Outcome of discussion sessions

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On Thursday morning and early afternoon, there were three plenary discussion sessions. In the first session, the possibilities and desirability of enhancing the HIRLAM postprocessing package with a collection of nationally developed postprocessing tools were considered. The second session dealt with known problems of the HIRLAM model and possible ways of dealing with them. In the third session, the possibilities of operational cooperation between HIRLAM institutes were discussed.

Discussion session 1: Postprocessing products
(animator: Sander Tijm; rapporteur: Jeanette Onvlee)

The present HIRLAM model is fairly restrictive in its output, in the sense that few diagnostic fields are provided in addition to the prognostic variables. Many national implementations of HIRLAM therefore are complemented with a separate post-processing package, in which products are calculated which are of diagnostic interest to duty forecasters and/or of direct importance to end users. These post-processing products range from the almost trivial (e.g. daily minimum and maximum T2m) to complex (e.g. model pseudo-radar reflexivity images), and are not always consistent from institute to institute in the ways in which certain products are calculated (e.g. a variety of methods exists for calculating wind gusts). The variety in post-processing applications reflects the fact that the interests and needs of HIRLAM institutes for post-processing products differ. However, there clearly are many HIRLAM post-processing products imaginable which are of common interest to all countries. For this reason it has been suggested that the HIRLAM institutes could make more efficient use of their joint resources by making use of a jointly developed and maintained set of post-processing products.

In his introduction, Sander Tijm showed a number of sample products which could serve as components of a common HIRLAM post-processing package. Standard and undisputed features which are in use in almost all countries are facilities to calculate daily maximum and minimum values, and values at high, medium and low levels in the atmosphere for various parameters. More contentious and diverse are the various methods by which diagnostic parameters such as boundary layer height, wind gusts and TKE are determined. Many indices are in use as indicators for severe weather, the best known of which is probably CAPE as an indicator of thunderstorm activity. It is often unclear, however, which of these indicators has the best predictive potential in real-life situations. Model simulations of remote sensing images are often highly appreciated by users, as they greatly facilitate comparison between the model and observations. Pseudo-satellite images are relatively easy to calculate, but the production of model pseudo-radar images is a great deal more complex and computationally demanding. This can create problems in post-processing for nowcasting applications.

In the ensuing discussion, most participants favoured the definition of a common HIRLAM post-processing package, containing at least a basic set of products: daily minimum and maximum values for near-surface parameters; high/medium/low values and values at specific pressure levels; commonly used diagnostic parameters such as boundary layer height, wind gusts, cloud base and TKE (the latter two being of great specific interest to aeronautic applications); commonly used severe weather indicators such as CAPE, Boyden index etc; and satellite pseudo images. Aarne Männik also expressed strong interest in model cloudiness maps such as produced by ECMWF.

The question always is, of course, how widely should the idea of a HIRLAM post-processing package be interpreted? Should it include e.g. MOS applications, or local 1D downscaling modules? It is generally agreed that, in first instance, a common post-processing package should be kept simple and not include such applications, but that they might be considered at a later stage. The labour-intensiveness of creating such more complex applications is an argument in favour of joint development, but usually they require a great deal of tailoring to national needs and knowledge of local conditions in the development phase. An added complication is the fact that NWP modellers do not always know the possibilities and their “own” national forms of processing, as they are not always involved in and aware of all the post-processing which is applied to “their” HIRLAM model.

Another question to be considered is whether it is possible to make better use of existing products. For near-surface parameters, an obvious possibility in this respect is to make use of the model output for individual surface types. In particular, it appears to be useful to make an explicit distinction between land and sea surface tiles, and to output both "land" and "sea" values for a number of parameters.

Another issue is how to allow access to the post-processing code and products. A common HIRLAM post-processing package can be made available within the Reference System or outside of it. There are arguments for both, and it is therefore proposed (and generally supported) to make a common post-processing package available both as an option in the Reference system and as a standalone package. Sander will define an initial package, to be included in the next release of the Reference System.
It is generally agreed that pseudo-radar images, made with the radar simulation model, would be a very useful component of a common post-processing package. But it is questioned whether this application is not too computationally expensive to be included in an on-line post-processing system. It is clearly important to ensure that the speed of the radar simulation algorithm is adequate to permit real-time use. It is also concluded that the post-processing package should be made available both as a stand-alone package and as an integrated module within the model, and that users should have freedom to select or deselect any parameter they wish to include/exclude.

For nowcasting purposes, there is a need to have products available at time slots (a time resolution) shorter than 1h. At present, a 1h time resolution is maintained. This restriction needs to be done away with soon, as are file name limitations.

Documentation of the components of the post-processing package should be made available on Hexnet. This documentation should entail not just a description of the products themselves, but also of the methods and definitions used in deriving them. For several of the diagnostic parameters suggested to be included, there exist a variety of definitions. In such cases, a validation and inter-comparison of the various methods is indicated. Such an exercise has for example been carried out in Spain, where a number of methods for deriving wind gusts were compared.

Discussion session 2: Known problems with the model
(animator: Bent Hansen Sass; rapporteur: Xiaohua Yang)

In his brief introduction, Bent raised the following questions:
- What do users feel to be problems of the model?
- What do the modellers feel to be the problems of the model?
- Do the problems pertain to specific parameters? If so, then:
    - What are the ideas on the origin of the problem, on possible solutions or diagnostics?
    - Do the identified problems differ between countries?
    - What should be the priorities for tackling problems?

Several people in the audience emphasize that by far the biggest problem of the model is that it is not very easy to use by duty forecasters. The model output contain relatively few diagnostic tools, and is often not easy to interpret in terms of weather phenomena relevant to forecasters. What appears to be needed first of all is a set of comprehensive guidelines for the forecaster on how to use and interpret HIRLAM data. A User's Handbook, such as is employed by ECMWF, could be very useful for HIRLAM as well.
The discussion then focussed for a while on the relations between forecasters and model developers. The various institutes employ different means to encourage and regulate such contacts, but on the whole the participants are of the opinion that the chain from a forecaster reporting a problem with the model until a corrective action by a modeller is far too weak. A stronger interaction between forecasters and developers, and a quicker response to noted problems should be established. A more intensive communication between operational meteorologists and HIRLAM researchers will also become increasingly important as the trend towards higher resolution models continues: the forecaster needs this in order to learn to interpret what is noise and what is real in this new category of models.

Then the discussion turned to a number of specific problems of the model itself:

- The overestimate of low precipitation amounts. In recent model versions, the behaviour of the model in this respect has already improved significantly, but there is still a substantial positive bias for low amounts of precipitation. It is expected that further improvements can be achieved by the introduction of moist CBR, tuned together with the condensation/convection scheme in Reference System version 7.1.
- The description of low clouds and fog over land and sea. Over sea, fog occurs too often, resulting in a gradually building up of a temperature bias. Over land, the onset and development of low clouds in the model appears to be closely linked to the description of soil moisture. For both land and sea, the errors observed appear to be caused by a combination of analysis and model deficiencies.
- Temperature problems connected with the surface model, such as the poor description of snow melt in the spring in the Nordic countries. The new snow and forest adaptations to the surface scheme should go a long way towards curing these problems.
- The performance of the near-surface water vapour and humidity analysis. In particular, RH2m shows a bias which can change from one period to the next. For Spain it is particularly important to resolve these problems, in the interests of irrigation policy. It is suggested that improvements in RH2m should mainly be sought in extending the surface data assimilation with more observations of relevant vegetation characteristics from satellites, such as leaf area index observations.
- The location of severe precipitation. This will be tackled in the context of the development of mesoscale models and ensemble forecasting techniques suitable for the prediction of extreme events.
- The description of 10m winds in mountainous region (which is affected heavily by resolution and orography effects) and under stable boundary layer conditions (where low winds are typically overestimated by the model). Upcoming changes in the physics parametrizations which are likely to affect this are the introduction of the MSO/SSO scheme and the stable boundary layer changes proposed for the turbulence scheme on the basis of the work of Sukoriansky and co-workers.
- The persistent bias in the mean sea level pressure, which appears to have an annual cycle and to be related to the model behaviour at or close to the boundaries. Suggested ways of tackling this are further tuning of the rotation of the stress vector, and assimilation of low-level AMV winds.
- In studies of the model irradiance at INM, it was found that the model atmosphere was too transparent in certain regions in Spain. It appears that errors in the model description of near-surface humidity (and the associated low-level clouds) are primarily responsible for this. It will be advisable to study what impact the introduction of the new surface scheme will have on these problems.

There are a lot of model developments close to implementation in the Reference System which appear capable of either solving or alleviating the systematic errors noted above. These changes should therefore be implemented first, and their impact assessed. After that, it can be decided whether it is worth the while or not to undertake further actions. It is generally agreed that for the future, the upper-air and near-surface assimilation of moisture variables is clearly an area in need of much more attention.

Discussion session 3: Operational cooperation
(animator: Xiaohua Yang; rapporteur: Jeanette Onvlee)

Until HIRLAM-A, the HIRLAM programme has always been a research cooperation, operational aspects having been specifically kept outside of its scope. However, in the memorandum of understanding of HIRLAM-A, the HIRLAM team has been explicitly tasked to actively investigate the possibilities of closer operational cooperation between HIRLAM institutes.

The HIRLAM management group has made an inventory of possible ways in which the programme might contribute to an enhanced operational cooperation between member institutes. Xiaohua Yang lists a number of potential activities in the short and the longer term.
Possible actions that can be implemented on the short term are for example:

- Mutual support in cases of operational problems with national HIRLAM implementations, to be provided primarily by members of the system group.
- Operational exchange of near-real-time model products and monitoring and verification data via a HIRLAM data portal on Hexnet. This will provide HIRLAM institutes with a data backup in case of failures in their own operational infrastructure, and will also provide duty forecasters with a poor man's HIRLAM ensemble. A prototype data portal has already been set up.
- Make an inventory of relevant tools related to HIRLAM for all institutes, in order to increase the awareness of both modellers and users of facilities available elsewhere. Encourage the exchange and common use of tools.
- Develop a more common approach to the pre-processing of observations.
- Set up a forecasters' forum or organize users' meetings, either at the national or the HIRLAM level
- Joint education and training activities for research staff and/or operational meteorologists

Longer term possibilities include:

- Harmonization of in/output formats and tools for pre-and post-processing and verification / validation
- A distributed production of ensemble forecasts, such as envisaged in the GLAMEPS system.
- Common operational production of the synoptic scale analysis (with 4D-VAR) and/or forecast in one center.

The various options are each discussed in turn. Some are seen as more realistic and desirable than others.

Mutual assistance in case of operational problems has of course already been provided quite often in the past, on the basis of informal personal contacts between local system managers. It is felt that the HIRLAM programme may have an added value in supporting and promoting these mutual aid activities. The newly introduced system of wiki pages and mailing list system is helpful for a rapid exchange of experiences.
From several sides, a need has been expressed for more training of new or existent staff in HIRLAM system management aspects. This involves both new HIRLAM users (Estonia, Lithuania), and long-standing members like MetEireann and INM. The proposal to organize a yearly brush-up (1 day) meeting for local system managers, to bring them up-to-date on new aspects of the model, is generally supported. Training weeks intended to introduce HIRLAM research staff to new developments, such as the 4D-VAR training week held last April, are also welcomed. As much use as possible should be made of the extensive tutorial material from ECMWF. Furthermore it is suggested that the ASM itself could also be used for a more efficient knowledge transfer: by starting topical sessions with introductory talks which aim at explaining the science and methods behind recent model developments.

As to the exchange and common use of model output and tools, the main issue in the discussion is: which information and instruments are most suitable and should have the highest priority? The presentation of GLAMEPS results is seen as high-priority, as is the inclusion of information on data usage and the output of ACMA files on the Hexnet monitoring pages. Markku Kangas remarks that the RCR monitoring pages, as they are now, already contain a lot of information, and asks what people are actually using from these pages? It is pointed out that there are practical limitations in data communication; data to be presented on Hexnet should therefore be selected carefully. More tools are wanted for comparing output of different models. For the validation of the experimental mesoscale models, the general availability of the radar simulation model is considered to be important. For presentation of model verification data, the question is raised whether a verification of the Reference

System itself is sufficient or whether national operational model data should be included; opinions on this differ.

The audience is quite sceptical about the opportunities for enhanced cooperation in the pre-processing of observational data. In all services, pre-processing activities are seen to involve too many people and too many local constraints which are outside the sphere of influence of NWP. Previous attempts to coordinate activities in this area have failed. One facility, namely the use of a common black- or white-list for the assimilation of in-situ data, has been developed, but does not appear to be used in an optimal manner.

Cooperation in terms of joint operational production is found to be plagued by many practical and political problems. In the Nordic countries, the possibilities and consequences of joint production have been under consideration for many years, and so far it has not turned out to be feasible. The trend towards high-resolution models with hardly overlapping domains will only exacerbate these problems. A cooperation in terms of common production of a short-range ensemble stands a better chance. But it is cautioned that even this will require a true and long-lasting commitment in all participating institutes to a common setup. If such a commitment cannot be found, then it would be better to persuade the management of the HIRLAM institutes not to pursue the idea of joint operational production any further.