

# Report on HIRLAM management group visit to met.no

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## 1 Meeting with met.no management

On Monday 19 June the MG first met with representatives from the met.no management (Oystein Hov, Jens Sunde and Eivind Martinsen). The main points of discussion were:

- With the new IBM computer, met.no intends to run its present 20-km area at 10km resolution. Tests will then be done with running the 10km model on various areas. The 20km model will be maintained for a while. Met.no has now introduced a HIRLAM hydrostatic 4km model and is comparing this to UM4. They appear to be similar in quality.
- Various aspects of operational cooperation within HIRLAM were discussed. Jens Sunde expressed interest in some of the possibilities raised by the management group in this respect, such as the common postprocessing package and the creation of a data portal, primarily as a backup tool. Harmonization of in- and output formats, and the common use of ODB should be considered. He suggested also the creation of common tools for the handling of gridded databases. Operational cooperation has also been considered in the Nordmet initiative. Jens suggested that the Nordmet workshop to be held this autumn should perhaps be extended to include all HIRLAM countries.
- The issue of running several mesoscale models (UM, HIRALD, AROME) on a common Norwegian grid was discussed. The HIRLAM MG would prefer these models to have a resolution of around 2km, as this is the programme's target resolution. Options and complications were considered. It was decided to wait for the installation of the new IBM in September before designing a configuration for these comparative runs. Xiaohua will then provide Ole Vignes with the relevant information on installation and computational requirements of the HIRALD and AROME systems.
- A group of researchers and forecasters has been established at met.no to serve as a bridge between research and operations. This is a development parallel to the activities of the new HIRLAM management group to increase contacts with users. Jens Sunde suggested that the Nordic meteorologists meeting may be a good platform for the MG to have contacts with duty forecasters. In consideration of the changing role of forecasters, met.no has begun a project in which forecasters do model modifications, run inverse models and check the outcome. Hereby they learn where the model is sensitive. The availability of many models between which a forecaster has to make a choice, necessitates the creation of tools to compare models and visualize the differences between them, to help forecaster deal with information overload.
- On 1 October, met.no expects to move to a new location nearby. This should facilitate contacts with the university.
- At their new location, met.no will be close to socio-economic researchers. Jeanette raised the question if met.no is interested in studying the socioeconomic impact of meteorology with them. Jens Sunde expressed interest to explore this further, and suggests that this could possibly be an optional project within HIRLAM. Nowcasting presumably has the greatest economic impact. Jens was interested in the use of mesoscale models for nowcasting and on-demand modelling. Very high resolution low-level turbulence forecasting for aviation is also of interest. At present met.no uses 100m resolution turbulent flow models within 1km-resolution UM model grids for this purpose. Initial results are promising.

## 2 Meeting with user representatives:

Monday afternoon the MG met with duty forecasters (Bard Fjukstad, Arnstein Tjostheim, Laila Sidselrud, Ole Nielsen) and two members of met.no's marketing division (Erik Hagemark, Borge Jansen). First, Jeanette presented an overview of HIRLAM plans, concluding with a set of questions

concerning the performance of the model and user needs in Norway. Then Bard Fjukstad presented the experiences of forecasters with HIRLAM.

Areas of attention for the programme:

- main parameters of interest at met.no: wind (incl. turbulence, gusts) and precipitation, both with very great spatial detail due to the complex Norwegian topography.
- Mesoscale polar lows are important for met.no to forecast well. The model is capable of developing these systems, but analyzing them correctly seems to be difficult.
- dynamics of strong winds along the ice edge. Possibly this can be improved after inclusion of assimilation of SST and sea ice in the model.
- snow melt in areas with snow under forest canopies. Thor-Erik Nordeng shows situations (may 2006) where the model allows snow to melt too quickly in spring. Day temperatures are not high enough, night temperatures are too low. This can probably be mended by the new snow/forest surface scheme, which should be tested on Thor-Erik's case.
- Convective precipitation in the met.no mesoscale models is realistic in intensity, but how to forecast the location of precipitation correctly? Upscaling to coarser resolution or interpretation by means of probabilistic postprocessing are possible solutions, but the forecaster lacks the tools for doing that. There seems to be a difference in behaviour concerning precipitation over orography between models with prognostic and diagnostic cloud water schemes, respectively. This needs to be looked into.
- pmsl description near topography. This problem is presumably due to an erroneous translation from p to pmsl, which has been solved in version 6.4.3.
- gusts in mountains: a simple translation to 10m height is insufficient here. After the removal of orographic roughness by the new MSO/SSO scheme, and improvements of the CBR scheme for stable conditions, the description of wind in mountainous regions should improve. Due to the lack of observations, this will be hard to verify however.
- Fog over sea appears too develop too early and too strongly. It causes too much cooling in the air above the sea. This is a difficult problem, research on it is ongoing.
- met.no is now running a 4km model with hydrostatic HIRLAM. Compared to the UM4, the model appears to give similar results, particularly for wind; but a more extensive comparison needs to be done.
- met.no is interested in both using and contributing to a common postprocessing package.

Erik Hagemark from the Marketing Division explained the position of this division within met.no. Its operations are kept strictly separate from the met.no non-commercial activities. The division consists of 34 employees, including forecasters, product developers and sales and marketing staff. The main customers are in the energy, maritime industry, transport and media businesses. Erik described the needs from a big customer, Hydropower, for accurate local precipitation forecasts. Verification against in-situ data shows that ECMWF scores significantly better than HIRLAM, mainly in terms of standard deviation. ECMWF therefore is better suited as input to statistical downscaling. UM4 also seems to be better than operational 10 and 20km) HIRLAM. The management group suggested to upscale HIRLAM and UM4 to the ECMWF resolution, to allow a fair comparison of verification results. It is also highly interested in the outcome of the direct HIRLAM-4-UM4 comparison which met.no is now performing. Erik asked if precipitation is advected horizontally in HIRLAM, as it is done in the ECMWF model; this is not the case. It was suggested that the relatively poor HIRLAM performance for precipitation in mountain areas could be due to the behaviour of dynamics over orography. This should be investigated further.

Both forecasters and marketing staff welcomed the efforts from the programme to actively seek out user needs and suggestions. Conversely, the Management Group found the discussions with these user representatives very informative, and appreciated the considerable efforts to which met.no went to arrange this meeting.

### 3 Meeting with met.no HIRLAM staff:

On Tuesday the MG had a meeting with met.no HIRLAM staff. First, the MG members presented the status and plans in their respective projects. Then there were several presentations from met.no staff on their HIRLAM activities.

Frank Tveter and Vibeke Wauters Thyness showed recent results of the remote sensing group. The work on assimilation of the upper AMSU-A channels over sea ice in the IOMASA project is nearly finished. The surface microwave emissivity over sea ice which is needed for this, has been estimated from OSI-SAF sea ice concentration fields. The possibility to use SSMI/I for this should perhaps be considered. In the quality control, a new cloud clearing algorithm has been used (calculating the Bayesian risk that the observation errors are not Gaussian distributed). In verification against EWGLAM stations, a positive impact has been obtained, but this impact is highly situation-dependent. The plans are: to prepare assimilation of AMSU-A over sea ice in the Reference System (after version 7.1); to further tune the emissivities; and to use the OSI SAF microwave sea ice emissivities directly.

The introduction of RTTOV-8 has been started by DMI, and will be completed by Frank. He will also work on simplifying the bias correction system. At present met.no, SMHI and DMI all use slightly different bias treatments. Frank suggests to let these approaches converge with the introduction of RTTOV-8. A new EUMETSAT fellow, Andrea Storto, has just begun work on binary cloud assimilation. A report will be prepared first on the theoretical aspects.

Next Mariken Homleid presented her work on SST and sea ice fields derived from the OSI-SAF. The quality of the sea ice fields appears to be good. The SST fields are ok for use at 20km resolution, but better results can be obtained by using OSAI-SAF SST in the surface analysis at higher resolution with an OI scheme. Mariken has made preparations to include the OSI SAF sea ice fields in the Reference System. John de Vries will visit met.no and take over this work.

For the assimilation of OSI-SAF SST she puts the following questions to the Management Group:

- 1) Do we replace the successive corrections scheme for SST with OI?
- 2) How to model the observation errors?
- 3) Do we use thinning to reduce the data density? How much?
- 4) How to deal with data gaps?

After some discussion, the MG proposes to use the ECMWF 50km pseudiobservations as background, and assimilate the OSI SAF SST with OI.

A more fundamental way to assimilate SST consistently will be to couple HIRLAM to an ocean model, and assimilate SST into this model (through surface fluxes). Met.no intends to experiment with this in the coming years.

Ole Vignes described his work on preconditioning of the (multiple outer loop) 4D-VAR minimization with Hessian eigenvectors. The background matrix is preconditioned by a linear variable transform, and the eigenvalues are then calculated using a Lanczos solver and conjugate gradient minimization. This way, the number of iterations can be reduced by a factor of 2-3. Further study is needed to solve memory and variational quality control issues, and on the number of iterations required for first and second outer loops.

Ole also showed the data monitoring pages which he has set up. This tool looks very flexible, and Xiaohua expressed interest in using it for the data monitoring of the RCR.

In conclusion, the MG found the discussions with the met.no management, user representatives and HIRLAM staff very fruitful and stimulating. In particular the discussion with the duty forecasters and marketing staff was constructive and informative, and the MG values the efforts from met.no to arrange this. Also the MG much appreciated the work presented by the met.no HIRLAM staff, and the strongly result-oriented attitude of the people present.