

# IFS/Arpège Memorandum

**From:** Deborah Salmond (ECMWF)

**To:** (ECMWF) HR, RD Division & Section Heads, Anne Fouilloux,, Tomas Wilhelmsson ,Yannick Trémolet , Nils Wedi , Mats Hamrud, Sylvie Malardel

**To:** (Météo-France) Arpège diffusion list, Claude Fischer, Ryad El Khatib, Philippe Marguinaud, Guillaume Beffrey, Karim Yessad

**To:** (ALADIN) Tomas Kral

**To:** (HIRLAM) Xiaohua Yang

**File:**R48.3/DS/0952

**Subject:** Minutes of the IFS/Arpège coordination meeting -Cycle 36 - held at ECMWF on 25<sup>th</sup> June 2009.

## **Participants:**

**Météo-France:** Claude Fischer, Ryad El Khatib, Philippe Marguinaud, Guillaume Beffrey and Karim Yessad

**ECMWF:** Jean-Noël Thépaut, Anne Fouilloux, Deborah Salmond, Tomas Wilhelmsson and Yannick Trémolet  
(Part time) Nils Wedi, Mats Hamrud, Sylvie Malardel

**ALADIN:** Tomas Kral

**HIRLAM:** Xiaohua Yang

## **0. Adoption of Agenda**

The agenda was adopted.

## **1. Approval of Minutes of Phone call of 24<sup>th</sup> March 2009**

Approved.

## **2. Review of list of actions from last conference call**

- *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)*

**Kept**

- *Further discussion on the recordings inside POS (Karim, Deborah and Nils)*

**Done**

- *EC to make comments on Karim's proposals for general cleanings in the IFS/ Aprège code (Deborah)*  
**Done**
- *MF to send EC the detailed technical documentation on the new dataflow structure for DDH (Olivier Rivière)*  
**Done**
- *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 14-15th)*  
**Done**
- *Mission for Anne Fouilloux to MF, to discuss ODB use and evolution at MF to be arranged*  
**Done**
- *Confirm dates for CY36*  
**Done**

### 3. Reports on Cycle 36

#### Post Mortem on CY35

Claude Fischer presented some details of the MF work for CY35. Changes in the satellite package by EC had given seemingly bad results in MF runs - but eventually this was shown to be not a problem after a warm-up period. EC agreed to warn MF of significant meteorological changes to be seen in a new cycle.

MF pointed out that the interfacing for RTTOV9 in the IFS had not included some optimisations to put allocations at the highest level. EC agreed to look into this with help from MF. **Action: DS and PM (Philippe Marguinaud) to move RTTOV 9 allocations to higher level in IFS.**

#### Status of libraries

Guillaume Beffrey said that Stéphane Martinez had successfully merged CY35R3 and CY35T2 with no big problems - only 180 routines out of 2000 had to be done manually.

He reported on some of the merging problems:

- The length of variables must be less than 32 characters for the NEC compiler (the Fortran 90 standard)
- Fortran 2003 features such as 'allocatable dummy arguments' to subroutines should not be used
- In the prism library >< had been used
- The DFI was broken - EC had not tested this as they no longer use it
- Non-initialised variables had been found in the surface scheme
- The new GPNORM routine had to be adapted to the LAM version
- The new Gaussian Grid calculations had to be adapted for use by MF

- Configuration 801 and some options for NH: for information, MF indicates that some of these configurations are regularly broken (although only R&D, MF systematically runs some validation of them on new cycles)
- The process of debugging the assimilation had been long, a quite usual feature for recent common cycles unfortunately
- IOSTREAM had needed some work-arounds to run successfully on the NEC
- L\_RTTOV\_INTERPOL should not be set to true in the module as MF need it to be false
- Patrick Moll had identified a problem where an actual channel number had been used instead of a counter for the channel - he would send an email about this. **Action: Patrick Moll, Ludovic Auger, Vincent Guidard and DS to sort out array index problem with channel number instead of channel count.**

Possibly EC could do a compilation on the NEC before sending the pre-Cycle to MF.

**Action: DS to investigate the feasibility of checking that all new releases compile on the NEC.**

### **Météo-France contributions to Cycle 36 (CF)**

#### **MF and partners contributions on top of CY35T2**

- AROME: MASDEV4.8 (mostly new EDKF scheme for shallow convection) S. Malardel and Y. Seity
- HIRLAM: shallow convection code from KNMI (W. De Rooy) via Sylvie+Yann's contribution (routines moved to "arp/phys\_dmn" and renamed)
- cleanings in the SL code, especially some reorganization of the SL/AD code (K. Yessad)
- Updated code in the dynamics for rotated/tilted Mercator, including both direct, TL and AD versions (P. Bénard, J.-D. Gril, G. Kerdraon, F. Vaña)
- some small rearrangement of the code for spectral orography filtering under key LSPSMORO in e923 (M. Dahlbom, F. Taillefer)
- minor bugfixes: SPECTRAL\_FIELDS, SUEJBBAL (O. Vignes)
- Introduction in MF's "bator" of the facility to read the BUFR format version from an external file (rather than an "IF" statement in the code). This facility will be first tested for IASI data in ECMWF's BUFR version by Hirlam (D. Puech, F. Guillaume, R. Randriamampianina)

### **ECMWF contributions to Cycle 36**

**Contributions to CY35R3 - see 'IFS Memorandum Cycle CY35R3' for more details**

#### **Scientific changes**

- Speed-up of exponential computations in RRTM\_SW using look-up tables
- Bugfix for the adjoint of the scatterometer observation operator.
- Weak constraint 4D-Var and 4D-Var diagnostics.

- Restructuring of Surface Analysis and Decoupling of the Jacobians computation
- Revised computation of the points and weights for the Gauss-Legendre
- VarBC development
- VarBC update for retrieved products
- Scatterometer and sea-surface analysis related modifications
- Bugfix in GPSRO tangent-linear code
- Add final Gribcodes for non-oro GWD tendencies
- Enable non-orographic gravity wave scheme and optimisation.
- Adapting TL/AD for non-orographic gravity wave scheme
- Enable TL/AD of longwave radiation in the topmost 10 levels.
- Tune remaining Rayleigh friction
- Enable Trace Gases CO<sub>2</sub>, CH<sub>4</sub>, O<sub>3</sub> from GEMS
- Avoid occasional unrealistic surface fluxes
- Gustiness
- Reduce SW cloud bias and upper-tropospheric temperature bias through retuning of RCLDIFF
- Removal of nvmass part of saturation calculation.
- Align the snow density operator in the analysis to the mode for new snow from satellite
- Completed snow revision:
- Activation of HUBER Norm
- New land surface emissivity scheme for AMSU-A/B
- VarBC bug fix for layer observations (to3, tcwv)
- Passive changes affecting all-sky assimilation of microwave imagers
- Modification to cloud detection for AIRS and IASI
- Modifications to include goes-13
- Activation of Envisat MERIS total column water vapour assimilation
- Implementation of mode based variational bias correction of observations
- Humidity Control Variable with supersaturation
- Back-fixes to operational suite
- Correction of a (long-lasting) bug in the TOA incident solar radiation
- Increase coefficient for horizontal diffusion on vorticity (LECMWF) for RESOL  $\geq 1279$ .
- Regularizing TL/AD advection at the model top

#### **Technical /Passive changes**

- Performance optimisations
- Enhancement to the GSTATS package
- Performance optimisation, fixes and cleaning.
- Postprocessing/archiving at selected time-steps (not full hours)
- Bug-fixes for the dynamical extra fields and gstats\_print
- Further developments for the prognostic aerosol model.
- Implementation of the ocean mixed layer model (KPP)
- Ducting Diagnostics
- Modifications to ODB
- Doppler wind lidar assimilation

- Revised stochastic physics
- Moving aerosol diagnostics from extra-fields to proper post-processed variables
- Introduction of GEMS-derived climatologies of CO<sub>2</sub>, CH<sub>4</sub> and O<sub>3</sub> to complement the
- Update to spectral stochastic backscatter scheme (SPBS) including option for vertical
- Optimisation of IOSTREAM
- Modifications in the routines for TL and AD tests (NCONF=401,501)
- Routines for calculation of aerosol reflectance
- Forecast sensitivity to observation
- Satmon changes
- Additional changes for satmon (Scatterometer and Windsat data)
- Safe OMP\_EVENT logic, binding for P6 and hpm for P6 in Dr.Hook
- Stack checking from Dr.Hook
- Modifications for 4D-Var bit-reproducibility
- Changed threshold for reducing the number of unpacked wavenumbers in spint
- Avoid abort if RTTOV returns a fatal error code
- Incremental improvement to IFS OpenMP performance

### **Issues emerging**

Ryad El Khatib introduced a discussion on the coding norms of IFS/Arpège. It was decided that the coding norms should evolve to allow for new developments.

**Action: DS, REK, KY and Tomas Wilhelmsson to look at evolution of Arpège/IFS coding norms.**

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

### **Progress**

**March 10<sup>th</sup> 2009 - IFS Cycle 35r2**

#### **Model:**

- TL/AD longwave radiation (removal of the neural network), optimization of the NL code for simplified longwave radiation, optimization (NL, TL, AD) of the shortwave radiation scheme optimized
- Revised snow scheme including a diagnostic liquid water storage and a new density formulation
- New ozone chemistry
- Technical modifications for the assimilation of JASON-2, treatment of singularity at the poles, technical bugfixes and optimization

#### **Assimilation:**

- Change in the limit for the surface pressure bias correction. More SYNOP stations are Ps-bias corrected and therefore used in the assimilation
- Active assimilation of IASI humidity channels and consistent use of AIRS and IASI humidity channels
- Active all sky 4D-VAR assimilation of microwave imagers
- Increase of the weight to GPSRO above 26km, and use of the data up to 50km
- Various satellite-related modifications, including activation of RTTOV-9
- Revised HIRS cloud detection

### **New observations outside Cycle**

- Re-introduction of SSM/I F15
- Assimilation of NOAA-19 (AMSU-A, MHS and HIRS)
- Thorough evaluation of the impact of METOP (first European operational polar satellite)

### **IFS Cycle 35r3**

#### **Satellite data:**

- Addition of METOP GOME-2 (ozone total column)
- Assimilation of cloud-affected radiances for IR-instruments
- Improved assimilation of land-surface sensitive channels
- Assimilation of MERIS TCWV
- Variational bias correction on ozone satellite data
- Improved quality control (using Huber norm) of conventional observations
- Improved error statistics for humidity, new humidity formulation
- Weak constraint 4D-Var (taking into account model errors in the stratosphere)
- First implementation of EDA (for EPS)
- Non-orographic gravity wave scheme, new trace-gas climatology
- Further revision to the snow scheme (re-whitening, melting,...)
- Wave damping in wind input source term
- Revision of the stochastic physics scheme
- New structure for the surface analysis

**Action: JNT to provide paper from Tony McNally to Nadia**

**Action: JNT to provide description of Elias Holm's work on humidity**

#### **Plans:**

#### **Configuration:**

- Deterministic model: T1279L91 (~16km)
- Outer loop of 4D-Var T1279L91 and increase inner loop (T159/T255/T399)
- EPS target resolution T639 (to 10 day) and T319 thereafter
- Wave model (25km and 36 directions)

**E-suite (Cycle 36r1) planned for September 2009, implementation end of November 2009**

**Vertical resolution increase planned for 2010 (~150 levels TBD)**

## 5. Progress and Plans of Météo-France

### Progress - second half of 2008

#### **ARPEGE and ALADIN-France E-suite No. 2 for 2008 (autumn/winter 2008): CY33T1**

- assimilation of METOP/GRAS radio-occultation (as soon as regular data dissemination from provider has started),
- assimilation of EARS/ASCAT data
- more microwave radiances over land,
- ARPEGE physical parameterization:
  - horizontal diffusion coefficients now similar for 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), modified to provide a new source term of turbulent kinetic energy
  - These changes lead to adjust parameters from other schemes, in particular within the extended Bougeault deep convection scheme. Furthermore, vertical diffusion, shallow convection and deep convection are somehow coupled.
  - extend from 2 to 6 solar radiation bands in the Fouquart and Morcrette scheme,
  - use of a version of the sea surface turbulent fluxes scheme ECUME from the GMGEC/MEMO group (see Weil et al., 2003),
  - a scheme for improving entrainment at the top of the boundary layer (“GBM”),
  - new Ozone monthly climatology (same as IFS),
- introduction of inline Fullpos post-processing
- ALADIN-France: same changes as ARPEGE plus introduction of the surface assimilation (CANARI) adapted from ARPEGE.

Turbulent mixing in ARPEGE PBL better for Humidity and Temperature and O<sub>3</sub> climatology gave improvement in the stratosphere.

#### **This e-suite was switched to operations on February 4<sup>th</sup> 2009.**

- Developments preparing for the NEC 2009 upgrade, focused on a new resolution of the ARPEGE system (TL800C2.4L70) have begun end of 2008.

#### **NEC SX9 - Phase-2 upgrade**

VA (Verification d’Aptitude = acceptance) finished on week 25 and VSR (Verification de Service Régulier = user acceptance) started. Plan to move operations to SX9 - 2 months after successful completion of VSR - in mid-August - with Cycle 33t1. It will be followed by a one-to-two week shut down of the old SX8 clusters, in order to re-assemble them into one single cluster. The SX9 has two clusters of respectively 6 and 7 nodes (each node has 16 CPUs).



In the fall and winter 2008/9, a major upgrade of the production and data bases environment has entered a pre-operational and porting phase. This project has reduced the ability of the Production Department to install e-suites. As a result, it was not possible to further develop MF's ensemble prediction PEARP over that period. On a non-operational basis, the PEARP developers have run separately from the operational application a further 10 member group under the OLIVE framework.

- AROME operational suite number 1 (spring to winter 2008):
  - Forecast model configuration:
    - 600\*512 gridpoint domain, 2.5 km resolution, 41 levels,
    - Méso-NH physics: turbulent kinetic energy version CBR – Cuxart, Bougeault, Redelsperger -, ICE3 microphysics that include graupel, Surfex coupled in explicit mode with atmospheric vertical diffusion including an additional CANOPY scheme for boundary layer profiles, IFS-based radiation scheme called every 15 mns, no deep convection nor gravity wave drag,
    - timestep = 60 s *not using* the Predictor/Corrector scheme.
  - Assimilation will be with a 3 h frequency 3D-VAR cycle, including:
    - ensemble B statistics recomputed on newly tuned horizontal diffusion version of AROME
    - Arp/Ald bias correction files so far, with later on switch to VarBC
    - GPS ZTD with specific (station, center) quality control and blacklist
    - specific channel selection for AMSU data (because of different vertical discretization than ARPEGE/ALADIN-FR)
    - 10 m wind
    - 2m T and RH on daytime
    - 2m T and RH first guess values extracted from Surfex model (rather than ACHMT)
    - radar radial winds assimilated (15 km thinning)
  - 6 hourly reset to the ALADIN and ARPEGE CANARI surface.

AROME runs four times a day up to 30 h range with a 3h 3D-Var assimilation cycle. One 30h forecast currently requires about 40 minutes elapse on 56 processors on the NEC-SX8R, without post-processing.

This AROME-FR suite has been declared fit for operational use by Météo-France Forecasters on December 18<sup>th</sup>, 2008.

### **Progress 2009**

- Introduce the ARPEGE ensemble-based flow-dependent  $\sigma_b$  information in regional assimilations such as ALADIN-France, ALADIN-Réunion and possibly AROME, and prepare the installation of the ensemble assimilation for the ALADIN-Réunion system (*to be confirmed*)

## Plans for 2009

### **ARPEGE and ALADIN-France E-suite No. 1 for 2009 (summer/autumn): CY35T2**

- new change of resolution of ARPEGE: T800C2.4L70
- new resolution for the 4D-VAR analysis increment: between T340L70 and T400L70
- move to 3 outer loops and minimizations (from 2)
- changes in the assimilation ensemble: L70
- Double the density of about all radiance types (change the scale of data use from one spot every 250 km to one every 125 km), with a higher priority put on IASI
- assimilation of NOAA-19 channels
- monitoring of SSMI/S data
- extend the number of assimilated advanced IR sensor channels (IASI, AIRS), in particular above clouds,
- introduce a bias correction for MSLP and T observations (based on ECMWF practice),
- ALADIN-France: L70, slight increase of resolution to about 7.5/8 km

### **AROME-France E-suite number 1 for 2009 (2.5km):**

- AROME will inherit some of the ARPEGE/ALADIN changes: doubled radiance density, NOAA-19, extra IASI channels, switch to VarBC
- Assimilation of radar reflectivities
- Increased vertical resolution (between 60 and 70 levels) - to use most of extra computer power.
- Activation of an upper level sponge towards the coupling model (in the forecast)
- test new choice for B-level parallelization (made possible after correcting an old, sleeping bug in the B-level decomposition of LAM Semi-Lagrangian advection scheme)
- new version of shallow convection (to increase the persistence of Sc clouds)
- new version of CANOPY, using the Beljaars scheme, to improve low level winds over orography
- ICE4 microphysics (including hail)

•PEARP (Prevision d'Ensemble Arpège) Version 2: main target is an increase of PEARP members to about [30-40] + coupling with the ensemble assimilation + some physics perturbations + L65. This will have the same stretching as the deterministic forecast. Forecast set-up upgraded to the latest standard of the deterministic ARPEGE physical parameterization except those schemes contributing to the "modelling error" representation approach.

After moving the operational suite to the new super-computer framework and once the 2009 configurations will be well under way, significant efforts will be dedicated to the following subjects. Those may influence the ALADIN activities:

1. works to upgrade the organization and maintenance of the operational suite, with a view to improve productivity to switch a suite from OLIVE to operations
2. revise, possibly in-depth, the schedule of the operational suite, with the primary objective of simplifying the 00 UTC production

3. decide of a future for ALADIN-France: it may well be that ALADIN-Réunion becomes the reference ALADIN, supplemented by 2 or 3 overseas ALADIN

## **Plans for 2010**

One important change will occur in the Computer Centre, with the successive upgrades of the two NEC/SX9 clusters (add 7 more nodes, in order to make 2 clusters of 10 nodes each). This upgrade will require them to be shut down successively each cluster for about two weeks, and new Acceptance Tests will be done. This work should take place over February/March/April.

## **6. Non-hydrostatic modelling developments**

Sylvie Malardel presented an update on progress for the Non-Hydrostatic global model from Nils Wedi, Karim and herself.

There had been no significant code development after the last stay of Karim at ECMWF.

Nils had done some tests at T2048 (~ 10km resolution) - this had shown identical scores between H and NH up to 6 days.

NH is 2 times more expensive than H at this resolution (300 sec time step for both). MF mentions that some extra cost is logical, due to the corrector step and the two extra 3D prognostic variables. Deborah suggests that some profiling could be done.

Sylvie had been looking at bottom boundary condition in the semi-Lagrangian for badly resolved structures, resulting in a spurious source of humidity at the ground.

There was some discussion whether the NH-dynamics should have all the moist processes - this would need a change of dynamical core. The Physics would then be only of sub-grid processes.

Short-term aspects concerning the multi-phasic code: the consistency between the equations and the code for moist dynamics should be further checked. Presently, there appears to be a missing term  $dR/dt$  in the models. Investigations continue in order to understand how to treat / what to do with this term.

The collaboration is working very well here, and further transversal contacts between all involved scientists certainly are encouraged (ECMWF, MF, Aladin/Hirlam).

## **7. ODB**

Anne Fouilloux gave an update of ODB developments. There was still outstanding the problem of the matchup - which currently had to be coded differently to work at EC from MF. Anne would fix this for Cycle 37.

Also for Cycle 37 a new (more convenient) distribution would be developed for SSM/I and other observation types that are treated in the grid-point part of the code. The

current distribution suitable for the calculation of observation equivalents in HOP meant that observation equivalents calculated in grid-point space needed much message passing - which was giving scalability problems. The new distribution would be switchable and an extra flag in the ODB would tell which sort of distribution the observational data are following.

## **8. Discussions within ALADIN/HIRLAM about the flexible Jb-code**

Claude Fischer gave an update on his analysis of the development of a more flexible Jb code - in terms of grid-definition and data flow - for the LAM. Several months of work would be necessary to separate the data flow and data layout. It had been decided not to start work on this in the LAM community and the work had been put 'on hold' for now. This issue will come up in for the Jb in the new OO code.

## **9. Report on porting exercise to the NEC SX9 at MF**

Ryad El Khatib gave a presentation on the porting exercise from NEC SX8 to NEC SX9.

### **Acceptance Period:**

#### **February 2009: Benchmarks measurements:**

- Cycle 29 on 4DVar, Arpege/Aladin forecasting suite, Arome forecast
- 12 nodes expected - 20 nodes needed to fulfil the contract.

#### **End-February to mid-April 2009: Intermediate period**

- Users' Software installations
- Benchmarking on Cycle 35t2 – Direct models only
- Installation and first acceptance of a 13th node

#### **Mid-April to mid-June 2009: Machine open to the users**

- SX8R executables not 100% compatible with SX9 - Bug report submitted
- Mirror-suite on SX9 to be re-compiled on SX9
- Several regressions of the compiler found while porting the 4DVar suite - Bug reports submitted
- Workarounds on top of Cycles 33t1 (mirror), 35t2 (dbl) and in Cycle 36.
- The late installation of a supplementary node caused a synchronization of GRIB data on local disk to be missed.
- Much time spent searching for a compiler bug - also true bugs in the code (related to the stack usage) had to be fixed

#### **SX9 fully accepted at mid-June**

An Arpège T798 forecast runs at 18 Gflops on 1 CPU of the SX9 compared with 10 Gflops on the SX8R.

Optimisation work with NEC would be carried out in the Summer.

## **10. Status on IFS modularisation**

Yannick Trémolet gave an update on the work to modularise IFS. Version 1 of the 'Toy' Fortran 2003 model had been tested using IBM and Nag compilers. In the Toy

code they had tested changing from 3-variable Lorenz model to 2-level QG model - and this could be done without changing any line of code.

MF reported that F2003 was not fully available on the NEC SX9 - and was not sure whether Object Oriented features would be available in the next 5 years of the contract with NEC. However, they would continue to pass the Toy models to NEC. There was some discussion of the possibility of using C++ rather than F2003 for the control layer.

Yannick encouraged modularisation work in IFS which could be done in Fortran 90 today.

**Step 1:** The main obstacle to having a modularised code is the 'global variables'. This would need to remove the ifs/module, ifs/namelist and ifs/setup directories and move the setup - for each part to be with the rest of the relevant code where it is used.

**Step 2:** Introduce modules which contain variables private to each part of the code.

Mike Fisher and Yannick will give a seminar and Tech Memo on this subject in Mid-Oct 2009. This seminar, internal to ECMWF, will however be open to MF and Aladin/Hirlam participants.

**Action: JNT and YT to agree date for F2003 seminar with MF.**

## **11. Status on IFS scalability project**

Mats Hamrud presented his work on scalability of IFS 4D-Var. Scalability curves of IFS run on the ECMWF IBM Power6 showed that the 'sweet-spot' was for runs on 24 nodes - as is used in operations at ECMWF - but the scalability curves flattened out after this. Mats had done all runs with extra MPI-Barrier around the message passing - so that communications costs could be obtained.

He pointed out that the Rain-assimilation part of 4D-Var was scaling particularly badly - and this had suggested the work for Anne to change the distribution of the SSM/I observations in the ODB.

Mats showed that the scalability of T799/T95/T159/T255 4D-Var could be studied by using a forecast of the same resolution as the final minimisation - in this case a 55-day run of T255 showed very similar characteristics to the 4D-Var.

Scalability runs had also been done on Cray XT4 and IBM Blue Gene - and similar results had been obtained.

Why 4D-Var does not scale:

- Incremental approach is sequential
- Minimization algorithm is sequential

- Time-stepping in TL and AD is sequential
- Parallel only at rather low level (model space, observation space etc.) with frequent communications
- First minimization has major communication every 30 ms on average (24 nodes)

Increased resolution may help:

- Solving a bigger problem alleviates the issue but does not resolve it as the sequential part also increases (shorter time-step)
- Bigger problem on more processors leads to higher sensitivity to “jitter”
- Resolution independent cost may increase - startup, jo computation, ...

He showed an analysis of the IFS’s ‘Weak Scalability’ - or runs of different resolutions on different numbers of processors chosen to run in 1 hour.

## 12. Cleaning of the code

Karim Yessad has produced an updated version (5d) of his ‘Proposal for Cleaning Arèpege/IFS in 2009-2010’. A set of cleaning actions to be done by CY37 by ECMWF were agreed:

- Removal of unused arguments - “Argument NOT used”
- Put in proper INTENT in cases of “UNDETERMINED INTENT”
- Remove unused YOE... modules
- Improve comments in modules as necessary
- Improve comments in subroutine headers as necessary

Conversely, the specific proposal for renaming the physics interfaces with “pdi1/pdi2” suffixes was rejected.

An intermediate stage of the POS improvements would be ready for Cycle 37.

For the LAM partners, Tomas Kral mentions that the cleaning actions shall preserve key options such as LPC\_FULL and LGWADV (NH dynamics). The LPC\_OLD option, however, can now be pruned from the code.

## 12. Report on IPR issues and consequences

ECMWF presented MF with a draft copy of their new IPR guidelines for distribution of code by ECMWF and inclusion of source code from external sources.

**Action: CF to read IPR guidelines and provide feedback before end of July.**

**Action: JNT and CF to look at current software agreement between MF and EC to see if it needs updating in view of HIRLAM.**

### 13. Content and timing of Cycle 37

#### Likely input from Météo-France to Cycle 37 (CF)

**CY36T1: to be prepared probably over November/December; deadline for contributions about mid/end-October 2009**

- Assimilation:
  - Cleaning of Neural Network routines for AIRS (V. Guidard)
  - Microwave radiances:
    - Addition of emissivity parameterization using a Lambertian approximation for refractivity (F. Karbou) and compare with the specular hypothesis,
    - add the term emissivity\* $T_{surf}$  ( $\epsilon.T_s$ ) to the control vector as a new sink variable for VarBC (E. Gérard & F. Karbou),
    - assess surface emissivity over sea and land ice
    - assess the dynamical emissivity retrievals obtained with MERIS channels
  - infrared radiances:
    - Computation of cloud top pressures for cloudy IASI radiances (performed once during screening with a different formulation than in the IFS, V. Guidard and N. Fourrié). Same development already is operational for AIRS.
    - Extension of the MSG/SEVIRI raw radiance assimilation in the LAMs (Aladin and Arome) to cloudy radiances (S. Guedj)
  - Adaptation of code to use the ECMWF bias correction for radiosonde and SYNOP at Météo-France (P. Moll)
  - preparation for the pre-treatment of ADM/Aeolus data at MF, mostly in the “bator” pre-processing tool (C. Payan, C. Desportes) – to be confirmed
  - bugfix for the correct check of observation positions for big LAM domains in rotated geometry (OBATABS) (J.-D. Gril)
- Model dynamics:
  - Miscellaneous cleanings following the agreements between MF+partners and ECMWF, based on Karim’s document
- Arpège/Aladin-France physics:
  - Finalize the code for using the external surface scheme SURFEX
  - Plug-in for using EDKF ; tunings for vertical turbulence (TKE-CBR) and shallow convection KFB
  - Adaptations for using 3MT (modular multi-scale microphysics/turbulence) – J.-M. Piriou
  - Cleaning of the MF\_PHYS interface (reduce substantially the number of dummy arguments) – Y. Bouteloup
  - Add tendencies from the dynamics to the DDH diagnostic package (F. Voitus)
- Arome :
  - Protection against negative values in the turbulence scheme
  - New diagnostic fields for wind gust (max value over the last 10 mns)
  - Introduction of SURFEX Version 5

- Proper patch to take into account gridpoint  $Q_l$  and  $Q_i$  when converting  $T$  back to  $T_v$  in the minimization (case  $LSPRT=.T.$ ) ; various other corrections for Arome/FGAT
- Alaro physics :
  - (input not yet finalized, but some significant modifications are expected to enter)
- Hirlam/Harmonie :
  - Implementation of code to allow to run the MF+partners' physics on a different grid than the dynamics (inspired from the IFS development) (M. Hortal and A. Fitch) – to be confirmed –
  - Implementation of the variable map factor formulation for the LAM models, in the LAM Semi-Implicit code (based on an approximated development and inspired from the global solution already present in IFS/Arpège) (M. Hortal) – to be confirmed -
- Miscellaneous:
  - Improvements in configuration 901 (CPREP1) for surface field conversion TESSEL => ISBA/SURFEX (J. Ferreira, F. Bouyssel)
  - Code reorganization under POS (K. Yessad)
  - Plug-in the missing model code for running the 1D vertical model version in Arpège/Aladin, “Single Column Unified Model” (??)

**CY36T2: deadline for contributions by end of February 2010, to be constructed in March**

- Assimilation:
  - Infrared radiances: Introduction of an alternative cloud detection method for AIRS and IASI (MMR code from Thomas Auligné), unless similar work planned at ECMWF (V. Guidard or N. Fourrié) – to be confirmed
- Arpège simplified physics schemes (O. Rivière):
  - Modified gravity wave drag scheme (by ignoring the perturbations of some terms)
  - New large scale precipitation scheme: adjustment Smith scheme ( $Q_v \rightarrow Q_v^*, Q_l^*, Q_i^*$ , cloud fraction) followed by auto-conversion and precipitation of all condensed excess ( $Q_r^*$ )
  - Convection scheme based on a simplified Betts-Miller scheme

**Further code contributions until CY37 will concern:**

- A thorough overhaul of the SURFEX to atmospheric models interface, in order to improve its robustness and prepare for further optimizations (make it Open-MP proof)
- An overhaul of the physics/dynamics interface (CPTEND, CPUTQY) in collaboration with the Aladin/ALARO partners



## **Input from ECMWF to Cycle 37**

### **Work on numerical aspects:**

- Research and Development on the Non-hydrostatic (NH) dynamical core (based on Aladin/Météo-France's model).
- Fully non-interpolating semi-Lagrangian scheme.
- Analysis of scalability of the IFS on future HPC architectures?
- Switch to GRIB\_API interface for any I/O in the IFS. This may affect Arpège configurations using GRIB files in the IFS-manner, like in multi-incremental assimilation (analysis increment,  $\sigma$  file, B-matrix files, etc.)

### **Work on physics:**

- New vegetation climatology
- Shallow cumulus convection
- New prognostic precipitation and cloud scheme, more comprehensive microphysics
- Model validation with AQUA train (Cloudsat/Calipso), preparation for Earthcare (together with the Satellite Section)
- Inclusion of land surface aspects in the linear physics
- Preparation for the assimilation of surface rain observations

### **Work on data assimilation and satellite data:**

- Generalisation of weak-constraint 4D-VAR
- Flow dependent background error (via EDA), flow dependent thinning and Q/C of (satellite) observations
- Extension of the assimilation window (?)
- Inclusion of observation error correlations in the assimilation
- Implementation of an EKF scheme for soil moisture analysis and exploitation of SMOS, ASCAT, etc.
- Modularisation of the IFS
- Preparation for NPP and ADM-AEOLUS
- Generalisation of rain-affected and cloud affected radiance assimilation
- Prospective work on assimilation of Principal Components composite fields from advanced IR sounders

Provisional timing for CY37: ECMWF would send its contribution to MF by early May 2010, and CY37 should be completed by the 2<sup>nd</sup> half of June 2010. This timing needs to be confirmed at the next phone call conference. **Action (DS, JNT, CF): confirm timing for CY37**

## **14. Potential issues raised by Hirlam/Aladin**

**none.**

## 15. AOB

### SUGAW

Mats and Nils Wedi's work to avoid the use of 128-bit precision in the computations of the Gaussian Weights had needed a complete re-write of SUGAW. Karim wished to split SUGAW to help incorporate this into the use of it and MF - it was hoped that this would not be necessary.

**Action: MH, KY and REK to find a way to not split SUGAW**

Further work to develop an nlogn Legendre Transform will mean further changes will be necessary in this part of the code.

### Interpolation of surface fields

MF has spotted some problems with interpolation of Surface Fields, including some potential for hidden/future bugs. Karim has prepared an analysis document which Deborah shall hand over to ECMWF contacts (Lars and Drasko). Karim remains the contact at MF for the time being (at the level of discussing the analysis of the problem). ECMWF shall study the document and check on their side (and from the point of view of the IFS) the robustness of the code.

**Action: Deborah to hand over Karim's document to Lars Isaksen and Drasko Vasiljevic. Then wait for some possible feedback from them.**

### New DDH

ECMWF should check and test the new DDH dataflow version (some code adaptations for the IFS will be necessary => contact for those would still be Olivier Rivière at MF, with Fabrice Voitus in copy). Otherwise, Fabrice Voitus is the new person in charge of DDH at MF, and he should be contacted later on for any matter on DDH.

### Access to Arpège/IFS documents

Claude suggested that documents for the meeting could be put on the password-protected web site which MF and Aladin/Hirlam partners already use for exchange of non-public information for coordination matters (mostly technical and operational coordination is concerned here). The URL of the site is [www.cnrm.meteo.fr/aladin/](http://www.cnrm.meteo.fr/aladin/) then follow "Partners Only" and access using the (presumably known !) user + password; then click on "Documentation on cycles and coordination meetings" etc.

**Action: whenever needed, Deborah and/or Jean-Noël may send ECMWF's preparatory documents to Patricia Pottier who's acting as webmaster. She would upload the files on the site.**

### Grib-API

ECMWF will be removing all GRIBEX calls and replacing them with Grib-API. This will allow a move to GRIB-2 and then the increase in the number of levels above 126.

## 16. Date and Place of Next Meeting

**Next telephone conference:** November 5<sup>th</sup> 1.00pm GMT (14:00 MEST)

**Next Coordination Meeting in Toulouse:** June 24<sup>th</sup> 2010

## **17. List of Actions**

- 1) DS and Philippe Marguinaud to move RTTOV9 allocations to higher level in IFS.**
- 2) DS to investigate the feasibility of checking that all new releases compile on the NEC.**
- 3) Patrick Moll, Ludovic Auger, Vincent Guidard and DS to sort out array index problem with channel number instead of channel count.**
- 4) DS, REK, KY and Tomas Wilhelmsson to look at evolution of Arpège/IFS coding norms.**
- 5) JNT to provide paper from Tony McNally to Nadia**
- 6) JNT to provide description of Elias Holm's work on humidity**
- 7) JNT and YT to agree date for F2003 seminar with MF.**
- 8) CF to read IPR guidelines and provide feedback before end of July.**
- 9) JNT and CF to look at current agreement between MF and EC to see if it needs updating in view of HIRLAM.**
- 10) DS, JNT, CF: confirm timing for CY37**
- 11) MH, KY and REK to find a way to not split SUGAW**
- 12) Deborah to hand over Karim's document to Lars Isaksen and Drasko Vasiljevic. Then wait for some possible feedback from them.**
- 13) Whenever needed, Deborah and/or Jean-Noël may send ECMWF's preparatory documents to Patricia Pottier who's acting as webmaster. She would upload the files on the site.**