IFS/Arpège Memorandum

From: Claude Fischer

To: A. Simmons, M. Hamrud, D. Salmond,

To: (Météo-France) Arpège diffusion list

File: (…)

Subject: IFS/Arpège coordination meeting (Cycles 32-33) held at Météo-France on 23rd November 2006.

Participants:
Météo-France: François Bouttier, Alain Joly, Claude Fischer, Karim Yessad, Antoinette Alias (all day), Pierre Bénard, Guillaume Beffrey (morning), François Bouyssel, Stéphane Martinez (afternoon), Eric Sevault, Dominique Puech, Eric Wattrelot (NEC, ODB and RTTOV), Jean Pailleux

ECMWF: Adrian Simmons, Mats Hamrud, Deborah Salmond

1. Adoption of Agenda

adopted

2. Approval of Minutes of Meeting of 23rd March 2006

minutes approved

3. Reports on Cycle 32

3.1 Status of libraries

MF have received CY31R2 in the first days of October from Mats. Phasing started almost immediately, with the help of 5 Aladin phasers and in November the visit of 2 Hirlam staff for short stays.

MF have encountered some (expected) difficulties for phasing the Arpège/Aladin-France physics interface, and have had to adapt the CANARI (old optimal interpolation) code to the new surface buffer structure. Another extra technical constraint was the last minute inclusion of the Alaro0 physics plug-in (also in the Arpège physics interface), which missed CY31T2 but is very useful for the concerned Aladin partners.

At the time of the meeting, two problems were remaining and caused troubles for the model forecast validation (Arpège and Aladin-France):

- Wrong deallocation of surface field pointers (IBM and NEC compilers happen to be quite permissive and only little informative on such bugs)
- Probably still a bug in the Alaro0 plug-in, causing wrong norms in the forecasts

Adiabatic configurations are almost fully validated. Global 4D-VAR could not be tested so far, but work has started on screening and 3D-VAR minimization in Aladin-France. Climate model still has problems, linked with the above mentioned bugs. Configuration 601 has been validated for Semi-Lagrangian (SL) advection, and eulerian test is underway. Arome model validation is ongoing (still some problems).

ECMWF would wish pré-CY32 to be sent back to Reading by about December 1st. It is agreed that indeed the code should be sent back in early December, so as to allow ECMWF to possibly validate and then build their next E-suite as a "CY32R1".

An open question was whether the most recent NEC optimization branch ("necplus") should be provided within CY32 (for the time being, it is outside pré-CY32, so only available as a branch on CY31T1). See point 6.3 for more info.

3.2 Météo-France contributions to Cycle 32

CY31T0:

* Some remaining bugfixes from CY31 phasing in order to run the Aladin 3D-VAR minimization
* Other small fixes for Arpège CY31

CY31T1:

* Changes in the Climate physics version
* Introduction of the Hirlam physics package: TKE, condensation and convection schemes, radiation. The calls are controlled by key LHL=.TRUE. in NAMPHY. Computational code is called at the beginning
of the timestep, like for Arpège physics
* Introduce the French DDH (mean zonal or areal physics and dynamics tendency diagnostics) for the Arome
model
* Bugfix for the Arome chemistry model

* Miscellaneous cleanings in the dynamics: adapt CPGTL/AD to direct code, memory optimizations for stretched Arpège geometry, small bugfixes
* Finalize default setup values for the SLHD diffusion algorithm
* Tangent linear code for the LAM Semi-Lagrangian advection scheme

* A few bugfixes had to be inserted in order to run properly the Aladin 3D-VAR (blacklisting and more importantly for the minimization: setup of Jb and handling of trajectory arrays in the TRAJ modules)
* Changes for Météo-France limited area diagnostic 3D-VAR package ("Varpack"), used for nowcasting purposes and based on the Aladin 3D-VAR.
* Adaptation of the randomized sigma_b code for Météo-France
* Non-linear and Omega balances adapted to the limited area geometry (originally developed by Mike Fisher
for the global system)

* Adaptations for Arpège and Aladin assimilation of ground GPS (concerns mostly MF's extraction and conversion to ODB tools: "oulan" and "bator", respectively)
* Other changes in "bator": include limited area geometry check, be able to handle ECMWF blacklists
* Remove obsolete option "-x" from "odbtools"
* Arpège code in the observation setup in order to assimilate about 20 AIRS channels

* code changes for portability to NEC platform
* Fullpos bug corrected which could cause aray overflow when NPROMA became smaller than the number of post-processed physics fields
* Arome changes in order to increase its overall platform portability; rationalization of the setup (initialization of pointers, dimensions and fields) and the computational call of the externalized surface scheme SURFEX, producing a reference interface for Arome/SURFEX.

CY31T2:

* Changes for the Climate model physics
* Changes in the externalized surface scheme SURFEX and its interfacing to the atmospheric models (enable implicit call to the town model, provide downward shortwave fluxes from radiation
* Enable the DDH tool to directly write into FA file format (the model standard), not anymore into the lower level LFI format
* Phase Odile Thouron's modifications into ECMWF's old shortwave radiation code
* Activate the cumulated and instantaneous flux computations of Arpège/Aladin for Arome
* Cleaning to call SURFEX more properly in Aladin and Arome

* Add radar table columns into the ODB
* Add 3 new GOM variables for the assimilation of radar reflectivities: snow, rain, graupel (liquid and solid cloud water already are present). This completes the potentially "observable" fields needed in the Arome assimilation

* Add 3D simulated reflectivity as a post-processed field (basically for Arome pp)
* More NEC portability code

Pré-CY32:

* plug-ins for the ALARO0 physics package. The plug-ins appear in the Arpège setup and physics monitor routine (mostly in APLPAR and below). ALARO0 is a specific physics brand developed by the Aladin consortium in order to have scale adaptive parametrizations, at fairly cheap numerical cost with respect to Arome physics for instance: self-extinguishing convection, improved radiation scheme (simpler than RRTM but able to perform as similar as possible), pseudo-TKE scheme (a TKE prognostic scheme but still using the Louis exchange coefficient formalism for the final fluxes), a prognostic cloud microphysics (different however from both Arome and Arpège/Aladin-France versions).

* some further code adaptation for NEC

3.3 ECMWF contributions to Cycle 32

CY31R1

- Aeolus assimilation (under ESA contract including MF)
- ODB for ensemble data assimilation: replicated databases as a virtual base for all members
- OpenMP optimization for IO_METHOD=1 in the ODB
- Compression of data values in the ODB
- Allow for new satellites and sensors in the IFS
- Separate code for simplified physics from the one of the full non-linear model
- Work on the IOSTREAM facility (confined I/O for IFS)
- GEMS variables in the IFS code
- Further development work on the 1D-VAR for rainy radiances

CY31R2

- PC scheme tidying-up for the IFS
- Optimization for vectorization in RTTOV (see also point 10.6)
- Variational bias correction scheme made reproducible and more flexible (develop a more platform and sensor-flexible structure): ECMWF indicate that VarBC requires some overloaded

scripts, which makes them more complicated. This has to be taken into account for MF in their research and operational environments when preparing for VarBC[1]. Especially, one needs to take care if long runs or old situations are tested, with changing identifications of satellites, sensors and possibly assimilated channels. VarBC coefficients require about 2 weeks of warm-up (before being stable), and a thorough monitoring of the coefficients is advisable.

- Revised data distribution for Gaussian grids
- Vectorization issues in the ODB
- Further code for GEMS
- Weak constraint 4D-Var: the model error forcing and the model bias formulations of weak constraint 4D-Var are now fully available in the IFS. The 4D model state formulation is still in development. For all formulations, the scientific question of determining the appropriate covariance matrix is still very open. Some work is currently being carried out to test various possibilities, with a primary focus on the very large model errors currently seen in the stratosphere.
- New shortwave RRTM code
- Modified convergence criterion for minimizations : the new criteria is based on the relative change in the norm of the control vector between iteration N and N+1
- More precise and reproducible code for summation (MPI and ODB compatible): in ifsaux only, will be coded into the control vector summations later on
- 4D-VAR optimizations (remove unnecessary I/O and memory transfers)
- 4D-VAR code for cloudy/rainy SSMI radiances: Note that further work has been done since this branch - for example to separate the TL/AD physics from the observation operator (still called in CALLPAR, however). Also the original 1D-VAR code for rainy radiances should eventually be removed (MF have no clear plans to test or adapt this one for the time being). *A careful analysis should be undertaken if the code had to be made more model-transversal (for Arpège or the mesoscale LAM models).*

ECMWF also indicate that research is ongoing on comparing accuracy of methods of computing the observation equivalents H(Xb)

(1) in the traditional IFS way i.e. interpolate model fields to the observation points, and then calculate observation equivalents, in HOP.
(2) in the reverse order i.e. calculate the observation equivalents at the model points - in CALLPAR- and then interpolate horizontally to the observation points.
(3) as (2) but use the observation equivalent at the closest model point to each observation point instead of interpolating. This method can only be used for observations 'near enough' to a model grid-point and the observation error can be inflated as the distance increases.

Method (2) could prove scientifically more precise (this is under investigation at ECMWF). Method 3, tested in SSMI 4D-VAR, is cheaper for high density observations (any model column would be used several times, with different weights, for a number of observational positions). If (2) or (3) were to be generalized to all radiance data this would require a more general and flexible layout for that code, in order to handle several platforms, sensors etc. The work is of potential interest also for mesoscale assimilation (LAM). *However, methods (2) and (3) would require a careful analysis to reinforce their transversal applicability to Arpège and the LAMs*.

4. Progress and Plans of ECMWF

4.1 Progress

Cycle 31r1 – Implemented 12UTC 12 Sept 2006
•Revisions to the cloud scheme, including treatment of ice supersaturation and new numerics

[1] To be carefully addressed by the OBS team in GMAP: V. Guidard

•Implicit computation of convective transports
•Introduction of turbulent orographic form drag scheme
•Gust fix for orography and stochastic physics
•Reduction of ocean surface relative humidity from 100% to 98% (due to salinity effects)
•Revised assimilation of rain-affected radiances
•Variational bias correction of satellite radiances
•Thinning of low level AMDAR data (mainly affects Japanese AMDAR network)

Monitoring of METOP data
•AMSU-A monitored operationally from 2 November

Cycle 31r2 – In e-suite
•Assimilation of GPS radio occultation data from CHAMP, COSMIC and GRACE
•Assimilation of MTSAT winds
•Monitoring of SSMIS, AMSR-E and TMI data
•Many technical changes, and un-activated code for future meteorological changes

4.2 Plans

Cycle 31r3/32r1 – The next e-suite
•Three-minimizations (T95/159/255) in 4D-Var
•Updated moist TL and ADJ physics (as used already in 1D-Var for rain-affected SSMI radiance assimilation) used in 4D-Var
•RRTM for shortwave (as well as longwave) radiation with McICA treatment of cloud/radiation interaction

Some other likely elements for 2007
•Revised treatment of entrainment in convection scheme
•Progressive assimilation of data from METOP instruments, SSMIS, AMSR-E, TMI, OMI
•Revised Jb statistics from a new ensemble data assimilation
•RTTOV9
•First utilization of BUFR-encoded radiosonde data including proper position and time
•New (Extended Kalman Filter) soil-moisture assimilation and upgrade of land-surface model
•New stochastic physics in the Ensemble Prediction System

ECMWF will be quite busy with the actions concerning the procurement for the next computer.

Ultimately, the ODB will allow for perturbed observations, to be used in ensemble assimilation, and to be included in a single base available to all ensemble members. MF ask whether the related developments were included already in a CY31Rx (action Adrian to check with Mike about timing and practicalities).

5. Progress and Plans of Météo-France

5.1 Progress

Operational suite on September 19th 2006, based on CY30T1:

- ground-based GPS assimilated
- clear sky SSMI assimilated
- 20 AIRS channels assimilated
- Sigma_b in screening, obtained by a Monte-Carlo method and consistent with B from c131 (following Erik Andersson's development)
- Re-defined number of inner loops in 4D-VAR: 25/25

Since November 16th, a new E-suite is under test:

- SL horizontal diffusion (a flow dependent diffusion, partly using specific SL interpolators; as a result, spectral diffusion is reduced)
- Semi-envelope orography
- 6 band shortwave radiation (old ECMWF code)
- various changes in the (formerly called "Lopez") Advanced Prognostic Cloud Scheme microphysics

5.2 Plans

There should be 4 e-suites in 2007, but 2 of them will be used for major upgrades in the computing system:
- February-April: test and move the operational suite from Fujitsu to NEC mainframe computer
- May-August: approx window for e-suite 2007-1
- September-October: approx window for e-suite 2007-2
- November-December: test and move the operational suite from HP to PC clusters communication and data-base computers

Evolutions of ALADIN-France should be followed by close evolutions of ALADIN-Reunion (Indian ocean area).

Use of observations in data assimilation:
- ARPEGE: monitoring then assimilation of clear sky METEOSAT radiances, possibly followed by GOES radiances
- ARPEGE and ALADIN: assimilation of AMI on ERS-2
- ARPEGE and ALADIN: assimilation of AMSU-A, possibly AMSU-B and HIRS data at 1,25° resolution
- ARPEGE: use of (southern hemisphere ?) PAOB messages (request from overseas divisions)
- ARPEGE and ALADIN: monitoring (possibly short) then assimilation of AMSU-A, HIRS and MHS/AMSU-B METOP instruments
- ARPEGE and ALADIN: monitoring then assimilation of METOP ASCAT scatterometer
- ARPEGE: set-up and use of variational bias correction, at least for the high resolution sounders AIRS and IASI
- ARPEGE: monitoring of about 300 IASI channels, then assimilation of some of these, possibly 100
- ARPEGE: monitoring then assimilation of GPS occultations from COSMIC and then GRAS METOP instrument
- ARPEGE and ALADIN: assimilation of microwave channels over land
- ALADIN: monitoring of radial winds retrieved from Doppler radars
- ARPEGE: SSMI/S monitoring

Most of these additions require Cycle 32 (i.e. rely on developments already made at ECMWF).

Data assimilation algorithm:
- ARPEGE and ALADIN: use of the modified humidity variable from IFS
- ALADIN: change to 3D-Var FGAT
- ALADIN: change to incremental digital filters
- ARPEGE: restoration of a basic water cycle in the TL/AD models for 4D-Var with introduction of a TL/AD version of the microphysical adjustment
- ARPEGE: use of 3 minimisations
- ARPEGE then ALADIN: gradual introduction of background error variance maps derived from a 6 elements ensemble of 3D-Var C=1 assimilations with perturbed observations, aiming at daily maps, followed by introduction of local correlation lengths; the ensemble will initially run off-line from the operational suite and it will be gradually integrated to it; (note that the actual variances are currently projected in observation space and used in the screening)

- ARPEGE: use high-resolution trajectory interpolation as trajectory for TL/AD[2]

Physical parameterizations:
- ARPEGE and ALADIN: change vertical diffusion to a turbulent kinetic energy scheme, with shallow convection handling capability
- ARPEGE and ALADIN: possible introduction of a mass flux historical variable (in relation to the above evolution), with some evolution of the deep convection scheme

Resolution and numerical schemes:
- ARPEGE: increase NL model resolution from T358C2.4L46 to T538C2.4L60 or T538C2.4L70 (15 km resolution over western Europe, model top unchanged)
- ARPEGE: increase TL/AD assimilation models resolution to T224C1.0L60 (or L70)
- ALADIN: increase vertical resolution to L70
- ARPEGE and ALADIN: use finite elements vertical discretization scheme

Ensemble forecast:
Météo-France ensemble forecast activity should be redefined during 2007.

In the meantime, the current application (PEARP: prévision d'ensemble ARPEGE) should be maintained and should be turned into a true global ensemble system. (PEARP has 10 members, it is run once a day based on the 18UTC analysis, a PEARP member has exactly the same characteristics as ARPEGE, the analysis is perturbed using singular vectors framed for the North-Atlantic-Europe area and short-range; the global extension will be obtained first from a breeding and later-on will be derived from the assimilation ensemble).

The overseas ARPEGE C=1.0 suite:
The plan is to replace at least the C=1,0 4D-Var overseas ARPEGE background assimilation cycle by the ensemble assimilation, following the implementation of the new resolutions.

There might be a continuation of the ARPEGE C=1.0 forecast, either from the closest ARPEGE analysis or derived from a 6-h C=1.0 assimilation using the closest ARPEGE assimilation as background for a while.

6. Matters Arising

6.1 HIRLAM/ALADIN collaboration:

Hirlam scientists (BH. Sass and B.S. Andersen) have implemented part of the Hirlam physics into the common IFS/Arpège library (CY31T1). However, so far, the phasing work is done in a lagged mode: Hirlam will need to re-phase their physics with respect to CY32, as there was no possibility to do this phasing during the main CY32 exercise in Toulouse. Some technical solutions will need to be found in order to increase the network capability during phasing: use a source code management visible through the internet ?, have some dedicated Hirlam staff well trained for clearcase work at a distance ?, check for a well performing video-conference device ? ECMWF indicate that they also would be interested in a video-conference installation, which could improve the present phone conferences.

Next steps in the coordination with Hirlam include the observation operator inter-comparison. The results will be sent to Erik Andersson. The outcome should tell what kind of code transfer should be done from the Hirlam synoptic assimilation system toward the common IFS/Arpège framework. Mats indicated that the vertical interpolation of temperature probably is different for IFS and Arpège (concerns RS data[3]). Some other work concerns the development of a tri-diagonal SI operator in bi-

[2] The next ECMWF data assimilation workshop will be in June 2007, and focus on flow-dependent aspects of data assimilation.
[3] could be checked by Patrick Moll at MF

Fourier spectral space in order to take into account more precisely the variations of the map factor over large LAM domains.

Concerning the participation of Aladin and Hirlam partners more directly to the collaboration, ECMWF indicate that, if desirable, one Aladin and one Hirlam *observers* to the coordination meetings is acceptable. However, the overall logic of having a "binary" system for the cycle production (ECMWF ⇔ MF), and for ECMWF to have only MF as a contact for scientific and technical issues, should be kept.

6.2 Status of AROME

- introduction of new shallow-convection scheme (KFB + EDMF components)
- Surfex upgrade (physiography fixes, new PBL diagnoses, better snow, sea fluxes)
- microphysics upgrades for fog simulation
- technical optimizations for NEC
- radar assimilation: Doppler radial wind, reflectivity Bayesian retrievals
- Jb computation using Arome ensembles run on EC HPC
- current tests: French daily for 18 months, some DA, tests in Sweden, Finland, Hungary, Czech Rep, on AMMA, Turkey, ParisFog
- next big experiments: Arome-France 600x600, long DA, COPS
- Aladin/Arome library at EC (in common cycles ?): ECMWF could be interested, also for possibly testing their IFS physics in high resolution (LAM) conditions => MF can send all source code projects of CY32 to ECMWF. ECMWF are welcome to use Aladin or Arome components for research and development. It is expected that any publication resulting from such work will acknowledge the use of these tools.

The cost of Arome has been evaluated to about 2.5-3 times the one of Aladin, for a given column grid point computation (including 1D physics and grid point dynamics). Other extra costs come from the denser grid, smaller time step and more advected 3D fields.

6.3 porting to NEC at MF

MF have introduced progressively NEC porting and optimization features into the common libraries. One last branch is the "_necplus" branch under CY31T1, which has not been included in CY32 (on the opposite for instance to the "_necbf" one, which is in). Eric Sevault explained that "_necplus" mostly contains Méso-NH physics optimization features, plus some RTTOV stuff, which can clash with already introduced code changes from ECMWF (they work on RTTOV optimization with the UKMO). It has been agreed not to introduce "_necplus" into CY32 (which would have slowed down the final validation at MF) but Eric Sevault and Stéphane Martinez should send the branch to ECMWF (Deborah) along with some documentation of the changes. Eric thinks that anyhow the RTTOV change from ECMWF is more promising than the one proposed for the Arpège porting (see also point 10.6).

7. Non-hydrostatic modelling: IFS experimentations and Vertical Finite Elements (VFE)

IFS-NH Experimentation (summary of discussions held the day before by Pierre, Deborah and Karim, plus input from the coordination meeting discussions):

Progressing at ECMWF : Low resolution experiments now show reasonable results (T159, L60, Dt=1h)

2 reported residual problems: (not blocking)
a) not fully understood sensitivity to horizontal diffusion (needs to diffuse D,P,d in same amount). Météo-France will help dig in (first, they will try to reproduce the problem in Arpège)
b) "bull's eyes" in low level T over Himalaya (needs NSITER=2 to cure the syndrome; note that IFS physics are called only once, in the last corrector step)

Overall impression about IFS-NH:

"A reasonable starting-basis":
- NH results compare well with Hydrostatic Primitive Equation model forecasts
- "Smooth-improvements" policy can still be considered from ECMWF point of view: ECMWF want to further make sure that the NH core developed in the frame of the Aladin collaboration is a robust solution for all their global, synoptic and sub-synoptic applications planned in the future. They plan for instance 10 km forecasts in about 2015-16.
- Reaching a fully satisfactory NH core seems less costly than a complete change of the Dynamical kernel, as far as can be inferred from the present results
- Work needed (but directions well identified)

Directions for future work:

a) Fundamentals of the NH core
- more rational ("intuitive") prognostic variable (e.g. d4 versus w)
    - might need deep modifications of strategic items (spectral, vertical coordinate, SI structure…)
    - main interest for this is at ECMWF
    - Météo-France and Aladin partners would however be happy to participate, and wish to be well informed on these issues by EC
- toward very high resolutions / slopes
    - might need deep modifications of strategic items (spectral, vertical coordinate, SI structure…)
    - main interest for this is at Météo-France (high resolution LAM applications)

c) Vertical Finite Element scheme
- substantial progresses have been made from Aladin side
- linear version now stable (under the same conditions as HPE version is !)
- some non-linear terms still problematic (must still be treated in FD way for the time being)
- needs a more global algorithm for solving of the implicit system (so called 2L*2L), because after careful elimination between equations, 2 variables remain in the Helmholtz system.
- more accurate, better scores in ECMWF => main interest at MF and ECMWF
- for the time being, there is agreement on the formulation of operators (integrals and derivatives): this should be kept.

importance of research tools for Eulerian Equations:
- analytical tools (von Neumann)
- 2D vertical slice models (cheap extensive and severe experimentation).
- MF proposes to share tools and help ECMWF migrating to these methods if needed

Further discussions will take place during the SRNWP Numerical Techniques workshop to be held in Zagreb in the first week of December.

Coordination / communication:

- Now, 4 groups involved in NH core:
  ECMWF, Aladin, HIRLAM, Météo-France
- We are entering in risky areas: coordination still at bilateral level (EC+MF), but more contributions from everywhere.
- correct level of coordination needs to be found: Météo-France have set up a coordinated group of scientists to work on the NH issues, with Aladin and Hirlam partners (coordinated by Pierre, with people like Mariano, Jozef Vivoda etc.). Pierre Bénard, along with the other MF staff involved regularly in the IFS/Arpège coordination, are in charge of passing information (results, coordination, visits) from this "LAM group" toward ECMWF. This does however not forbid direct scientific contacts between "LAM scientists" and ECMWF staff.

- ensure at least more fluid information: NH Newsletter will be regularly prepared by Pierre
- a specific small workshop might be organized in the first semester of 2007, if found necessary, which would then concern both ECMWF, MF, Aladin and Hirlam scientists. This issue will be further addressed (next phone call) and decided only if necessary.

(some further ppt slides with pictures can be obtained from Deborah or Claude)

8. ODB Developments

Mats has given a short summary of Sami's plans:

- Interpretive mode for read-only purposes in ODB data bases
- Interactive ODB viewer , ODBTK (probably used by some Aladin partners, but MF use their own tool "Mandalay")
- Ability to select observations based on region name (country, lake etc.)
- Ability to convert GRIB data in ODB format

ECMWF explained further that image-like data can be stored in the ODB as bulk data as Bufr data can currently be stored .

The work done by Mike Fisher and Gabor Radnoti on spatial observational correlations requires storage in the ODB . The following is an outline of what needs to be done from a memo by Gabor:

To apply the observation error correlation model we need to store the following information pre-computed at each high resolution trajectory (only because of *Jo* diagnostics) and minimization run:

-Eigenvectors of the observation error correlation matrix: the maximum number of retained eigenvectors is fixed, let's say 50 (changing this will imply recompilation of odb). Each eigenvector is stored as a vector in observation space. Therefore it is worth to introduce them as odb column entries. Perhaps the most straightforward location is table *errstat* and since the eigenvectors are of the same structure each, it is reasonable to introduce them as an array of columns.

-**Mask of observations**: this is an integer mask common for the whole eigenvector set and it defines the sub-groups of correlated data: one eigenvector column in observation space in fact consists of a lot of independent eigenvectors, each belonging to a given block in the block-diagonal error correlation matrix. The mask value should be missing value for all the observations that are assumed to be uncorrelated; all data with mask value *n* belong to the *n*-th block (a fully missing value mask would describe the present case of fully uncorrelated observation errors). This mask would be an additional integer column in table *errstat*.

MF mention that they have continued and basically completed the introduction of new tables for the radar data assimilation (both reflectivities and wind).

9. Specific Issues raised by ECMWF

none.

10. Specific Issues raised by Météo-France

10.1 SURFEX implementation and developments for the surface assimilation

Surfex code implementation has progressed a lot in the last year at MF: explicit coupling interfacing in CY31T1 (for Arome), implicit coupling interfacing for Arpège/Aladin (CY31T2). Scientific validation

in Aladin-France has started; for Arpège, the global Gaussian grid geometry needs still to be included into Surfex.

A dedicated workshop for surface processes and Surfex will take place in Toulouse on December 11-12-13; Gianpaolo Balsamo will attend it for ECMWF. There are two main goals for the workshop (which is common to Aladin and Hirlam): start some basic training on Surfex and work out a workplan for collaboration between Aladin and Hirlam. Surface field assimilation will also be discussed. The analysis of screen-level fields remains particularly open.

Surfex uses ECOCLIMAP databases, which are also standards for Méso-NH (and thus Arome), the Climate model at MF, and ECMWF. ECOCLIMAP however still needs to be tested in Arpège and Aladin-France, so the idea for a first implementation of Surfex would be to run it using the old databases, in order to separate the effect of the Surfex plug-in from the one of changing the physiographic dataset.

Mats points out that the different surface schemes (and surface representations) between the IFS and Arpège will be felt at some places in the code: surface information needed for observation operators (for instance cloudy/rainy radiances), post-processing (though Surfex does have its own post-processing).

10.2 Radiation schemes at ECMWF: status of work

RRTM_SW + McICA + cloud optical properties = McICA package

- Monte-Carlo Independent Column Approximation: Pincus et al., 2003, JGR, 108D
- RRTM_SW from AER, Inc, with reduced number of g-points from the original 224 to 112
- RRTM_SW is more expensive than SW6 therefore need to reduce [a bit] the radiation grid (e.g., at T_L799 from T399 to T319)
- McICA version for both RRTM_LW and RRTM_SW: no cloud fraction anymore: a layer is either clear-sky or overcast
- McICA does not cost anything (as such)
- Random generator (Raisanen and Barker, 2004) gives 0 or 1 cloud for each layer and each of the 140 (112) g-points of the LW (SW) radiation scheme for either a maximum-random or a generalized overlap assumption, with loose constraint over the total cloudiness
- "New" cloud optical properties as discussed in 2005
- Generalized overlap (a la Hogan and Illingworth, 2000) with a decorrelation length of 2km for cloud fraction, and 1km for cloud condensate

MODIS Albedo

- Replace the climatology of spectrally flat land albedo derived from ERBE by a new climatology of UVis, Near-IR albedos for direct and diffuse components derived from 4 years (2001-2004) of MODIS data.
- Available at all T_L resolutions from 95 to 799
- At present, only the snow-free land surface albedo is changed. No albedo changes to snow, sea-ice, Greenland or Antarctica. A sensitivity study on the role of snow and sea-ice albedo is to be carried out in 2007Q1 (cf J.Curry, Seminar 2006).
- Very little impact in FC

(a set of ppt slides can be provided for more info: Adrian or Claude)

Further work will address the aerosol modelling for GEMS. The optimization for a NEC platform might become an issue for ECMWF for the RRTM shortwave code (which is known to be quite costly). Otherwise, there are no deep modifications planned in the RRTM code.

10.3 1D models

There are now two different 1D model solutions coded and present in the common libraries. The one of MF is based on the full 3D code, and uses the 2D vertical slice setting (NMSMAX=0) along with a specific extra key to run in vertical column modes for grid point computations. It is possible to run this version with a sequence of parallel columns independent from one another. Each column's forcing terms are stored in a specific GFL field. ECMWF have specifically designed new driver routines which then call some low-level code. Phasing should not be too cumbersome, despite some duplicated/modified code. One advantage is that an automated code analysis can be performed thanks to the driver code, in order to only link those routines really needed for the 1D, which produces very small executable files (and linking sequences on PC are easy to handle).

MF point out that they will probably try to run the IFS physics with their 1D version (ECMWF would be interested to hear about it once completed).

10.4 High resolution trajectory: short status of MF work

Karim Yessad has explained how he has developed the Arpège version of the read/write of the high resolution trajectory within the 4D-VAR incremental algorithm.
ECMWF use some well optimized (for MPI) code, which can store HR grid point fields but without much control with respect to the changes in orography between high and low resolution, for instance. MF now test a "non-927" fullpos configuration: the idea is to compute all relevant trajectory fields in grid point (declaring the low resolution grid as the fullpos target grid, keeping vertical model levels). Eventually, this "non-927" fullpos should be called inline, during the Arpège trajectory computation of each outer loop. The advantages of this method are compliancy with the low resolution orography, the Arpège stretching, the possibility to transpose the solution to a LAM 4D-VAR later on. I/O use FA files.

Surface fields will be coded in 2007, with a clear separation from the altitude fields (Karim already has introduced this separation formally in the code).

Mats pointed out that the IFS code was bugged for a long time (the HR trajectory was read into t0 buffers, while the models TL/AD use t9 arrays for surface trajectory). This bug has been fixed in CY31R2. The impact of this correction on scores seems neutral. ECMWF would like to get figures about the extra cost of the MF solution in terms of overall elapsed time. Karim says this is quite difficult to measure, but an average could be assessed once he has run a long 4D-VAR assimilation with his method. Thus, MF could provide some figures maybe in summer 2007, once Karim has resumed his experimentations.

10.5 Coding norms and plans for further modularization of the IFS

The coding norm checker now also can indicate too long continuation lines (more than 39 continued Fortran lines), in addition to length of line (79), length of routine and length of variable names (31). Mats points out that it is difficult, and sometimes rather impossible, to correct these features in existing code.

There are no really new ideas about modularization. The breaking out of low level operators is difficult, but an issue could be to continue to work on the externalization of fullpos (could make the post-processing of incremental fields such as analysis increments, singular vectors or model error terms more easy). A more flexible setup and control level with respect to the definition (size, layout) of the model state vector could possibly allow this. Could the same sort of flexibility be generalized to the whole IFS/Arpège ? => Probably not without some major recoding.

François Bouttier also mentions that an investigation about the needed code modifications in order to add new facilities such as grid-nesting would be interesting, at least to understand how much efforts this would require. No concrete action has however been planned so far.

10.6 RTTOV-9

There is an ongoing collaboration between ECMWF and UKMO about code porting and optimization for RTTOV. They are basically working on the RTTOV-8 and RTTOV-9 code optimisation. UKMO have prepared a test configuration which allows RTTOV to be run under various conditions to assess its performance. ECMWF use it from time to time on the IBM or on Linux PC. Eric Sevault should try to install the test package on the NEC/MF, and try to run it with Deborah's help. They should also decide/assess which MF+NEC/France optimization features are valuable and should be kept and enter the next RTTOV-9 release (some optimisations from NEC/F and NEC/UK probably clash). Deborah will liaise with Roger Saunders (UKMO) for this purpose.

11. Other Scientific and Technical Points

none.

12. Content and timing of Cycle 33

12.1 Input from Météo-France

(as a preliminary, non-exhaustive version, with a provisional calendar …)

CY32T0; January/February 2007:

* bugfix for limited area plane geometries (Aladin, Arome, Hirlam versions)
* NEC portability and optimization (so called "necplus" branch)

CY32T1; after March 20th, but probably before our GCO move to the new clearcase platform:

* adaptation for Climate model to new features of the Arpège-NWP model: prognostic cloud scheme, TKE+shallow convection, 1D model
* rationalization of the ALARO0 plug-ins (especially the call to ACDIFUS for implicit treatment of surface fluxes in vertical diffusion computations)
* other ALARO0 contributions ?
* further improvements to the DDH tool and interface
* cleaning in the tendency aggregation routines ? (CPTEND, CPUTQY)
* a new (simpler than "Lopez") simplified condensation scheme for TL/AD
* finalize Arpège and Aladin-France TKE scheme, with a shallow convection facility
* possible introduction of a mass flux prognostic variable (related to the shallow convection)
* catch-up of phasing for Hirlam's physics plug-in (for CY32)

* dynamics: code cleanings by Karim: GFL setup in SUDIM/SUDYN, better modularization of LARCINBTL/AD, LATTEXTL/AD, obsolete keys
* LTRAJHR (high resolution trajectory) for Arpège surface fields
* tri-diagonal semi-implicit operator for large domain map factor variations (LAM, only if ready via Hirlam collaboration) ?
* LLONEM in Aladin ESPCM/AD and NFLEVL in Aladin ESPCHOR/AD
* adjoint of the LAM SL advection scheme[4]

* adaptation of the Variational Bias Correction scheme to Arpège and Aladin
* optimization of CPU for 3D-VAR FGAT (add an explicit increment to the time loops in CNT4TL/AD)
* adaptation of the modified (normalized RH) humidity control variable to Arpège and Aladin

[4] Incidentally, Filip Vana from Czech Rep. Also is working on the optimization of the adjoint SL code for NEC platforms: vectorization option LVECADIN, OpenMP, compiler option behaviour => could be of interest to ECMWF

* assimilation of METOP sensors
* assimilation of IASI data
* assimilation of microwave channels over land
* assimilation of radial Doppler radar winds
* adaptation of "bator" in order to handle SEVIRI radiances without using MF GRIB formats (for Aladin partners)

* changes in the FA Arpège/Aladin file system and GRIB interfacing in order to increase compression (useful for archiving and transmitting the LAM coupling files)

pré-CY33

* first code towards a finite element non-hydrostatic semi-implicit operator ?
(depending on the maturity of this topic in the LAM community)
* optimization in Full-Pos: some computations in post-processing mode are done in the first Full-Pos stage (in the departure grid) but require data from the arrival grid. These can then be poorly distributed over processors (arrival points but cast in the departure grid distribution), which can lead to load imbalance. The idea would be to add some transposition already in the Full-Pos first part in order to optimize these computations with respect to the arrival grid distribution. This development is a target for Arome post-processing.

12.2 Input from ECMWF

to be presented at the next phone call

12.3 Timing of Cycle 33, Cycle 34 and Cycle 35

To fit in with the procurement at ECMWF, it is proposed that Cycle 33 be planned for either September or October 2007. For MF, one important aspect would be the possible introduction of a new SI operator for Vertical Finite Elements (the "2L*2L" solution). If it is decided to include it for CY33, MF may need to do this in a September release, which then would delay the start of CY33 into mid-October. ECMWF say that they probably can be fine with this as well. Cycle 34 is (by default) planned for June 2008 (taken from the previous coordination meeting).

13. AOB

none.

14. Date and Place of Next Meeting

Next telephone conference: Friday 23 February 2007, 1.30 GMT (14h30 MEST)
Next coordination meeting: in Reading, Thursday 29 November 2007