Reference system status October 2001

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Release notes of HIRLAM 5.1.1

HIRLAM 5.1.1:

1. **Introduces official release 5.1**
2. Introduces beta release 5.1.1, apart from the technical changes equivalent to beta release 5.0.6

Meteorological impact

None, except by the change of official system (i.e. the default system), see Release notes for 5.1.

Description of the changes

Official release 5.1 is the same as 5.0.5, and beta release 5.1.1 is almost the same as 5.0.6, the difference being that two scripts, `Vn` and `Hirlam`, were modified. The rationale behind the revision re-numbering is described in the release notes for 5.0.2.
In script `Vn` the two new version numbers 5.1.0 and 5.1.1 were introduced.

Release notes of HIRLAM 5.1

HIRLAM 5.1 is the official release, equivalent to beta release 5.0.5

Meteorological impact

The meteorological changes between the previous offical release, version 5.0, and 5.1 are the STRACO shallow convection in, correction to avoid semi-Lagrangian trajectory trunctation in extreme situations in the parallel code and a correction of message passing of scalar variables (see Release notes for 5.0.4, 5.0.3 and 5.0.1). The main reason for releasing 5.0.5 as the 5.1 Reference system is use of mini-SMS as a default and the much improved efficiciency at ECMWF. The meteorological impact is generally very small and neutral in terms of EWGLAM verification scores. The STRACO shallow convection reduces the overprediction of small precipitation amounts and breaks up the stratocumulus cover a bit more than before, thus increasing the diurnal cycle slightly.

Release notes of HIRLAM 5.0.6

HIRLAM 5.0.6:

1. modifications to the CBR scheme with associated changes to the STRACO scheme

2. a large number of techical changes

Meteorological impact

CBR

The CBR scheme has been modified by Geert Lenderink and Wim de Rooy. This summarises the impact:

> There are several reports of positive biases in the 10m wind speed with the original CBR scheme. Using Cabauw tower data, De Rooy (2000) and Lenderink and De Rooy (2000) (HIRLAM Newsletters 35 and 36, *resp.*) showed that this can be explained by the excessive mixing of momentum by the CBR scheme during (near) neutral conditions, leading to unrealistic wind profiles for the lowest model levels. Using the mixing length scale as proposed by Geert Lenderink, this problem is solved to a large extent. For temperature, differences between the reference CBR scheme and the update according to Geert Lenderink's proposal are small and less conclusive.

STRACO scheme revisions: revert to HIRLAM 5.0.3

A TKE profile may show large vertical gradients, in particular near cloud tops. The vertical discretisation of the TKE equation in the CBR scheme became substantially more accurate by moving TKE from full to half levels. Of course, this change should be carried through to the other HIRLAM components using TKE. Before HIRLAM 5.0.4 the only affected parts were the dynamics, for advection of TKE. Because the vertical profiles of the horizontal and vertical advection velocities are smooth, the error made by not adjusting the dynamics routines to the new vertical grid of TKE is small, and it is not worth the substantial effort to implement dynamics routines also for half-level quantities. So the change of vertical grid for TKE only affected the CBR code.
However, in the most recent version of the STRACO scheme (HIRLAM 5.0.4), TKE is used to model detrainment at the cloud top. The description of shallow convection now needs considerable re-tuning, because the shift of TKE by half a level has huge consequences at the cloud top, where TKE has large gradients. Wim de Rooy (HIRLAM Newsletter 39) reports a severe degradation of 10 m temperature forecasts due to the combination of the latest STRACO and the new CBR modifications. Considering the modest improvements by that STRACO change, and the substantial benefits of the CBR modificiations (better boundary layer profiles, increased time-integration stability), it was decided to take out the latest STRACO change (*i.e.*, revert to HIRLAM version 5.0.3 in as far as STRACO is affected), and await re-tuning of this version of STRACO before its re-implementation.

Technical changes

Some of the technical changes may have a meteorological impact as well. In particular, there may be an effect from using more observation types (but fewer radiances); and from maximising snow depth to 2.54 m (a value of 2.55 m used to be interpreted to mean 'missing', and higher values were mutilated.

Radiation scheme

The modification in the radiation routine do not affect the forecast, but merely the calculated budgets. The effect is described by Carl Fortelius:

> The net long wave fluxes (at the surface and the top of the atmosphere) used by the diagnostics package contain errors, because only the land surface temperature variable is used to compute the surface emission.

Release notes of HIRLAM 5.0.5

HIRLAM 5.0.5:

1. corrects an error in the OI analysis scheme at ECMWF
2. optimises compilations of large libraries
3. has a few other, minor code improvements

Furthermore, the local installation procedures have been upgraded for version 5.0.2 and later (i.e., for mini-SMS).
The changes concern source libraries. and local installation procedures.

Meteorological impact

The error in the OI analysis scheme resulted in not updating the analysis error coefficients after each cycle; so effectively, each cycle started from assumed statistics. The error also resulted in each cycle not using the list of black-listed observations from the previous cycles.
The error does not affect HIRLAM runs on single-hosts installations. The error was introduced into the reference system with version 5.0.2. It entered the pre-releases of mini-SMS when the OI scheme was migrated from `ecgate1` to `vpp`.
The impact of the error is not systematic; it depends on the data distribution. So it normally does not invalidate clean comparison experiments, if the two experiments to be mutually compared both have the error either in or out.

Release notes of HIRLAM 5.0.4

HIRLAM 5.0.4:

1. revised shallow convection in STRACO
2. technical changes and code corrections in the template for the suite definition file
3. add colour scheme to the graphical monitor

The changes concern source libraries.

Meteorological impact

The effect of the change in STRACO is described by Bent Hansen Sass:

> The effect of increased upward moisture flux and downward heat flux, from shallow convection affecting the cloud and the stable layer aloft, is primarily to
>
> - reduce small precipitation amounts from boundary layer clouds subject to cloud top radiative cooling. The reduced precipitation is caused by the heating and drying at cloud top, associated with the entrainment process.
> - prevent a too unstable temperature lapse rate beneath low tropospheric cloud tops.
> - increase the occurrence of 'cloud breakup' for low tropospheric clouds, mainly during the season where solar heating is important. This has consequences for the diurnal cycle of temperature and humidity near the ground, *e.g.*, allowing for increased amplitudes over land during spring.

Release notes of HIRLAM 5.0.3

HIRLAM 5.0.3:

1. treats too small lateral boundary zones and/or halos
2. has a much cleaner and more efficient code for initialisation
3. introduces a file to record the history of a cycle
4. has facilities for statistics for 2D physics quantities
5. allows the `DISPLAY` variable to be set for the graphical interface
6. corrects errors (mainly in the 3DVAR part)

The changes concern source libraries and local installation procedures.

Meteorological impact

In the reference configuration, none of the changes has a meteorological impact.

Description of the changes

Lateral boundary zone

The correction to the treatment of the lateral boundary replaces truncation by extrapolation of the semi-Lagrangian trajectory if the number of lateral boundary points is 0 (but the reference value is 2).

Halo zone

If the halo zone (overlap of areas between processors in case of multi-processor processing) is too small to fully contain the semi-Lagrangian trajectory the model will now abort. This will happen if the time step is large in relation to the resolution which is not the case in the reference configuration).

Initialisation

Xiang-Yu Huang and Xiaohua Yang rewrote the code to control the initial steps in the forecast model (initialisation, backward and forward steps in DFI). The option to use implicit non-linear mode initialisation has been revived; there are now also options not to initialise at all or to apply incremental digital filtering initialisation (IDFI). The reference still is non-incremental DFI.
In the new code, the intermediate initialised fields are not written out and read back in again. This leads to substantial efficiency improvements; but as a conseqeunce, the files containing those fields (`im` after backward, `in` after forward DFI) are not available anymore. Initialised fields are now written to the file with forecast length 0 (`fc00`); this file cannot be produced if initialisation is switched off.

History of a cycle

The cold start of an experiment must not be initialised with incremental DFI, even if IDFI is chosen for the experiment. Before 5.0.3 there was no reliable way to identify whether a cycle was a cold-start or a continuation. In 5.0.3 each cycle has a file called `$CYCLEDIR/history` in which the ‘history’ of the cycle can be recorded. Currently, it records whether `scripts/Fg` decided to cold-start or continue the experiment. The file is archived in the file `AR`*`yyyymmddhh`*`.tar`.

Two-dimensional physics quantities

Code to collect, and print domain averaged, statistics of the following two-dimensional physics quantities was added:

- total cloud cover
- high cloud cover
- medium cloud cover
- low cloud cover
- 'fog' (lowest model layer cloud cover)
- height of cloud base
- height of cloud tops

Planned releases

Below is a list of modifications that are in the pipeline. The new revisions numbering strategy inhibits the assignment of tentative version numbers to the modifications: as long as version 5.*n.m* has not been proven to be good enough to become version 5.*n*+1, a new release will have a revision number that is obtained by incrementing the minor release number, so as to become 5.*n.m*+1. On the other hand, if the validation tests did promote 5.*n.m* to 5.*n*+1, the new release will receive number 5.*n*+1.1. So the progress of release numbers depends on the progress of the validation tests. The list below is ordered according to the tentative implementation schedule.

1. ISBA with the new surface analysis.
2. 3DVAR as default
3. Boundary interpolation in model incl. frame
4. Resolution increase of Reference system and DMR & 2 delta x orography smoothing.
5. The vertical resolution increase of the DMR is likely to take place later than the horizontal, based on the impact studies and also on cost considerations.
6. Kain-Fritsch and Rasch-Kristjánsson
7. Semi-Lagrangian physics coupling
8. Stable ABL parameterisation
9. GWD and new physiography for high resolution