WWW TECHNICAL PROGRESS REPORT ON THE GLOBAL DATA-PROCESSING AND FORECASTING SYSTEM (GDPFS), AND THE ANNUAL NUMERICAL WEATHER PREDICTION (NWP) PROGRESS REPORT FOR THE YEAR 2005

SWEDEN

Swedish Meteorological and Hydrological Institute SMHI

1. Summary of highlights

During 2005 there was a mayor upgrade of the NWP system at SMHI:

- The HIRLAM forecast model was upgraded from version 5.1.4 to version 6.3.5
- FGAT – first guess at appropriate time – introduced in the analysis
- The 11 km horizontal resolution domain, E11 , was made bigger
- The E11 run started to use the horizontal boundaries from ECMWF, the BC-project.
- The SGI ORIGIN 3800 was replaced by a Linux cluster

2. Equipment in use at the Centre

SMHI operational forecasts are run at computers at NSC, the National Supercomputer Centre, at the University of Linköping.
SMHI operational forecasting system, HIRLAM weather forecasting and the oceanographic HIROMB model, are for backup reasons, run on 2 separate computer systems.
SMHI are now entirely using Linux cluster's for operational NWP.

- BLIXT. Operational machine
  60 dual Intel XEON 3.2 GHz nodes.
  Infiniband interconnect
  PCI Express
  Scali MPI connect
  768 GFlops peak performance
  5.6 TB disc

- Backup machine
  16 dual Intel XEON 2.2 GHz nodes.
  SCALI interconnect

BRIS and BLIXT are dedicated entirely for SMHI operational forecasts and are placed in computer halls at SMHI.

The preprocessing of observational and boundary input to the models are run on Alpha servers.

The output of the models are stored on a file-server and also put into SMHI operational database.

3. Data and products from GTS in use

SYNOP, SYNOP SHIP, TEMP, PILOT, BUOY, AIREP, AMDAR

4. Data input system

HIRLAM is written to accept observational input in BUFR format.
ECMWF preprocessing has been implemented at SMHI to convert WMO Alphanumerical Codes in telegrams from GTS to BUFR format.

5. Quality control system

The preprocessing system does not contain any quality control on the incoming observations except for a formal control on the code format.
HIRLAM analysis system makes both a gross error check on the observational increments and also a variational quality control in the variational analysis.

6. Monitoring of the observing network

Available observations as well as observational increments are monitored in a locally developed monitoring system.

7. Forecasting system

SMHI is part of the international HIRLAM project which has a goal to produce a Limited Area Model for operational use for short-range Numerical Weather Prediction in the participating National Meteorological Institutes. SMHI runs the HIRLAM analysis and forecast model for national use for forecasts up to +48 hours.

SMHI is also a member of ECMWF, European Centre for Medium-Range Weather Prediction and uses the operational output, which is received in real time from ECMWF dissemination system. The products from ECMWF is mainly a +240 hours deterministic forecast twica a day and products from ECMWF EPS, Ensamble Prediction System once a day and also products from the BC-project to provide horizontal boundaries for HIRLAM 4 times a day.

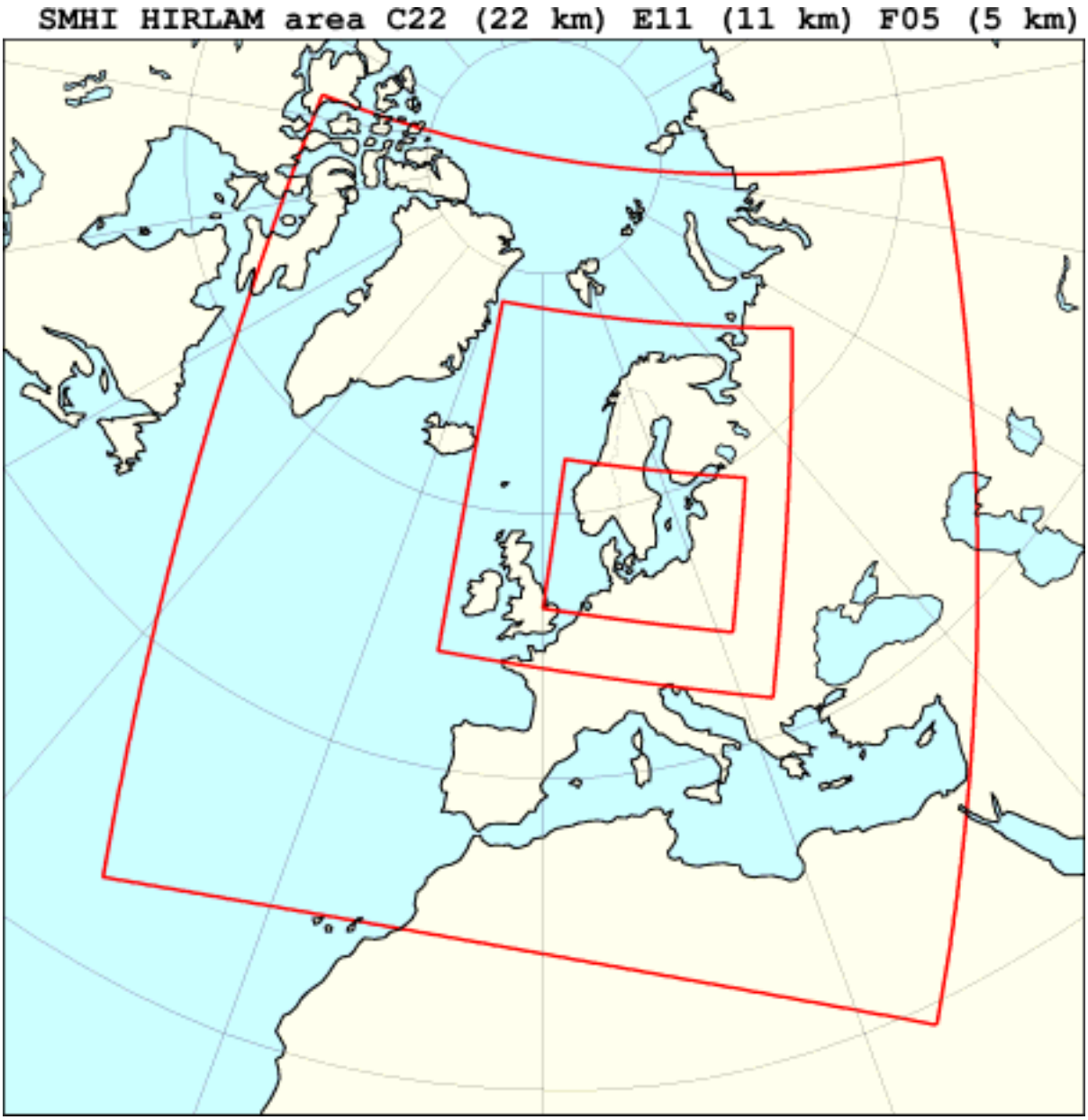

FIG 1

7.1 System run schedule and forecast ranges

At SMHI the short-range NWP system are run on two different domains, C22 and E11 (see figure 1) with different resolutions. Both areas are run 4 times a day at 00, 06, 12 and 18 UTC with their own data assimilation cycle. An additional domain, F05, are run in test mode.

A. The C22 domain with a horizontal resolution of about 22 km (0.20 degree on the rotated lat/long grid) and 40 vertical hybrid levels are run to +48 hours with a +2 hour data cut-off time. Lateral boundaries comes from the ECMWF BC project with a 3 hour time resolution. The BC (Boundary Condition) project are run 4 times a day and provides 6 hour old boundaries.

B. The E11 domain has a horizontal resolution of about 11 km (0.10 degrees on the rotated grid) and 60 vertical hybrid levels. It is run to +48 hours with a data cut-off of 1 hour 15 minutes. The lateral boundaries comes from the ECMWF BC project

C. The F05 domain has a horizontal resolution of 5.5 km (0.05 degree on the rotated lat/long grid) and 60 vertical levels. Lateral boundaries come from the E11 run with a 1 hour time resolution.

7.2 Medium range forecasting system

No medium range forecasts are run at SMHI. Products from ECMWF are used.

7.3 Short-Range forecasting system (0 – 72 h)

The HIRLAM analysis and forecast system are described in HIRLAM-5 Scientific Documentation (Undén,P et. al. 2002)

The 3 HIRLAM domains at SMHI are run with the same version of the NWP system. The only difference is that satellite data are not used in the small-scale E11 and F05 setup.

7.3.1 Data assimilation and initialization

The analysis is HIRLAM 3D-VAR analysis version 6.2.1
Initialization is done with DFI, Digital Filter Initialization, developed within the HIRLAM project.

7.3.2 Model

The forecast model used is a somewhat modified HIRLAM version 6.3.5 with the following characteristics:

- ISBA surface scheme
- Kain-Fritsch convection scheme
- Rasch-Kristjansson large scale scheme
- CBR turbulence scheme
- Savijärvi radiation scheme

7.3.3 NWP products

The HIRLAM model produces output on files containing the model parameters like wind, temperature, specific humidity, cloud water and TKE (Turbulent Kinetic Energy) on all model levels as well as parameters that describe the state of the ground like temperature and available water on the different land tiles in the model and on the soil levels. The model files also contains physiographic data like orography and roughness.
In addition the model files the output can also, by namelist arguments, produce postprocessed files for parameters on pressure levels and parameters like 2 m temp and 10 m wind.

7.4 Specialized forecasts

HIRLAM output are used as input data for a number of other models:

- HIROMB. An oceanographic forecast model for temp, salinity, currents, ice cover and water-level.
- Wave model. At present HYPNE

- MESAN. An analysis model for analysis of weather parameters not normally analysed by meteorological models such as fresh snow-cover, visibility and 10 meter winds.
  MESAN is used for diagnostic and now-casting purposes and uses an Optimum Interpolation technique.
- MATCH. A Transport and Dispersion model.
- HBV model. A hydrological run-off model for different catchment areas.

7.5 Extended range forecasts (10 – 30 days)

No Extended range forecasts are made at SMHI

7.6 Long-range forecasts (beyond 30 days)

No Long-range forecasts are made at SMHI

8 Verification of prognostic products

HIRLAM output is continually verified using the EWGLAM (European Working Group on Limited Area Models) verification scheme to verify model output against observations in well specified station lists.

The forecasts are also verified to see its possibility to forecast specified events, like e.g winds above a certain limit.

SMHI regularly publish a Verificaton Bulletin on a monthly, seasonal and yearly basis.

9 Plans for the future

The plans for 2006 are:

- Starting preoperational near real time tests with 4D-VAR analysis on a limited area
- Starting test with ALADIN/AROME model in the new HIRLAM-MeteoFrance collaboration in very high resolution modeling.

10 References

Undén P., Rontu L., Järvinen H., Lynch P., Calvo J., Cats G., Cuxart J., Eerola K., Fortelius K., Garcia-Moya J. A., Jones C., Lenderlink G., McDonald A., McGrath R., Navascues B., Nielsen N. W., Ødegaard V., Rodrigues E., Rummukainen M., Rõõm R., Sattler K., Sass B. H., Savijärvi H., Schreuer B. W., Sigg R., The H., Tijm S. (2002) HIRLAM-5 Scientific Documentation. Hirlam scientific report.