Report on HIRLAM management group visit to FMI 2-3 October 2006

Jeanette Onvlee

Meeting with users' representatives:
The user forum on Monday afternoon started with a presentation of the Programme manager on the aims, plans and recent results of the HIRLAM-A programme. This was followed with a series of presentations by user representatives.

Ilkka Juga presented the experiences and needs of users from aviation meteorology and the public weather services. Aviation forecasters generally desire a more accurate description of stratocumulus below 850 hPa, and a wider range of postprocessing products from the model: cloud top and base, visualization of icing forecasts, maximum wind gusts etc. These postprocessing needs can to some extent be met with the introduction of an extended common postprocessing package, foreseen for Reference System 7.1, but will also require local developments at FMI.
For general weather warning forecasts, there is a need for better moisture forecasts in the boundary layer. An increase in vertical resolution from the presently used 40 layers is requested. There is also great interest in a rapid update version of the model for nowcasting purposes, running every hour for the forecast range +12 - +24h, and in a short-range ensemble prediction system. Furthermore, forecasters would appreciate to have the possibility to compare the forecast to model climatology (an extreme forecast index tool, for forecasting extreme events), and to rerun the model using different initial conditions (to study e.g. convective developments). A variety of derivative products, such as stability indices is requested.
Hydrological forecasting is now generally done on the basis of the ECMWF EPS. Users are interested to apply HIRLAM (EPS) to this as well. High temporal and spatial resolution are critical to flood forecasting. An accurate description of soil moisture is the most decisive factor for hydrological forecast quality. Lake surface temperatures are required to model evaporation more accurately.

Next, Mikhail Sofiev described the air quality forecasting, for which FMI uses the Lagrangian chemical transport model SILAM, operational since February 2006. The model is run daily, up to +48h in 1h output time steps and at 30km horizontal resolution. Sofiev points out that air quality models are specific, tough and heavy users of NWP. They have strict requirements as to model consistency, and are sensitive to mass conservation. As they are very sensitive to parameters which within NWP are often considered relatively unimportant, nearly all air quality models have their own ABL diagnostics and pre-processing. This can lead to inconsistency problems and communication problems with NWP modelers. Dispersion sometimes only occurs above threshold wind speeds and humidities. Thus, the model is sensitive to the tail of the distribution of these quantities, and therefore also to model version and resolution. Each time the atmospheric model is updated, the transport model therefore needs to be retuned, which is quite cumbersome.

Laura Tuomi describes the range of maritime forecasting products: wave, water level and drift forecasting, a 3D ocean model, and ice modelling. The experience with these models is that they depend sensitively on the horizontal resolution of the atmospheric forecasts: the 9km HIRLAM model gives much better forecasts than the 22km model. The maritime forecasters would appreciate to have more regular information on the strong and weak points of the atmospheric model, and the developments therein. Also, more emphasis on the description of air-sea interaction processes is warranted.

Martynas Kazalauskas describes the NWP activities and plans at LHMS. They are now working on experiments with the HIRLAM system, tuning its performance on their cluster and on visualization tools. They plan to upgrade to version 7.1, set up a verification system and study the application of forecast products next. It is intended to promote NWP more at Vilnius University. There are only two people at LHMS working on this full-time, with no active supervisor. Potential users of the HIRLAM products are the environmental protection agency, and wind energy industry.

Meeting with FMI HIRLAM staff:

Carl Fortelius first gave an introduction of the NWP modelling activities at FMI. The two main trends there are an increasing emphasis on probabilistic forecasting and on nowcasting at a high level of spatial detail. For this reason the development of mesoscale analyses using the NOAA LAPS system and of a LAMEPS are priority areas.

This was followed by a number of presentations on models used at FMI.
Niko Sokka first described the RCR operations. Because of FMI's role to run the RCR operationally, in recent years the model has been updated much more frequently than before. Users are generally happy with this, as they have noted the significant progress. On the whole, FMI is satisfied with the RCR arrangement. The 9km HIRLAM model is well liked by users, and quite reliable. A problem noted by Niko is that the definitions between the RCR mini-SMS system and the full SMS as used at FMI differ. He asked what will be the system to be used for AROME, and whether it will be worth the effort to harmonize the two scheduling systems at the synoptic scale. Also, he noted that the RCR archive is widely used, but growing rather fast. New solutions for the archiving may be needed.

Sami Niemela then described the experimental 2.5km AROME model.For technical reasons this model is nested within 11km ALADIN. It is remarked that nesting it directly into HIRLAM can be achieved, and is worthwhile doing in the near future. Monitoring results can be seen on fminwp.fmi.fi/AROME and fminwp.fmi.fi/WebgraF. Sami pointed out the heavy computational cost of AROME: a +24h forecast requires 3h15m. Qualitatively, the precipitation patterns and the classical features of MCS systems are reproduced well by the model. It tends to overestimate convective precipitation and produces too much drizzle and fog. The surface variables are not yet satisfactory, nighttime 2m temperatures are far too cold.

Next, Erik Gregow gave a brief description of the LAPS/MM5 high-resolution analysis and nowcasting system. MM5 is used as background model for LAPS, at around 1km horizontal and ~25m vertical resolution. At the moment the surface observations from the Heslniki testbed are used in the analysis; this will be extended with radar, soundings, profiler data, satellite and GNSS observations. The system is flexible and can be applied anywhere in the world. Use of HIRLAM or AROME rather than MM5 is possible.

Pilvi Siljano described the pollen long-range transport forecast system. This is based on the SILAM transport model, augmented with a pollen emission term and a flowering parametrization. NWP data are used in the calculation of transport and sinks, and as input to the flowering model. Results can be seen at pollen.fmi.fi.

Kirsti Salonen and Reima Eresmaa presented their research in the use of radar winds and GNSS delays. Kirsti showed the 3-step bias estimation procedure for radial winds. After ambiguity removal by the dual Doppler technique, the quality of the resulting winds is quite good, although some aspects are still puzzling. She has been working on Swedish radar data mostly, as the processing of those data contains a proper de-aliasing procedure. Nils remarks that it is intended to generalize the Swedish radar processing software. It will then be of interest to test if radar data from other countries can be processed with this software. Reima spoke of his work on interpreting slant delayes. First, zenith total delays (ZTD) are estimated from a fit to all observations, next the slant delay is taken to be the sum of the fitted ZTD and an asymmetric slant delay component.

After this, there were several presentations on model physics aspects. Laura described Kalle's experiments with the snow scheme. 2m temperature and relative humidity are improved by the snow scheme. However, there are problems with its performance in summer.

Markku described his work in streamlining the boundary layer verification against masts and in archiving these data. Inclusion of non-meteorological (broadcast) masts is possible, but should be done only after including more model data and arranging the archiving in a better way.

Evgeni Atlaskin showed results from his evaluation of the Quasi-Normal Scale Elimination (QNSE) turbulence scheme in stable boundary layer situations. QNSE and CBR appear to be much closer to each other than to observations, so QNSE does not seem to improve much on model performance under stable conditions over CBR.

Timo Vihma described the Nordic temperature problems and their underlying cause: a very shallow stable boundary layer with small heat capacity, in which even small errors in heat flux will results in larger errors in air temperature. The shallow region of constant flux does not actually reach the lowest model level, but the model parametrizations assume that it does. Under these circumstances standard Monin-Obukhov theory is not really valid. It remains to be seen to what extend the new snow scheme can improve the situation. Validation of the scheme against Sodankyla tower data remains to be done.

In the DAMOCLES project, Priit Tisler has studied the performance of HIRLAM over sea ice. The model behaviour seemed OK, but it has been problematic to get the sea ice edge correctly into the model.

Christoph Zingerle has verified cloud convection schemes with brightness temperature observations from satellites. RTTOV has been used to map model forecasts onto brightness temperatures, thereby circumventing the need of cloud classification. The model brightness temeperatures were underestimated at midlevels, and overestimated for high clouds. This could imply an underestimate of the level of entrainment. The Rasch-Kristjansson Kain-Fritsch scheme appeared to be performing better in this respect than STRACO. Christoph has applied an Ebert-type pattern matching tool in his verification. The method used is to threshold observations, and move the resulting observation patterns around until they best fit the structural features in the model. From this, a displacement error is calculated. Then calculate the volume error. Then determine the total error, and subtract displacement and volume errors from this to obtain the pattern error. This pattern matching verification tool is to be implemented at FMI; introduction of it as a more general HIRLAM tool should be considered.

Lorenzo Claveri described his activities in the mesoscale modelling of coastal wind for wind farms. For this, he has applied a wide variety of models, e.g. MM5, WRF, the WASP statistical model and an LES model.

Finally, Laura Rontu showed her work on the MSO-SSO scheme, which is now technically ready for implementation in the Reference System, and which should replace the use of all orographic roughness enhancements which now exist in the HIRLAM code. Considering the HIRLAM postprocessing system, Laura proposed to include in the HIRLAM stand-alone postprocessing a number of new variables on model levels and single-level variables, which she and Carl Fortelius have described several years ago in HIRLAM Newsletter 36.

The presentations were followed by a brief discussion on the relation of FMI's activities and the priorities within the HIRLAM programme. Carl Fortelius asked the management group if they felt that FMI has struck a right balance in their choice of activities, or that FMI should perhaps put more or less effort in certain areas. To this, the management group responded that they had been impressed by the broad range and high quality of FMI's NWP activities. FMI staff play key roles in several areas of the programme. Also, the strong role played by FMI in promoting Baltic cooperation is highly appreciated by the MG. The experiences at FMI in coupling the NWP model to a chemical transport model, related by Mikhael Sofiev, were quiet enlightening to the MG, and will be very relevant for future research in how to best accomplish such a coupling.

The one area where the MG would seriously like FMI to reconsider its efforts in, is the field of probabilistic forecasting. According to the FMI management, the availability of LAMEPS products is considered to be of increasing importance. In view of this, the MG expressed its surprise that apparently no manpower seems to be devoted to R&D on this issue. Even when not participating in the

GLAMEPS research, with its new supercomputer FMI could still participate in the production of GLAMEPS, and that would be a valuable contribution as well. But also at this lower level of ambition, manpower would still be required to install and maintain the ensemble generation system. The new project leader for predictability, Trond Iversen, will contact Carl Fortelius to further consider the possibilities for FMI to participate in the GLAMEPS activities.