

OOPS technical video-conference of July 11, 2013
meeting number 1 towards CY41

Participants (MF) : Claude Fischer, Karim Yessad, Alexandre Mary, Etienne Arbogast, Ryad El Khatib, Ludovic Auger

Participants (EC) : Deborah Salmond, Tomas Wilhelmsson, Yannick Trémolet, John Hague

Participants (LAM): Daan Degrauwe (RMI/Aladin), Ulf Andrae (SMHI/Hirlam) => both excused

This meeting was the first among three, planned for discussing the Fortran re-factoring until CY41, and perhaps a bit beyond until CY42. In preparation, Karim updated various technical notes which he continuously keeps at the level of the state-of-art IFS code, and ECMWF had sent a list of priority topics for re-factoring (see Appendix). John sent an e-mail about the progress with running the IFS forecast from the OOPS layer.

1. cleaning issues:

- replacement of GPPRE, GPXYB by GPPRE: this is Appendix K in Karim's note. EC plans to work on this for CY41.
- removal of obsolete CDCONF in the surface scheme of IFS: EC will do this pruning.
- Appendix E (renaming, moves): EC agrees to perform the suggested renames and moves. Karim will make the changes for SUECHK (becomes SUCHK) and YEMCHK (becomes YOMCHK). MF and Aladin partners will perform those changes related to the “ald” project (LAM code). Before the work starts, Ryad will send to Deborah and Karim a list of Full-POS routines that should not be touched, as they shall be changed later in the course of externalizing and re-factoring FP.

2. re-address elements of F2003 that could enter CY41 .

For reminder, the issue of implementing F2003 features in the IFS code was addressed in 2012 (mostly at the technical meeting of Dec 5). 5 coding features were then suggested for being useful in order to further clean and factor the code in future cycles (see minutes of that meeting at <http://www.cnrm.meteo.fr/aladin/spip.php?article219>).

Items 2-5 were accepted for CY40, as all known compilers were accepting them.

Items 1-3-4 are still in discussion, and not yet agreed for an IFS cycle, because of compiler issues (see below). In addition, EC proposes to add ISO_C_binding in the list. The complete list of suggested F2003 features, as of July 11, now reads:

1. Data Pointer Assignment to include bounds specifications and remapping to define the subscript extents:

```
REAL, TARGET :: DATA(10000)
REAL, POINTER :: Z(:), SQUARE(:, :)
INTEGER :: FIRST
```

```
FIRST=10
Z(0:) => DATA(FIRST:FIRST+10)
SQUARE(1:100,1:100) => DATA
```

2. Derived type data definition to include ALLOCATABLE

```
TYPE :: MY_TYPE
  INTEGER, ALLOCATABLE :: P(:)
END TYPE MY_TYPE
```

3. Dummy arguments may have ALLOCATABLE attribute

```
SUBROUTINE CALC(A)
  REAL, ALLOCATABLE :: A(:)
```

(The corresponding actual argument must be ALLOCATABLE too.)

4. Protected Attribute

```
MODULE M
  INTEGER, PROTECTED :: I
  CONTAINS
    SUBROUTINE SET(VAL)
      INTEGER, INTENT(IN) :: VAL
      I=VAL !only allowed here
      RETURN
    END SUBROUTINE SET
END MODULE M
```

5. Default values in Type Definition

```
TYPE TEMPERATURES
  REAL :: LOW=0.0
END TYPE TEMPERATURES
Suggested list of F2003 features for IFS/Arpege from CY40+
```

6. Fortran/C binding

```
SUBROUTINE ISO(C_SELF, C_NAME, C_LEN) BIND(C, NAME='ifs_obsvec_read_f90')

USE ISO_C_BINDING

IMPLICIT NONE
TYPE(C_PTR), INTENT(OUT) :: C_SELF
CHARACTER(KIND=C_CHAR, len=1), dimension(C_LEN), intent(in) :: C_NAME
INTEGER(C_INT), INTENT(IN) :: C_LEN
REAL, POINTER :: SELF
```

```
CALL C_F_POINTER(C_SELF,SELF)
```

```
END SUBROUTINE ISO
```

For 1-3-4, the problematic compilers were NEC/SX and PGI. About 6, EC would like to implement asap ISO_C_binding in order to call C++ functions for XML objects in Fortran. Indeed, C++ classes exist and are tailored for this purpose, while handling XML objects using only Fortran structures is very difficult.

MF is not opposed to any of these features, but raises the issue of portability in the view of all remote partners using the IFS locally (LAM partners, OpenIFS ?). For EC, OpenIFS users were not expected to have problems with the specific F2003 features (liaison with OpenIFS team at EC). For Aladin and Hirlam partners, the most critical known issue is for NEC/SX users.

For the short term, it is decided that:

1. EC prepares a simple code example for implementing ISO_C_binding as it would appear in the IFS later
2. MF will repeat the inquiry towards Aladin and Hirlam partners, in order to announce the coming features, and ask them to check which ones would be problematic on their local machine. A high priority is on the ISO_C_binding aspect, that will be evaluated also in MF's models (Ryad) on NEC/SX and BULL.
3. Come back to this issue at the next video-conference and take decision for CY41.

For the longer term, the list of presumably compliant compilers was re-addressed: CRAY XLF, IFORT (BULL, Intel PC, ...), GFORTRAN (versions since 4.7 can compile OOPS / version 4.8.1 is a recent and recommended one for IFS code installation now), IBM.

On the opposite, some (old ?) versions of PGI/PGF90 and the NEC/SX compilers were found problematic both for OOPS and for various aspects of F2003. For PGF90, versions 10.8 and 12.4 were reported to be able to compile the F2003 extensions.

The group of attendees to this meeting made a few recommendations for future calls for tender for new HPC purchase in NMS:

- the RAPS benchmark for F2003 should work on the target machine 
- same for F2008
- the OOPS code along with the toy models should work (and therefore, be part of any benchmark suite)

3. re-organization of global variables (Karim's note) and disentangling of Setup.

Karim wrote a short note suggesting additional moves and a split of Setup routines related to geometry, post-CY40. Tomas agreed he would take into account the proposal for the follow-on re-factoring of the horizontal geometry. The proposal for the share of work is that:

- Karim will do the changes in § 2.1, 2.3 and 2.4 and send the new codes to EC (base: CY40)
- Tomas will implement the other changes of §2 plus any additional change needed to

- complete the Geometry object for OOPS/IFS. Tomas will send this code back to MF.
- MF (Karim and Alexandre) will study that code and propose any further adaptation for Arpège and LAMs.
 - For the time being, the proposed phasing strategy would be that EC implements the final new code into a CY40R. in preparation for CY41. MF would adapt the LAM codes where necessary (possibly with help from an Aladin staff) as a (pre-)phasing step.

Some moves of variables imply strictly speaking also a move in namelist blocks. The namelist moves are however cumbersome to reflect in any namelist file later on, so there is an issue on keeping the frequency at which namelist parameters change place or name in blocks, rather minimal. Ryad suggested an alias-approach so that as an intermediate step, parameters can be set from their original namelist block, while the value is then re-affected to a companion parameter inside a (new) Fortran block.

Ryad will send a short note explaining the “alias-approach” to the other participants. The proposal shall be discussed and a decision for implementing it (or not) shall be taken at the next video-conf.

John explained he now can run an IFS T21 forecast from the OOPS layer. To do so, a pointer to a Fortran structure encapsulating the spectral buffers (SPA3/SPA2/SPA1 etc.) has been defined (YLSPEC). A new STEPO_OOPS has been coded that only treats the sequence of operations for one model time step. It calls directly the transform interfaces from the TFL package (dir_trans/inv_trans) rather than the intermediate interface routines (transdirh/transinvh). Input files are read from the usual IFS I/O routines, in GRIB spectral format. More splitting of the Setup routines remains to be done (collaboration with Tomas and Karim/Alexandre). John will send the code version used for running IFS from OOPS to MF in September, after more of the code re-factoring has been done.

EC mentioned that DDH were difficult to switch off, as there was not one single logical control for it (but several ones, and still some code probably is active). EC can contact Fabrice Voitus in GMAP for liaison on this (e.g. ask questions for how to best switch off DDH), with copy to François Bouyssel and Claude Fischer. It was also noticed that each Centre had its own DDH file format, different from the model one (EC have pseudo-grib, MF have LFA).

This autumn, MF would start work for adapting the Fortran and OOPS codes in order to be able to run an Arpège, then an Aladin forecast from the OOPS layer. This work would be done by Alexandre with support from Karim. It's supposed at this stage that this work includes switching I/O to FA format I/O routines + adapt namelists + implement LBC code in STEPO_OOPS + implement pointers where necessary for LBC (Fieldsets, work prepared by Daan Degrauwe). A few other issues discussed in May when Daan was visiting GMAP about LAM/Aladin code in OOPS/IFS, probably will be raised again during this effort.

4. make a synoptic view of the other re-factoring work for CY41 and beyond

The list of IFS re-factoring priority topics until CY41 (see Appendix) was reviewed. Alain Geer will study the implications of removing one call to COBSALL (and keep one single call only). It is suggested that Alan writes a short note about his analysis, and sends it once ready to MF (Claude can be correspondent for dissemination in MF & to partners).

Mike will adapt the nonlinear elements in the Jb code to the trajectory re-factoring (Claude is correspondent at MF). For Jb, MF is using the NL balance but not the NL change of humidity. The “old” change of variable of Q will be kept in the code and shall be validated for Arpège and the LAM by MF and the LAM partners. It is recalled however that most of the Jb re-factoring is already completed thanks to Mike's efforts and Thibaut's work for the LAMs. Mike will also plug the TOVSCVX control variable segment to the OOPS/C++ layer. This will allow to activate the Tb online adaptation for radiance observations¹ during minimization in the 3D-Var prototype. No specific impact on Arpège or LAMs is expected as this is the same code and option for all models. Note: the general strategy for the control variable is to plug in little by little all extra segments (w/r to the IC slice) directly from C++ (specific pointer) to the Fortran additional term (TOVSCVX for Tb adjustment; later VarBC etc.). Eventually, the Fortran CONTROL_VECTOR structure will become obsolescent (it won't be used from OOPS).

Mats and Deborah will adapt the write out of model fields in FDB GRIB format. In the meeting, it was felt that this work is unlikely to interfere with Arpège or LAM I/Os (however: FA file format I/Os will have to be tested in the now existing OOPS/IFS prototypes; see above or below).

Filip Vana will encapsulate the Fortran code of the trajectory. It's suggested that Filip prepares a short note about the work for the September video-conference, so that all partners can study the code changes and impacts on Arpège/LAMs. Filip would later also adapt the TL/AD codes to STEPO_OOPS.

EC raised the question of Ryad's implication for interfacing Full-POS to OOPS. Ryad and Yannick have already had preliminary discussions on this work in June; we will come back to this aspect in a forthcoming video-conference.

At MF, Alexandre and Karim will take part in the re-factoring of Setup. They will adapt the forecast model prototype by John to Arpège, then to Aladin. Etienne will start adapting the 3D-Var prototype to an Arpège context (note: he's furthermore presently active with implementing gridpoint localization for the IFS/Arpège grids).

5. dates for next two video-conferences.

To match various periods of leaves (holidays), we suggest:

- Week 34 (Aug 19-23): the tentative date is Thursday Aug 22, 1.30pm UK / 14h30 MEST
- Week 38 (Sept 16-20): ibid with Thu Sept 19, same times

the week 34 video-conference would be dedicated mostly to a wrap-up of actions decided and Level 1 topics. The week 38 video-conference would be dedicated to Level 2 topics.

6. AOB:

¹ This is the adjustment of the brightness temperature very near to the surface (aka skin temperature) during the minimization. This value is defined at obs location and reused as bottom boundary condition in the RTTOV calculation for H(x).

Deborah and Ryad/Philippe Marguinaud shall liaise about a specific problem of unsafe code inside the NEW_THINNING code of screening. The agreed solution shall enter CY41.

List of Actions :

1. Before the renames and moves from Appendix E in Karim's note are started at EC, Ryad will send to Deborah and Karim a list of Full-POS routines that should not be touched (as they shall be changed later in the course of externalizing and re-factoring FP).
2. F2003 features for CY41:
 - 2.1. EC prepares a simple code example for implementing ISO_C_binding as it would appear in the IFS later
 - 2.2. MF will repeat the inquiry towards Aladin and Hirlam partners, in order to announce the coming features, and ask them to check which ones would be problematic on their local machine. A high priority is on the ISO_C_binding aspect, that will be evaluated also in MF's models (Ryad) on NEC/SX and BULL.
 - 2.3. Come back to this issue at the next video-conference and take decision for CY41.
3. Ryad will send a short note explaining the “alias-approach” to the other participants. The proposal shall be discussed and a decision for implementing it (or not) shall be taken at the next video-conf.
4. John will send the code version used for running IFS from OOPS to MF in September, after more of the code re-factoring has been done.
5. Towards Level 2 actions:
 - 5.1. Alan Geer would write a short note about the work towards a single call to COBSALL
 - 5.2. Filip Vana would write a short note about the encapsulation of the trajectory code

Appendix: Priority list for OOPS-IFS

Level-1

1. **GEOMETRY** -- Separate setups for geometry (modules are separated in CY40) - **Tomas 31/08/13**
 - **MILESTONE:** 2 states with different horizontal geometries in same run of executable* **31/08/13**
2. **STEPO** -- Separate setups for model (linked to 1.) - **Tomas 31/10/13**
 - Run Forecast from OOPS - **John & Deborah 30/06/13**
 - **MILESTONE:** Run Forecast from OOPS - bit reproducible with IFS **30/06/13**
 - **MILESTONE:** Run 2 Forecasts with different horizontal resolutions (step towards inner and outer loop in same executable)* **31/10/13**
 - Start/End time-step as Grid-point (spectral internal detail of IFS model) - **Nils**
3. **OBS-OP** -- One call to COBSALL - investigate amount of work - **Alan 31/07/13**
 - a) Leave one COBSALL in STEPO - ?
 - b) Move COBSALL out of STEPO - ?
 - Vertical interpolation will remain in HOP for now
4. **JB and Change of Variable** -- Non-Linear balance - **Mike 31/08/13**
 - Non-Linear change of Variables in Q and O3
5. **TOVSCV** -- **Mike 30/09/13**
6. **IOPACK** -- Write out model fields (to FDB) - **Mats & Deborah 31/07/13**
7. **3D-Var Debugging and Assembling** -- **Gabor, Mike, Deborah, John 30/09/13**
 - **MILESTONE:** 3D-Var with Full observations **30/09/13**
 - **MILESTONE:** Scientific work can start on 4D-Ens-Var* **30/09/13**

Level-2

8. **TRAJECTORY** -- Encapsulate trajectory handling - **Filip 30/10/13**
9. **INTERPOLATION** -- Interpolate between horizontal resolutions - **Tomas 30/11/13**
10. **TL/AD STEPO** -- TL/AD version of 2. - needs 2. & 6. - **Filip ?**
11. **PARALLELISATION** -- Put in parallelism from TASKOB etc. - **John 31/07/13**
12. **FULLPOS** -- **Ryad ?**
 - **MILESTONE:** Simple 4D-Var - **Early 2014**
 - will enter **CY41**
 - **MILESTONE:** Run split window 4D-Var in parallel* - **Spring 2014**

Level-3

13. **VARBC** -- Re-factor and call from OOPS - **Alan 31/12/13**
14. **VARQC, Huber Norm and Obs Error Covariance** -- Separate & call from OOPS - **Lars & Niels 31/12/2013**
15. **WAM/Ocean** -- **Kristian 28/02/14**
16. **MODEL BIAS** -- **Yannick 28/02/14**
 - **MILESTONE:** Full 4D-Var similar to current operations **28/02/14**
 - will enter **CY42**
17. **MACC** -- Special Obs operators and physics etc. - **MACC**
18. **DDH** -- **MF**

19. **Consolidation of scripts** -- implications for various applications: EDA, EPS, Surface analysis, FSO etc.

Further Improvements: General Re-factoring and Cleaning

20. **Cleaning** -- From Karim's Document Version 9b

21. **MODEL FIELDS** -- Re-factor based on Alan's plan - will simplify other work

22. **PHYSICS** -- Follow on from Filip's work

23. **LASCAW and SEMI-LAGRANGIAN** -- Follow on from Karim's work

24. **TRANSFORM** - Move Global/LAM IF test into transform package - Mats and Ryad

25. **RESTART** -- Model and Assimilation

26. **SURFACE ANALYSIS** - Clean current OI and SEKF codes - Patricia and Deborah