

# IFS/Arpège Memorandum

**From:** Claude Fischer

**To:** (ECMWF) J.-N. Thépaut, D. Salmond, A. Fouilloux

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

**To:** (ALADIN) R. Brožková / T. Kral

**To:** (HIRLAM) X. Yang

**File:** (...)

**Subject:** IFS/Arpège phone call conference of March 24<sup>th</sup> 2009.

**Participants:**

**Météo-France:** Alain Joly, Claude Fischer, Karim Yessad, Ryad El Khatib, Stéphane Martinez, Guillaume Beffrey, François Bouttier (partly)

**ECMWF:** Jean-Noël Thépaut, Deborah Salmond, Anne Fouilloux, Yannick Trémolet, Elias Holm (partly)

**Aladin :** none

**Hirlam :** none

**1. Any introductory matter ?:**

none.

**2. Review of actions listed at the last coordination meeting:**

*\* MF will do performance checks of RTTOV9 on the NEC vector computer (Vincent Guidard) and send their results to EC (Deborah)*

MF mentions very good performance for the model-to-satellite application inside the AROME post-processing. More results on 4D-VAR are expected based on CY35T2.

*\* EC is curious to get info on performance issues of Arpège on the SX-9 => MF shall give news at the next phone call*

The Initial installation test<sup>1</sup> for the SX9 has been closed. As a result, a new contract is being drafted according to which the final configuration will ultimately have 20 nodes (some hardware work needs to be done at MF's computer Center in order to cope with

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<sup>1</sup>Vérification d'aptitude in French

the expected power supply for this configuration). This configuration will be available in early 2010.

More figures on performance tests will be sent by MF to EC by early April.

MF development teams are now waiting for access on the SX9, for starting the Acceptance test<sup>2</sup> period. This period shall begin on April 20<sup>th</sup> (just after Eastern).

*\* Actions for the near future concerning the "Object-Oriented" recoding project of the IFS (will be called "OO" for short):*

*\*\* ECMWF to send MF any new information on the OO-recoding project: dates of informal seminar, planning memo, any specific technical memo, ...*

one introductory memo by Yannick and Mike has been sent to MF.

*\*\* MF to send Mike's first internal memo to a list of restricted Aladin and Hirlam contacts*

done. No specific feedback so far.

*\*\* MF to keep the survey action on availability of F2003 compilers in the Ald/Hir community*

Survey action has been launched, with several feedbacks. Aladin partners have checked the general support for F2003 features. The main outcome is that some support of F2003 options seems provided with the INTEL compiler version 11. Fewer options seem supported on the IBM compiler. Austria mentions that a feature like object-oriented coding is not provided on NEC compiler. MF also has made some investigations with its local NEC support, which confirm that some critical features for the OO-redesign presently are absent from the NEC F2003 compiling system (object-oriented coding, like generic procedures).

Finally, a few partners definitely still have older HPC systems, with only F90/F95 supporting compilers. (10 answers so far from Aladin countries; Hirlam has not replied so far).

The overall discussion about the OO-redesign shall now take place within the general Arpège/IFS coordination (with correspondence with Aladin/Hirlam partners by MF, according to the evolution of this topic). The specific actions are closed.

*\* Specifications for recoding inside POS shall be produced by MF for after CY36 (Karim<sup>3</sup>). Contact at ECMWF is Nils Wedi*

Karim has sent his document to EC; he will send an updated version to EC asap<sup>4</sup>. EC shall make its comments by end of April (Nils and Deborah).

*\* The old bias correction is not used anymore at MF; MF will re-contact Aladin and Hirlam partners to warn them on the future pruning of this code out of the IFS (action Deborah ; exact scheduling to be decided ?).*

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<sup>2</sup>Vérification de Service Régulier in French

<sup>3</sup>Karim may send the doc by about mid February 2009

<sup>4</sup>Updated doc ... sent the very same day (24/03/09) to EC by Karim

no partner is using this facility anymore. AROME-FR has however only very recently switched to VarBC. The pruning is decided for after CY37 (action Deborah).

*\* EC has problems with the code for analyzing humidity (new humidity variables in the control), after changes made by MF for CY34/35. Deborah and Elias Holm shall contact Loik Berre to sort out the question.*

Elias has sent a short note describing the correction he has done (move the computation of the humidity control variable change inside the change of variable code, so as to use total temperature instead of unbalanced temperature). The code should be readily transposed to the LAM context (to be checked at CY36 => Loik Berre at MF). The action is otherwise closed.

*\* MF is curious on some updated information about the global NH tests with the IFS => Nils Wedi shall prepare some summary of the progress for the next phone call<sup>5</sup>.*

EC will send the link to a submitted QJ paper. Karim mentions a correction for the deep-layer global NH code (case LRNSDLR=.T. And LRWSDLG=.T. Only), which will enter CY36. Action closed.

### **3. Status and progress of operations**

#### **3.1. ECMWF:**

**CY35R2:** this cycle has been switched to operations on February 10<sup>th</sup>. See minutes of previous phone call for a detailed list of content, or the technical memorandum (“flub” Fortran Library Update Bulletin) for this cycle.

**CY35R3:** should be ready for experimentation within the next two weeks.

- Cycle targeted for the tests of the next high resolution IFS (T1279L91)
- new Jb humidity statistics + control vector with the possibility for super-saturation over liquid or ice water
- switch on Huber norm in VarQC
- use refined surface emissivity maps (see work with F. Karbou)
- assimilation of Envisat/MERIS total column water vapour
- assimilation of cloud affected IR radiances from HIRS and AIRS/IASI
- assimilation of NOAA-18
- new orographic drag scheme
- new parameterization for trace gases
- new perturbations in the EPS, coming from the Ensemble Data Assimilation system (which consists of 10 parallel 12h 4D-VAR, in addition to the control IFS); *these perturbations come in addition to the present ones (SVs)*
- weak 4D-VAR with model bias representation in the stratosphere and switched off horizontal balances also in the stratosphere
- VarBC for Ozone data
- optimization for IBM/Power 6, cleaning, optimization of the IOSTREAM function

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<sup>5</sup>Karim intends to send information on his Arpège NH TL538 experimentation as soon as ready

miscellaneous: EC plans to install a low resolution data assimilation suite for research purposes, which would run and be maintained in parallel to the operational suite. The ERA interim reanalysis will now run in near real-time.

### 3.2. MF:

#### **CY35T1: completed in December, declared early January**

- Assimilation:
  - Plug-in LAM wavelet code (A. Deckmyn)
  - Make baseline ALADIN 4D-VAR minimization work (B. Chapnik), including Jc-DFI and multi-incremental treatment of analysis increment (UPDSPEC, ...)
- ARPEGE and ALADIN-FR Physics:
  - completed code for TKE-CBR
  - modifications in KFB shallow convection and in the Bougeault mass flux deep convection scheme
- Dynamics:
  - Rationalisation of the SL Interpolators (plus pruning some options) – J. Masek & F. Vana
  - cleanings in semi-Lagrangian code (including too long lists of dummy arguments) – K. Yessad
  - replace LPC\_XIDT by a simple XIDT management in PC schemes
  - prune obsolete options (conf 951, option LSL\_UNLPHY=T, etc...);
  - recode option NxLAG=2 in an alternative way and prune old code
  - unify some DM-communication routines
  - split 'eta' into 'eta\_vfe' (for VFE operators) and 'eta\_sl' (for SL trajectory research and vertical interpolations), allow LREGETA\_VFE=T and LREGETA\_SL=F in a same run
- Extensions and bug corrections inside EGGPACK (= limited area, plane projection geometry package)
- Surface/PBL observation operator compatibility (L. Kullman, R. Hamdi, J.-F. Mahfouf) => code contribution only inside SURFEX libraries (via P. Le Moigne); more generally, 35T1 contains updated SURFEX code (version 4 bugfix 3)
- Full-Pos:
  - Try to compact sections 2.1 and 3 in POS
- Complete prototype of new DDH dataflow structure => MF shall send EC a technical description for the new dataflow, which presently exists in parallel to the old code (new one is activated for AROME only, old one remains valid for all other models like Arpège/IFS)<sup>6</sup>
- AROME:
  - Introduction of Surfex V4 :
    - rotated lat/lon (HIRLAM projection)
    - I/O (for off line version only ?) :
      - reading of forcing in ascii, binary or NETCDF formats

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<sup>6</sup>A draft document by O.R. was sent by F. Bouttier to M. Hamrud, M. Miller and A. Beljaars on April 25<sup>th</sup>, 2008

- read/write of surface fields in LFI format
- read/write of surface fields in FA format (for the time being, only on regular lat/lon grids)
- CMO1D model (1D ocean superficial mixing layer)
- Interface with ECOCLIMAP2
- optimisation of ECUME (sea surface flux model)
- further modifications :
  - for operations (« rimax », flag for field writes)
  - for simulations at the Dome C location
- Introduction of Masdev4.8 :
  - New version of EDKF (modified tunings)
  - microphysics : Homogenization of Méso-NH and AROME codes for statistical sedimentation and introduction of a switch (for activating statistical or eulerian sedimentation)
  - Modifications for chemistry and desert sand particle transport (in link with the surface)
- Clim files (e923):
  - Introduction of a relaxation of the orography towards the orography of the coupling model (key LOROCPL)
- Reflectivity:
  - Cleaning and harmonisation (reflsim\_dop, reflsim, gpprs0d, ...)
  - New modifications for the 1D+3DVAR code according to tests to be performed in summer 2009
- Assimilation:
  - Modifications for activating the “Jk term” in AROME
- E927 and fullpos:
  - Some corrections for AROME, if ready
- Dynamics:
  - Code adaptations in order to be able to switch on the rectangular truncation

## **CY35T2: declared end of February**

- Assimilation:
  - write out of background fields in GRIB format, instead of FA format (for use in the ensemble D.A. and B-computations) – G. Desroziers -
  - Computation of dynamical emissivity over sea-ice for AMSU instruments (F. Karbou)
  - Coding of the neutral wind observation operator for scatterometer data (C. Payan)
  - Some cleanings in codes concerning scatterometer data (scatt parts in Bator and ARPEGE) (C. Payan)
  - Decoding of Aeolus L1B data in Bator (beginning of the work by Charles Desportes – post-doc -) (C. Payan)
  - Choice by namelist of the AMV channels inserted in Météo-France's ODB and Bator, with some additional cleanings (Bator, ARPEGE) (C. Payan)
- Full OpenMP parallelization for AD of SL code on vector computers; TL and AD code for SLHD (F. Vana)

- Further cleanings in the SL code and merger of some routines below CALL\_SL and LACDYN(+TL/AD)(K. Yessad)
- Scale selective DFI (P. Termonia)
- optimization features and model I/O improvements in the LAM models (R. El Khatib)
- improvements in the new DDH dataflow: inclusion of 2D fields, call from ARPEGE global model (O. Rivière)
- AROME changes (Y. Seity):
  - some cleanings in APL\_AROME and for chemistry model
  - updated version of SURFEX4 (bugfix version 8)
- HIRLAM: miscellaneous bug and portability fixes
- ARPEGE/ALADIN physics:
  - Correction of bugs related with the use of SURFEX in ALADIN:
    - initialization of Wpi in PREP\_SURFEX,
    - inquiry mode of roughness lengths (Z0, Z0h),
    - creation of PGD executable with gmckpack
  - Correction of a bug in the setup of the entrainment namelist parameter used in the "CAPE fullpos" computation
  - Correction of a bug in the algorithm for the adjustment of negative humidity
- ALARO0:
  - Rationalization of the turbulence scheme, new options for p-TKE (F. Vana)

On February 4<sup>th</sup>, MF has switched its autumn/winter E-suite to operations, with primarily changes brought to the overall representation of turbulence (for instance, turbulent kinetic energy scheme). The preparation of the next E-suite awaits access to the SX9 (high resolution suite T798C2.4L70 and doubled density for many radiances) and the solving of reproducibility problems between CY35T2 and the operational version (based on CY33T1).

Regional LAM model coupled with the IFS, "Aladin-CEP": MF now operates twice per day for the Forecast Dept an Aladin-France version coupled with altitude fields from the IFS (surface fields are taken from the regular Aladin-France assimilation cycle).

#### **4. Flexible Extension zone issue (C. Fischer, Yannick Trémolet)**

On behalf of the Hirlam/Aladin partners, Claude has written a technical note describing the changes to be done in the IFS/Arpège code in order to make a separate spectral representation for the (non-wavelet) Jb code possible, with respect to the model spectral space. The initial idea was to allow for a larger truncation in the LAM Jb (and thus, increase the width of the Extension zone). The analysis shows that this effort is quite significant and difficult with the present code. MF and the partners have submitted this note to EC for their comments.

Yannick mentions that to separate the Jb code completely from the model code is a good idea. However, given the amount of work, the question is whether this is useful in the present code, knowing that the IFS shall evolve (at about this required level of the code) through the OO-redesign. MF mentions that the final decision to actually perform

the work described in Claude's note has not yet been taken by the partners. Yannick further indicates that new objects shall appear with the OO-redesign, such as generic objects representing gridpoint fields, with self-contained data description, for regular grids. Different spectral spaces also shall be possible (see also item 5 below). MF mentions that this approach probably would allow for the required level of flexibility, if all the data layout including message passing and distribution aspects indeed are « packed » in the new objects<sup>7</sup>.

There was an underlying consensus within the phone call discussion that the best decision probably would be to wait for such work/study, if not urgent, until the OO-redesign has been analyzed and performed.

NB: Yannick and Mike also made detailed comments on Claude's note, which MF leaves at the disposal of all LAM partners as well (contact is Claude).

### **5 . « OO » recoding project. Status report (Yannick Trémolet)**

The general idea is to move part of the setup of the IFS from above the control routine level down to within the control, and thus change the general calling tree architecture of the highest IFS Fortran levels (new tree would be like `setup0 => cnt_high => setup1 => cnt_low` where the separation between “high” and “low” should be somewhere between the present CNT1 and CNT3 probably). Accordingly, data description and layout should be packed into new objects.

Low level computational routines (STEPO and below) should not be affected. Thus, the OO-redesign should not affect properties of the IFS such as vectorization, or the work on scalability (Mats Hamrud's project at EC). Further ideas such as testing different dynamical kernels also are orthogonal to this re-design (the latter remains focused on the data assimilation structure). The new design should allow an easier transposition of the 4D-VAR to alternative assimilation algorithms. MF insists that the OO-redesign could be the opportunity to make the dataflow more flexible, between the new objects (see item 4 above). With the OO proposal, MF and the Aladin/Hirlam partners would have to analyze, propose and apply the adequate adaptations for the LAM geometries (ensure that any regular grid can be represented in the GP-objects, Extension zone description, mean wind SPA1 component in spectral objects, etc.). Some of these features would be present from scratch, if “old” data description is reused and simply packed (which is EC's presently proposed strategy for creating the new objects).

On practical short-term issues: EC has coded a toy model version in F2003 (Lorenz 63 model), which however does not yet compile on the IBM (nor with the NAG compiler). This code shall be sent to MF as a means to get NEC interested into the inclusion of the OO-required instructions into their compiling system.

Mike and Yannick shall be in Toulouse on May 14-15<sup>th</sup>, and a by-side meeting on the OO-redesign could be arranged for either the 13<sup>th</sup>, or during the 14/15<sup>th</sup>. Yannick shall check for the possible dates, and then contact MF to arrange the meeting (Claude).

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<sup>7</sup>After the meeting, François Bouttier raised the issue that the data layout flexibility alone would not be sufficient for Jb: grid transforms probably still remain necessary inside Jb in order to apply gridpoint balances (NL, Omega) on the “right” grid (model grid actually). See also in Claude's note (use of trajectory fields, need for some sort of injection routine).

## **6. Re-assess dates for phasing of CY36; tentative schedule for CY37**

EC would send MF its contribution for CY36 by May 4<sup>th</sup> (CY35R4 presumably). MF would go for a rather quick phasing (with the help of some LAM dedicated staff) and send back the merged pre-cycle to EC by about June 19<sup>th</sup>. These dates remain to be validated with respect to MF's constraints for porting to the SX9, and with respect to EC's constraints for the tests of the next high resolution IFS (deadline in September). A final decision shall be taken by Friday March 27<sup>th</sup>.

## **7. AOB:**

7.1. Informations on porting activities in both centres (status of NEC SX9 at MF, status of EC's new IBM computer "C1A")

MF: Initial installation test completed; waiting for users to access the SX9 for first portings and reliability test. EC: Acceptance also completed, porting and reliability test should start soon, first operations possibly as soon as April.

7.2. news from Mats' investigations on scalability of the IFS

Mats has been working on the optimization of the IOSTREAM code. More evaluation and work will be resumed after switching to the new IBM ("C1A").

7.3. miscellaneous cleanings in the code, based on Karim's documents (comments in modules, pruning of obsolete variables, P0 priorities for cleaning between CY36 and CY37)

EC needs more time to evaluate the document. Deborah will send EC's comments to MF/Karim after Eastern. Both parties shall then agree on the desirable cleanings, those optional (possibly to be done by MF), and those to be left aside (=abandoned).

7.4. Relevance and timing of ODB visit from Anne Fouilloux to MF

EC proposes that Anne Fouilloux visits MF in order to discuss with ODB users and developers in Toulouse, both on the side of NWP (GMAP) and verification (DP/COMPAS team). A suitable date for this visit shall be found between EC (Jean-Noël and Anne) and MF (Claude, Dominique Puech and Hervé Bénichou). If present at that time, discussions with Aladin or Hirlam contacts could be fine as well. Costs for the visit shall be shared between EC and MF.

## **8. Next meetings:**

next coord meeting is kept for June 25<sup>th</sup> 2009 in Reading. The list of the MF delegation will depend on the progress and needs coming from the "OO" recoding project.

## **APPENDIX:**

Updated list of actions:

- MF to provide information on performances on the NEC vector computers SX8R/SX9: RTTOV9 in 4D-VAR (based on CY35T2, on SX8R or on SX9); general performance issues on the new SX9 (Ryad and Deborah mostly)
- further discussion on the recordings inside POS (Karim, Deborah and Nils)
- EC to make comments on Karim's proposals for general cleanings in the IFS/Aprège code (Deborah)
- MF to send EC the detailed technical documentation on the new dataflow structure for DDH (Olivier Rivière)
- discussion on flexible Jb dataflow to be reported back to Hirlam/Aladin partners (MF action, Claude) meeting on OO-redesign to be arranged in Toulouse, during Yannick and Mike's visit (May 14-15<sup>th</sup>)
- Lorenz63 toy model code in F2003 shall be sent to MF (Yannick => Ryad), for tests of compilation on NEC
- visit of Anne Fouilloux to MF, to discuss ODB use and evolution at MF (and possibly in partner centers), to be arranged (shared costs)
- confirm dates for CY36