

# IFS/Arpège Memorandum

**From:** Claude Fischer

**To:** (ECMWF) J.-N. Thépaut, M. Hamrud, D. Salmond

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

**To:** (ALADIN) R. Brožková

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

**File:** (...)

**Subject:** IFS/Arpège coordination meeting (Cycles 34/35-36) held at Météo-France on June 24<sup>th</sup> 2008.

## **Participants:**

**Météo-France:** Claude Fischer, Florence Rabier, Karim Yessad, Ryad El Khatib (all day), François Bouyssel, Stéphane Martinez (morning), Alain Joly, Guillaume Beffrey (afternoon), Paul Poli (ADM-Aeolus), Vincent Guidard (VarBC and RTTOV), Jean Pailleux, François Boutier (partially)

**ECMWF:** Jean-Noël Thépaut, Mats Hamrud, Deborah Salmond

**Aladin :** Radmila Brožková

**Hirlam :** Xiaohua Yang

## **1. Adoption of Agenda**

item 10.1 added; agenda otherwise adopted. The Aladin observer has changed since the last meeting, as Martin Janoušek has taken a position at ECMWF. Tomas Kral, from the Czech CHMI, is replacing him as “Aladin Coordinator for Transversal Aspects”. For this specific meeting however, Radmila will represent Aladin. Another personal change, at ECMWF, is the replacement of Mats Hamrud (will work on scalability issues) by Deborah Salmond; Erik Andersson is moving to the Operations Department as Head of Meteorological Division.

## **2. Approval of Minutes of Meeting of 29<sup>th</sup> November 2007 and 13<sup>th</sup> of March 2008**

minutes adopted.

## **3. Review of actions identified at last coordination and teleconf meetings**

(29/11/07):

- MF to send "bator" code to EC: Ryad has been in contact with Sami; code will be sent to EC within pre-CY34 ("pandor" directory in the "odb" project). => *action closed*
- MF to report on ODB contacts in Ald/Hir: Aladin has nominated two contacts (D. Puech, A. Trojokova); so did Hirlam (R. Randriamampianina, T. Wilhelmsson). Contacts have agreed to act as centralizing persons for ODB questions or problems, between the Consortia staff and ECMWF experts. => *the ODB contacts are invited to download and read the ODB User's Guide available from the ECMWF website, action closed. ECMWF will nominate Sami Saarinen's successor in September.*
- GP Balsamo to give details on surface field/forcing conversions from Tessel scheme: GP presented his approach to Claude last November. The technique, based on interpolating the Soil Wetness Index, is also the one set up at MF following a suggestion by D. Giard (ERA40 or IFS coupling with Arpège or Aladin). Work in this direction might start still before the summer 2008 at MF. => *action closed*
- Mats and Erik to investigate a possible externalization of obs operators: not really started; JNT has contacted the Canadian Center (actually, Pierre Gauthier) to get their experience. He will need to come back to them (new contact: Godelieve Deblonde). The soon-to-come change of positions of Mats (scalability aspects of the IFS) and Erik (head of Met Division at EC Operations) will force EC to resume this effort once their successors have been chosen. JNT confirms that EC wished to continue progress on the side of specifications. => *action to be continued. This issue shall become a specific item for the next coordination meeting. ECMWF feel that it is increasingly difficult for short-term or contracting visitors to import new observation types and operators into the IFS. **First specifications on the proposed changes shall be sent by ECMWF to MF in the autumn.***
- Mats and Karim to distribute work on commenting modules (plus more generally preparations for the cleaning cycle CY35): MF has included some comments in modules in its CY33T1, plus some pruning of obsolete routines; EC (...). A major effort will concern renaming and moving routines within the projects and libraries. Mats has sent a script for automatic actions in April, which MF has started to test (plus adaptations for Aladin). => *almost closed (awaits for CY35 to be completed)*
- CF and JNT to check for video-conf possibility: no practical system is available at EC. This item is closed for the short-term coordination. => *closed*

(13/03/08):

- MF ask EC to send the code and documentation of the bias correction for RS and Synop data. Drasko V. shall contact P. Moll asap. M-F received documentation on 13/03/08 and a list of relevant routines from Drasko on 15/05/08. Some ODB requests are missing from our Pack, interaction with ECMWF is ongoing. => *action closed*
- EC mention that Paul Burton is working on an improved compilation tool (analysis of dependencies). Ryad shall be kept informed. => ***Paul Burton should contact Ryad and keep him informed.***

#### 4. Reports on Cycle 34/35

##### 4.1 Status of libraries

Source code phasing for pre-cycle 34 went on rather smoothly at MF. All forecast model versions have been validated (Arpège, Aladin, Arome, a small suspicion still for Alaro). However, the data assimilation has not yet been validated, due to several severe crashes in the screening. Thus, the delivery of pre-CY34 to ECMWF is delayed, into early July.

Ryad has noticed a 9 % increase of coding norm violations, but has fixed a lot of them. Both MF and ECMWF sides are reminded that these violations should not increase with time; developers absolutely need to check their code with the norm checker. Several of the violations that appeared were GOTO statements. Mats advocated that most of them, coming from "copy and paste", were not directing upward in the code (especially in the screening decision making part). Mats recalled that "GOTO" statements might be hard to clean up.

ECMWF ask whether performance issues with the pre-CY34 have been noticed so far at MF. Apparently not for the forecast models. MF will check that further. ECMWF mention that they have performed some optimization in the new short-wave radiation code (SRTM) and in the dynamics.

MF recall that they generally never receive some useful auxiliary logfiles: logfile from screening (here, from CY33R2), files in project "bla" (blacklist) – external\_part, data\_selection\_part -. MF ask ECMWF again to provide those files with the tar version of their interim cycle. For specific cases, direct contact should be immediately established (logfiles from job runs => with Deborah; blacklist files => with J. Haseler).

## **4.2 Météo-France contributions to Cycle 34**

### **CY33T0: in January 2008**

- Catch-up of changes for the Arpège HR E-suite from CY32T0\_op2
- Introduction of a new routine allowing to merge VarBC files

### **CY33T1: early-March/mid-April 2008**

- Assimilation:
  - cleaning of code for scatterometer winds
  - Code adaptations for reading in maps of (small ensemble DA derived)  $\sigma_b$ 's
  - Variational bias correction adapted for Aladin (to SEVIRI HR radiances)
  - New humidity control variable (E. Holm's dev.) in Aladin
  - adaptations in obs part for HR AMDAR and AMSUB (G. Bölöni)
- Arpège and Aladin-FR Physics:
  - frame for calling TKE routines (but TKE code itself not yet fully included)
  - fixes in CBR and top-PBL entrainment
  - SURFEX plug-in: make implicit coupling between surface and atmospheric vertical diffusion possible for any model version (Arpège, Aladin-FR, Alaro0)
  - Store exchange coefficients for vertical diffusion from the low resolution trajectory and read them in the TL/AD integrations
  - fix a bug for CAPE computation in fullpos (Y. Seity)

- AROME:
  - Surfex3 including CANOPY scheme for PBL diagnostics,
  - EDKF shallow convection scheme,
  - Hail as an option in the microphysics, plus fullpos extensions for hail
  - Optimization of size of LFI surface files; control surface file outputs with the usual logic for model output files (frequency or hours)
  - Isba Aladin fields useless for arome case cleaning (read and write)
  - ensure the possibility that model and surface orography are identical
  - fix a bug for Radiation computation (short wave computation for near IR case .NOT.LSRTM)
  - new XFU 2D field ( $\theta_w$ )
- ALARO0: *vertical diffusion implicit coupling with SURFEX now possible (see above)*; updated code, mostly for 3MT, to the CHMI-operational version of February/March 2008 (R. Brozkova)
- enhanced portability (R. El Khatib & Hirlam)
- fullpos adaptations for post-processing the Model-To-Satellite (MTS) fields (simulated radiances). Old dataflow via XFU buffers has been removed.

33T1 should become an export cycle for Aladin partners.

MF haven't produced any CY33T2. Some small code changes have been prepared just before phasing with CY33R2 in order to be included in CY34 (mostly, module comments, code cleaning and bugfixes).

#### **CY34: started on May, 19<sup>th</sup> 2008**

Limited extra inputs from MF (to catch up on some developments):

- module comments and possible pruning of obsolete physics routines;
- new Projects and libraries ("bip", "pandor" directory in "odb");
- Correction of the statistical sedimentation (ICE3 - Arome)
- Optimisation in APL\_AROME
- Arpège-Climat physics changes (missing from CY33T1);
- Small patch in BUFR\_MODULE in order to allow bigger allocated BUFR arrays for radar data (pre-compiler directive)
- Bugfix and code adaptations for the "Jk" term in the Aladin 3D-VAR

Followed by the library reorganization and cleaning for CY35.

### **4.3 ECMWF contributions to Cycle 34**

#### **CY33R1:**

- Preparations for GOME2 Ozone observations (MetOp)
- Several physics changes (including moist physics in TL/AD)
- Optimization (inlining) in the GPS Radio-Occultation code
- Activate assimilation of rain-affected radiances (TMI, AMSRE)
- Changes in the QuikSCAT treatment (use of the 4-wind solution)
- Optimizations for the IBM (mostly in the physics)

- Fix for computing GPNORM norms when run on more than 512 processors
- Option LIMP\_NO\_OVERLAPpruned
- Fixes for AMSU-A and MHS radiances
- Change in the blacklists: reference to the cycle number now is possible
- Changes in the stochastic physics backscatter scheme
- Fix for the gradient test
- Monitoring of AVHRR winds
- Post-processing of the “eta-dot” field has been developed
- Improved, more informative print-outs for “SEMILAG trajectories underground” => the lat/lon position now is indicated (a number of such messages appear in the EPS runs; this problem is presently under investigation)
- Changes in the format of the wavelet statistics file (it isn’t any longer a “stabal” file); very small coefficients are now zeroed and removed from the file (makes it smaller)

### CY33R2:

- RTTOV-9 implemented and called like RTTOV-8 (vertical interpolations performed outside the RT code). Note that the old VarBC coefficients (from older cycles) cannot be used with RTTOV-9, because the bias correction coefficients now are defined on model levels (and not any longer on RT-levels). One needs a cold restart for VarBC with RTTOV-9.
- Doppler wind LIDAR code added (ADM-Aedus)
- NH model adaptations for the IFS (stay of Karim in Reading)
- Modified thinning for rain-affected microwave radiances (TMI, AMSRE)
- Switch on Huber norm for VarQC (affects code in HJO mostly)
- Code to account for spatial correlations of observation errors (SATOB winds only, but makes screening much more expensive)
- Cloud top pressure information for IR sounders
- Change in the diagnostics of cost functions ! => values of cost function and gradients have been halved (the “1/2” in front of the usual formula for J)
- GEMS contribution (includes OASIS coupler)
- Technical preparation for weak-constraint 4D-VAR: for temperature in the stratosphere
- Remove a useless spectral transform for gridpoint increments (affects Q and O3)
- LASCAW: memory-bank conflicts checked for the IBM, through the inclusion of specific code under cpp-directives.
- Adjoint of SL advection code now Open-MP safe and optimized
- Some cpp-directives added in order to avoid misleading array bound checking => this has allowed ECMWF to run a full 4D-VAR with array bound check
- Message passing of observation equivalents optimized in 4D-VAR: the  $H(X_b)$  ( $H \cdot \delta x$ ) are message passed before (after) the time window for all timeslots in one go (interpolations remain performed in each timeslot)
- A mass-weighted norm has been introduced in GPNORM
- Possibility of academic test cases (via grib files)
- GEMS contribution

MF should check performance figures between their CY33T1 and CY34 in order to assess the impact of RTTOV-9 and of the various optimizations.

## 5. Progress and Plans of Météo-France

### 5.1 Progress

- End the Arpège-Tropiques assimilation cycle, run Arpège-Tropiques forecasts at TL538C1.0L60 resolution from the Arpège assimilation cycle. This switching eventually took place on June 11<sup>th</sup>
  - Start on a routine basis an ensemble of 6 assimilation cycles of 6h-window 3D-VAR FGAT in TL358C1.0L60 under OLIVE (started in early February 2008).
  - Arpège and Aladin-France E-suite number 1 for 2008 :
    - CY33T0
    - assimilation of new AQUA/AIRS channels (~54 channels in total),
    - assimilation of MetOp/IASI channels (~50 channels), MetOp/HIRS,
    - assimilation of MSG/SEVIRI Clear Sky Radiances (the 2 so-called “water vapour channels”),
    - assimilation of clear-sky microwave radiances over sea (DMSP F14 SSM/I),
    - Increase in the number of assimilated microwave radiances (AMSU-A/B, MHS from NOAA and MetOp) over land, in clear-sky, using improved surface emissivity computation (no additional channels used),
    - assimilation of AMSU-A channel 13 (with a frozen bias correction)
    - Increase the number of assimilated GPS-RO data (improved vertical thinning), with an assimilation from 1km to 6km at the lowest (from poles to equator) until 25km (top)
    - Increase the horizontal density of Aircraft observations
    - Switch-on the assimilation of 4 ambiguous winds from QuikSCAT to prepare for a new set of data
    - couple the Arpège assimilation with variances "of the day" derived from the real time ensemble assimilation,
    - ALADIN-France: new observations as in Arpège, remove RH2/T2 observations in night time analyses (spurious surface/PBL forcing via **B** matrix, flag will be on real solar time), VarBC for SEVIRI.
    - ARPEGE physics: new GWD, revised surface turbulent exchange coefficients, corrected snow melting reaching the ground
    - modified timestep of Aladin-FR (450 s) to have an even number of iterations for 1h, modified post-processing for isolated lakes
- This E-suite is under test from February up to June 2008. The E-suite has been first monitored under OLIVE, then delivered to Operations (end of May). A switch to operations should occur on July 1<sup>st</sup>. For Aladin-France, the Arpège VarBC file is read in and the coefficients are merged with those computed adaptively for SEVIRI by the Aladin/VarBC.

### 5.2 Plans

- Arpège and Aladin-France E-suite number 2 for 2008 (summer and autumn 2008):

- CY33T0 or CY33T1
- assimilation of METOP/GRAS radio-occultation (as soon as regular data dissemination from provider has started),
- more microwave radiances over land,
- ARPEGE physical parameterization: identical horizontal diffusion of vorticity, divergence and temperature, vertical turbulent diffusion scheme with prognostic turbulent kinetic energy following Cuxart, Bougeault and Redelsperger (2000), shallow convection scheme from Bechtold et al. (2001). These changes lead to adjust parameters from other schemes, in particular within the extended Bougeault deep convection scheme. Optional further changes may include moving from 2 to 6 solar radiation bands in the Fouquart and Morcrette scheme, the use of the sea surface turbulent fluxes scheme ECUME from the GMGECMEMO group (see Weil et al., 2003) and a scheme for improving entrainment at the top of the boundary layer.
- ALADIN-France: same changes as ARPEGE plus introduction of the surface assimilation (CANARI) adapted from ARPEGE.
- Developments preparing for the NEC 2009 upgrade, focused on a new resolution of the ARPEGE system (TL800C2.4L70) should begin during the second half of 2008.
- Arpège and Aladin-France E-suite number 3 for 2008 (Dec 2008):
  - CY35
  - Double the density of about all radiance types,
  - extend the number of assimilated advanced IR sensor channels (IASI, AIRS),
  - introduce a bias correction for MSLP and T observations (based on ECMWF practice),
  - possible use of Doppler radar radial winds,
  - consistent use of  $\sigma_b$ 's of the day within the ensemble itself (in place of a climatological  $\sigma_b$  map)
  - ARPEGE and ALADIN-France physics: possibly, introduction of 3MT deep convection scheme
  - ALADIN-France assimilation: 3D-VAR FGAT

This fall should see a major upgrade of the communication and data bases environment. This progress will reduce the ability of the Operations Department to install e-suites. As a result, it will not be possible to further develop our ensemble prediction PEARP. On a non-operational basis, its developers will run separately from the operational application a further 10 members group under the OLIVE framework.

The main NWP objective for Fall 2008 is the operational switch of the AROME system suite.

## **6. Progress and Plans of ECMWF**

### **6.1 Progress**

**06/11/07 IFS cycle 32r3 :**

- New formulation of convective entrainment and adjustment, reduction in free atmosphere vertical diffusion
- new soil hydrology/runoff
- new radiosonde temperature and humidity bias correction
- increase amount of radio occultation data from COSMIC
- Assimilation of AMSR-E, TMI and SSMIS window channels
- Assimilation of SBUV from NOAA-17 and NOAA-18.
- Reduce initial perturbation amplitude for EPS by 30%, use new moist physics package in computation of targeted tropical cyclone singular vectors.

Problems have been encountered with CY33R2 with the wind in the Tropics. This has led to several re-tunings in the physics, leading to improvements in the Northern Hemisphere and over Europe, but to a slight deterioration in the Southern Hemisphere.

### **03/06/08 IFS cycle 33r1 :**

- Improved moist physics in tangent linear/adjoint of 4D-Var.
- Physics: Retuned entrainment in convection scheme. Bugfix to scaling of freezing term in convection scheme. Additional shear term in diffusion coefficient of vertical diffusion. Increased turbulent orographic form drag. Fix for soil temperature analysis in areas with 100% snow cover. Change in surface roughness for momentum.
- Modified post-processing of 2m T and q.
- Active assimilation of AMSR-E and TMI rainy radiances.
- Use of 4 wind solutions for QuikSCAT.
- Extended coverage and increased resolution of limited area wave model.
- Improved shallow water physics and modified advection for ocean wave model.

And outside main IFS cycles...

- 12/06/2007 Active use of IASI and ASCAT from METOP
- 11/03/2008 Combine VAREPS and monthly forecasts
- 20/5/2008 Active assimilation of GRAS GPSRO bending angles

### The problem of excessive snowfall forecasts in the IFS in the winter 2007/08:

Snowfall in CY32R3 increased in marginal snow/rain situations compared to earlier cycles because:

- Unrealistic rain generation at  $T < 0^{\circ}\text{C}$  was no longer allowed (snow instead), therefore more snowfall at the melting level.
- Falling snow melt timescale was increased by 50% to improve tropical scores near the melting level.
- There was a bug in the convection scheme relating to the scaling of frozen precipitation fraction.

The following changes to the snowfall have been tested at CY33R1 (Peter Bechtold and Richard Forbes):

- Significantly reduced the falling snow melt timescale (to approx. half the value in CY32R3). This reduces the depth of the melting layer.
- Fixed convection scheme bug.



- Also, changed the formulation of the onset of snow particle melting to depend (more physically) on wet-bulb temperature (not dry-bulb). At low relative humidity, snow particles evaporate which delays the start of melting.

These changes improve the marginal snow/rain anomalies, with roughly neutral impact on the climate of the model and scores (as changes to the melting layer latent heat profile can affect atmospheric dynamics in the tropics and extra-tropics). The modifications should become active before next winter (CY33R3, then CY35R1).

## 6.2 Plans

Work on numerical aspects:

- Research and Development on the Non-hydrostatic (NH) dynamical core (Aladin/Météo-France model):
- Other projects:
  - Fully non-interpolating semi-Lagrangian scheme (this scheme would require to re-use partly a piece of code – key LVENIN – which has been pruned in 2002).
  - Preparation for the next horizontal resolution increase to T1279L91 (planned for 2009).
  - Vertical resolution increase (2010)

Work on physics:

- New vegetation climatology
- Stratocumulus convection
- ...

Work on wave modelling:

- Adding surface currents, even in uncoupled mode can be beneficial.
- Effect of adding high resolution current fields will be added to the atmospheric model.
- Impact of waves on the ocean model will also be studied.
- Optimise use of Altimeter data by revising the wave data assimilation scheme. Use of Jason-2 data.

VAR-EPS/monthly forecast system:

- Ensemble data assimilation (end 2008/2009) should replace the evolved singular vectors
- Use of ERA interim reanalysis in the re-forecasting suite (2008)
- Revised stochastic scheme (EDA and ensemble forecast) (2008/09)
- Tropical singular vectors (2009)
- Increased resolution in VarEPS/Monthly (2009/10)
- Monthly forecasts twice a week
- Ocean model: Use of NEMO instead of HOPE and coupling after day 10 extended to 12Z (in progress)
- Coupling from day 0 (OGCM or ocean mixed layer model)

Satellite data:

- 4D-Var microwave radiance assimilation in presence of clouds/rain (2008).
- Addition of METOP GOME-2 (ozone total column) (2008).

- Evaluation of cloud-affected radiances for most IR-instruments (2009).
- Improved usage of advanced sounder data (e.g. water vapour) (2008).
- Preparations for NPP (NPOESS Preparatory Project: ATMS, CrIS, OMPS, VIIRS).

#### Data assimilation:

- Expected in 2008/2009 (likely delayed):
  - Development of a new surface analysis scheme (primarily driven by SMOS and ASCAT soil moisture observations).
- (Not so) Longer-term projects:
  - Ensembles of data assimilation to investigate and quantify analysis uncertainty will be used soon in the context of Ensemble Prediction System
  - Development of advanced diagnostic tools to understand impact of observations on analysis/forecast.
  - Weak-constraint 4D-Var accounting for model error.
  - Observation error correlations: code should be made general enough to accommodate with radiances; but this code is fairly expensive in the screening (all observations being there ...)

#### Reanalysis:

- ERA-Interim is based on CY31R2, 12 hour 4D-Var, model T255L60.
- Started in August 2006 running period beginning in 1989.
- Now into 2004, real-time will be reached later in 2008.
- ERA-Interim will continue as Climate Data Assimilation System, subject to funding.
- Data available for the first 10 years on the ECMWF Data Server
- Several aspects in the analysis quality indicate significant improvements over ERA-40.
- A larger project (ERA-75) is being built to be proposed for funding by EU (FP7). Meeting to prepare the answer to the forthcoming FP7 call on July 2007 (MF will be there).

## 7. Matters Arising

### 7.1 Interfacing of ADM-Aeolus code with Arpège/IFS

MF reported that they have encountered difficulties for installing the ADM-Aeolus package sent with CY33 or pre-CY34. Problems have appeared due to duplicated modules and to special information to be found inside the Aeolus Makefiles. Eventually, MF have created an external plug-in script, using 2 new specific files to be added in the Aeolus package. MF propose to share the use of such “build-files” with a given structure to accommodate both MF’s and EC’s build systems.

=> *Ryad and Deborah shall check whether both Centers can share a common “dependency-file” for specific compilation and linking rules.*

A further issue concerned the change of some duplicated modules into single routines using cpp-directives. This however might not be feasible, due to the code management and portability requirements within ESA projects. => ***Ryad and Paul Poli shall contact David Tan to assess whether some code adaptations are possible.***

## **7.2 Performances of RTTOV-9 on vector computers (MF's NEC)**

EC inform MF that the definition of the variational bias correction coefficients has been modified in CY34: the coefficients now are defined on model vertical levels, instead of RT-levels. As a consequence, when switching from CY33 to CY34, all bias correction terms need first to be re-computed from a cold start. Comparison between the two cycles, as concerns radiances, also is not reproducible (departures, cost function).

EC have done performance inter-comparisons in the IFS between RTTOV9 used as RTTOV8 (interpolations done outside the RT code), and RTTOV9 used in "standalone mode" (interpolations done inside RT): RTTOV9 called as RTTOV8 is about 2.5 % more expensive (elapse time) as RTTOV8; RTTOV9 called as a full package is about 5 % more expensive as RTTOV8.

Deborah mentions that RTTOV9 might better vectorize than RTTOV8=>

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

EC explain that, in any case, the call to the RTTOV package using external vertical interpolation (in RTTOV8 manner) shall remain maintained inside the IFS as a permanent option.

## **8. Non-hydrostatic modelling:**

Karim has summarized the outcome of his stay at ECMWF. He's been working on the evaluation of a global NH version of the IFS with Nils Wedi. Main items:

- Removal of an instability in the treatment of the "X-term"
- Implementation of Vertical Finite Elements in NH but keeping the Finite Differences in the linear term of the Semi Implicit.

With these actions, the IFS NH model reproduces very acceptably the hydrostatic model (scores).

Some further options have been developed in the dynamics kernel:

- No interpolation at Origin point in the Corrector step (LPC\_CHEAP in case of LPC\_NESC)
- Possibility to mix the use of LSETTLS two-time level extrapolation and LPC\_NESC for right hand side and Origin point computations, respectively.
- A first prototype of a  $(\Phi, w)$  NH model (keeping T as a prognostic variable), which does however not work properly yet, has entered CY34.
- Work on an alternative  $(\Phi, w)$  NH model (with T diagnostic and  $\ln(p/\pi)$  prognostic) is in progress. No code has been provided to the common libraries so far, however. This work is also linked with work done in HIRLAM (M. Hortal).
- Removal of thin layer hypothesis for the LGWADV NH model

ECMWF wish to produce a reference simulation at T799 or T1279 by the end of 2008, in order to decide on the usage of this NH kernel (originally, coming from Aladin) for the future global NH IFS version.

Karim mentioned several issues to make the code more “NH-compliant”: post-processing (POS), physics/dynamics interfacing. Mats mentioned a possible shortcoming on massively parallel computers, due to extra transforms in the Predictor/Corrector solution.

## **9. ODB Developments**

The successor of Sami Saarinen for the ODB will be designated in the autumn. One of his/her first duties will be to insert Sami’s last development branch into CY35R1. This development will allow the definition of 2D fields as observational field (eg., satellite images).

## **10. Specific Issues raised by ECMWF**

### **10.1 Fortran 2003 (F2003)**

ECMWF have started to investigate the possible usage of F2003 structures inside the IFS. Some facilities of this language version might be useful for the further code evolution (submodules, inheritance of attributes, closer link with C-structured objects). A possible first candidate for a change could be the definition and management of the CDCONF/NCONF main model parameter. However, one needs to carefully check for compiler robustness with respect to these new features (norm-compliant F2003 compilers, and existence of extended F95 compilers otherwise).

ECMWF state that, in any case, the IFS code shall, for the time being, remain F95-compliant.

*Yannick Trémolet will prepare an input document listing some incentives and initial proposals, for further discussion inside the IFS/Arpège coordination. The topic of F2003 shall then be revisited regularly. => in the meanwhile, MF and the observers might start informing also the Aladin and Hirlam partners about the F2003 issue.*

## **11. Specific Issues raised by Météo-France**

### **11.1 Cleaning of dynamics code (proposals by Karim Yessad)**

Karim has produced an updated version for code cleaning proposals. This document is available from Karim ([karim.yessad@meteo.fr](mailto:karim.yessad@meteo.fr)) and has already been disseminated to several ECMWF, Aladin and Hirlam contacts. The P0 priorities in Karim’s list have been discussed and mostly adopted for action in preparation of CY36:

- Prune configuration 951
- Prune option LSL\_UNLPHY\_F=.TRUE.
- Remove LPC\_XIDT, replace it by a simple scalar XIDT in the P/C scheme
- Merge routines DISSPEC0 and DISSPEC, DISGRID\_C and DISGRID
- Cleaning in the SL scheme, including too long lists of dummy arguments

- Change (W, S, ITM) into (L, I, LSM) in the names of variables containing respectively liquid water, ice and land/sea mask.

And also, to be confirmed:

- Remove minimizer N1CG1
- Shorten some parts of POS (mainly Sections 2.1 and 3)

For one P0-listed pruning (option NxLAG=2 of the SL scheme), ALADIN partners asked to keep it. In order to still improve code readability, the old code will be pruned and an alternative code will be produced, reusing as much as possible the dataflow of option NxLAG=3.

Additionally, key LFREIN (enhanced horizontal diffusion), which was not referenced in the cleaning document, also has been accepted for pruning in CY36.

A “free” discussion on further code re-structuring has then taken place, showing evidence of some complex interactions between the POS recoding strategy and the observation interpolators for instance. Typically, to force low-level interpolators to work on model grid would impact not only the observation operator calling sequence, but also imply a drastic revisiting of the message passing and load balancing for distributed computations (Mats). Other problems have been raised by Karim, on the difficulties to run in-line Full-Pos in the NH model for the time being, or the potential impossibility to cleanly implement alternative NH dynamics (deep layer equations, ( $\Phi$ ,  $w$ ,  $Q_{\text{hat}}$ ) NH model) under POS. These difficulties partly come from a lack of separation between dynamics and vertical interpolations (too many hydrostatic-type of GP routines spread inside the vertical interpolation code). Such facilities will require an in-depth analysis of the POS strategy before any further discussion or decision.

Thus, no concrete action inside POS (other than shortening the code if possible) has been decided. *Specifications for recoding inside POS shall be produced by MF for after CY36. Contact at ECMWF is Nils Wedi.*

Some other by-side items:

- LSLONDEM shall be kept in the code (still good for testing)
- *JNT shall check whether EC use L\_USE\_CONGRAD for the computation of singular vectors in the EPS*

## 11.2 Towards a new physics diagnostic sourcecode project at MF

A new DDH-prototype dataflow will be introduced by MF after CY34/CY35. The code probably will be installed as a separate project. EC raise the issue of Open-MP compliancy of the new code. MF ensure that the code should be safe for Open-MP use.

## 11.3 ECLIB into IFSAUX (XRD) library

“eclib” will become a new directory in the auxiliary project (“xrd”/“ifsaux”) in CY34.

## 11.4 Pruning of old bias correction code (related to the “bcorr” files)

*The old bias correction code shall be kept inside the IFS at least until CY37. MF (for internal, Aladin and Hirlam usage) and EC will check who's still using it, and make an update on its usage at the next coordination meeting.*

## **11.5 Evolution of VarBC code towards more generality ?**

A generalized VarBC code already has been developed at ECMWF, and shall enter CY35R1. This extended version will be valid for radiosonde data, aircraft, profilers, ...

The surface pressure bias correction scheme also will be adapted and made closer to the VarBC formulation (work by Drasko Vasiljevic).

## **11.6 BUFR software at ECMWF in relation with radar data (esp. OPERA)**

In the previous cycle (CY33), a problem was encountered at ECMWF with the radar contribution from MF. To be able to read in some specific radar BUFR tables, statically allocated arrays had to be increased in memory size. The factor of increase (about 8 times) was however unjustified for installations with no radar BUFR data. Thus, the code change eventually was removed from CY33.

For CY34, a temporary patch has been introduced, by securing the big allocation for the radar BUFR case under a cpp-directive (in BUFR\_MODULE).

For the mid-term, MF will check with their Observation Department for a possible move to an IFS-compliant BUFR format. Otherwise, MF would develop a BUFR convertor in order still to enter the ODB programs with a recognized, IFS-like BUFR format. This change would make the provisional cpp-directive useless.

## **12. Content and timing of Cycle 36**

### **12.1 Input from Météo-France**

The exact schedule remains open to progress with the validation and installation of CY34/CY35 in Toulouse. Some further uncertainty remains linked with the progress of the installation and porting to the NEC Phase-2 at MF.

### **CY35T1: deadline for contributions about Sept. 22<sup>nd</sup> ?**

- Assimilation:
  - Plug-in LAM wavelet code (A. Deckmyn)
- Arpège and Aladin-FR Physics:
  - full code for TKE
- 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...); alternative code for NxLAG=2 in SL scheme
- unify some DM-communication routines
- rename some variables (root L,I,LSM for liquid water, ice, land-sea mask everywhere)
- adapt "DYNCORE" set-up to MF applications
- 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
- Scale selective DFI (P. Termonia)
- Surface/PBL observation operator compatibility (L. Kullman, R. Hamdi, J.-F. Mahfouf)
- Full-Pos:
  - Try to compact parts 2.1 and 3 of POS
- Arome compliant version of DDH (horizontal diagnostic averages for physics tendencies) - "version 0" (before further dataflow and logic re-structuration);
- 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
      - 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 de Masdev4.8 :
    - New version of EDKF (modified tunings)
    - microphysics : Homogenisation of Méso-NH and Aromecodes 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, gprs0d, ...)
    - New modifications for the 1D+3DVAR code according to tests to be performed in summer 2008
  - 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
- ALARO0:
  - Reordered p-TKE code, new options (F. Vana)

### **CY35T2: deadline for contributions about Nov. 17<sup>th</sup> ?**

- Assimilation:
  - Cleaning of Neural Network routines for AIRS
  - Computation of dynamical emissivity over sea-ice for AMSU instruments
  - Addition of emissivity parametrization using a Lambertian approximation
  - Introduction of an alternative cloud detection method for AIRS and IASI (MMR code from Thomas Auligné), unless similar work planned at ECMWF
  - Adaptation of code to use ECMWF bias correction for radiosonde and SYNOP at Météo-France

## **12.2 Input from ECMWF**

New schedule due to new HPC installation (no operational change accepted between 15 August-15 November):

### **CY33R3 (to be merged later in CY35R1):**

- Cool skin/warm layer ocean parameterization
- Albedo over permanent snow (.75 > .8)
- Improvements to melting of falling snow
- RTTOV-9 (RTTOV-8 like)
- Improved trajectory interpolation
- Enhanced bias correction for HIRS/AIRS+revision of advanced sounder usage (e.g. WV channels)
- Use of the High-resolution OSTIA SST product (from the MetOffice)

### **CY35R1 (December/January?):**

- Assimilation of cloud/rain-affected microwave radiances in 4D-Var
- Extension of VARBC to other observation types
- TL/AD long wave radiation revision
- JB statistics from recent T399 DA-ensemble
- Modified humidity analysis with Jb statistics from new ensemble (ice supersaturation and better T-q coupling)
- Routine use of FSO (forecast sensitivity with respect to observations)
- Improved assimilation of T/Q sounding AMSU-A/B/MHS channels which are surface sensitive
- Non orographic gravity wave scheme
- First implementation of EDA for EPS suite.
- Enhancements to ODB



## **CY35R2 (May 2009)?**

- Correlated observation error for SATOBs
- Improved interface between IFS and RTTOV
- Assimilation of AMSU-A/B/MHS total column humidity in window channels over sea
- Operational low resolution data assimilation ensemble (providing flow dependent JB variances)
- Weak-constraint 4D-Var accounting for model biases in the stratosphere
- New shallow convection/boundary layer scheme
- Assimilation of scatterometer winds as neutral winds possibly including current effects
- Upgrading of the wave data assimilation system, including ODB
- Use of surface currents in the European shelf model
- Use of ERA-interim in reforecast suite
- Implementation of stochastic backscatter scheme in VAREPS
- Implementation of moist SVs in the Tropics? (to be balanced against EDA)

## **12.3 Timing of Cycles 36 and 37**

For winter/spring 2009, EC have no specific constraint (porting to the new IBM should be completed by that time). MF have a difficult calendar early 2009, with the installation and validation of their NEC Phase-2 platform. Especially, the regular service validation is scheduled for 15/03/09 until 15/04/09.

The decision is to start phasing for CY36 in May, fixing 05/05/09 as starting date.

## **13. AOB**

none.

## **14. Date and Place of Next Meeting**

Next telephone conference: November 6<sup>th</sup> 2008<sup>1</sup>, 1.30 GMT (14h30 MEST)

Follow-up phone call: March 26<sup>th</sup> 2009 (same time)

Next coordination meeting: in Reading, June 25<sup>th</sup> 2009

### **A. List of actions decided:**

- First specifications for the externalization of observation operators shall be sent by ECMWF to MF in the autumn(2008)
- Paul Burton should contact Ryad and keep him informed on his investigations with compilation tools
- Ryad and Deborah shall check whether both Centers can share a common “dependency-file” for specific compilation and linking rules (ADM-Aeolus)
- Ryad and Paul Poli shall contact David Tan to assess whether some code adaptations are possible (ADM-Aeolus)

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<sup>1</sup> This date has been shifted after the meeting to: Tuesday, November 18<sup>th</sup> (same time)

- MF will do performance checks of RTTOV9 on the NEC vector computer (Vincent Guidard) and send their results to EC (Deborah)
- Yannick Trémolet will prepare an input document listing some incentives and initial proposals, for further discussion inside the IFS/Arpège coordination. The topic of F2003 shall then be revisited regularly. => in the meanwhile, MF and the observers might start informing also the Aladin and Hirlam partners about the F2003 issue
- Specifications for recoding inside POS shall be produced by MF for after CY36. Contact at ECMWF is Nils Wedi
- JNT shall check whether EC use L\_USE\_CONGRAD for the computation of singular vectors in the EPS
- The old bias correction code shall be kept inside the IFS at least until CY37. MF (for internal, Aladin and Hirlam usage) and EC will check who's still using it, and make an update on its usage at the next coordination meeting