

# IFS/Arpège Memorandum

**From:** Deborah Salmond (ECMWF)

**To:** (ECMWF) HR, RD Division & Section Heads,  
Mats Hamrud, Sami Saarinen, and Nils Wedi

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

**To:** (ALADIN) Martin Janoušek

**To:** (HIRLAM) Xiaohua Yang

**File:**R48.3/DS/0808

**Subject:** Minutes of the IFS/Arpège coordination meeting -  
Cycle 33 - held at ECMWF on 29<sup>th</sup> November 2007.

**Participants:**

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

**ECMWF:** Jean-Noël Thépaut, Mats Hamrud and Deborah Salmond,  
(Part time) Philippe Bougeault, Sami Saarinen, Nils Wedi and Erik Andersson

**ALADIN:** Martin Janoušek

**HIRLAM:** Xiaohua Yang

**1. Adoption of Agenda**

The agenda was adopted.

**2. Approval of Minutes of Meeting of 13<sup>th</sup> June 2007**

Approved.

**3. Observers status and their expectations**

Jean-Noël welcomed the observers from HIRLAM and ALADIN and asked them to express their expectations for the meeting.

Martin Janoušek (CHMI) - the observer from ALADIN - said that he served as the ALADIN-2 Officer for Networking Aspects. He is responsible for informal exchange as well as the coordinator for operations. The phasing of ALADIN was traditionally coordinated through MF and took place in Toulouse - but during last years they had started to distribute these actions to the ALADIN partners. He hoped to further

improve the dissemination of the expected changes in the code relevant to the LAM configuration and extract any matters of interest to ALADIN.

Xiaohua Yang (DMI) - the observer from HIRLAM - said that he was part of the HIRLAM management group and was in charge of 'Applications and System Matters'. He similarly hoped to find out what was planned for the code and to help with the learning process of the ALADIN code for the HIRLAM partners. Xiaohua mentioned bilateral cooperation between HIRLAM and ECMWF as well as ALADIN and considered it desirable to reduce the current phase lag between HIRLAM's IFS implementation compared to those at ECMWF and MF. He said that the HIRLAM partners would expect to replace the synoptic HIRLAM by ALADIN the next 2-5 years. They have started to run the 2.5 km version of AROME but the EPS systems would run HIRLAM and ALADIN at synoptic scales.

Claude Fischer said that Météo-France had set up a (password-protected) web-site with Tech Memos, FLUBs (Forecast Library Update Bulletin = IFS Memorandum) and other technical information for HIRLAM and ALADIN partners.

## **4. Reports on Cycle 33**

### **4.1 Status of libraries**

Mats Hamrud said the ECMWF had sent the pre-Cycle 33 - which was CY32R3 (including Aeolus) to MF on 1<sup>st</sup> October. Guillaume Beffrey said the MF had merged this with CY32T3 and now all configurations worked satisfactorily. They had had some compilation problems on the NEC in particular for the ODB code - but these had now all been fixed. MF said that they find the full outputs from 4D-Var very useful and asked ECMWF to systematically add them with the pre-cycles.

Mats Hamrud mentioned that at ECMWF Paul Burton was looking at improving the compilation system as ECMWF currently have problems with compilation of the Aeolus library. He said Paul would be investigating the UK Met Office compilation system as a possible replacement. Xiaohua mentioned that in HIRLAM Toon Moene and Tomas Wilhelmsson have been interested in the same tool to replace the MF-gmckpack that they currently use.

MF said that they still used the old satellite bias-correction scheme in operations but were currently testing VarBC in E-suite. It was decided that the old bias correction scheme can be removed in about 2-3 cycles - and in the interim MF would be responsible for this part of the code.

Mats pointed out that subsequent to the pre-Cycle 33 release a bug had been found by Niels Bormann in **hopad** - this fix would be included in Cycle 33 before it is sent back to MF.

### **4.2 Météo-France contributions to Cycle 33**

#### **CY32T0: declared early February 2007**

- Bugfixes for LAM 3D-VAR
- Catch-up of MF E-suite for operations
- Optimisation for NEC platforms
- (final) bugfix for LAM geometry

**CY32T1: declared April 2007**

- ALARO0 code updated within the official releases; R&D updates for 3MT
- OMP and AROME optimisations

This cycle became an export version for the Aladin partners.

**CY32T2: declared June 2007**

- Climate group contribution for Arpège-Climat
- Stronger compression option for GRIB fields (second-order compacting)
- BATOR adaptations for reading GRIB instead of RGB libraries for SEVIRI data (useful for the assimilation of SEVIRI radiances in Aladin-Hungary)
- Corrections in the call to the externalized surface scheme SURFEX in Arpège and Aladin-France
- Optimisation of FGAT configuration for LAM
- MPI bugfix for the NEC SX8
- Bugfixes from phasing for ALARO and configurations 401/501/601/801 LAM
- Adaptations for the use of ASCAT data in Arpège and LAM
- Further adaptations and bugfixes for the “Diagnostiques Horizontaux”, zonal and local horizontal model diagnostics (DDH)
- Adaptations for the use of METOP sensors and SEVIRI Clear Sky Radiances in Arpège and LAM
- New pre-processing for ground-based GPS (ZTD)
- Adaptations for the use of GPS radio-occultations in Arpège and LAM
- Version 2 of SURFEX in AROME; consistency checks on physiographic fields; get PBL fields directly from SURFEX (for diagnostic purposes only, so far)
- MASDEV4.7 version of Méso-NH physics for AROME
- Implementation of the 1D Bayesian retrieval code within the Arpège/IFS assimilation software, for radar reflectivity assimilation
- Implementation of the radar radial wind observation operator in Arpège/IFS
- Update to HIRLAM physics on CY32
- Miscellaneous cleanings in the dynamics code
- Adjoint of the SL advection scheme for LAM

For CY32T1, the total amount of modified or new routines is about 1200. The new version of the AROME physics package represents about 50 % of this figure.

**CY32T3: declared end of September 2007**

- Further changes for the Arpège/SURFEX interface
- Use PBL fields directly from input file (possibly computed by SURFEX previously) –under logical key
- Corrections for ALARO0 physics to match the operational version at CHMI and ZAMG
- Protections against too aggressive optimisation by NEC compiler
- New treatment of surface emissivity for microwave radiances over land
- Adapt DDH for 3MT and prognostic microphysics
- NEC optimisation features for AROME
- Bugfixes for CANARI OI scheme
- Optimisation of SL/AD code

- Screening of radar radial winds made available within Arpège/IFS software
- Adapt code for the assimilation of relative humidity retrievals from the 1D Bayesian inversion of reflectivities
- Further cleanings in dynamics; setup for VFE-NH code

### 4.3 ECMWF contributions to Cycle 33

#### CY32R1

- Preparation for ASCAT
- Modifications to the heterogeneous term of the linearised ozone chemistry to incorporate improvements to this term developed at Meteo-France.
- Fixes for problems found when preparing and testing the benchmark code for ITT192.
- Modifications for the short-wave and long-wave radiation schemes: RRTM SW and LW working in a McICA configuration, use of MODIS surface albedo
- Fix for bug in DDH for limited areas and points.
- Passive observations in the analysis

#### CY32R2 (went operational on November 6<sup>th</sup>)

- Parallelisation of the I/O in getmini/savmini
- Doppler wind lidar assimilation
- Modifications related to weak-constraint 4DVAR, mainly to the 4d state-vector control variable version (NTYPE MODERR=1)
- Changes to allow processing of IASI radiances.
- Fine tuning of assimilation of ASCAT
- HTESSEL land surface scheme (activated by LEVGEN=.true. ; LESSRO=.true.) which includes a new hydrology (variable infiltration runoff and Van Genuchten soil water transfer scheme).
- Removal of Harris and Kelly bias correction in the VarBC configuration
- Antenna correction for AMSUA aboard Aqua and Metop (Niels and Blazej)
- VarBC bugfixes
- ODB technical modifications: NEC-SX and CRAY XT4 port, New ODB compiler [for offline jobs] that does not generate C-code, input BUFR-data that is embedded in ECMA-database removed when \$DOFDBK != true, ODB/SQL SELECT now supports functions and aggregate functions.
- Passive monitoring of OMI total column ozone.
- Include MTSAT CSRs data in passive monitoring, and secondly to clean-up the geostationary radiance quality control

#### CY32R3

- Write gridpoint cloud fields to trajectory structure. Preset IFS defaults for reading and writing gridpoint fields to consistent values.
- A modification of the bufr to ODB routine was introduced to enable processing of GRAS measurements from METOP-A.
- Doppler wind lidar assimilation.

- Changes to COSMIC RO usage in DS blacklists
- Changes to 1D+4D-Var with new passive imagers TMI/AMSR-E/SSMIS and code for 4D-Var rain-affected radiances
- Changes to GEO CSR usage QC and bias correction
- Clear sky assimilation of newMW-imagers
- Var-BC code clean up
- AMSUA-14 bias correction frozen at zero
- New AMSU-A RT coefficients with Zeeman-effect removed and improved layer averaging
- Passive monitoring of OMI data and assimilation of SBUV data from NOAA-17 and 18
- Remove temporary reduction of increments at model top.
- “Univariate” tracer assimilation in 4D-VAR: on for ozone
- Bug-fix to reestablish the calculation of the diagnostic UV-B and PAR that had gone to zero with the implementation of McRad in 32R2
- Quality control on sea ice for scatterometer data moved to the blacklist formalism.
- Modifications to 1D+4D-Var of rain and cloud-affected SSM/I observations
- Revised version of the capability to have coarser or finer resolution physics. All contained inside ec\_phys\_drv (the calling routine for the ECMWF physics from gp\_model).
- Library (trans) support for grid-only resolutions
- Improved (NPRTRW,NPRTRV) partitioning for fourier and spectral spaces

## 5. Progress and Plans of ECMWF

### Progress

IFS Cycle 32r2 went into operations on June 5th 2007. This was followed on June 12th by the introduction of IASI and ASCAT. On Nov 6th 2007 IFS Cycle 32r3 went into operations.

#### CY32R2 (June 5th 2007)

- RRTM-SW + McICA
- MODIS albedo + revised cloud optical properties
- Three minimizations in 4D-Var with improved moist physics in TL/AD
- Revised convergence criteria for 4D-Var
- Retuned subgrid-orography scheme
- Improved parametrization of the heterogeneous ozone chemistry
- Explicit numerical treatment of convection in tropical moist SVs

#### CY32R3 (November 6<sup>th</sup> 2007)

- New formulation of convective entrainment
- Variable relaxation timescale for closure
- Reduction in background atmosphere vertical diffusion
- New soil hydrology/runoff

- New radiosonde temperature and humidity bias correction
- Increase of number of RO from COSMIC
- Assimilation of AMSR-E, TMI, SSMIS window channels (clear sky)
- Assimilation of SBUV (N-17, N-18) and passive monitoring of OMI
- Revised RTTOV (correct for Zeeman-splitting effect)
- Updated linear physics (32r2) used in Tropical SV calculations

## Plans for 2008

- Physical Aspects:
  - New shallow convection scheme.
  - Mass flux momentum transport in vertical diffusion.
  - New description of vegetation (ECOCLIMAP).
  - Effect of gravity waves in the middle atmosphere.
- Satellite Data:
  - Addition of METOP GRAS/GOME-2.
  - 4D-Var microwave radiance assimilation in presence of clouds/rain.
  - Evaluation of cloud-affected radiances for most IR-instruments.
  - Improved usage of advanced sounder data (e.g. water vapour).
  - Improved surface emissivity retrieval
  - Preparations for NPP (NPOESS Preparatory Project: ATMS, CrIS, OMPS, VIIRS).
- Data assimilation
  - Development of a new surface analysis scheme (primarily driven by SMOS and ASCAT soil moisture observations)
  - Ensembles of data assimilation to investigate and quantify analysis uncertainty.
  - Development of advanced diagnostic tools to understand impact of observations on analysis/forecast.
  - Weak-constraint 4D-Var accounting for model error.
- Reanalysis
  - ERA-Interim is based on CY31R2, 12 hour 4D-Var, model T255L60.
  - Started in August 2006 running period beginning in 1989.
  - Now past May 1999, real-time will be reached by the end of 2008.
  - ERA-Interim will continue as Climate Data Assimilation System, subject to funding.
  - EU funding is sought for a proposal for a 75-year reanalysis
- The probabilistic prediction system:
  - Currently:
    - The 15-day VArIable Resolution Ensemble Prediction System (VAREPS).
    - The 32-day coupled monthly ensemble system.
    - The 6-month seasonal ensemble System-3.
  - Future changes:
    - The unified 32-day VAREPS/monthly forecasting system.
    - The new ocean model NEMO and NEMO-VAR in the seasonal system.

## Outlook for 2009-10

- Implementation of the next resolution upgrade (T1279, ~16 km) shortly after the computer upgrade in 2009.
- Vertical resolution increase planned for 2010.
- Start of 75-year reanalysis project in 2009, subject to funding.
- Completion of GEMS in 2009, to be followed by MACC (monitoring of atmospheric composition and climate) near-real time and delayed-mode global analyses.

## 6. Progress and Plans of Météo-France

### Progress

#### E-suite on CY32T0 containing :

- CY32T0
- assimilation of GPS radio-occultation (8 satellites, based on COSMIC constellation)
- modified pre-treatment and data selection for ground based GPS delays, leading to the assimilation of more GPS zenithal delays (20 to 30 % more data)
- assimilation of AMSU-A (12 channels) and MHS (formerly AMSU-B, all channels) sensor radiances from METOP
- assimilation of scatterometer data from ERS-2; monitoring of scatterometer data from ASCAT onboard METOP
- modified clear sky IR radiance selection (placed before sampling/thinning, rather than after). This change allows for about 10 % more clear-sky IR radiance data to pass screening
- stop assimilating some AMSU-A channels from NOAA 16
- reduction of the rate of evaporation of precipitations, in order to avoid spurious too strong local circulations in the Aladin-France forecasts
- in the Aladin-FR assimilation: assimilation of 10 m SYNOP and MESONET observations
- new NESDIS SST data (on a 1/12 deg grid resolution)
- correction of a bug in the treatment of soil water content in the surface CANARI analysis (Françoise Taillefer and Alena Trojakova)

This E-suite has turned into operations on September 5<sup>th</sup>, 2007

#### E-suite for global higher resolution: CY32T0

- TL538L60C2.4 for Arpège, with 4D-VAR minimization increments at TL107/TL224(C1.0) and 25/30 iterations per outer loop. This leads to about 15 km resolution over France. Increased vertical resolution is around the tropopause and in the lower stratosphere.
- Variational bias correction
- Assimilation of METOP/ASCAT
- Monitoring of some IASI channels (314)

- PDF-based sedimentation for the Advanced Prognostic Cloud Scheme (formerly “Lopez-scheme”)
- Increased asymptotic mixing length in turbulence for momentum
- Vertical finite element discretized scheme
- Aladin-France: incremental digital filters (stop-band edge at 2h), retuned global REDNMC (1.2 instead of 1.5), L60 vertical levels (same as Arpège) but horizontal resolution kept at 9.5 km, surface OI analysis before 3D-VAR (Canari, to be confirmed)

Technical start has taken place on November 5<sup>th</sup>, but its evaluation currently starts from October 6<sup>th</sup> (initial segment was run in R&D mode).

### Plans for 2008:

- PEARP version 1.5 which uses the same basis as the current PEARP version (10+1 members at TL358C2.4) plus the following changes: 55 vertical levels, revised initial perturbations (global singular vectors and some kind of evolved/bred modes added to the targeted SV) => evaluation and switch to operations expected by end of 2007. Completion of PEARP contribution to TIGGE (Tmin, Tmax).
- Stop the Arpège-Tropiques assimilation cycle, switch Arpège-Tropiques production runs on the Arpège assimilation cycle. Tropiques model goes to TL538C1.0L60 resolution (January 2008)
- Start on a routine basis an ensemble of 6 assimilation cycles of 6h-window 3D-VAR FGAT in TL358C1.0L60 (January 2008)
- Arpège and Aladin-France E-suite number 1 for 2008 :
  - Double the density of about all radiance types (adaptation to T538),
  - assimilation of new AIRS channels,
  - assimilation of IASI channels,
  - assimilation of GRAS radio-occultation,
  - assimilation of SEVIRI Clear Sky Radiances,
  - assimilation of microwave radiances over land,
  - couple the assimilation with variances derived from the ensemble assimilation,
  - re-introduce a simplified water cycle in the physics for 4D-VAR,
  - switch on the new humidity control variable (E. Holm's),
  - ALADIN-France : 3D-VAR FGAT; Doppler radial winds assimilation; surface assimilation (if not switched on before).

This E-suite is expected for testing over February-April 2008.

- Development of on-demand LBC file production for any Aladin partner domain, from an Arpège E-suite => spring 2008 ??
- Arpège and Aladin-France E-suite number 2 for 2008 (spring 2008):
  - TKE CBR
  - Shallow convection scheme
- Preparations for the evaluation on the NEC Phase 2 Arpège system (TL800C2.4L70) should start in summer 2008, for a delivery of the prototype application in the autumn. This version will be used for the technical validation process on the NEC Phase 2.



- PEARP Version 2: main target is an increase of PEARP members to 30-50 + coupling with the ensemble assimilation.
- Arpège and Aladin-France E-suite number 3 for 2008 (Sept-Dec 2008):
  - New GWD, new orography definition (mean or semi-envelope)
  - first tests of SURFEX in either Aladin-France and/or Arpège, probably with equivalent “ISBA-2-layer” scheme and old clim files (not ECOCLIMAP)
  - Assimilation of cloudy microwave radiances (using a simple linear regression method for bias correction, with IFS coefficients as predictors)
- Install the ensemble assimilation for the Aladin-Réunion system (target is January 2009)
- Complete Acceptance Test (“VSR” in French acronym) for the NEC Phase 2 cluster: end of January 2009

### **Arome first pre-operational suite:**

600\*512 gridpoint domain, 2.5 km resolution, 41 levels (adapted for convective modelling with a refined PBL and first full model level at 17.5 m height), Méso-NH physics (CBR TKE, ICE3 microphysics that include graupel, Surfex coupled in explicit mode with atmospheric vertical diffusion, IFS-based radiation scheme called every 15 mns, no deep convection neither GWD), timestep = 60 s using either the Predictor/Corrector or the simple Predictor scheme. Assimilation will be with a 3 h frequency 3D-VAR cycle, with radar radial winds assimilated (15 km thinning). A specific surface analysis is run every 6 hours. Arome will be run with a 30 h production forecast four times a day. One 30h forecast takes about 35-40 mns elapse on 64 PE/NEC-SX8R. The pre-operational E-suite is scheduled for April 2008, but a regular daily monitoring and evaluation of the target configuration has started since beginning of October (monitored under the OLIVE system at CNRM). Ongoing work currently focuses on the following topics:

- In-depth evaluation of PBL diagnostics (2m fields and 10m fields), for which a new computation of PBL diagnostic values has been developed (solving for the vertical profiles on extra PBL levels between the ground and the first model level, with surface fluxes from SURFEX as input and adaptive fields). These diagnostics also will be evaluated in data assimilation, as input to the low-level PBL observation operator (collaboration with Hungarian Met Service)
- Over-intense evaporation of precipitations leading to exaggerate cooling and unrealistic low level divergent wind. This problem has lead to a revision of the choices for horizontal diffusion
- Shallow convection parametrization following the lines of the “EDMF” approach (collaboration with KNMI)
- Lack of shallow clouds and too dry initial states in the model: the question whether this is a model problem (link with microphysics and diffusion) or an initialization and coupling problem (consequence of either fullpos or LBC formulation) remains under investigation

## **7. Non-hydrostatic modelling**

Nils Wedi presented the work on testing and performance evaluation of NH-IFS. In summary the progress was as follows:

- NH-IFS climate performance (done)
- Series of T159L91 scores (in progress)
- Investigations into instabilities of NH-IFS (in progress)
- Test-bed for non-hydrostatic effects and physics coupling (in progress)

Karim Yessad is at present visiting ECMWF to work on this.

### **7.1 Near surface sensitivities in the vicinity of steep orography**

The problem of instabilities near steep orographies when the NH-IFS was run with timesteps that could be safely used for the Hydrostatic- IFS was being investigated. Various methods had been tried to fix the problem - but now a solution had been found by careful analysis of the 'X-term'. The solution was to re-calculate X after physics and advection in the corrector step and then consistently update d4 and X for the next step. It has been found that LGWADV=true improves stability and is currently the only option that adequately simulates the cold bubble in a neutrally stratified atmosphere. It had been found that NSITER=0 was insufficient, furthermore the 3TL version does not work, as LPC\_FULL was not implemented for this case. The modifications to the X term have been added to CY33.

### **7.2 Remaining stability issues**

- Oscillation in time in the vicinity of orography in the presence of vertical shear of horizontal wind.
- Oscillation in time of acoustic perturbations, especially near surface.
- Inconsistent initial condition with respect to surface boundary condition – a source of acoustic disturbances?
- NH effects in the stratosphere may lead to convective instabilities and blow-up

### **7.3 VFE scheme and d4**

Karim presented his work on instabilities that come from the Semi-Implicit scheme and his investigations of including a Vertical Finite Element scheme. Josef Vivoda proposed a first version of the NH VFE scheme - this has been adapted by Karim so that VFE is used for the non-linear part - with the finite differences for the linear part. For this it seems attractive to change the prognostic variable from d4 to vertical velocity - but this would be a major piece of work. The NH VFE code will be provided for CY34. The collaboration with other Aladin and HIRLAM scientists on this issue is welcome; especially the role and help of Josef Vivoda (in addition to Piere Bénard) would be very useful in 2008.

Nils presented his test-bed for NH effects running experiments for a planet with  $R < R(\text{Earth})$ . This showed satisfying results for acoustic waves in academic flow. Further work by Nils and Karim was under consideration - possibly the coding of a deep atmosphere version.

## **8. ODB Developments**

Sami Saarinen responded to a series of points raised by MF:

### **Plans for pre-SQL interpretive language**

This is now available in CY33 and will be slightly modified in the next release. This 'interactive' feature is not designed to be part of a batch job - i.e. it is not high performance or vectorised etc. - however, it is a good tool for post-processing in that a user can look directly at an ODB. The interactive and batch use the same backbone (odb98.x) - so all updates to ODB will be automatically available to both uses. For the batch use c code is generated and for the interactive use instructions are generated in the interpretive language.

### **Re-running old cases**

The ODB software can read any ODB - old or new. However, the IFS interface to the ODB may be expecting to find some data that is not there in an old ODB - so a job would fail. This is not a problem at ECMWF as the archives are kept in BUFR format which then can be converted to ODB. However, if a user requires to read an 'old ODB' software exists to convert from the old ODB to ASCII format and then to a new ODB.

### **Ensemble data assimilations and ODB**

When the Ensemble data assimilation is run the control ODB is obtained from the BUFR data. Then the observations are perturbed to form several independent new ODBs - for each of the members of the ensemble. All these ODBs can be merged into the control ODB (which saves space) or each separate ODB can be saved.

With a 'merged ODB' the user can query data from different members and the control and does not need to open several ODBs - but this merged file can be very large. At ECMWF the ENDA runs do not currently use merged ODBs as the feedback cannot cope with the merged ODB.

### **Status of old thinning code**

There is a multiplicity of thinning codes which are all rather similar. It is planned to merge these into a generic thinning code.

### **Other points**

Sami then asked MF if it was possible for ECMWF to have a copy of the pre-processing code used at MF to create ODBs. This would help him when he gets asked to help with problems in generating ODB using this software. This source code could be placed in its own directory in the odb library. **Action:** Dominique Puech, Ryad El Khatib and Frank Guillaume (MF) to send Bator code to Sami.

Sami also asked who at MF supported the ODB for HIRLAM and ALADIN users. MF said that since Sandor Kertesz had left his position at the Hungarian Met Service. Dominique Puech is the contact point. at MF However, both ALADIN and HIRLAM need to designate and train further ODB contact persons. Their names will be forwarded to ECMWF. **Action:** MF

Sami informed MF that BMRC Australia and UK Met Office were using the ODB software on the NEC systems.

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

### **9.1 RTTOV-9**

Deborah presented work on vectorisation and optimisation of RTTOV-9. RTTOV-9 is now in beta-testing and is expected to be released early in 2008. RTTOV-9 takes about the same time to run as RTTOV-8 on the IBM at ECMWF. However, vectorisation improvements mean that the efficiency of RTTOV-9 will be much better on the NEC. RTTOV-9 includes an internal interpolation scheme - originating from Rochas at Environment Canada. This interpolation scheme had been the subject of much optimisation work and now runs several times faster.

Niels Borman has been testing RTTOV-9 in IFS and will be testing replacing the interpolation in **ppobsa** by the RTTOV-9 internal interpolation. It is expected that RTTOV-9 will be included in Cycle 34. Currently, Niels should verify that the old interfacing to RTTOV, where vertical interpolations are done prior to the call to RTTOV, remains active for at least one more cycle. (Contacts at MF: Florence Rabier, Nadia Fourrié and Vincent Guidard).

### **9.2 Vectorisation of RRTM and SRTM**

MF had provided a branch containing the version of RRTM vectorised for the NEC. The vector length can be controlled by NRPRIMA at ECMWF and NPRIMA at MF. This had been tested on the IBM with small NRPRIMA and it was found to run efficiently and with little memory overhead. This will be included in Cycle 33. Following the example of the RRTM vectorisation work SRTM had also been vectorised - giving efficiency improvements on the IBM as well. The SRTM vector version will be included in Cycle 34.

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

### **10.1 Tessel-2- conversion to other-surface-schemes**

MF asked for information on conversion from Tessel-2 to other surface schemes like SUREX. It was agreed that Gianpaolo Balsamo would contact François Bouyssel to give information on this. Claude would also discuss directly with Gianpaolo after the meeting.

### **10.2 GRIB-2 status**

Mats Hamrud informed MF that EC would move Grib-2 using the new Grib-API software interface. This provided a much higher level of abstraction and could access either Grib-1 or Grib-2 formats. Currently testing of Grib-API was being done at EC. The current version was very slow and work was being done to improve this. There was no push to move to Grib-2 until the number of vertical levels was increased above 126. However, TIGGE was already using Grib-2. One advantage of the Grib-API was that the interface would be thread-safe unlike gribex which was not. It was not expected that the Grib-API would be introduced before Cycle 34.

### 10.3 ENDA

Erik Andersson presented the work at EC on Ensemble Data Assimilation (ENDA). This was mainly being done by Lars Isaksen:

- A functioning ENDA has been developed
- Integrated into the data assimilation scripts – based on EPS design and structure (using pf type and enfo stream)
- About half of the data assimilation scripts modified and xcdp/prepIFS definition file significantly changed,
- But the system is designed so it requires very little maintenance when the standard data assimilation system/scripts are updated in the future
- Standard assimilation system now an ENDA with zero members
- Control assimilation determine varBC, Ps biases and EA/EF
- User control on the number of (possibly 0) ENDA members for which ODB processing and long forecasts are performed
- MARS, fdb and obstat seems to work correctly for control and members

Gérald Desroziers showed the progress on EnsDA at MF: a small 6-member 3DVAR-FGAT ensemble assimilation will be tested in 2008. Perturbations are located in observations, and parallel screenings are run. Eventually, filtered maps of  $\sigma_b$ 's (“background error standard deviations”) from the EnsDA will be fed into the next control analysis to provide the daily, flow-dependent error variances. This approach would be extended also to the LAM assimilation systems.

### 11. Increasing complexity of the IFS: What should we do?

Karim introduced his document ‘Proposal of Cleanings in Arpège/IFS in 2008-2009’. It was agreed that most of the suggestions in the document should be introduced. Mats pointed out that the suggested renaming of routines and moving of routines between projects would have to be done in a ‘Cleaning Cycle’ as Perforce can’t follow moves. Mats offered to provide a script to do the move/renaming automatically in a ‘Cleaning Cycle’ straight after Cycle 34 - this would be Cycle 35. It was not clear whether the history of the moved/renamed routines could be kept – this would be different for Perforce and Clearcase – Mats agreed to look into this. As some people at ECMWF still use the ‘Shallow-Water’ model for academic simulations, it was discussed whether this and other non-operational features should remain in the code - but no decision was taken at this time. Note that the rationalisation of the old thinning code proposed by Sami (see section 8) is part of the ‘cleaning and code rationalisation’.

Mats then presented a more general view of the increasing complexity of Arpège/IFS, showing the growth in number of lines of code, number of IF statements etc.

#### Current Arpège/IFS code complexity:

- 950,000 lines
- 40,000 branch statements (IF/ELSEIF)
- 20,000 calls to other routines
- McCabe Cyclomatic Complexity (D+1) -- 51+ “untestable, very high risk”

There was some general discussion of what can be done to improve this situation. The main methods were code cleaning and pruning – such as that in Karim’s document. No significant pruning is expected for CY34 - however, the P0 priority task from Karim’s cleaning document would be included. This task is to add comments to declaration modules where necessary and the work would need to be shared between the relevant people. Also simplification could come from externalisation and modularisation of parts of the code - in the style of the transform library, rttov and the surface scheme. It was thought that a good candidate for this would be the ‘observation operator’ code. **Action:** Mats and Erik will start investigating a possible externalisation of the observation operators. (Contacts at MF: Claude, Ryad and Florence Rabier).

## **12. Content and timing of Cycle 34**

### **12.1 Input from Météo-France to Cycle 34**

#### **CY33T0: presumably in mid-January/mid-February 2008**

- ALARO0 vertical diffusion implicit coupling with SURFEX
- Catch-up of changes for the Arpège HR E-suite from CY32T0\_op?
- Plug-in LAM wavelet code
- Code adaptations for producing maps of (small ensemble derived)  $\sigma$ 's
- Physics: final versions of TKE and SURFEX plug-in
- New humidity control variable (E. Holm’s dev.) in Aladin
- Variational bias correction adapted for Aladin (to SEVIRI HR radiances)
- finalize the VFE-NH scheme for the d4-log(pre/prehyd) set of equations.
- VFE-NH version of the Phi-gw set of equations.

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

- Store exchange coefficients for vertical diffusion from the HR trajectory and read them in the TL/AD integrations
- 3MT (Modular Multiscale Microphysics and Transport convective scheme) for Arpège and Aladin
- Arome compliant version of DDH (horizontal diagnostic averages for physics fluxes)
- Rationalisation of the SL Interpolators (plus pruning some options)

### **12.2 Input from ECMWF to Cycle 34**

#### **SATELLITE**

- Activation of AMSR-E, TMI for 1D+4D-Var over oceans, revised thinning, q/c and bias correction

- Bug Fix in adjoint observation operator (improves the accuracy of the gradient)
- Assimilation of OMI TCO
- Monitoring of AVHRR AMVs, direct broadcast MODIS AMVs, and AMSU-A/B/MHS from pacific RARS
- GPSRO efficiency mods
- ODB mods
- RTTOV-9

#### **PHYSICAL ASPECTS**

- Fixes/retunings to land surface module
- Reclassification of deep soil textures esp. tropics (requires changes to climatology)
- Ocean 'cool skin' warm ocean layer parametrization switched on
- Use of Persisted SST anomalies
- P/P of clouds (LCC,MCC,HCC,TCC) now consistent with McICA
- Background vert diffusion retuned to account for subgrid background windshear (minimum value of 0.005/s)
- Add a constant to organized entrainment to avoid too small entrainment when relative humidity close to 100 %. Also bugfixes
- Revised TL/AD physics (substantial upgrade of convection and diffusion)
- Vectorised SRTM

#### **WAVES**

- Modified advection scheme
- Upgraded European waters model(LAW): Horizontal resolution now deg (10km). More shallow water physics and updated bathymetry
- Several minor mods and bugfixes
- QuikScat mods to accommodate changes in data ingest
- New post-processed parameters (Max wave height and corresponding wave period)

#### **DATA ASSIMILATION**

- Technical mods in preparation for new JB statistics

#### **13. Tentative timing of Cycle 36**

Early spring 2009 – this would be discussed at the next telephone-conference.

#### **14. AOB**

EC Operations department had asked that in view of problems getting the full **eclib** to compile on various computers – the subset of **eclib** routines needed by Arpège/IFS would be extracted and put in the **ifsaux** library. Ryad agreed to provide a list of the routines that MF need from **eclib**.

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

MF asked about the possibility of video conferencing for the intermediate tele-conference meeting. Jean-Noël will investigate this at ECMWF.

The next telephone-conference was scheduled for Thursday 13<sup>th</sup> March 2008 at 13:30(EC) and 14:30(MF).

The next physical meeting was tentatively planned to be on Tuesday 24<sup>th</sup> June in Toulouse.

## **16. List of Actions**

**Section 8:** MF to send Bator code to EC

**Section 8:** MF to contact EC with details of ODB support in ALADIN and HIRLAM

**Section 9:** Gianpaolo to contact François Bouyssel to give information on conversion of Tessel-e to other surface schemes. There were discussions between Gianpaolo and Claude after the meeting - so no further contacts between Gianpaolo and François will be necessary.

**Section 11:** Mats and Erik to start investigating a possible externalisation of the observation operators.

**Section 11:** Mats and Karim distribute work for commenting declarations in modules to relevant people

**Section 15:** Claude and Jean-Noel to check out possibilities for video-conferencing