Report on HIRLAM management group visit to DMI, 26-27 November 2007

Jeanette Onvlee

On 26 and 27 November the HIRLAM management group visited DMI. From the side of DMI the following people were present: Bent Hansen Sass, Bjarne Amstrup, Alexander Bakhlanov, Mats Dahlbom, Henrik Feddersen, Ulrik Korsholm, Alexander Mahura, Sören Olufsen, Kai Sattler, Bjarne Stig Andersen and Henrik Vedel.

The visit began with a plenary discussion. After a brief introduction by Bent Hansen Sass, the HIRLAM project leaders outlined the main plans for their areas and the possible role of DMI staff therein.
Next, forecaster Sören Olufsen described the operational experiences with DMI-HIRLAM. On the whole, he expressed satisfaction with the model quality. He gave an example of very good wind storm forecasting, and the need for such high-quality, high-resolution information for driving sea level forecasts. The forecasted intensity of orographically induced winds over Greenland however is sometimes problematic. Maximum day time temperatures are good enough. Improvements are required in the description of low clouds and fog; a recent change has indeed led to better behaviour in this aspect. Also, greater accuracy is required in convective precipitation is required; Sören illustrated this by six cases in August 2006, involving two false alarms and four missed warnings for extreme precipitation.
Snow forecasting based on a combination of radar and HIRLAM is quite successful. Aviation is an important user, with a huge demand for very short range wind, cloud and visibility forecasts for airport capacity planning in particular. The increasing availability of observations from other airplanes and of model information in airplanes during flight puts some pressure on HIRLAM as data provider: it needs to be a source of high resolution data that outperforms everything one can get on the web. Finally Sören noted that it is increasingly important to forecast the impact of weather, rather than the weather itself; in that context he was happy to hear of the goals and developments of GLAMEPS.

Henrik Vedel then described the processing and monitoring of GNSS data within the EUMETNET program E-GVAP (see also http://egvap.dmi.dk, under heading validation). For HIRLAM most work required for the assimilation of these data is in preprocessing: QC of data, correlation of ZTD error both in space and time. Bjarne Amstrup and Henrik Vedel are working on automated detection of station with non-Gaussian error distributions. Then O-B statistics from “Gaussian” stations are used to derive bias corrections (bc’s) and possibly apply spatial thinning to obtain a station white list. DMI and INM are working on monthly bc’s, KNMI and SMHI on a 3-day running bc. A new Eumetsat fellow, Elena Padorno Prieto, has just started work on the assimilation of radio occultation data in HIRLAM. The type of data to be assimilated (refractivity or bending angle) is still uncertain; Henrik recommended the use of refractivity.

Bjarne Amstrup presented 3d-VAR OSE experiments with METOP AMSU-A, NOAA16/16 AMSU-B and NOAA-18 microwave humidity sounder (MHS) data. For the short period for which METOP data have been available in near-real-time, impact has been neutral to slightly positive (worse bias but better rms), with some cases of very good impact. The present impact of AMSU-B is neutral. Use of the new moisture variable should help improve results. In the future, DMI intends to assimilate

ASCAT (reported by ECMWF to be of very good quality), MODIS winds, wind profiler and radar wind data (when available).

Kai Sattler listed the HIRLAM EPS script developments within GLAMEPS-v0 of the past months. At present, boundary data are still only available from EPS and NORLAMEPS, not yet from the new European TEPS. Kai also described the HIRLAM EPS - data assimilation cycling. He reviewed a number of open issues: e.g. the need for an instruction on how to derive background error statistics; interruptions of larger experiments due to wall clock limits in miniSMS, requiring changes in the ways in which experiments are submitted; and the need for an abort strategy for handling failing members.

Henrik Feddersen described his work on stochastic physics for GLAMEPS, using random perturbations of physics tendencies related to convection and condensation. The tendencies are updated hourly, with a factor of +/- 0.4. He showed results for the "Finnish case" of 22 August 2007; here, adding stochastic physics tendencies improved the performance of the 21-member ensemble a lot in the case where the STRACO scheme was used; as for the ensemble made with the KF/RK scheme the outcome was already pretty good, adding the physics tendencies there had less impact. Henrik has also been experimenting with perturbing physics parameters related to entrainment, evaporation of cloud water, and evaporation/sublimation of precipitation, and showed a case study of this for June 2007. What remains to be done is to build in the stochastic physics options in HIRLAM with reasonable default parameters, objective verification and a more elaborate study of the random parameter approach.
The management group was quite impressed with the quick progress made by Henrik. Nils suggested that additional perturbations of surface parameters can be made available within a short time with the ETKF.

Next, Bent Hansen Sass described the system used at DMI for very short range forecasting for road stations and (in the future) for road stretches, which has been integrated in HIRLAM. The lately revised setup for this system uses the 0.°05 model with 40 levels and semi-Lagrangian advection, with assimilation of MSG cloud information (modifying humidity tendencies and cloud condensate by nudging) and assimilation of road observations in ISBA. Future steps will be to introduce an iterative initialization of cloud-related variables, a distinction of cloud water at low, medium and high levels, and a larger domain with increased horizontal and vertical resolution (0.°025, 60 levels). The intention is to make forecasts for road stretches by means of interpolation; this work is in a preliminary stage, and requires incorporation of orography-related adaptations in parametrizations. Nils remarked that a complementary approach to this nowcasting system could be created within HIRLAM, where clouds may be initialized by including a heating term in the omega equation.

Alexander Mahura showed results of the verification of very high resolution HIRLAM runs using urbanization and building effects parametrizations. The surface scheme has been enhanced with terms for anthropogenic urban heat flux and roughness, and with a building effect parametrization. Alexander presented the outcome of both long term verification runs (several months) and case studies of typical meteorological situations for HIRLAM with the adapted scheme at 1.4km which was nested within the 5 and 15km (S5 and T15) DMI models. A slight improvement in overall performance was seen, with greater effect in urban areas and with stronger impact for low wind conditions. This verification work will soon be extended to other months to evaluate the month-to-month variability.

Ulrik Korsholm presented the ongoing work in DMI related to integrated HIRLAM and atmospheric chemical transport (ACT) modelling, some experiences gained in the COST-728 project, and the

ideas on how to realize a future coupled HIRLAM-ACT capability. He described the pro's and con's of on- and offline coupling mechanism, favouring an online approach himself; he stressed that to achieve this it is essential to have a very open, transparent model structure, such as is demanded for example in WRF-CHEM. He then explained the modular setup of DMI-ENVIRO-HIRLAM, the ideas behind this structure and the chemical feedback mechanisms available in it.

Next, Henrik Feddersen briefly described the probable setup and vastly enhanced capabilities of DMI's new supercomputer, which will be a factor of ~15 more powerful than the previous one. Bent Hansen Sass said that both the present DMI operational system and the HIRLAM Reference system will be ported to the new computer around March 2008. After the operational DMI-HIRLAM has been ported, a more ambitious system based on the Reference System can be set up, under the condition that the performance of the Reference system is competitive with the DMI-system. It will be attempted to identify the critical differences between the two setups; if certain features of the present DMI system prove to be beneficial, the aim is to promote them to be incorporated into the Reference System. The MG applauds this attitude of promoting "strong" features of local operational systems to be adopted in the Reference.
Bent then gives his views on the likely evolution of DMI-s operational system in the coming years. For 2008, a resolution increase is foreseen in the vertical (60 -> 70 levels) and horizontal (15->10km and 5-> 4km). 2.5km ALADIN models with ALARO and HIRALD physics are likely to be used for Danish and Greenland domains. 4D-VAR is not likely to be introduced before early 2009, and in the 10km model only. The 4km model will use 3D-VAR in rapid update cycling mode (hourly to +24h), Other changes in 2009 will presumably include participation in GLAMEPS using both STRACO and KF/RK, and improved HARMONIE cycles. As HARMONIE with variational data assimilation is likely to be computationally very expensive, Bent doubts that HARMONIE with 4D-VAR can be made fast enough to allow operational introduction before 2010.

Finally, Bent mentioned some other developments at DMI which may be of relevance for HIRLAM. Niels Woetman Nielsen is working on alternative formulations of PBL turbulent fluxes along the lines of Zilitinkevitch and Esau (Boundary Layer Meteorology, November 2007). It is intended to improve the description of the onset of convection in STRACO through avoiding an explicit dependency on moisture convergence. Bjarne Stig Andersen and Mats Dahlbom have found that the Linux PGI compiler used by Cray has problems with routines related to the creation of HARMONIE FA-files. Finally, Bent remarked that requests for downscaling HIRLAM to higher (sub-km) resolutions are definitely on the rise. He raised the question if this should preferably be dealt with in national projects, or if it can be seen primarily as a HIRLAM-A task. This is something for the management group to consider.

The following day, the management group had a brief discussion with Bent Hansen Sass on HIRLAM staffing issues. Bent informed the HIRLAM team of a new researcher joining the DMI HIRLAM group, Anna Fitch. Possible activities for her in HIRLAM context were considered. Also, the research activities of the remaining DMI HIRLAM staff were reviewed.

The remaining time of the visit was spent in informal discussions of management group members with DMI staff in several subgroups.
Trond Iversen took up GLAMEPS-related issues with Kai Sattler and Henrik Feddersen. Nils Gustafsson discussed data assimilation issues with Bjarne Amstrup and Henrik Vedel, and activities in the coming months required for the CIS studies. The remaining management group members spoke with DMI atmospheric chemistry experts on the strategy to be followed for the development of a coupled HIRLAM-chemistry transport system. The management group agreed with the DMI staff on the desirability of developing an online coupling, introducing modules from chemistry transport

models in HIRLAM following strict interfacing guidelines, rather than coupling at a very high level through an OASIS-type coupler. It was suggested to try to get the experts within the HIRLAM institutes together in the beginning of next year, in order to reach a common agreement on this strategy. The COST-728 meeting of July 2008 can then be used as a natural meeting place to solidify common plans in more detail and to assess the progress.

The management group also briefly visited the forecasting room, and spoke with several forecasters on the general HIRLAM performance and its use in aviation forecasting. On the whole the forecasters expressed very positive opinions on the model, and noted that one of the main weak points, the description of low clouds and fog, appears to have improved recently after a change in the forecast model. Convective precipitation was mentioned as something which could be further improved.

The management group was impressed by the broad span of HIRLAM activities ongoing at DMI, and the progress being made there. Both the plenary and the subgroup discussions proved quite useful for the further planning of HIRLAM work. The management group expresses its gratitude for the hospitality offered by DMI and their efforts to arrange this meeting in a pleasant and relaxed atmosphere.