OOPS technical meeting of October 30th 2012
IFS cleaning and re-factoring (post CY39): Part 2

Participants (MF) : Florence Rabier, Claude Fischer, Karim Yessad, Alexandre Mary, Etienne Arbogast
Participants (EC) : Deborah Salmond, Alan Geer, Tomas Wilhelmsson, Mike Fisher
Participants (HIRLAM): Niko Sokka
Participants (ALADIN): Daan Degrauwe

1. Introduction

This conference was the first 4-point video-meeting. With Toulouse, Helsinki, Brussels connecting to ECMWF.

2. Wrap-up of 39

2.1 38t1

For MF Cycle 38t1 which would be the basis for their next E-suite was just in final stages of debugging. Claude commented that there had been a very large effort to find all bugs in the code – and had taken over 4 months from June to October with a good half dozen experts from various areas (especially for pieces of the DA system) involved. There was no common cause of the bugs: Some were related to SURFEX, some to inconsistencies in the link between ODB and the IFS/Arpège code (contexts / tables / SQL requests), and some from the OOPS restructuring. The bugs caused the data assimilation to crash – but sometimes it took many cycles of assimilation before the crash occurred.

2.2 pre-39

It was felt that the merge for Cycle 39 was no more complex than that of Cycle 38[1]. ECMWF have already tested Version 06 of the pre-39 code on model and 4D-Var. A month of data assimilation had been run to check the meteorological results were comparable with Cycle 38r2. MF had a Version 07 in preparation which was expected to be ready to send to EC by November 14th.
The main outstanding issues were:

- Some OpenMP and NPROCB>1 reproducibility issues reported by Oldrich Spaniel – these had not been seen in EC configurations.
- Legendre Transforms 4% slower on NEC. This was due to the replacement of the MXMAOP interface to DGEMM with a direct call to DGEMM – which made the code simpler. This did not show any performance degradation on the IBM at EC as the DGEMM on the IBM was able to do the necessary transpositions. It was agreed that the MXMAOP could be reinstated for MF. As this is only an issue in the global configuration this is not relevant to ALADIN or HIRLAM partners.
- A change to the RRTM (rrtm_taumol*.F90) routines done by EC had

1 Post-meeting: Karim mentions difficulties because of late entries into pre-CY39 from MF, and expresses some worries due to the very late declarations of CY38T1 and CY38R2 (making early merge actions subject to missing late corrections committed to the “main” versions of these cycles).

stopped the unrolling of the outer loop before vectorisation on the NEC – and so increased the cost of an Arpege Forecast by 20%. This change had been done to give some flexibility by changing PARAMETERs NG1 etc. to integer variables. It was hoped that this would enable a saving in the EPS configuration at ECMWF. However this had not proved to be useful and so the change could be reverted.

- Deborah would introduce in V07 and test (for bit-reproducibility) the calls to Karim's new GPHPRE – which simplified the code by replacing consecutive calls to 3 routines GPPREF/GPXYB/GPPREH - in the EC physics and Obs Operator.
- Also the indenting to HRETR which Karim pointed out had been lost when the subroutine was re-merged by EC would be redone by EC before declaration.
- ESIG was to be moved back to QASSET module for its use in CANARI as is was not part of the JB_STRUCT (the new Fortran encapsulated structure for VAR B-matrices). The old situation with a global variable in a MODULE is not ideal w/r to OOPS-specifications for the Fortran. We may have to come back to this in a later cycle (Note: we checked with Yannick & Mike that this solution is not hampering the present developments of the OOPS VAR prototype).
- Sigma-B bug was reported for Arpège 4D-VAR in CY38, at the level of index assignments for Ozone GFL fields used at the beginning of SCAN2MTL when CDCONF(6:6)='A' or 'B'. This code is related to the computation of background error standard deviations in observation space by randomization with B. Alas, so far, we have not been able to understand the root of the problem (DA experts would have to further liaise). For the time being, the problematic piece of code has been wrapped with a conditional LECMWF test.

MF would inform Deborah if they wanted her to revert either the MXMAOP or RRTM for Cycle39 on top of V07 ACTION Ryad or Claude

The target for declaration of Cycle39 would be 19th November.

3. ACTIONs for 19/09/12 Video-Conf

3.1 About setup and Geometry object*: Tomas will now start coding some prototype re-factored setup and related modules, and send any consolidated code proposal to MF (Karim & Claude) OPEN*

Tomas gave an update on his work on the Geometry object for OOPS. He pointed out that his work was focussed on enabling the code satisfy the OOPS requirement to have multiple resolutions of the model instantiated in the same run. So rather than trying to be a 'pure geometry' – the geometry object would include some other quantities that were different for different resolutions – but would not include quantities that were the same for different resolutions. For the setup routines - Tomas said that it was sometimes not possible to untangle them – as there were good reasons for the dependencies – so he was not aiming at a complete split – more to do what was necessary to get multiple

resolutions. Anyway the OOPS/C++ code did not need to know about the details of the geometry.

Claude asked about the link with Karim's 'Reorganisation of setup for OOPS' document: ptr2013_reorganisation_yomdyn_v1.pdf and the geometry work. Tomas said this was needed – but it was later in the setup chain.

Tomas expected that he would be ready to send a prototype code to MF within a month. ACTION Tomas

> ***3.2 Further discussions about Setup+Geometry questions****: ECMWF will set a specific email diffusion list so that all relevant contact persons can liaise and exchange information in an electronic forum mode => Action to MF/Aladin/Hirlam: send list of relevant correspondents including email addresses to Yannick & Deborah OPEN*

Not done yet

> ***3.3 New model field structure****: Alan Geer is preparing a proposal to overhaul the model field structure, in a spirit close to what he proposed for the GOMs earlier (now in CY39). Alan is preparing a prototype code => Deborah will send this code to MF before the next video-conf (Karim&Claude) CLOSED*
> ***3.4*** *Karim has prepared a new version of his rolling* ***cleaning document*** *=> Claude will send the link where all new docs by Karim can be found CLOSED*

*See:*Latest Cleaning Doc(based on 38r2): ptr2012_cleanings_in_arp_v8c.pdf

Note: MF is offering to continue to host these technical notes on the Aladin website. Readers may check at: http://www.cnrm.meteo.fr/aladin/spip.php?article222

4. C++/OOPS training in Madrid

Dan gave a report on the HIRLAM/ALADIN/AEMET C++/OOPS training that had been held last week at AEMET in Madrid.
The training had been in 3 parts:

- C++ and O-O programming and design patterns (2.5 days)
  This had been useful to give a taste of the advantages that O-O could bring.
- OOPS code : TRAITS and TEMPLATES (1day)
  This was given by Jesus Montero Garrido – it was too short to understand the subtleties of OOPS – and due to technical reasons the Doxygen/UML could not be shown. Also Nils Gustafsson presented his OOPS version of the QG/LAM and Dan presented his work on the extension of the fieldset to include coupling fields for Lateral Boundary conditions.
- Discussions (1.5 days)
  - LAM: how OOPS should deal with it. Should it be hidden or more

elegantly visible to the O-O ?
- Future data assimilation techniques in the OOPS structure: hybrid methods using ensembles.

The outcomes would be written up in a document by Jelena.

The QG/LAM from Nils and Trygve had been sent to EC – and Tomas had checked it worked and proposed to put it in the OOPS git-repository. Their method was to keep below the OOPS layer and mainly put the LAM aspects in the QG fortran. It was discussed whether it should be in the git-repository – and finally it was agreed that this would enable everyone to see the code – but it should not be considered to be frozen as the way forward for a more general OOPS/LAM. Claude said it would be useful to have some documentation on the design decisions that Nils and Trygve had made in producing the QG/LAM code.

5. New Model Field structure

Alan gave a presentation on his proposals for a new structure to replace GMV/GFL and surface fields. See model_fields_ideas.pdf.
This was a development in the spirit of what he had developed for the (new) GOM which was now in Cycle 39. This would make a single place for the definition of a model field – also including information about its interpolation to Observation points. So the addition of a new model field would be very much simplified – and only involve edits in one place – not edits in six different routines as at present. This work is designed to complement Tomas' work – and would help to enable the removal of the Tomas-trick.
MF said they needed some time to think about this development. For Claude, the proposal implicitly suggests that GMV/GFL structures would be suppressed from the code, including their understanding in terms of dynamics and/or tracer fields (SI-affected versus physical fields, in a wide sense). Alan said this could be kept by using the “list of fields” facility he had provided with the new structure. In addition, Claude said that this proposal, if accepted and implemented (in a form to be further discussed), raises a question of priorization with respect to the other important Fortran code re-factoring aspects that already are under discussion (break of Setup, interpolators, etc.). He sees two aspects where more clarity may be needed: (1) the precise link and relative weight of such dataflow overhaul with respect to OOPS-requested re-organization; (2) depending on (1), the layout of tasks and manpower efforts for the coming months & cycles. Claude also asked about how MPI parallelism and OpenMP would be handled, as those features were not fully coded in the code example sent so far by EC, while they remain crucial for optimization & porting. Alan expected to have a prototype code showing how this would work in practice in the radiation code in a few days. This would be circulated to MF to help them see what the code would look like and evaluate the implications.

6. Dates of Next Meetings:

The next video-confs:

OOPS/Cleaning: Last week of November

- **status on code cleaning following Karim's doc, version 8c.**
  - **Appendix L: GPHPRE**
  - **Appendix C: Calling tree**
- **decisions on next cleaning tasks**
- **discussion about a proposal for renaming .h interfaces**

Coordination: 5th December - 13:30 Rdg / 14:30 Tls

OOPS/Technical: January 2013

7. ACTIONS

1. *About setup and Geometry object: Tomas will now start coding some prototype re-factored setup and related modules, and send any consolidated code proposal to MF (Karim & Claude) OPEN*
2. *Further discussions about Setup+Geometry questions: ECMWF will set a specific email diffusion list so that all relevant contact persons can liaise and exchange information in an electronic forum mode => Action to MF/Aladin/Hirlam: send list of relevant correspondents including email addresses to Yannick & Deborah OPEN*
3. *MF would inform Deborah if they wanted her to revert either the MXMAOP or RRTM for Cycle39 on top of V07 (Ryad or Claude)*
4. *Tomas expected that he would be ready to send a prototype code to MF within a month. (Tomas)*
5. *Alan or Deborah would send an extended prototype of Alan's model field proposal, applied to EC's radiation scheme, to MF for further discussion & evaluation*

8. Appendix: List of Karim's Documents on cleaning and OOPS reorganisation of Fortran code:

*** Externalized interpolators**
status_interpolators_v8_sept2012.pdf

*** CDCONF**
status_clconf_cy39_v4_sep2012.pdf

*** Physics Dynamics interface proposals**
ptr2012_intphysdyn_v3.pdf

*** GFL**
ptr2012_gfl_v3.pdf

*** Remove use of command line Options**
ptr2012_commandline_v3.pdf

*** Latest Cleaning Doc (based on 38r2)**
ptr2012_cleanings_in_arp_v8c.pdf

*** Reorganisation of setup for OOPS**
ptr2013_reorganisation_yomdyn_v1.pdf

*** Cleaning of modules for OOPS**
ptr2012_oops_variables_v6.pdf

*** Recommended variable naming in IFS/Arpege**
ykvarname_2012.pdf

Note: all available at
http://www.cnrm.meteo.fr/aladin/spip.php?article222