Reference System Status November 2002

Gerard Cats, Per Undén and Kristian Mogensen

Summary

HIRLAM 5.2.2; to be released 18 November 2002; beta-release

1. 3DVAR replaces Optimum Interpolation
2. The HIRLAM GRIB file Server HGS
3. Revisions to the climate generation system
4. Redefinition of screen-level temperature and humidity field identification
5. Code corrections and extensions

HIRVDA 5.1.0 released 13 September 2002

Index field updated. DAR Quikscat. Semi-Lagrangian code updated. Technical updates.

HIRLAM 5.2.1; released 1 July 2002; beta-release

code corrections (with minor meteorological impact) and technical improvements

HIRLAM 5.2.0; released 11 June 2002; **official release**

equal to version 5.1.4, apart from the necessary technical changes

1. The ISBA surface parameterisation scheme replaces the HIRLAM 2.7 surface scheme
2. A new scheme for surface parameters, which matches the ISBA scheme

The reformulation of the CBR scheme has little, and extensions to the verification package however important, have no meteorological impact

HIRVDA 5.0.3 released 15 March 2002

KNMI Quikscat cost function. RTM cloud mask. Index field scaling of background errors. Singular vectors of the Hessian. Integr. Water vapour observation operator. Technical changes. Statistics plots.

HIRLAM 5.1.4; released 11 March 2002; beta-release

1. corrections to bugs in the analysis of sea surface temperature and soil moisture
2. reformulations of vertical diffusion: fractional time stepping and conserving scheme
3. some bug corrections and code improvements

Release notes of HIRLAM 5.2.2

Gerard Cats (cats@knmi.nl)

HIRLAM 5.2.2 introduces:

1. **3DVAR**.
2. Revisions to the GRIB numbering of screen-level temperature and humidity.
3. Code for asynchronous IO (not active by default).
4. Code for IBM/AIX/SP3.
5. Modifications to the climate generation system.
6. Corrections to coding errors.

The changes concern source libraries, resource files, and local installation procedures.

Meteorological impact

The impact of the replacement of the Optimum Interpolation scheme by 3DVAR for the analysis of upper-air fields has been described in many articles in HIRLAM Newsletters and Technical Reports, and in other refereed publications. Several HIRLAM member institutes have been using the 3DVAR scheme in their operational production already, and are satisfied of its quality.

In summary, the impact on forecast quality is positive. It is small when only conventional data are used, but the merits of 3DVAR are pronounced with non-conventional data. In the current installation, data are used from SYNOP, SHIP, TEMP, PILOT, DRIBU and AIREP reports.

In the reference configuration, none of the other changes has a meteorological impact. But it should be noted that the revisions to the GRIB numbering of screen-level temperature and humidity results in different fields being identified by parameters 11 (temperature), 17 (dew point temperature), 51 (specific humidity) and 52 (relative humidity) at 2m above terrain. They used to identify the values averaged over the land fractions of the grid square, and they are now the values averaged over all tiles in the grid square (averages are always weighted with the fractions taken by the tiles). The old values, *i.e.* the averages over land fractions only, are now available as parameter numbers 140, 143, 141, and 142, *resp*. Note that this change only affects the 2m level temperature and humidity fields.

Description of the changes

3DVAR

In the reference system; and at ECMWF

Essentially, the 3DVAR scheme is switched on by putting `ANALYSIS=3DVAR` in `scripts/Env_expdesc`. The 3DVAR code has been made available for experimentation already in HIRLAM version 5.0.2. It is part of the general HIRVDA (HIRLAM Variational Data Assimilation) system. Since then, changes have taken place, both in the HIRVDA system (requiring changes to HIRVDA-related scripts), and in the management of the system. The HIRVDA system has its own system manager, Kristian Mogensen (ksm@dmi.dk). Ole Vignes (ole.vignes@met.no) and Xiaohua Yang (xiaohua@dmi.dk) have been assisting Kristian in the preliminary integration of HIRVDA into the HIRLAM reference.

My own involvement is currently limited to keeping the HIRVDA system at ECMWF available under the HIRLAM system manager's user code, `~nkg`. The currently active version is kept in `~nkg/hirvda` on `ecgate1`. Because the HIRVDA system does not have a proper version control, it is not clear yet how to treat older releases. For the time being, the only thing possible is to keep only the current version available. Today, this is HIRVDA version 5.1.1. But remember:

Experiments will always use the current release, even if the release is only approved at the beta level.

We are aware this is unsatisfactory; the situation will definitely improve in the future, but we like to tackle it in the context of the full system overhaul, planned for HIRLAM-VI. This overhaul will also be used to integrate the HIRVDA system and the rest of HIRLAM. Until then, the HIRVDA system will be totally disjoint from the other HIRLAM components.
In terms of computing costs, the 3DVAR scheme is not much more expensive than the Optimum Interpolation method.
Ole modified the HIRVDA-related scripts.

Local installations

Because the HIRVDA system is not an integral part of the HIRLAM reference system, it is not automatically included in the HIRLAM export versions, as generated with the utility `~nkg/LocalInstall/GetRef`. Instead, it has to be acquired separately. Xiaohua Yang wrote documentation to assist you in local installation of the HIRVDA system.

New GRIB numbers for T and Td at 2 m

With the implementation of the ISBA scheme (HIRLAM 5.1.3), it was decided to pass the averages values of screen level (2 m) temperature and humidity, averaged over the land fractions of the grid square *only*, in the fields that are identified by the standard WMO tables, e.g. 11 for temperature, at level 2 of level type 105 (m above terrain).
HIRLAM end users, however, expressed the wish to have the values averaged over the whole grid-square, that is, including the water fractions, in the GRIB messages that are identified by standard WMO values. The main reason is that these whole grid-square averages better describe the screen level fields over sea near land.
Stefan Gollvik implemented this user request, and his code was adjusted for this release of HIRLAM by Ernesto Rodriguez. To allow continued access to the land-fraction averages, Stefan made those available in the parameters 140 to 143.
The standard verification package has not been adjusted. Hence, it now will verify grid-square averages of screen level temperature and humidity, where it used to verify the values representative for the land fraction of the grid-square. Because most observations are over land, a deterioration of the verification scores has to be expected, even though there are no meteorological changes. It would be a relatively small change in the verification package to continue to verify the land fraction averages (replace for *e.g.* temperature parameter 11 by 140). But because it raises the question what field to verify (it would not be appropriate to verify the land fraction values against sea stations, for example), it has been decided to first investigate this question before adjusting the verification package. For the time being, we accept the (slight) deterioration of verification scores.

Asynchronous IO

Ole Vignes implemented the HIRLAM GRIB Server (HGS), to perform input and output (IO) concurrently with computations during the forecast model. Essentially, HGS dedicates one or more processors from the total pool of processors, to IO. If the total number of processors is big, and/or the amount is of IO is also big, this may result in very good performance improvements.

HGS was originally developed by Jan Boerhout, and Jan wrote an article about it in HIRLAM Newsletter 39 ("Improving HIRLAM scalability by asynchronous GRIB file handling"). Jan's version uses Unix features (so-called 'System-V IPC') that may not be working properly on all hardware; 'System-V IPC' may not even be always available, in particular on MPP machines. Therefore, Ole also merged in the parallel

developments by Kalle Eerola and Jussi Heikonen, that were using MPI for communication. MPI is less efficient than 'System-V IPC' but still the possible performance improvements are substantial.

You may choose which paradigm to use by the environment variable `HGS_TYPE`. The default is '`NONE`' (no asynchronous IO); the other legal values are '`MPI`' and '`IPC`'.

Ole wrote:

I doubt there can be any speedup on the vpps (at ECMWF). At least one processor must be reserved for IO only. When running in a queue with only 4 or 8 processors, you must have a lot of IO (or it must be very slow) if the IO speed-up is to make up for the fact that you now have fewer processors left for computations. So I find it highly unlikely that there is any reason to go for asynchronous IO on the vpps. (...) I prefer HGS_TYPE=NONE (because) the users should know that this is 'beta' software, and that they use it at their own risk.

I have now compiled and run HGS (on vpp7 at ECMWF) with HGS_TYPE=NONE and with HGS_TYPE=MPI. The first one was successful, the second crashed with 'mailbox overflow', which indicates that I would have to increase VPP_MBX_SIZE more. The problem is that sometimes it works, sometimes not, so it is hard to find a value that guarantees success. This is another good reason to have HGS_TYPE=NONE as the default.

Ole stresses this is a beta-release, and users are invited to experiment and report experiences.

code for IBM/AIX/SP3

Kalle Eerola and Jussi Heikonen developed the modifications needed for the FMI/CSC IBM. Much of it has been implemented now, not just to facilitate porting to local installations with this kind of machines, but also in preparation of ECMWF's transition to IBM.
The changes are:

- Introduction of proper compile and load sequences in the makefiles `scripts/Makefile` and `scripts/Makefile_x`, *resp*.
- Modifications to `scripts/mSMS.pl` to resolve the IBM/AIX (Korn, Bourne) shell peculiarities.

  Now that these peculiarities have been resolved, the environment variable `MY_BASH` is no longer needed. Yet, it is kept as an option: by setting `MY_BASH`, the shell it points to will be used to submit the HIRLAM scripts.

The climate generation system

The land-use classification

Han The introduced global coverage for the land-use classification. He also added PELCOM data sets. The list of files searched for land-use data is given in the file `gtopo/glcc.lst`. In this file, the PELCOM data have been commented out (skipping of comments required a small change in `scripts/Climate`). You can make the PELCOM data active by uncommenting the relevant lines in `gtopo/glcc.lst`. Currently, on SGI (and perhaps on other machines), not more than 30 files may be processed from `gtopo/glcc.lst`. Han is developing code to avoid reaching this limit, but for the time being you should remove at least 3 data sets if you want to use the PELCOM data. This is not a serious restriction, because the PELCOM data are only over Europe, and so it safe not to process data on the other side of the world if you want to use PELCOM data.

Orography and orographic surface roughness

Han also created the files for global coverage of the digital elevation maps (DEM), that we, meteorologists, normally refer to as 'orography'. The resolution of these DEM files is sufficient for HIRLAM grid point distances of 0.02º over Europe, and 0.05º globally. To limit the file sizes Han used a polar-stereographic projection for the polar areas. The code to process data in polar-stereographic projection was added to the climate generation system. The global DEM files have been added to the reference system. However, similar to the situation with the land-use data, not more than 30 files may be listed in the list of files to be searched, which for DEM is `gtopo/gtopo30.lst`.
The orographic surface roughness algorithm for HIRLAM grids of high resolution has been developed by Kai Sattler. Han has implemented this algorithm, but because of its (minute) meteorological impact it has not been activated yet. The current algorithm, on the other hand, requires fields (with orographic variance) that Han has not produced globally, pending the implementation of Kai's algorithm. So, until the HIRLAM management group deems the meteorological impact of the new algorithm acceptable, and until the limit of 30 files has been relieved, the global DEM data are not usable. I decided not to modify the list of files, `gtopo/gtopo30.lst`, for the time being; the effect is that the **current climate generation system still does not know of the global DEM data sets**. In `scripts/Climate`, the code of Kai's algorithm has been made inactive by making it depend on the environment variable `CLIMATE_REVISION`.
Note that you may make use of the global data or the European data at high resolution already, but it requires some work:

1. Find out which HDF data sets to use, from the list in `$HL_RESOURCES/dat/gtopo`. Choose at most 30 files on the basis of their (sometimes cryptic) names, and use the files that contain the dataset '`peaks`'. To assist you with the latter, the executable `hdfview` is created by `scripts/Climate` (and at ECMWF, it is kept as a utility in `~nkg/hl_util/bin`).
2. List those files in the file `$HL_WD/gtopo/gtopo30.lst`.
3. Start HIRLAM with
   `Hirlam start CLIMATE_REVISION=20021101 DTG=....(`*`etc.`*`)`

Coding errors and consistency checks

Several consistency checks in the generated fields (e.g. fraction of sea ice not more than fraction of water) have been built in, some of them suggested by Karl-Ivar Ivarsson.
Niko Sokka corrected a coding error in `hdfg/hdf2asim.f`. It is hoped that this will reduce the risk of failure of this program (to my knowledge, this program is the most frequent source of technical problems with the climate generation system).

Corrections to coding errors

Apart from the corrections mentioned above, a few more errors were corrected:
Isabel Martinez corrected an error in `prpo/POSTPP.f` and Ole Vignes one in `grdy/CHFRAME.f`.

Release of HIRVDA 5.1.0.

Problems with ships for KNMI BUFR data solved.

DAR Quikscat code updated.

Problems with FGAT and ISBA solved.

Various performance optimizations.

Support for NEC/Intel and NAG IA64 compilers.

Support for NEC SX/6.

New compilation set-up allowing for compilation multiple
architectures and parallel make
(use gmake if GNU make is not your default make).

Bug in MPI code for colfld/disfld fixed.

Support for parallel make within the new compilation set-up.

Support for Intels math kernel library fft's.

Index field code updated (including bgos).

Semi-Lagrangian code for the non-linear spectral model updated.

Bug in RTM screening for nproc > nobs fixed.

GBGPS screening added.

Release notes of HIRLAM 5.2.1

Gerard Cats (cats@knmi.nl)

HIRLAM 5.2.1 collects a number of technical changes.
The changes concern source libraries, and local installation procedures.

Meteorological impact

The change to `prpo/PUTH3C.f` makes it possible to distinguish in the surface analysis the temperature of inland lakes and sea in case there are observations available from the lakes. The effect is local in the near-surface parameters, like T_2. (Thanks to Kalle Eerola).
The winds at 10 m as postprocessed from upper-air fields in the ECMWF files are never used, except perhaps in the first cycle of an experiment. They were wrong, in that the v-component was set equal to the u-component. This may have impacted the use of 10 m wind observations in the first cycle of an experiment.
In the reference configuration, none of the other changes has a meteorological impact.

Description of the changes

climate system

The climate generation system is a continuing source of concern. Most, if not all, complaints relate to the program to convert HDF files to ASIMOF, `hdfg/hdf2asim.f`. It is feared that the problems are due to some error in the standard Fortran HDF library. Ray McGrath developed a modification to `hdfg/hdf2asim.f` that seems to work-around the problem on IBM and on my Linux.
If the climate generation fails on your machine, there is always the last resort of running it on `ecgate1` at ECMWF. To help you do this, I wrote `scripts/climate.tdf` which will generate all 12 monthly climate files in one job.

usage:
Create an experiment, as usual, with a file `scripts/Env_domain` to specify your domain. Then type

```
Hirlam start DTG=2002010100 PLAYFILE=climate
```

In here, `DTG` is required but not used (until we know how to change the climate). After job completion, you will find the 12 climate files in `HL_DATA`.

System extensions

Additional options to the console script `Hirlam`
`Hirlam echo variable_names`
will now also list the values of variables from the file `$SETENV` (default: `ENVIRONMENT`), if possible.
`Hirlam cleanup -d`
will list all files of the experiment on disk, but not those in the permanent file system (`ecfs` at ECMWF). Add the option `-go` to remove only the temporary disk files, but keep the permanent ones. (option name '`-d`' derives from 'disk').
Treatment of files in PAREXP
When running an experiment using the `PAREXP` option (in `scripts/Env_input`), the aggressive disk cleaning by `scripts/SaniDisk.pl` does not treat the files of the experiment that was being used for the input files (i.e. the experiment identified by `PAREXP`). The reason

is that other experiments may also be using those files. In particular for large experiments (many cycles and/or large areas) this may exhaust the user's disk quota. The script `SaniDisk.pl` has now been modified such that if the variable `LAST_PAREXP` is set in `scripts/Env_input` (to 1), the files from `PAREXP` will also be removed aggressively. Conversely, if an experiment that does not use the `PAREXP` option is run with `LAST_PAREXP` set to 0, the files of the experiment will not be removed; this is because the value 0 of `LAST_PAREXP` is deemed to indicate that another experiment is going to use the files.
At this stage I want to stress that during the course of an experiment no-one but the experiment itself should remove intermediate files. But once an experiment has stopped, there is no risk in removing those files, because when it is resumed the experiment will recreate them as needed. At ECMWF, most of us will not be allowed to run two experiments concurrently, and then it is safe to set `LAST_PAREXP` to 1, even if you intend to later run a parallel experiment. It will save you disk space, at the expense of additional `ecfs` activity.

cdp commands now also in mini-SMS

In full SMS, many `cdp` commands can be executed from a running job. A few of those have now been implemented in mini-SMS. In particular, `force` is now available. See the mini-SMS documentation for up to date details. HIRLAM does as yet not use the new possibilities created through this extension of mini-SMS, but there surely is a prospect use.

> For example, currently an expensive (MPP) job is started to test whether the analysis has to be done; if the answer is yes, the job continues, but if there is no need for the analysis, the job leaves execution immediately. The sad thing is that the job may have had to wait a long time in the input queue before enough resources were free to start the execution, which is a waste if the job is not going to do anything after all. With the new extension to mini-SMS it is possible to make this decision quickly, in a cheap job before the main one.

Installation

Several modifications ease installation on other hardware.

Release notes of HIRLAM 5.2.0

Gerard Cats (cats@knmi.nl)

HIRLAM 5.2.0 is an official release. Apart from the necessary technical modification to introduce this version number, 5.2.0 is equal to 5.1.4.
The changes concern source libraries.

Meteorological impact

The main meteorological changes between the previous official release, version 5.1, and 5.1 are:

1. The ISBA surface parameterisation scheme replaces the HIRLAM 2.7 surface scheme
2. A new scheme for surface parameters, which matches the ISBA scheme
   The reformulation of the CBR scheme has little, and extensions to the verification package however important, have no meteorological impact.

Release of hirvda.5.0.3.

RTM code rewritten so constant terms in the gradient calculations are stored instead of recalculated every interations.

The cloud masking algorithm for RTM observations is now actually used.

The RTM code can now be parallized using OpenMP.

libgen4 splittet into a new strgen4 library for string handling and the existing obop library for observation operators.

The information needed in order to calculation bias for RTM observations is now included the code. The data is now put in CMA and can be converted to the format of the bias calculation code by the rtmcmaextr program.

The first version of the DNMI DAR Quikscat code added.

The KNMI cost function for preprocessed Quikscat data has been implemented.

Code to calculation singular vectors of the hessian of the cost function is added.

Bug in cmastat.x causing occasional crashes has been fixed.

backst.ascii format changed.

IBM ESSL FFT calls modifed.

Less print outs from obsproc.

Problems with too much stack space in horint_remote fixed by using heap instead.

Various bugs for the 4D-VAR set-up removed.

Ship anemometer height now used for ship surface winds.

Station heights can now be corrected by an input file for SYNOP and TEMP

New scripts to plot observations statistics and usage include in script/obsplot. These scripts requires gnuplot.

NIRWV satellite integrated water vapour above clouds observations added.

Rescaling of background errors by an index field added. Activated by setting l_indexfld to true in namrun.dat and link hirvda.5.0.3/data/strfun_data/smindex_fis.dat to fort.8 in running directory.

BGOS moved from separate executable into the hirlam.x executable.

Release notes of HIRLAM 5.1.4

Gerard Cats (cats@knmi.nl)

HIRLAM 5.1.4:

1. corrects a bug in the Sea Surface Temperature (SST) analysis
2. corrects a bug in the soil moisture assimilation
3. avoids soil freezing in forest
4. introduces fractional time stepping between dynamics and verical diffusion.
5. uses a conserving formulation in vertical diffusion.
6. corrects several bugs (*e.g.* to revive the option for Eulerian advection) and implements several minor improvements

The changes concern source libraries, resource files, and local installation procedures.

Meteorological impact

The changes in the SST and soil moisture analysis correct coding errors. Their impact will be described in a Newsletter article. Avoiding soil freezing in forest has a very small impact on the atmosphere dynamics, but it improves 2 m winter temperatures in Northern latitudes considerably.
The (partial) fractional time stepping reduces the risk of instabilities in a forecast. Also its impact will be described in a Newsletter article.
The introduction of better conservation properties in the CBR scheme is reported to have a slight positive impact.
A coding error in script `Climate` prevented the use of the DWD soil texture data set. This omission has negligible impact because missing soil texture data are normally completed (by the program `previ`) from *e.g.* land use.
The other changes have no meteorological impact in the reference configuration.

Description of the changes

SST analysis

Quoting Ernesto Rodriguez:

> A bug has been identified in `GETBCK` consisting of an erroneous reading of the forecast length of first guess from the climatological file. As a consequence the SST was not relaxed to climatology. Furthermore, a high discrepancy has been observed between SST data measured by buoys and the SST from ECMWF, especially in the northern latitudes, where pseudoobs from ECMWF present a high resolution. It has been decided to do not use buoy data, and to leave the ECMWF data to determine the border of ice. Finally, and in order to avoid the bull eyes produced by ship SST data (as a consequence of the inconsistency with ECMWF data), the weight given to ship observations has been decreased by increasing the data to guess errors ratio to the value used by Smith *et al.* in the NMC SST analysis. The resulting SST analysis is now smoother and agrees very well with the ECMWF border of ice.

soil moisture assimilation

Quoting Ernesto Rodriguez again:

> With respect to the soil moisture analysis, a bug has been identified in version 5.1.3

that may produce a bad assignment of the vegetation type and soil texture for certain platforms and/or compilers. This bad assignation implies that unrealistic soil moisture analysis increments are computed, and therefore they could be rejected by the safety checks at the end of SOILAS. This rejection could manifest after 2-3 weeks of assimilation as a warm/dry drift.

soil freezing in forest

In cold conditions, the soil in forest could become far too cold. A fix is to avoid soil freezing in forest altogether.

fractional time stepping

To balance the tendencies of vertical diffusion and dynamics, which is particularly important when they are big (*i.e.* in unstable, strong wind conditions in the planetary boundary layer, vertical diffusion is now applied to the fields after they have been updated with the dynamical tendencies. The code was there already, it meant switching on NLDYNVD.

conserving formulation of vertical diffusion

Quoting Per Undén and Geert Lenderink:

The turbulence scheme is solving (in this example for u, but also for v, theta etc.)

```
d u / dt = d / dz ( K du /dz)
```

This is correct if rho (density) = constant. However the correct equation is

```
d u / dt = 1 / rho d / dz ( rho K du / dz) )
```

This latter equation can be rewritten in the first plus an additional term

```
(- K d u / dz ) (- d (ln rho) / dz
```

so this term is what was missing. This is a sink term for momentum and a source term for heat. In practice, the modification consists of replacing dz with dp/g and K with $K_{eff}=K*(rho)^2$ in the original equations, thereby solving the correct equation above. (note: dz=dp/(g*rho) and dz appears twice). Including the extra term(s) makes the scheme almost conservative. In a 1D simulation of a convective boundary layer, with prescribed surface fluxes, it did within 0.5 % or better (mostly 0.2 %) (due to implicit numerics it will not conserve completely). The old version leaks about 5-10 % (heat and moisture) and also looses about 5 % stress.

In two tests (2 weeks and the other 10 days) small positive impacts on the scores (2m T, 10m wind, and ps) were seen compared with 5.1.1 (with Lenderink's revision to CBR).

bugs and minor improvements

As you may have expected, the application of version 5.1.3 (ISBA and extended verification facilities) on other computer systems, and in a variety of conditions, revealed a number of bugs and weaknesses in the codes. The known ones have now been attacked.
In 5.1.3, the large library grdy (grid point dynamics) had to be compiled twice at ECMWF (once for ecgate1, once for VPP). By moving GRWEIGHT to library util, and by a redesign of the treatment of physical tuning parameters, the ecgate1 compilation is now avoided.
Physical tuning parameters used to be set by a namelist (namtun), but are now set in a Fortran

source file (`phys/CONTUN.f`). These parameters are rarely the subject of experimentation, so carrying around namelists became a bit heavy (and because the namelist appeared in three different scripts, there was ample room to specify inconsistent values).
Users can replace a data file from the reference system by a private one by a fairly complicated procedure (copy the `HL_RESOURCES` directory, and replace the resource file corresponding to the private version by one listing the directory of the private version; make the environment variable `HL_RESOURCES` point to the new `HL_RESOURCES` directory). This is mcuh more complicated than the procedure to replace a source file (place the source file in the corresponding subdirectory of `HL_WD`). The reason for this is that the data files may be too big to place them under the user's home directory. This, however, is not the case for two files in the climate generation system, **`gtopo/gtopo30.lst`** and **`gtopo/glcc.lst`** (the first containing the list of topo files, the second the list of land-use files). These files may be the subject of experimentation, *e.g.* to replace the reference system versions by local (possibly very high resolution) versions. To facilitate this experimentation, it is now possible to place those two `.lst` files in subdirectory `gtopo` of `HL_WD`; those files will be used then to replace their reference counterparts. Note that these files merely list the actual data files to be used. If you want to replace or add one of those files, you still have to place the new file in the reference system location, `$HL_REF_CP/dat/gtopo`.

Planned releases

After the release of HIRLAM 5.2.2, the following are in the pipeline:
1. Testing for a Reference release
2. DMR with mini-SMS
3. Climate system updates
4. Resolution increase of the Reference system and DMR & 2 delta-x orography smoothing.
5. Testing for a Reference release
6. Radiation updates and interface.
7. CBR stable case extensions
8. STRACO updates depending on tests
9. Semi-Lagrangian physics coupling and SL T-equation and extrapolation.
10. Boundary interpolation in model incl. Frame.
11. GWD and new physiography for high resolution.