Introduction - All Staff Meeting 2001

The HIRLAM-5 Newsletter NL38 is a special issue containing mainly the write-ups from the recent All Staff Meeting in Reykjavik 7-9 May. It was a very intensive meeting with very many interesting and stimulating presentations and with both organised and in-promptu discussions on many subjects. The meeting was well attended with 36-37 attendees in spite of the geographically distant location. (It is roughly in par with previous years if you bear in mind the large number of national NWP scientist usually taking part and of which there are very few in Iceland). Visiting Iceland was a new and interesting experience for many of us.

The meeting was opened by Magnús Jónsson, General Director of Vedurstofa Islands. He welcomed us to this most westerly part of Europe where the weather is of great importance for the country and its people. The weather service is also responsible for warnings of other natural hazards like avalanches and earth quakes. Iceland does not run Hirlam operationally itself, but uses DMI products. Due to the small population and relatively large area, the amount per capita spent on observations is about 50 times larger than e.g. in Germany and France. Obviously international cooperation is vital for Iceland.

The Project Leader gave an account of the order of the development of the Hirlam Scientific Plan and All Staff and Advisory Committee meetings. This years' plan was essentially an update of the initial one and has had input from the sub-projects. It has been discussed quite extensively at the HAC meeting in Helsinki and the priorities are supported by the committee. They are briefly: implementation and improvement of 3D-VAR (with improved back ground quality control), 4D-VAR physics, turbulence parameterisation, surface scheme and convection/condensation. Other important medium-longer term areas are boundary conditions, physics-dynamics coupling and non-hydrostatic modelling.

Operational Implementations

Kristian Mogensen described the DMI implementation and events. Aprt from the NEC SX-4 and 2 SGIs there is a HP Mass storage with 15 TB of data. A tender is out for the next supercomputer. 3D-VAR became operational (in the large area) 26 September 2000. Twice a day the data assimilation is including the differences between ECMWF and HIRLAM analyses. AMDAR are used +-30 min of the analysis time. No surface analysis (ECMWF SSTs interpolated). The operational code is the one recoded by Jess Jørgensen but has the same physics as the Reference. Longer time steps for the physics are however used.

Kalle Eerola presented the FMI setup. It has not changed since last year. SATOBs are used but not yet AMDAR. They use rotated boundaries and are waiting for the frames. Own SST/ice analysis used N of 58°. Optimised compiler options give speed improvement, particularly for maof. Monitoring tools have been developed.

Jean-François Geleyn gave an account of the developments at Météo-France. About a year ago there was a re-tuned cloud scheme and 4D-VAR became operational. 1D-VAR ATOVS are used. 4D-VAR is multi-incremental and the regularised physics is only used in the 3rd loop. There is a DFI weak constraint but a semi-external DFI had to be introduced for the trajectory. A new version of the CYCORA physics changes was introduced, inter alias allowing non-entraining clouds to reach the top.

Ray McGrath gave a presentation of the Irish system. They use re-analysis cycles to compensate for the short 2 hour cut-off. The WMO catalogue is checked and modified for station heights. A black list is maintained and used. There is a high resolution 0.15° assimilation and forecasting system, but the OI analysis is seen to smooth the good quality UK buoys too much. A 10 node IBM 6000 SP with 36 processors has been installed. The plans are to move to 4.9 and 3D-VAR. Stack resources is a problem on IBM with particularly the extensive use of them in the Hirlam OI code.

Ben Wichers Schreur talked about the KNMI implementation and, since there had been no changes, there was a growing discontent. The credibility due to the T_2m cold bias was low. However, interestingly the recent 5.0 Reference system does not appear to have the problem. Investigations showed that the crucial point was the modification to STRACO, initialising the cloud cover formulation. The previous too low cloud cover radiated and precipitated too much in the data assimilation. The high resolution experimental 0.10° XHR receives favourable comments. An ITT will be issued in September and the next model should be at 0.2°.

Ole Vignes described the operational work at DNMI. Hirlam 2.7 is still used but they aim to introduce 5.x. 3D-VAR is operational and a re-run is done with ECMWF analysis as background once a day. SMS is used and they run at the computing centre NOTUR. In addition to the T3E there is now a 160b node SGI 3800. They will try to increase resolution to 0.2° and 40 levels with a 0.03° model over Norway.

INM is issuing its tender in June and José Antonio García-Moya mentioned that it would be a staged process leading to a 100 GFlops/s sustained rate at the beginning of 2004. The resolution will be increased to 0.15° and 60 levels with forecasts out ot 72 hours. In addition there will be a 0.05° model, but the representation of orography and noise was of concern at the moment. Also short range multi-model EPS are to be run.

Lars Meuller talked about the SMHI system, which hasn't changed. 3D-VAR has been run in parallel for a long time on the new SGI 3000 at NSC. 3D-VAR is tested with Hirlam 4.7.3 but Sundqvist and Louis. Still, model differences to 2.7 were noticeable and have been investigated and identified. 3D-VAR scales only up to 16 PEs on SGI. Plans are to introduce 3D-VAR and ISBA.

The discussion about operational matters was about nesting and vertical resolution. Two-way nesting was mentioned but not seen as essential. The fresher boundaries from ECMWF now available should give improvements but there is no evidence on how much. The vertical resolution will be increased both in the Reference system (DMR) and many national implementations to 40, 50 or even 60 levels. The resolution increase is in the BL and the 10 hPa top essentially unchanged. It was remarked that if the tropopause resolution is increased, the top might have to be raised somewhat for a smooth distribution of levels. A question was raised whether we would meet accuracy problems at 32 bits in high vertical resolution.

Data Assimilation

Nils Gustafsson gave an account of a number of implemented developments in HIRVDA and also of the immediately planned ones. A very useful tool is the computation of the

effective background error in observation space, used for tuning. Some changes will be done to remove an inaccurate linerisation giving noise near orography. The balance in the background term will be tested for a southern (INM) area. Cycling and flow dependency of σ_b will be introduced. Results were shown from assimilation of GPS ZTD data. A running bias estimation is necessary. Magnus Lindskog had prepared some slides with results from radar wind assimilation but with data over Sweden since the Finish data are affected by the ambiguity problem contra range.

Ole Vignes has coded and run some tests with the momentum coordinate transform suggested by Thor Erik Nordeng. It turns out to be relatively straight forward in 3D-VAR with additional change of variable. A slightly larger area is need for the extension zone and there is some choice of wind (geostrophic or full) and rotation. Preliminary results seem neutral.

Sigurdur Thorsteinsson gave an overview of the ATOVS assimilations that have been done at DNMI and SMHI over the last three quarters. The data are thinned to 50 km. The winter case at DNMI showed improvement over the ocean. Recent SMHI experiments with ECMWF data showed large problems if surface sensitive channels or biased data were used. Tuning of observation errors were done.

Frank Tveter described the work on use of scatterometer winds (from QuikScat). The winds are from ambiguous directions and a probabilistic technique was developed (DNMI Res. Note no. 53) based on the innovation vector and computations are done for the two most likely directions and most of the time it is possible to select the most likely direction of the two. It will be implemented in 3D-VAR next year.

Sibbo van der Veen has continued work on initialising the 3D water vapour field based on cloud cover and cloud top analyses. It impacts on ω in wet regions and p_s in dry ones. After 6h run there is not much impact left of the initialisation. The Kain-Fritsch scheme has also been used.

Beatriz Navascués went through her extensive work on re-designing and re-writing of the surface analysis and its connection with the ISBA surface scheme. It is now in a single script and library. SST, fractions of water and ice are analysed. Over land average ice and snow cover, 2m temperature and relative humidity as well as surface values for ISBA, for each type, are analysed. There is an analytical formulation for on/off switches (for soil). The technical arrangements have changed significantly and arrays are kept for fields and outputs. The 6 hour forecasts show improvements of 2m values.

Then there was a discussion about data assimilation. Some would like to keep OI for a long time, for areas where 3D-VAR would not cope and maybe for meso-scale analysis? But the 3D-VAR statistics can be computed for different areas and scales, so there is no intrinsic reason to keep OI. Some participants thought however that in a nested system a very simple analysis method would suffice in the very high resolution case. There was also interest in using the new surface analysis even if ISBA is not used, but the coding is done very much around ISBA and the tiling.

Model Physics

The session started with 4 talks on the CBR turbulence scheme and improvements of it. Geert Lenderink gave a background of the problem with too much mixing in near neutral situations. There are two branches of solving this problem. The one developed by Geert Lenderink has a smooth formulation of the length scale, which is a function of the integral stability of the boundary layer. Near the surface this mixing length formulation can match the surface layer similarity. The other branch is developed by Joan Cuxart at INM where the factor C_u in the exchange coefficient is made dependent on Ri. NWP simulations with the reference CBR scheme showed numerical instabilities. This instability problem is now solved in both CBR updates by making the boundary conditon for the momentum flux implicit. 1D-tests were shown by Enrique Sanchez for different cases.

Simo Järvenoja has tested the two variants for the FMI area. The Reference CBR has a positive 10m wind bias and positive pressure bias in cyclonic areas. The modified CBR reduces the pressure bias but has slightly larger RMS, somewhat more in the KNMI version. This was shown to be caused by a general lowering of the bias over most of the area and on occasions causing more negative bias, but without changing the overall bias pattern. For 10m winds the KNMI variant was slightly better than INM, but both halved the bias.

Wim de Rooy verified against especially Cabauw mast data. For wind shear in July 1996 the KNMI modified CBR is a bit closer to the observations resulting in an improvement of the RMSE in the df of 0.3 m/s. However, both updates are reasonable and much better than the original CBR scheme. For the temperature profiles the the INM looks somewhat better (not resulting in a significant RMSE improvement). The hirlam gridpoint for Cabauw has a higher z0 than the actual z0 in Cabauw (representation problem). For February 2001 this representation problem is compensated by a model error, namely too much unstable conditions. These unstable conditions are the results of low clouds with too much cooling at the lowest model levels (compared to RS data). The z0 field is not very realistic over large areas of the continent (too low) and creates positive biases in f10m and increasing biases in the pressure with forecast time. It must be optimised. In general there are compensating errors in the model and one has to be careful in interpreting especially T2m and f10m verification results.

Veniamin Perov presented the parameterisation using extended similarity theory for stable BL. It reduces the de-coupling of the surface often seen in models in long-lived stable BLs. It has been tested in assimilation and forecasts show reduced T2m bias (warmer).

A lot of concentrated effort has been devoted to the ISBA implementation, tuning and testing. Work on snow melting is planned for later. Four different seasons have been tested at INM and show clear improvements of T2m biases and RMS. Also RH 2m is generally improved. Simo Järvenoja has made tests over three seasons for the FMI (22km) area. The area extends further east and the biases of 2m T were not improved in the same way. Looking at horizontal plots of station biases, one can see areas of positive and negative biases and the average is very sensitive to the choice of area. In the summer period there is a problem with too much reduced diurnal cycle and too low day time temperatures in Eastern Europe. In the discussion, the limitation to one soil layer was suggested as a difficulty in the ISBA scheme and that most schemes used something like 4 layers.

Eric Bazile has been developing the idea of functional boxes based on the Rasch-Kristjánsson

condensation scheme. The convection-condensation and micro-physics are separated into 6 boxes and particularly the iteration over the microphysics is tricky. Some working results were shown. It has quite a noticeable impact on the precipitation pattern. 3D-experiments will hopefully be done by Christmas time. He also showed some cold bias problems over areas in Asia and Canada in the border zone with snow and forest. It was important to include the effect of the forest to reduce the effective snow fraction for the albedo.

José Antonio García-Moya showed results with Kain-Fritsch convection for two periods and case studies. Also the resolution dependence when going from 0.5 to 0.25° was investigated. For some cases the increased resolution gives most of the improvement, other cases the KF makes the difference. For one of the periods the verification showed reduced temperature (profile) bias with KF, for the other period not. The low level cloud problem with the Reference is not so visible with KF. The current code needs optimising for vector computers where it is far too slow. Ray McGrath showed FASTEX cases run by Klara Finkele where KF gave quite different cloud pictures. There were some T bias at 500 hPa but rainfall pattern is better with KF, but not strikingly so. STRACO overpredicts. The scatter in verification of rainfall makes it difficult to judge.

Xiaohua Yang described the background and the results from making a shallow convection parameterisation with STRACO. It addresses the overprediction of low level clouds and drizzle to some extent. The increased mixing is needed at the top of the BL with the dry CBR. The scheme works in the expected way and lifts the inversion and sometimes breaks up clouds. He also described the ongoing investigation of the spring excessive low cloudiness problem in the Reference but which was not seen in the DMI operations. It seems to be related to the very cold surface temperatures and through the Data Assimilation. DMI uses ECMWF fields over sea, incorporates ECMWF analysis twice a day and has more levels in the BL.

Kai Sattler described the newly developed aggregration of sub-grid orography fields needed in the climate files for the GWD parameterisation. The preprocessing from the original data files produces a source data set in HDF format with a certain resolution. Then the climate generation needs to produce climate files on the model's target grid, at a lower resolution and usually in a different rotation. The aggregation needs to take care of how the points in the two grids relate. The parameters used in the meso-scale orography parameterisation are produced on basis of low-pass filtered and high-pass filtered orography to take into account only those scales for which the MSO parameterisation is supposed to work for.

Laura Rontu described the implementation of the Météo-France GWD scheme and the tests done. The scheme works in its expected way but usually the effect of the GWD is a small fraction (~ 10%) of the tendencies caused by the turbulence. Some further tuning of the scheme is possible and will be tried. The filtering of orography was included here, as an important component. Discussion ensued where it was pointed out that it was important to separate orographic and vegetation roughness (for momentum versus temperature) as is e.g. done in ISBA.

Erik van Meijgaard has interfaced the ECMWF physics in Hirlam and started to try some parts of it. It is far from straight forward and has taken quite some time. The idea

is to be able to benefit from ECMWF physics developments and for the KNMI climate research: to catch up with the Hirlam Reference and facilitate cooperation with other groups in this area. Also it should strengthen the cooperation of the climate group with the Hirlam Project. He described the particularities of the ECMWF physics, where the radiation is done at much lower time and space resolution to save time. For Hirlam this aspect was not implemented, but to compute it all the time. There is a prognostic cloud scheme connected to the Mass flux convection. Components are kept untouched as far as possible in order to be able to update. There are many more fields, variables and constants. Climate generation had to be done for the ECMWF schemes of course (tiles and GWD). The interface is ready and some case studies have been done. They show some differences but no dramatic ones yet. Assimilation of soil variables has not been solved yet.

There was then a general discussion about Model Physics. A strong point was made that the whole physics package needs to be tuned together. The contents of such a package should be defined and then all groups come together an work on this package. This was widely supported and the Management Group will define such a package. First there are the short term changes (CBR and STRACO) which should be implemented imminently, but after that there will be a package.

The physical consistency of a scheme is the most important aspect to ensure. Conventional verification results usually give little indication or may be misleading. There is a wide gap between the level of the turbulence schemes used in Hirlam with some countries still using the conservative approach of Louis. The Reference has a more radical scheme in form of the TKE CBR scheme. Questions were whether the old schemes could still be improved or should be dropped. With the new scheme there is a slowness in response to problems in terms of Reference system improvements and the Core group should do more.

Working Groups

Turbulence.

The short term work is quite clear. The KNMI and INM variants of CBR are to be tested for stability at 20 km with long time steps and SL. This should be done within 2 months. The performance should only be judged at "normal" operational time steps. Aidan McDonald will do this and Colin Jones will also be asked. There is still a winter month to be tested with both schemes. Simo Järvenoja and Wim de Rooy will do this. José Antonio García-Moya offered in addition to run in his setup for his periods at 0.25°. A decision of which variant to introduce in the Reference scheme should be based on this evidence.

In the medium term a new roughness length needs to be used. The "effective" roughness was discussed; how to represent groups of trees and cities? Kai Sattler's work on the the computations of the orographic fields should be included.

The prospects for a moist version of CBR was discussed. At the DMI meeting last November the shallow convection in KF was thought to be sufficient. A moist version is tricky but ought to be developed. Enrique Sanchez and Joan Cuxart will study the question. One should also look at the alternative developed by Robert Sigg. The parameterisation

of the stable ABL should be introduced, but more experiment periods need to be run and checked.

There was also discussion about the aggregration of surface fluxes and tiling. This is not a trivial problem and there is no obvious solution.

Mountain effects in Hirlam and NH model.

A number of different approaches for the smoothness of the reference pressure in the NH Hirlam will be investigated. E.g. the interpolated boundary fields can be DFI initialised. SCANIA should be used to understand the problems and try solutions.

The meso-scale orography work and parameterisation work will be completed with analysis and documentation. More understanding and tuning of the lack of wave breaking is needed.

Laura Rontu had not seen a large sensitivity to z0, but it is important to separate the use of orographic and vegetational components. Filtering of orography will be implemented. The scaling of orographic roughness has been seen important in the PYREX COMPARE experiments. An enhanced z0 has been seen to create the around-mountain flow that occurred in reality.

Observation handling and ATOVS.

The ODB will not be introduced just yet in HIRVDA since there are other more pressing priorities. For this generation of satellites CMA is sufficient but not for future, like IASI. Some restructuring of the code to isolate the CMA interfaces will be done.

The ATOVS work was discussed and the work agreed according to the updated Scientific Plan.

Model Dynamics

Jean-François Geleyn described some very positive developments for stabilising the 2TL SL NH ALADIN model. So far, with the use of the hydrostatic Laprise vertical coordinate this has proven very difficult. It is somewhat akin to the SHB instability of SI schemes where the choice of reference temperature profile solved the problem. It turned out that a re-scaling or change of variables using a reference density gives much increased stability. There is still a predictor-corrector scheme with 3 iterations.

Isabel Martínez reviewed her work with the physics coupling to the dynamics with the SL scheme. Also here a first guess predictor can be used for some processes. One has to distinguish between slow and fast processes, similar to Wedi at ECMWF. The main advantage is that the integration is more stable. Some improvement of RH can be seen in verifications.

Aidan McDonald talked about the longer term work on not only well posed but transparent boundaries, which seems to become more and more essential as we will employ higher and higher resolution in the inner nested area, but with a limited area. This area will be dominated by boundaries during the course of the forecast. 2D shallow water modelling with transparent LBC have been documented. This will be extended to 3D through the

use of Normal Mode space. Another challenge is with the NH equations.

Rein Rõõm talked about the developments of the NH Hirlam. A SI version has been developed and allows significantly longer time steps and is also cheaper per time step than Eulerian. There is however a spurious reflection at the top which needs to be solved.

Aarne Männik showed tests of the NH Hirlam with assimilation at 11 and 5 km resolution. There is a little more noise in the NH runs. The NH assimilation's analysis fits data slightly worse. Also the forecast RMS values are just slightly worse, but interestingly, when looking at case by case, one can see that the worst scores of the hydrostatic system are avoided! Vertically, some layers are slightly better with the NH model, others not. In all, bearing in mind the short period, one can only say that the results are very comparable.

Xiaohua Yang described the background to and implementation of the new initialisation interface. Instead of writing to and reading files, it uses memory. There are new namelist parameters and much easier for the user to modify. The incremental DFI will be tested but is not ready. The new DFI implementation has been tested and the results don't show much spin up.

A discussion followed where the question whether mesoscale models could be SL. This seems to be quite possible and accurate enough for the resolutions we are contemplating. The need for transparent LBC has not quite been demonstrated in practice, where the Davies scheme works quit well, but when we go to higher resolutions at e.g. 2km it might be another question. The filtering of orography for the shortest resolved scales is essential, not to create noise.

Embedding, synoptics and verification, cooperation

Dominique Giard described the status of the ALADIN and ALATNET cooperation. A lot of work had been done on merging with the new IFS cycle. Blending research is done at LACE with DA. It is based on lagged NMC statistics and incremental DFI in the blending. A new physiography has been produced and new methods of postprocessing by interpolation to target grid before postprocessing have been developed.

Simo Järvenoja showed the problems with the T 2m forecasts over Finland in the winter half year. It is coupled with a negative forecast bias at 925 hPa of 2K. In the 0-+48h trend there is a cooling of up to 3K in the average in winter. It is the lowest 2km that cool. The evaporation from the surface is too strong and going on all the time. A low cloud layer forms. The BRIDGE assimilations with STRACO and with KF+RK showed much less of a problem with KF. This spring record forecast errors of about 20 degrees too cold were reached one day. The credibility is low. A test with reduction of evaporation showed much less bias. However, from May until September the temperatures are much more realistic.

Ben Wichers Schreur reviewed the recent verification workshop held at KNMI. There was agreement that conventional verification measures did not apply, e.g. a double penalty is encountered at high resolution. Non-GTS data and data exchange are required. An optimal use of existing score definitions should be made rather than invent new ones.

Ulf Andræ described the ongoing BALTEX/BRIDGE reanalyses, carried out by SMHI

and FMI. A good deal of the period has been assimilated. KF+RK, CBR and the Rossby centre surface scheme are used. A monitoring system has been built and is used for the assimilations. Modifications to the high cloud cover will be done. Surface fluxes over sea have verified quite well with mast data.

Gerard Cats gave a demonstration of the new mini-SMS together with the mini-Xcdp graphical user interface developed by Ole. It allows both monitoring of and interaction with the suite. This interface provides also a lot of information via the Help button. The use of mini-SMS will mean a lot of new things for the user, but also a much more efficient suite and maybe eventually greater clarity of how things are done.

Kalle Eerola has investigated the technical efficiency of Hirlam and gave a number of results. For I/O he has a project with CSC where one PE serves as an I/O PE and just receives data from all other nodes and writes out while the others compute. Extra buffers are used and several writes can be waiting for I/O. This seems to be one much more efficient way of doing the I/O. He also showed the well-known fact that reproducibility for different number of PEs is not exact at the moment and that it is in the physics and primarily over the oceans. The worst part of the model for lack of parallel efficiency is the Helmholtz solver coupled with the implicit horizontal diffusion. An idea would be to re-programme these together in the same unit.

Gerard Cats presented the ideas behind the overhaul specified in the Plan. It should result in a re-designed system during HIRLAM-5 with interfaces, coding standards and addressing portability and efficiency as well as user friendliness. Unfortunately the efficiency and the other two aspects don't always go together. In the code, one can discuss fluxes/tendencies, use of conserved variables, use of one or several libraries. Other external projects should also be taken into consideration. Coding language and then the coding standards will be defined. Quite obviously it will be FORTRAN 90/95 but may or may not be complemented with other languages and for scripting it may be pearl or python. Source code management will also be part of the project. Parallel I/O solutions are being discussed. Then is the question what to write out, GRIB or e.g. HDF.

The design is estimated to be 0.25 years x 4 persons and the coding (for HIRLAM-6) 0.5 years x 4 persons, for user friendliness probably an additional 2 years x 2 persons. In the discussion a similar project at Météo-France, meso, was mentioned, with similar goals and plans for making a common Météo-France mesoscale forecasting system. A difficulty which we have already seen is that we need to phase new developments with the overhaul.

Finally, some general points were discussed. The frequency of updating the Reference system (and beta-releases) seemed roughly right by the ASM participants.

Allowing time for Working Groups is still a good idea and useful, particularly when concentrated on very concrete sub-projects. Some thought that meetings could have taken place elsewhere, but time and travel budgets are short, and certainly for some areas, the ASM was the only chance for a number of people to come together. One problem this year was seen in that there was not enough time for discussions, both after the working groups and after the main sessions. It was suggested to be useful to first have presentations of the working groups and suggest areas to discuss. Then there should be a break before the discussion, so that the subjects can be properly sorted out (by a chairman) and to give

time to think. The meeting duration could possibly be a little bit longer, also to use the last afternoon (although previously it has been a problem of people departing for flights in the afternoon).

Per Undén, 14 May, 2001.

Recent meetings:

- HIRLAM-5 Management Group visit to FMI, 12 February, Helsinki.
- HIRLAM-5 Management Group Meeting 7, 12-13 February, FMI, Helsinki.
- HIRLAM-5 Management Group Meeting 8, 23 March, telephone conference.
- HIRLAM-5 Management Group Meeting 9, 22 and 24 April, Utrecht/KNMI, De Bilt.
- Hirlam/SRNWP workshop on verification research, 23-24 April 2001, KNMI, De Bilt.
- HIRLAM Advisory Committee meeting, 3-4 May, FMI, Helsinki.
- Hirlam All Staff Meeting, Reykjavik, 7-9 May.

Forthcoming meetings:

- HIRLAM-5 Management Group Meeting 10, 14 June, telephone conference.
- HIRLAM Council Meeting No. 3, 27 June, Reading.
- HIRLAM-5 visit to DMI and Management Group Meeting, September, Copenhagen.
- Hirlam/SRNWP workshop on surface processes, turbulence and mountain effects. 22-23 October, INM, Madrid.
- HIRLAM Advisory Committee meeting, 29-30 October, KNMI, De Bilt.