Reference System Status April 2004

Gerard Cats

Main changes since September 2003

The current official release is still version 6.2; there have been a few β–releases since the release of 6.2. The β–release 6.2.3 is currently under testing to become official release 6.3. The main changes between 6.2 the current (6.2) and the prospect (6.2.3, to become 6.3) official release are:

- Incremental DFI replaces full DFI.
- A number of changes in the lower boundary condition, including the introduction of a Raymond filter for orography, sea ice description consistent with ECMWF's analysis and several bug fixes, *e.g.* in the treatment of soil ice and deep soil climate.
- Several changes in the variational data assimilation scheme, of which the removal of small-scale increments (less than 40 km) has the biggest impact.

The current β–release number is 6.2.4. It implements increased surface roughness, which is more realistic in particular over vegetation, increased mixing in stable conditions, and improved data communication in the parallellized version of the model (with thanks to Jan Boerhout, NEC).

Apart from a few technical differences, release 6.2.3 is the version that was accepted for production at FMI, starting 2 February 2004.

Detailed description of the changes

Version 6.2.1 (17 November 2003)

Deep soil temperature and humidity
The deep soil fields are now relaxed to the climatic values. These fields are hardly used, only to relax the shallow top layer parameters in the water tile over land (mostly lakes), so the impact is small.

Soil freezing
When the surface temperature is around 0, a coding error caused too quick freezing in the top 1 cm of the soil. The impact is small, because the top layer reacts quickly anyway, and because conditions under which there is a difference (around 0, partially frozen top soil layer) are rare.

Incremental digital filtering initialisation
As shown in Newsletter 43, incremental DFI gives smaller spin-up, and hence is preferable over the old method.

Changes in the default domain
The default domain is now that of RCR at FMI. In HIRVDA, the analysis increments used to be at the resolution of 44 km (because the structure functions have been derived from SMHI operations); but with the now default resolution of 22 km, the

analysis became noisy. Excluding small scales in the analysis, by setting the variable LOWRESINCR, has cured this.
The structure functions, originally derived from a 31 level model, are now calculated with an algorithm that gives reasonable results for 40 levels.
Adjustments have been made in the algorithm to set the width of the extension zone used by HIRVDA, to allow analysis on relatively small domains, as usually used by very high resolution runs.

Technical changes
The biggest change was in the file titles, that now carry the analysis date/time, and allow forecast lengths up to 999 hours; the format now also is ready for further extensions *e.g.* even longer forecast lengths, or higher frequency than once per hour.

Bugs and bookkeeping
Several bug corrections and code improvements have been implemented in the climate field generation, in HIRVDA, in the parallelisation of the surface parameter analysis scheme (under OpenMP), and in many other modules.

Version 6.2.2 (2 February 2004)

Sea freezing
Open sea is supposed to be frozen if its temperature is below a certain limit, which was -1.8°C. In the ECMWF analysis, used to generate pseudo observations of SST, the corresponding limit is -1.7°C. To avoid that ice in the ECMWF analysis becomes water again in the HIRLAM analysis, the HIRLAM limit must not be lower than the ECMWF one. This inconsistency now has been removed by setting the limit to -1.6°C. The inconsistency was discovered by the pre-operational tests of the reference system at FMI (in preparation of their running RCR in operations). The effect was masked by a coding error in the treatment of the soil freezing limits, but this error was removed in 6.2.1, and so the effect of the inconsistent SST/ice limits is seen in 6.2.1 only. The error had a serious impact in that the Arctic sea did not freeze in winter, and this withheld taking RCR into production at FMI for a month.

Topographical data
The Faeroes and the Azores were missing from the original data (hence they were seen as sea). This has been corrected. Over Europe, topographical data at a resolution of 2.5 km have been made available. Instructions how to use them are on the HeXnet.

Version 6.2.3 (22 March 2004)

Raymond filtering of orography
An omission in release 6.1.1 inhibited the use of a Raymond filter on orography. This has been corrected. Other surface fields are now consistent with the new orography.

Topographical data
New data sets should avoid large jumps in resolution. The data sets are already available, as described on the HeXnet, but the code to treat them is not flawless yet. Hence, as yet the new data sets are not used by default.

Version 6.2.4 (29 March 2004)

Radiation
The changes described in Newsletter 43 and 44 have been implemented. The impact is small.

Increased mixing in stable conditions
It is not clear why mixing in stable conditions has to be bigger than simple similarity theory predicts. At the All-Staff Meeting in Madrid we learned that Sander Tijm, Niels Woetmann Nielsen and Bent Hansen Sass found a better method to obtain the proper filling rate of cyclones. This method is still under development.
Although we expect to eventually implement this new method, the effect of the current parameterisation of mixing is considered to be so bad that we decided to temporarily employ the stop-method of artificially increased mixing in stable conditions.
The increased mixing leads to more rapid filling of cyclones, in particular when they hit the land. The verification scores improve markedly, although extreme storms may become slightly more underpredicted.

Improved surface roughness
The surface roughness due to vegetation was modelled unrealistically low. A substantial increase of z_0 leads to a much better fit to observed profiles. Also, the orographic surface roughness and z_0 over sea have been increased, the former substantially. (Of course, the increase in z_0 gives also more mixing).

Improved parallelization
Jan Boerhout's proposal, presented in Newsletter 43, has been implemented. The model execution time scales now much better with the number of processors.

Technical changes
Jussi Heikonen (CSC, Finland) found why asynchronous IO was not always successful on IBM. Further preparations for the use of the new topographical data sets have been implemented.

Plan for the Reference System

6.2.5 -> 6.3.1 (Including 6.2.4 above, of course)
Migration to ecgate (IBM) from ecgate1.

6.3.2 (May)
New rotated data sets for climate generation from Kai.
OI snow analysis.
Rotated stress vector
Kain-Fritsch convection as an option.
Revised esat tables (and prob. coupled with radiation ice/water change)
Semi-Lagrangian T equation and extrapolation.
HIRVDA updates.
Code improvements.

Testing for a Reference system release 6.4

6.3.4 (July)
Further integration of HIRVDA (revision control)
Semi-Lagrangian physics coupling.
SSO and physiography.

September:
Statistical Jb and Index field for background and qc in 3D-VAR.
ATOVS active (bias correction code and files).
QuikScat active.
New climate data bases and other updates.
Surface analysis changes, SST/ICE, 2m new statistics etc.

November:
Moist CBR.
Snow scheme and forest treatment
Kain-Fritsch as a default.

Testing for a Reference system release.

2005:
Radar VAD or radial winds.