

SMHI operational HIRLAM system

HIRLAM ASM 2004-03-01 – 2003-03-03
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1. Computer system

HIRLAM at SMHI is run on computers at the National Supercomputer Centre (NSC) at Linköping university.

Hirlam is run on both a shared memory SGI, and a distributed memory PC-Cluster.

BRIS is a PC-cluster with 1+16+2 nodes, each with 2 Intel Xeon 2.2 GHz processors. Each node has 2 GB memory and 60 MB local disk. One node act as a login node and for interactive work and is connected to the other nodes with Ethernet. The other PE's are also connected to each other with Ethernet and 16 of the PE's are connected with a fast SCALI network. There is also 1 TB of disk to the system.

BRIS is using Redhat Linux operating system and have:

- PGI, GNU and Intel compilers
- ScaMPI, MPICH and LAM MPI-libraries
- Intel Math Kernel Library
- OPEN PBS queue system

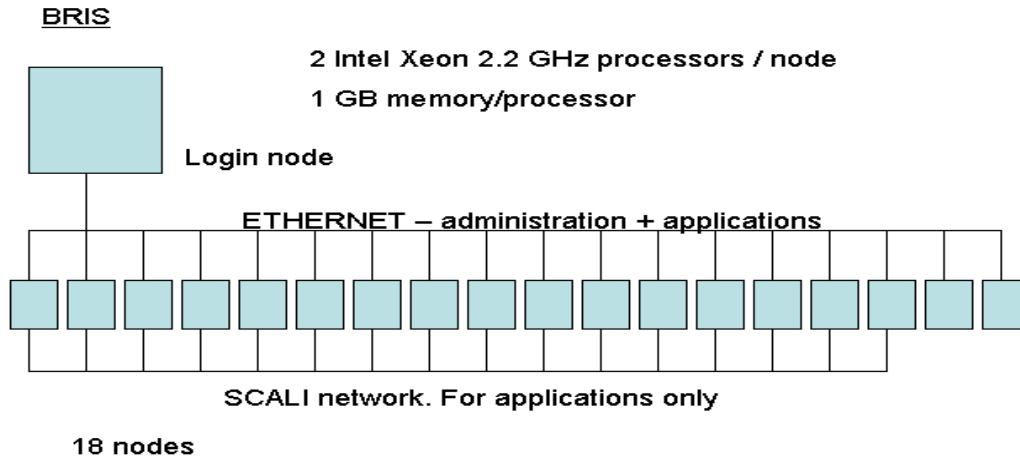
BRIS is dedicated entirely to SMHI operational models, HIRLAM and also the oceanographic model HIROMB.

For SMHI development work, HIRLAM, HIROMB, dispersion model MATCH and ROSSBY climate centre use an additional cluster, Monolith with 200 dual nodes are used and shared with university users.

BRIS is placed in the computer room at SMHI although it is still a NSC resource.

The SGI 3800 at NSC has 128 PE's with 128 GB shared memory, 128 Gflops peak performance, IRIX operating system and LSF batch system. For operational Hirlam only 16 PE are used due to bad speed-up on more PE when using MPI for parallellization.

Preprocessing are run at SMHI on high availability DEC/Alpha servers.



2. HIRLAM system

The operational Hirlam model is based on HIRLAM 5.1.4 with certain modifications:

- Kain-Fritsch convection
- Rasch-Kristjansen condensation
- Soil freezing removed in forest and low vegetation (ktyp = 4 and 5)
- Modified CBR
- 40 levels that differs from the one in Vineta. Mainly the lowest level is higher (c:a 28 meters in stead of 10)
- smooth orography

In the surface analysis SMHI also merge the icefield from the Baltic ice model BOBA.

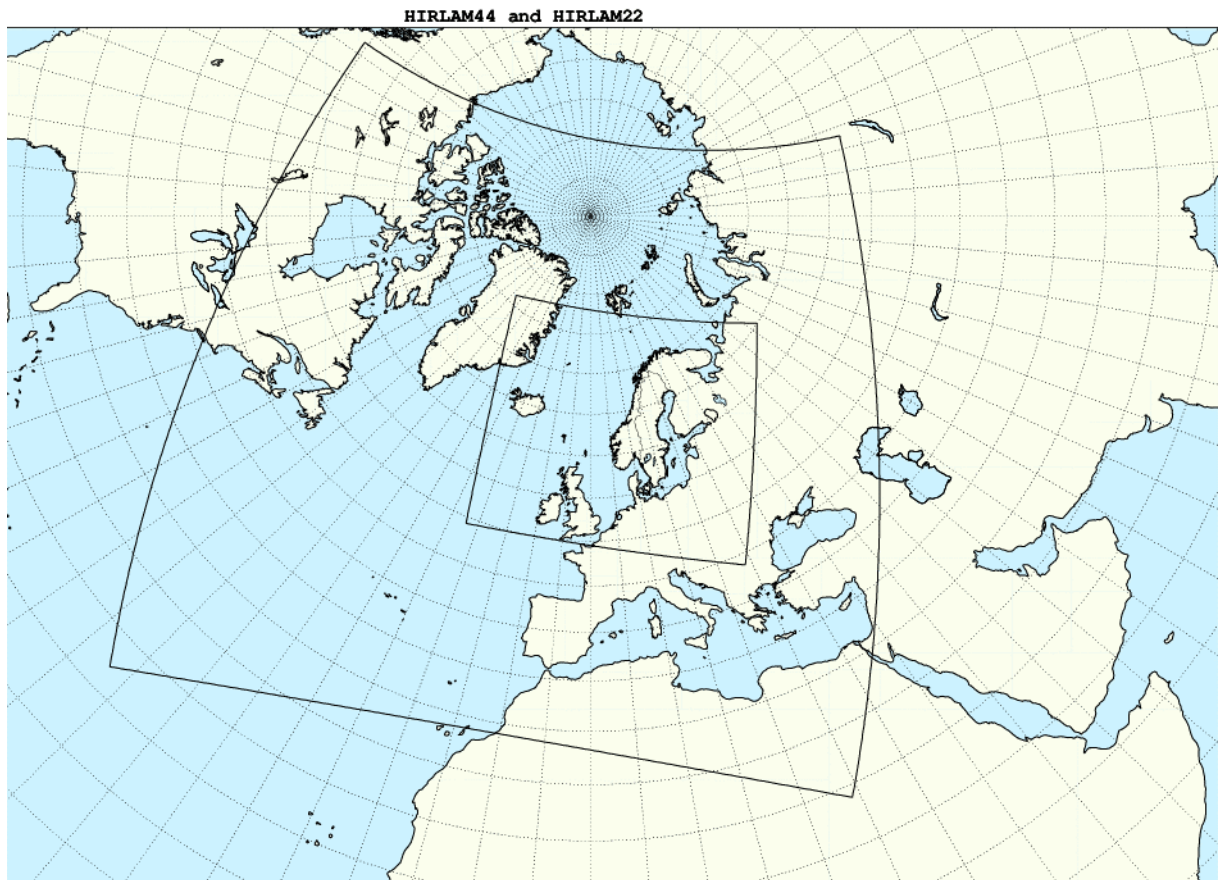
The analysis is HIRVDA version 5.1.1

3. Operational setup

SMHI has for many years operationally been running two completely separate suites of the HIRLAM setup on two computers. Many forecast products are now being generated directly from model output which makes it crucial that the models are run without interruption and in time. SMHI has solved this by running an operational suite and at the same time run a backup suite on another machine. To switch between the two suits is a simple operator command. At present the PC-Cluster, BRIS, is normally the operational machine and SGI works as the backup machine.

SMHI runs HIRLAM at two domains with different horizontal resolution. H44 has a resolution of 0.4° over a rotated grid with 202x178 horizontal gridpoints. It uses ECMWF boundary conditions 4 times a day from ECMWF BC project with a temporal resolution of 3

hours. A nested H22 is run at 0.2° resolution over 162×142 gridpoints and with boundaries from the 44 model. Both versions have the same 40 model levels.



Model files are written every hour and sent to SMHI UNIX system. The postprocessing used to be at SMHI but in the new setup it is done inside the ordinary HIRLAM run.

MPI parallelisation is used both for the forecast model and for the analysis.

The BOBA sea ice model and pseudo SST observations from manually analysed Baltic SSTs are used in the surface analysis.

The statistics files are produced operationally and they are converted to formatted files so that they can be used on the workstations for a graphical monitoring tool and for accumulating and plotting RMS observation statistics. These are essential tools for monitoring of the operational runs and for evaluating modifications.

SYNOP, AIREP, AMDAR, BUOY, TEMP and PILOT observations enter the analysis using a version of the ECMWF observation pre-processing system to convert from the WMO alphanumeric code forms used on GTS to BUFR format.

TOVS AMSU-A (EARS) are used in the analysis

VAD wind profiles are used in passive mode.

Operational schedule

At every 3 hours +0h25m a preliminary H44 analysis is run using mainly SYNOP data. The output is mainly used for automated analysis of weather charts.

Every 6 hours, HIRLAM 44 is run with a cut off of 1h55m. The forecast is run out to 48 hours and then HIRLAM 22 is started, and the forecast is run to 48 hours.

HIRLAM operational runs and other things like available disk space on involved systems, availability of resources, the automatic product generation from HIRLAM data and communication links are continuously supervised by SMHI general supervising system KARO.

4. Events

During 2002 SMHI made a major upgrade of the operational HIRLAM system and last year only a few changes were made.

- dec 2003. The new model did not solve all weaknesses of the forecast model but some still exists: positive bias in t2m in cold situations, too slow filling of lows, too much cloud in the lee-side of mountains, rain instead of snow in convective precip just above freezing, too much low convective clouds.
To correct some of this an update of the physics were made in the end of 2003:
 - water vapour pressure computations
 - freezing of lakes
 - postprocessing of convective precipitation
 - shallow convection cloud fraction computations
 - new radiation (from ROSSBY centre RCA model)
 - increased roughness
 - enhanced mixing-length in boundary layer in stable stratification
 - tuning of microphysics
- feb 2004. ATOVS AMSU-A used in the analysis

5. Coming work

- SMHI has for many years been running the same horizontal grid and has now a rather low resolution setup and at the same time the computer resources has increased. SMHI will shortly (20040512) increase the resolution and replace the 44 and 22 km runs with a 22 km resolution on (nearly) the same area as the present h44 grid. The grid (C22) will be 306x306 horizontal gridpoints with the same 40 vertical levels. In addition to the new 22km grid we will also start an 11 km run where we also will increase the vertical resolution to 60 levels. This domain (D11) will have 246x268x60 gridpoints and is planned to be run before the C22 run with 6 hours old boundaries from the previous run and the boundaries will be updated every hour.

- At the change to the new domain we will also replace HIRVDA version 5.1.1 with version 6.2.1.



- NSC will end running the SGI 3800 from the beginning of 2005. They are going to continue with a shared memory machine but SMHI have decided to continue to run on a new PC-cluster in replacement for the SGI. With the fast development in this area it was considered possible to buy (or build) a cluster that was capable of running 4D-VAR on our new domain.
At present (spring 2004) a group from NSC and SMHI are working with specifications for the new cluster and 4D-VAR and hlprog for the new C22 domain are used for benchmarking. The aim is to have the new cluster installed 2004-10-01 and operational in january 2005.
The present cluster have Xeon processors and Scali network but for the new there are more options for processors (Xeon, Opteron, P4) and interconnect (Scali, Infiniband, Myrinet, Quadrics)
- When Kain-Fritsch / Rasch-Kristjansen will be included in the reference HIRLAM we will replace the old version 5.1.4 with the new version.