

# **Annual WWW Technical Progress Report**

## **On the Global Data Processing and Forecasting System 2004**

### **IRELAND**

#### **1. Summary of highlights**

Met Éireann runs the Hirlam numerical weather prediction system, operationally, four times per day. Forecasts are produced out to 48-hours. Hirlam is an international co-operative project and details may be obtained from the Hirlam web site [<http://knmi.hirlam.nl>] or from papers by Lynch et al. [2000] and by Undén et al. [2003].

We have been running Hirlam on an IBM RS/6000 SP since 2001. However, in 2004 we started to experiment with running Hirlam on a small Linux cluster based on Intel Xeon hardware. Results with the cluster have been very promising. (See Hamilton [2004]).

#### **2. Equipment in use**

The operational Hirlam system is run on an IBM RS/6000 SP with 9-nodes each with 4 cpu's [i.e. a total of 36 cpu's]. The experimental version runs on a 6-node dual Xeon cluster [i.e. a total of 12 cpu's].

#### **3. Data from GTS in use**

SYNOP, SHIP, BUOY, AIREP, AMDAR, ACARS, TEMP, TEMPSHIP, PILOT, SATOB and SATEM observations are used. The data are packed into BUFR format both for storage and for input to Hirlam.

#### **4. Data input system**

Automated. [The automatic data extraction program is known as WADE – it makes extensive use, internally, of BUFR code].

#### **5. Quality control system**

WADE [the automatic data extraction program] applies extensive tests to observations before they are input to the Analysis stage of Hirlam.

#### **6. Monitoring of observing system**

Irish observations are monitored 24-hours per day at our central computer facility in Dublin.

## 7. Forecasting system

Met Éireann uses the Hirlam weather prediction system to provide high accuracy meteorological forecast products, with a special priority on forecasts valid for up to about two days ahead. The system provides guidance to both meteorological staff (forecasters) and to numerous customers. Furthermore, the results are used as input (forcing) for various specialized forecasts (e.g., a WAM model for forecasting sea conditions; a road-ice model; and various agro-meteorological models).

The following paragraphs give details of the Hirlam system in use

- **Analysis:** Hirlam 3D-Var [3-dimensional variational assimilation]. The analysis runs on 31 hybrid [eta] levels. Upper-air observational data is accepted on all standard and significant levels (10 hPa to 1000 hPa) and interpolated to eta levels.
- **Assimilation Cycle:** Three-hour cycle using the forecast from the previous cycle as a first-guess. [It is also possible to use an ECMWF forecast as a first-guess].
- **Analysed Variables:** Wind components (u,v), geopotential and specific humidity.
- **Forecast Model:** Hirlam 5.0.1 reference system grid point model.
- **Horizontal grid:** A rotated latitude-longitude grid is used with the South-Pole at (-30° longitude, -30° latitude). Fields are based on a 438x284 grid corresponding to a 0.15° x 0.15° horizontal Arakara C-grid.
- **Vertical Grid:** Hybrid [eta] coordinate system with 31 levels.
- **Initialisation:** Digital Filter.
- **Integration Scheme:** We use a two time-level three-dimensional semi-Lagrangian semi-implicit scheme with a time-step of 300 seconds.
- **Filtering:** Fourth order implicit horizontal diffusion.
- **Physics:** CBR vertical diffusion scheme; Sundqvist condensation scheme with the 'STRACO' (Soft TRAnSition CONdensation scheme) cloud scheme; Savijarvi radiation scheme.
- **Lateral Boundary Treatment:** Davies-Kallberg relaxation scheme using a cosine dependent relaxation function over a boundary zone of 8-lines. The latest available ECMWF 'frame' files are used [based on 4 ECMWF runs per day at 00Z, 06Z, 12Z and 18Z, respectively]. ECMWF data is received on a 0.3° x 0.3° rotated latitude-longitude grid on a selection of the 60 ECMWF eta levels. The data is interpolated both horizontally and vertically to the Hirlam 0.15° x 0.15° rotated latitude-longitude grid at [Hirlam] 31 eta levels. [The selected 0.3° x 0.3° grid corresponds to half the resolution of the 0.15° x 0.15° grid, the line speed is not sufficient to receive the data at full resolution]. In general the ECMWF boundary files are just provided as 'frame' boundaries where the data is not defined in the central section

of the grid. However, the ECMWF analysis fields are received on a 'full' grid and so can be used as a 'first-guess' in the case of a 'cold-start'.

## **8. Verification of prognostic products**

Objective verification comprising both field verification and 'OBS-verification' has been implemented. The latter concerns comparison of forecast values with data from both SYNOP and radiosonde stations over the European area according to a station list originating from EWGLAM (European Working Group for Limited Area Models). Special efforts are devoted to forecast verification over Ireland.

## **9. Plans for the future**

Upgrade Hirlam from version 5 to version 6 and purchase a new NWP computer in 2006.

Include ATOVS (EARS) data in Hirlam 3-dimensional variational assimilation in 2005.

## **References**

Hamilton, J (2004). Running the Hirlam NWP model on a 6 x dual-Xeon cluster at Met Éireann, 11<sup>th</sup> Workshop on High-Performance computing in Meteorology, ECMWF.

Lynch, P., Gustafsson, N., Sass, B., and Cats, G. (2000). Final report of the hirlam 4 project, 1997-1999. HIRLAM 4 Project Report, 59 pp.

Undén, P., Rontu, L., Järvinen, H., Lynch, P., Calvo, J., Cats, G., Cuxart, J., Eerola, K., Fortelius, C., Garcia-Moya, J. A., Jones, C., Lenderlink, G., McDonald, A., McGrath, R., Navascues, B., Nielsen, N. W., Ødegaard, V., Rodriguez, E., Rummukainen, M., Room, R., Sattler, K., Sass, B. H., Savijärvi, H., Schreuer, B. W., Sigg, R., The, H., and Tijm, A. (2003). HIRLAM-5 scientific documentation. Hirlam scientific report.