most likely to after the move of the data and computing centre to Bologna.

More details about continuous DA and COPE are in Peter’s slides.

### **9.2. OOPS Progress (mostly EC)**

Steve gave an update of the progress and plans for OOPS-IFS. The original planning was to test OOPS-IFS in CY46R1 in the Research Dept by June 2018. However, a few re-factoring items remain open, and technical testing proved more difficult than expected (to solve them sometimes

<sup>1</sup>Claude joined an example of a HTML output file to all participants



requires to do some more re-factoring). Despite the overall significant progress of re-factoring since CY43, the remaining issues have forced to revisit the planning, and it is now foreseen that the OOPS-IFS configurations of full 4D-VAR will not be fully ready for Cy46r1, though it is expected to complete shortly afterwards. In terms of cycles, CY46R1 will therefore be open to scientific changes in preparation for the next e-suite versions, while outstanding OOPS developments will enter a “CY46R1O”. Open issues in OOPS include VarQC, all-sky radiances, restart configuration.

Claude mentioned that progress with Full-POS in OOPS had been very satisfactory. MF probably would have a fairly completed re-factored FP code for June, or early September. Already in CY46, FP is ready for testing the post-processing object instantiation in OOPS (required by EC), and soon will be ready for change of geometry applications (eg. for Arpège 4D-VAR required by MF).

An open question was whether MF would port their OOPS-Arpège and Arome/LAM prototypes on top of CY46 codes (note: they are still in CY43++ with quite a few hacks here and there). There are both pros and cons for this. Consensus was reached for porting the prototypes and resume testing on top of CY47. The latter however should then contain all remaining re-factoring from 2018, thus CY47 should be built in beginning of 2019. In the meanwhile, a high priority at MF should be to realize validation of Arpège and Arome assimilation in the recent IFS/Arpège cycles, either CY45 or CY46, and for the classical non-OOPS binaries (so-called MASTERODB binary files).

MF further asked about EC’s plans for surface assimilation under OOPS. EC indeed plan to adapt their surface assimilation to OOPS, but not in the time line of their first OOPS operational implementation. The first OOPS versions will be ready for IFS 4D-VAR and for the ocean system NEMOVAR. Surface (continental) assimilation would follow only later, after the move to Bologna and the first OOPS-IFS operational implementation. A high priority for surface assimilation in 2018 was to enable the computation of the surface Jacobians from the EDA (which does not require OOPS versions).

Steve mentioned that EC might have to handle another specific code version, namely a CY46R1-based code for migration to the next HPC in Bologna (“CY46R1B”). A fairly long period of frozen operational versions, for preparing the move of applications to the Bologna centre, was being asked by Operations for 2019.

The exchange of information about calendars of HPC and Bologna will be continued in the upcoming coordination meetings. Timing of cycles until CY47 is discussed in item 10 (see decisions below).

### **9.3. Outlook on IFS technical changes under discussion for after OOPS (all)**

Upcoming technical changes for CY47 or later have been addressed:

- ATLAS interfaces will enter CY47 protected within pre-compiler directives (thus, the codes can be filtered before compilation, which is probably how MF will implement this cycle in 2019). There is for the time being no agreement between MF and EC for sharing, testing or using ATLAS in the common codes.

- Olivier presented his proposal to work on pruning NCONF and the set-up level in CNT0. The goal eventually is to make extensive use of OOPS re-factored set-up (from constructors) also in classical non-OOPS binaries. The MODEL object constructor interfaces (in FORTRAN) for instance could become a main element of high level initialization. This change would ease cross-validation and maintenance of both OOPS and non-OOPS binaries in future cycles. Whether the change could become effective already in CY47 was left open.

## 10. Content and timing of cycles

Below is an updated version of the overview Table of Cycles, after discussion. It was stressed at the meeting that after CY47 most of the planning and the schedule still had many “?”. One reason for the uncertainties is the yet-to-be-confirmed calendar of HPC operations both in MF (HPC upgrade followed by porting of NWP suites planned basically for S1/2020) and at EC (for the time being, fairly same schedule as MF but with a large “?” about the exact timing of the move to Bologna).

It was stressed that there was a potential risk to have two follow-up joint cycles separated by significantly more than 1 year (CY47 – CY48). The recommendation in the meeting was not to allow more than one year delay between joint cycles, which means to keep a watchful eye on the post-CY47 planning as decisions about the new HPCs, resp. the move to Bologna, become consolidated.

Joint cycle	ECMWF	MF	Start of phasing	Declaration	Misc. / Oper plans
CY45			March 2017	28 June 2017	MODEL object re-factoring
		CY45T1	2nd October 2017	24 January 2018	Including Aladin and Hirlam
	CY45R1		May 31 <sup>st</sup> 2017	August 2017	Operational June 2018
	CY45R2		Mar 31 <sup>st</sup> 2018	Technical cycle for introduction of ecBuild	
CY46			Start Jan 15 <sup>th</sup> , 2018	End of March 2018	<i>OOPS aspects added as extra branch on CY45R1 for CY46</i>
		CY46T0 or CY46T1	Sept-Oct or Oct-Nov 2018		Either very technical update for fixes (T0) or with some specific science included (T1)
	CY46R1		31 May 2018	September 2018	OOPS updates + science
	CY46R1O			Until end of 2018	Continuously updated cycle version for testing

					OOPS-IFS
CY47			Mid-January 2019	End of March 2019	Target joint cycle for baseline OOPS in Research mode
		CY47T1	May-June or autumn 2019 ??		Could contain OOPS fixes for Arpège and Arome
	CY47R1			2 <sup>nd</sup> half of 2020 (after move to Bologna) ??	
CY48				Q2 2020 ??	

## 11. AOB

none.

## 12. Next meetings

### Next technical video-conferences:

- ⇒ reminder of Tue 6 February (minutes available from Claude)
- ⇒ Thursday 7 June, 2018 14h30 CET / 1.30pm UK

### Next Coordination video conferences:

- ⇒ Thursday 21 June, 2018 14h30 CET / 1.30pm UK
- ⇒ Thursday 20 September, 2018 14h30 CET / 1.30pm UK

### Next physical Coordination Meeting:

- ⇒ March 2019, meeting to take place in Reading (full day). Precise date tbc in upcoming coordination videoconferences.

For information: next OOPS Project Board on Tuesday 15 May, 10h CET / 9.00am UK. Steve (Project Manager at EC), Deborah and Claude will attend.

In closure of the meeting, Claude thanked Deborah for her truly excellent, skilful and friendly coordination of the IFS/Arpège code evolution, and the collaboration with MF. Deborah is to leave the IFS/Arpège collaboration in the end of September 2018, when she will leave EC for retirement.

### List of actions decided:

1. MF and EC: continue investigate the codes for LSPRT=.T. and exchange information on any further testing or code fixing.
2. MF (contact: Patrick Moll) and EC (contact: Lars Isaksen) to exchange detailed information about how GNSS data are being assimilated.
3. Questions for EC (Steve):
  - a. MF asked EC about their future plans for SST, whether daily MERCATOR products for instance would be considered (HRES and ENS).
  - b. MF asked about how EC were handling the drift information of dropsondes, whether this was handled the same way as for RS.
  - c. Which component of the HRES/ENS systems have been optimized for Open-MP in CY45R1 ?
4. EC and MF to exchange information about strategy for testing ENS and EDA systems. MF to provide any comment about M. Leutbecher's note (strategies for early testing and evaluating changes in the ensemble systems).

## Appendix 1: content of CY46 with a focus on re-factoring items.

List of content:

- OOPS re-factoring in IFS FORTRAN codes:
  - VarBC (work started to split into smaller pieces, to be continued after CY47)
  - pruning of TSCV and LTSCV from control vector codes
  - encapsulation of TOVSCVX and LTOVSCV for control vector
  - code adaptation for multi-incremental (multiple resolution) – Sqrt\_B formulation added to OOPS
  - adapted handling of time and time step variables for multiple MODEL instantiation - Step 1 - to be continued for CY47
  - Full-POS work not already in CY45T1 (this is a continuous work in progress until end of 2018)
  - pruning of many of the duplicated model routines temporarily defined for CY45\_OOPS. For the parallel maintenance of OOPS-IFS and IFS, for a few cycles, the STEPO(TL/AD) routines, as well as the TRAJ\* routines, will have to be maintained with both their OOPS-IFS and IFS versions
  - removing/pruning many of the global model variables references in USE statements (duplicated with passing by arguments of CY45)
  - Removal of LQSCATT switch
  - Cleaning and improvements to oopsifs interface layer – especially consistent use of linked list
  - Cleaning of NOBSHOR settings
  - Move of GBRAD Obs operator to HOP position
  - Some fixes for T to TV conversions – expect more needed here
  - any other content of the CY45\_OOPS branch that might not already have done it into an interim cycle in either Reading or Toulouse
- pruning of deep atmosphere code option in IFS/ARPEGE/LAM dynamics; pruning of namelist key LNHDYN replaced by LNHEE (== former LNHDYN version) and LNHQE (K. Yessad)
- fixes for Quasi-Elastic NH version (KY). Note that the NH-QE code is not yet fully functioning in a scientific proof manner. In particular, the RHS of the tendency for vertical velocity  $w$  has to be redesigned. This is a target for CY47.
- LAM code phasing (K. Yessad, R. El Khatib, O. Spaniel, A. Ambar)
- OOPS/C++ or system aspects (scripts etc.):
  - split namelist blocks enabled for multiple objects instantiation in OOPS-IFS (+ use of json to handle the namelist trees), link with new scripts for OOPS-IFS
  - Jo-table enabled
  - test programs for model TL/AD, obs operator TL/AD
- scientific contents of CY45T1 and CY45R1+OOPS -note: there was no CY45R2 at ECMWF