IFS/Arpège Memorandum

From: Claude Fischer

To: (ECMWF) DR & RD Section Heads

To: (Météo-France) Arpège diffusion list

To: (ALADIN) Piet Termonia, Daan Degrauwe

To: (HIRLAM) Daniel Santos-Muñoz

File: RD20-xxx

Subject: Draft minutes of the IFS/Arpège coordination (videocon) meeting of 23 March 2020.

Participants:

Météo-France: Claude Fischer, François Bouyssel, Jean-François Mahfouf, Yves Bouteloup, Ryad El Khatib, Alain Joly

ECMWF: Steve English, Michael Sleigh, Olivier Marsden, Tomas Wilhelmsson

ALADIN: Daan Degrauwe

HIRLAM: Daniel Santos-Muñoz

1. Adoption of Agenda

agreed

2. Approval of Minutes of meeting of 29 November 2019

approved

1. List of actions from previous meeting (29 November 2019)

1. training material; exchange of information or collaboration on IFS-Arpège code training sessions in 2020: Nils to send Claude relevant information about the ATLAS Hackathon in March & Claude to forward to GMAP; keep-in-touch about DA code training days in 2020 (MF); Michael to send the link to information about the technical training sessions on prepIFS etc. => *Michael sent information about training of EC staff on how to run IFS from OOPS and how to code keeping OOPS in mind. Claude explained that MF are considering to organize a specific code training session in the Autumn 2020 (September), with the aim at*

providing staff from GMAP and from Aladin/Hirlam with know-how about the new IFS assimilation codes, after the heavy re-factoring from CY43-CY46. EC and MF will continue to exchange on their training activity for 2020. (action reformulated)

2. Olivier, Claude and Etienne to liaise in due time and agree on code versions to share: CY48_OOPS Fortran branch, appropriate OOPS/C++ version from OOPS-GIT repository. Possibility to meet on this subject at the technical VC of 21 January 2020. => *a phone call meeting had taken place. We agreed to try to phase MF changes into an IFS-OOPS version ready to work with CY48. This will require a few steps of code exchange, validation on either side and some additional technical information hand-over (eg. Olivier will provide MF with the GIT-tag for OOPS/IFS in CY47R1/pre-CY48). The ultimate goal is to try to have one common OOPS/IFS-Arpege working C++/Fortran code for declaration of CY48. Action closed.*

3. Claude to send an updated MF note on ML areas of interest (refer to the EC/RD note RD19-101) to Peter Dueben and Steve. => *Claude sent a MF summary to Peter and Steve. At MF, Matthieu Plu (GMAP/RECYF team) can be further contacted by Peter for questions or issues of collaboration. Action closed.*

4. Action on Olivier to provide MF (Alexandre) with access information to the IFS test case repository. => *Done. Action closed.*

5. Two actions on MF about the observations code (lead P. Chambon):

    1. send EC a proposal for the GOM-2D flexibility increase (for CY48 if possible)

    2. send EC a proposal for a modified double-box strategy in thinning (in view of CY49)

    3. => *all these items: actions open.*

6. Olivier to send MF information about the confluence page with the description of the work on the IFS physics interface changes (ref to: wrapper, DSL-kind of choices, CPU/GPU oriented code versions) planned to enter CY48. => *Olivier sent the information to Claude; that info exchange was followed by liaison with the EC Confluence administration team in order to correctly provide access to all necessary pages. Claude should now send Olivier a first list of MF staff for granting access to the IFS technical pages about GPU, ATLAS, DSL etc. => action reformulated.*
7. MF (Harold, Claude) to send EC the code proposal for the tidying-up of su_surf_flds.F90, planned to enter CY49. => *done, awaiting reply by EC. Action closed.*

2. P&P ECMWF & MF

2.1. METEO-FRANCE Operational versions: status and plans (François)

■ 02/07/19 : operational switch of CY43T2_op2.02

- *New resolutions for global models Arpege (T1798c2.2L105) & PEARP (T1198c2.2L90)*
- *50 members for AEARP, 16 members for PEARO*
- *new observations assimilated from Metop- C and NOAA-20*

- *new diagnostics: type of precipitations, visibility, etc.*

■ **01/10/19 : operational switch of CY43T2_op2.03**

(New observations assimilated from IASI/Metop-C and CRIS/NOAA-20, new list of ground GPS)

■ **15/01/20 : operational switch of CY43T2_op3**

- *Arome-France: Implementation of a snow analysis, Assimilation of OPERA radars, New satellite observations assimilated (ScatSat1, AMSU-A & MHS/Metop-C, ATMS/NOAA-20, IASI/Metop-C)*
- *Arpege: New diagnostics for aeronautics (clear air turbulence and icing), assimilation of ASCAT/Metop-C, preparation of observation monitoring for AMV GOES17, NOAA-20, Metop-C, AEOLUS and GOES17 ABI radiances)*

■ **On-going R2O modifications based on CY43T2_op4**

Assimilation of AMV-GOES17 in Arpege, new list of ground GNSS obs in Arpege/Arome, + other technical modifications

MF are working on a new version of physics for Arpege, including the ECMWF versions of radiation and convection. Experimental results so far provide rather positive signals (score cards). Another important change could be to switch on the GELATO 1D sea ice model. The overall plans in MF read:

■ **Operational switch of O-suite on new HPC expected in September based on CY43T2_op4**

■ **Assimilation of new observations (AEOLUS, etc.) in Autumn based on CY43T2_op5**

■ **Beginning of next E-suite end of 2020 based on CY46T1:**

- Arome (PEARO) and Arpege (PEARP) EPS change of resolution to the deterministic ones
- IFS convection and radiation schemes in Arpege and PEARP
- Snow analysis and sea-ice model in Arpege
- New version of sea surface fluxes scheme (ECUME)
- First use of SPP scheme for model error in PEARP
- Assimilation of microwaves observation in cloudy and rainy regions
- New observation assimilated (AEOLUS, Mode-S, ...)
- New diagnostics

MF: Cycles and code versions (Claude)

- **CY43T2_op4** is operational
- **CY46T1_bf** is the target version for the 2020/S2 e-suite. We have v02 and very recently major progress was achieved in fixing 3 difficult bugs in the VAR/LAM codes. Apparently, the fixes enable to now run both Arpège 4D-VAR and Arome 3D-VAR with technically good results. A v03 will be built, in some future, containing:
    - the VAR/LAM fixes in the adjoint codes (computation of T for conventional observations – bug also affects IFS/Arpège btw -, rotation of wind in TL/AD which is effective in VAR/LAM, computation of geopotential when LDRY_ECMWF=.FALSE.). *Note: all three fixes have been found thanks to the OOPS/DAVAI unit tests.*
    - The OOPS/DAVAI and OOPS/EnVar updates for LAM.
    - The wrap-up of the coed contributions delivered to CY43T2_op3 and _op4, which are not in v02.
- **CY47T1_bf**: a bugfix branch only for OOPS/DAVAI technical update.
- Finalization of CY48 with ECMWF (see item 5 below).
- **CY48T1**: October-December 2020. MF want to test an incremental build process, with systematic DAVAI testing of each contribution at every step.

EC made comments on the use of COSMET-2 data (MF contact is Dominique Raspaud in JFM's team). Daan asked about the level of dependency of DAVAI w/r to cycles (according to Claude, the dependency should be w/r to namelist and input file definitions).

2.2. ECMWF P&P (Michael & Steve):

cy47r1 content:
• Declared and handed over to Production
• E-suite is cycling
• Still aiming for implementation in late June or early July
• High chance we could delay till September/October
• Even if we are ready Member States might not be
• Initial announcement with test data set should be available in next week or two
• If not then June is out of the question
• First of two webinars should be announced shortly, some time after Easter school holidays

HPC:
• Had access to a remote familiarization system in January – compiled IFS
• Just got access to the Test and Early Migration System, installed in Reading
• Significant system (already second-largest cluster here)
• Can do the bulk of the porting work, hopefully, using this system, so expect to make good progress over the next few months
• Data centre building work ongoing, but hard to see how it will continue on track
• Original date for access to the first cluster – mid-November 2020
• Fully operational in Bologna – September 2021
• Impossible to say what delays we could see

cy48r1: nominally, at least, the plan for 48r1 is:
• Individual scientific contributions ready - Q3 2020
• Evaluation and selection – Q4 2021
• Pre-merging and evaluation of pre-merges – Q1 2021
• Start of incremental build (v-versions) – Q2/Q3 2021
• Handover and operational implementation – Q4 2021/Q1 2022
• Will need to start brainstorming soon for options in the event of significant delay to the data centre

Steve listed the plans for R&D in the upcoming cycles.

Observations changes outside cycles:
• Aeolus L2A wind operational assimilation since January 2020
• GOME-2 from Metop-C operationally monitored since February 2020 (so now all Metop-C instruments are in operations)
• FY-3D MWRI to be activated in the next few months (in all-sky, over sea)
• COSMIC-2 RO obs passive, will be active later this week [Post-meeting note: Confirmation that active assimilation of COSMIC-2 data went operational at ECMWF on 25 March 2020]

Provisional tentative plan for new observations in CY48R1 with IFS code modifications to handle (this list can still change quite significantly in the coming weeks!):
• FY-4A GIIRS
• FY-3E suite of instruments (satellite launch expected 2020 or 2021 into E-AM orbit)
• SLSTR (supporting “in house” skin temperature analysis)
• ATMS 183 GHz channels over snow, possibly including handling of Lambertian effects (48R1

candidate, tbc)
• SMAP passive monitoring
• SMOS (and SMAP) through all-sky and ASCAT soil moisture ODB feedback

Provisional tentative plan for other new developments foreseen for CY48R1 (this list can still change quite significantly in the coming weeks!):
• New EDA skin temperature background error over ocean.
• Extended assimilation of hyper-spectral IR over land surfaces (same as for ocean).
• New LBLRTM latest spectroscopy RT coefficients for all hyper-spectral IR and updated CO2.
• Switch off of cold skin physics over ocean, key part of new skin temperature analysis effort.
• Possible scene dependent OBS error covariance for hyper-spectral IR.
• Aim to update scattering properties in RTTOV-SCATT.
• COPE-related modifications, for instance in the pre-screening (details can be obtained from Peter Lean).
• Re-introduction of balance constraints in stratosphere with re-calibrated balance operators.
• Increase in inner loop resolution (T511 or T639, tbd).
• Re-configuration of EDA with 1-OL and some form of re-centring on the control (fg and/or bg).
• Extensions to current WC-4DVar (activation in EDA, changes in varBC).
• SEKF-EDA extended to soil temperature variables
• Ensemble Data Assimilation for the ocean system and ORAP6 ocean system
• Reanalysis capabilities partially available (ERA6 preparation)
• Enhanced outer-loop coupling system, including skin temperature assimilation

Longer term research activities, possibly for a CY49R1:
• All-sky MW imager assimilation over land for higher frequencies (89, 150/166 GHz).
• Use of model clouds for height assignment for low-level AMVs.
• AMSU-A moved from clear-sky to all-sky assimilation route.
• OOPS-IFS: all bar some aspects of Continuous DA in place, plus staff training and documentation;
• Adjoint-based model parameter estimation (initial focus on surface drag / gravity wave schemes);
• Machine learning techniques aimed at improving current WC-4DVar.
• Parallelisation of 4D-Var minimisation in the stochastic SVD framework, and comparison to on-going research elsewhere with saddle point.
• Further changes in the EDA setup (multi-centring, distributed observations).
• Investigation of spatially correlated R (with Meteo-France, Yann Michel etc.!).
• Development of 2D-ACV skin temperature analysis, if agreed;
• Development of variational emission retrieval algorithm (CO2…);
• Application of hybrid B models for future very high resolution 4D-Var

Steve listed a number of initiatives by EC, which can be of interest to MF:
• EC are planning to do ESA-funded work on impact from a constellation of MW instruments on small satellites. Provided ESA accepts the proposal, this should include technical preparations for MWS.
• EC are looking into the effect of updated EDA-B in OSEs (using a MW sounder experiment as an example)
• EC are seeking funding for VIS assimilation.
• EC are seeking funding for improved MW radiance assimilation over snow/sea-ice (including, long term, for snow analysis).

MF made comments and raised questions on the following items: operational plan for OOPS at EC (EC's plan is: CY49R1 in 2023), singular vectors in OOPS (no high priority at EC for now, as this is not a showstopper for 4D-VAR OOPS/IFS), coupled ocean/atmosphere DA, surface assimilation in

or outside OOPS.
Regarding surface assimilation, EC indicated that porting to OOPS was not of high priority. It seemed also important to discuss which algorithm would be targeted for a code renovation. The tpoic of a renovation of the surface assimilation codes is of interest to all partners, EC, MF and Aladin-Hirlam. It was agreed that we should start an overview and brainstorm discussion involving all partners.
Action on Steve: trigger a discussion about the renovation of the surface assimilation codes, involving contacts at EC (Patricia de Rosnay, David Fairbairn, Pete Weston, Phil Brown, Stephen English), MF (Camille Birman, JF Mahfouf, C. Fischer), Aladin-Hirlam (Patrick Samuelsson, Roger Randriamampianina, Roel Stappers, Asmund Bakketun, Daniel Munoz, Tomas Landelius, Rafiq Hamdi).**3. Exchange on new situation with Covid-19 restrictions & new working conditions**

Most MF and EC staff, bar a core crew to maintain IT and operations, will work remotely from home in the coming weeksto comply with government lockdown instruction and guidance. It is unclear when this situation will cease, but it is to be expected that confinement and remote working conditions will last several weeks. In MF, individual situations are extremely diverse. For a number of colleagues, home working already was in place before the Covid-19 outbreak and they will simply homework until further notice. Other colleagues had no special home work conditions and they sometimes now have little connexion possibilities to the MF environment. It is expected that this situation will evolve, but only slowly. Claude will keep the EC coordination contacts informed about the practical conditions for the follow-on of the IFS/Arpège coordination during confinement, regarding MF aspects.

EC explained that all their staff had remote access facilities to the Centre's IT infrastructure, and R&D work is expected to continue at a pace close to normal. Such activities like testing code branches, running experiments, preparing new code versions should go on mostly as usual. Scientific evaluation and documentation may however be slowed down. Operational changes would continue as planned, but are pending to practical evaluation and feedback about the impact of confinement and remote coordination.

4. Discuss grouping topics for dedicated coordination VCs in the coming weeks (possibly suggest some rough timing or order)

Claude suggested that during the confinement period, the planning and content of coordination meetings might be adapted. The proposal is to limit to half-day with a focus on one or two specific topics each time. This proposal was welcome and adopted. A list of topical VCs was established:

- (reminder from above:) surface assimilation discussion
- adaptation to GPU (will involve Olivier ad Michael Lange): in April => Claude and Olivier to propose a date and invite participants
- modelling aspects, wrap-up about CY48, reduced coordination VC: in May
- discuss outcome of Paris scientific MF/EC bilateral meeting: first requires that minutes are made available (by A. Brown and M. Pontaud)
- technical VC: tbd

5. Status on build of pre-CY48

MF sent the preliminary pre-CY48.02 to EC in beginning of March. This version contains CY47T1 and the January version of CY47R1. In between, CY47R1 has evolved in EC with additional changes included in the automatic integration process. Tentatively, Olivier merged the additional

changes between the January and the March versions of CY47R1 into pre-CY48.02. Olivier will soon start testing pre-CY48 at EC.

MF will evaluate whether the additional changes from CY47R1 are safe to include in pre-CY48 (i.e. no additional phasing constraint or technical novelties). *Post-meeting note: the additional changes involved significant new compilation steps (in ODB and for pre-processing some of the IFS model code). Therefore, it was decided in agreement between MF and EC to not include the additional CY47R1 changes into CY48. The changes will have to be re-merged on top of CY48 later.*

6. Content and timing of next cycles: what can we actually say about this today ?

This discussion was postponed.

7. AOB and end of meeting

none.

List of Actions:

1. training material; collaboration on IFS-Arpège code training sessions in 2020: EC and MF will continue to exchange on their training activity for 2020.
2. Two actions on MF about the observations code (lead P. Chambon):
    1. send EC a proposal for the GOM-2D flexibility increase (for CY48 if possible)
    2. send EC a proposal for a modified double-box strategy in thinning (in view of CY49)
3. Claude to send Olivier a first list of MF staff for granting access to the IFS technical Confluence pages about GPU, ATLAS, DSL etc.
4. Action on Steve: trigger a discussion about the renovation of the surface assimilation codes, involving contacts at EC (Patricia de Rosnay, David Fairbairn, Pete Weston, Phil Brown, Stephen English), MF (Camille Birman, JF Mahfouf, C. Fischer), Aladin-Hirlam (Patrick Samuelsson, Roger Randriamampianina, Roel Stappers, Asmund Bakketun, Daniel Munoz, Tomas Landelius, Rafiq Hamdi).
5. Action on Claude who will keep the EC coordination contacts informed about the practical conditions for the follow-on of the IFS/Arpège coordination during confinement, regarding MF aspects.
6. Dedicated VC on adaptation to GPU (will involve Olivier and Michael Lange): in April => Claude and Olivier to propose a date and invite participants