# Satellite observation delivery requirements for HIRLAM

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HIRLAM (High-Resolution Limited-Area Model) is one of several European consortia for limited-area numerical weather prediction. Regional weather prediction models are run by most national forecasting centres in Europe and are able to supplement and add value to the output from global models in several ways. The most important aspects are that they provide information on higher resolution features and that they are able to make forecasts up to a given time range available faster than the global models.

As an example of how such limited-area model suites are set up, we can illustrate with the model system run operationally at the Norwegian Meteorological Institute (met.no). The main operational limited-area model runs four times daily with forecast data from ECMWF on the lateral boundaries. This model has 20 km mesh width and covers a large area centred on Norway containing North-East Atlantic and surrounding continents. Higher resolution runs over smaller domains centred on Norway are also performed as part of the routine.

In addition to the quality of the high-resolution limited-area forecast model itself, the forecast quality depends on the quality of the estimated initial state and the quality of the lateral boundary input from the outer forcing model.

The potential benefit of observation usage for determining the initial state in limited-area modelling depends on the size of the model domain and the forecast range. For small domains, after a certain forecast range, the lateral boundary input dominates as determining factor for the forecast, and the initial state is less important. The larger the domain and the shorter the forecast range to be considered, the higher is the relative importance of the initial state. Because of the emphasis on short-range forecasting and the large area of forecast responsibility of the Norwegian Meteorological Institute, it is believed that data assimilation will still be performed in the limited-area model within the foreseeable future.

The initial state in the 20 km model is estimated using the HIRLAM 3D-Var data assimilation system. The observation cut-off time for these runs is about 2 hrs for the main termins. The HIRLAM 3D-Var version presently in use in Norway is a version that assimilates conventional observations, aircraft observations and ATOVS radiances. In addition observation operators and assimilation have been developed or is under development in HIRLAM for several other observation types which are not operational in Norway at present, but may become so in the future. This includes for QuikSCAT and ERS-2 Scatterometer winds, radar retrieved wind vector profiles and radial winds, HIRS and AMSU-B radiances as well as ground based GPS delays.

The present cut-off time for the analysis of approximately 2 hrs is mainly motivated by the delivery time for radiosondes (see *Eerola*, 2003), which is believed to be the most important observation type for the analysis at present. The relative importance of radiosondes is however likely to become smaller in the future. Today AMSUA radiances give some positive impact in the HIRLAM system. The EUMETSAT ATOVS retransmission service (EARS) now delivers these observations within 30 minutes after observation time. This shows the feasibility of building retransmission solutions, which can enable fast delivery of more remote sensing data within a large domain. Within local areas also radar and ground based GPS are today available with a similarly short time lag.

The relative importance of radar and satellite data will be enhanced by potentially more optimal usage in the HIRLAM 4D-Var assimilation system, which is under pre-operational testing. With the developments of use of non-conventional data it is therefore probable that the radiosonde delivery need not be the dimensioning factor for the analysis cut-off, and that the limited-area forecasts will be made with a shorter cut-off, maybe of the order of 30 minutes in the not too far future. It is highly desirable that satellite observation providers consider infrastructure for delivery of observations to be assimilated in limited-area numerical weather prediction within such a time frame.

## Reference

**Eerola, Kalle**, 2003: Statistics of the arrival times of conventional observations for HIRLAM at FMI. *HIRLAM Newslette*, **44**, November 2003, pp 20-31.