

HIRLAM operations at KNMI, 2002/2003

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Abstract

This report summarizes the experiences of KNMI with the HIRLAM 5.0.6 model that was put into operations in a 22km and a 11km version in March 2002. The model has shown consistent improvements over previous versions, albeit not in the numbers that are used to gauge its performance under KNMI's Management Contract. It has proven to be essential to make user-oriented presentations to convey the added-value in the new model to meteorologists and end-users.

1 Configuration

The HIRLAM version currently in operation at KNMI has been presented at the HIRLAM All-Staff Meeting 2002 and has remained basically unchanged over the last year. It is based on the HIRLAM reference version 5.0.6 and uses the Optimum Interpolation analysis scheme, TDFI digital filtering initialisation, the STRACO convection scheme, the Simple Surf surface parameterization scheme and the CBR turbulence scheme modified according to Lenderink's recommendations. The model runs on a SUN Fire 15000 in three versions: a 22km resolution version, an 11km resolution version, and a pre-operational test version, which currently encompasses a QuickScat update run. Table 1 presents the run schedule.

The forecasting system in this configuration has met few intrinsic problems. Some data array sizes in the analysis had to be increased to account for the ever increasing volume of AMDAR aircraft observations. Most failures encountered were related to hardware problems and memory management on the SUN Fire 15000.

The forecasting system has remained basically unchanged over the past year. On May 7th 2002 a change to the lateral entrainment in the STRACO convection scheme was introduced. This led to an unrealistic increase of precipitation amounts and in particular an overprediction of precipitation extremes as is evidenced by figure 1. This modification was undone on July 3rd 2002.

2 Performance

The increase in resolution from 55km to 22km and the improvements in the new model version have led to increased skill in precipitation forecasting. Figure 2 shows the Hansen-Kuipers score per class for daily precipitation forecast on Dutch precipitation districts (about 2500 km² in size.) The 22km model version has clearly more skill than the old 55km version for large precipitation amounts. Figures 3 a, b and c show the standard deviation of forecasts minus observation over the EWGLAM verification area as a seasonal average for the years 1998 through to the present, for the 500 hPa geopotential, 10 meter wind speed and 2 meter temperature respectively. The standard deviation may be seen as a measure of accuracy of the detail contained in the model. This verification shows that the increase in model resolution does not just add detail to the forecast, but that this detail is accurate information. This holds true both for the synoptic quality of the model, as verified by the geopotential, and for near surface parameters.

The main performance issue lies in the nowcasting range +00-+04 hours. It is found that there is a spin-down effect of the initialization on model parameters such as the momentum flux and cloud water and related parameters, figure 4. This effect is detrimental to frequent analyses in a rapid update cycle and to nowcasting. As these are for KNMI important areas of application of the HIRLAM model this issue has been studied thoroughly. This is the subject of a further report.

3 Usability

Improvements in model accuracy are not always evident to meteorologists and end-users. Meteorologists may be confused by the additional detail of a high resolution model and end-users may not be able to translate improved accuracy into terms of usability. Attention has therefore been given in the past year to the presentation of model results in forms that directly relate to the use that is made of model results. For meteorologists pseudo-satellite imagery was derived, figs 5 a, b and c, that, just as real Meteosat imagery, serves as a background in meteorological map preparation and SatRep satellite report production and supports the monitoring of model forecasts. For runway allocation purposes at Amsterdam Airport Schiphol a local interpretation of surface winds is made by a downscaling procedure using very high resolution (building) roughness. These winds are presented as maps of local wind and as timeseries of cross and tailwinds in relation to safety limits (figure 6.) Further products not shown here include gust maps calculated from model TKE, regional weather reports, vertical cross sections and time-height maps of cloud parameters for airports. It was found that these products support the understanding and acceptance of model forecasts by end-users.

Other applications that supported the confidence of users in model results are case studies of historical events, such as the 1953 Storm Flood (reported on in

UTC	H22	H11	QUD
00.15-00.30	-	-	18+06
01.00-01.55	-	00+24	-
02.00-03.05	00+48	-	-
03.15-03.30	-	-	21+06
04.00-04.55	-	03+24	-
05.00-05.20	03+06	-	-
05.40-06.40	-	-	00+48
07.00-07.55	-	06+24	-
08.00-09.05	06+48	-	-
09.15-09.30	-	-	03+06
10.00-10.55	-	09+24	-
11.00-11.20	09+06	-	-
12.15-12.30	-	-	06+06
13.00-13.55	-	12+24	-
14.00-15.05	12+48	-	-
15.15-15.30	-	-	09+06
16.00-16.55	-	15+24	-
17.00-17.20	15+06	-	-
17.40-18.40	-	-	12+48
19.00-19.55	-	18+24	-
20.00-21.05	18+48	-	-
21.15-21.30	-	-	15+06
22.00-22.55	-	21+24	-
23.00-23.20	21+06	-	-

Table 1: HIRLAM run schedule at KNMI

a separate article in this Newsletter) and model scenarios, such as a translation of the German 2002 Elbe floodings to the Rhine basin.

4 Plans

KNMI plans for the immediate future are to introduce HIRLAM 6, including 3D variational assimilation and the ISBA surface scheme, as soon as the new Solaris 9 operating system is implemented on the Sun Fire 15k. This version will then also include improvements made to the STRACO convection scheme and to the CBR turbulence scheme. The medium term goals are to implement a rapid update cycle and nowcasting mode. This implies that continued attention is given to the improvement of the initialization scheme and spin-up (-down) behaviour of the model and that in assimilation the emphasis will shift to locally obtained high resolution observations from radar, profilers, amdars and such.

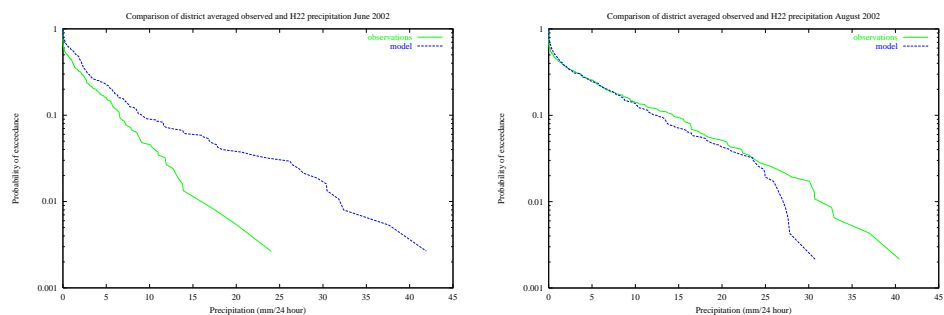


Figure 1: Cumulative probability distribution of district averaged precipitation amounts. Left: modified STRACO overpredicts large precipitation amounts. Right: original STRACO approximates probability of observed precipitation amounts.

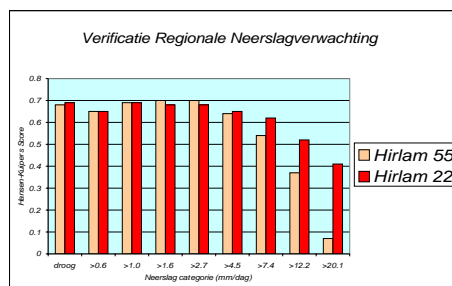


Figure 2: Hansen-Kuipers score of district averaged daily precipitation amounts per class. The 22km HIRLAM model has skill for large precipitation amounts, where the 55km model is no longer useful.

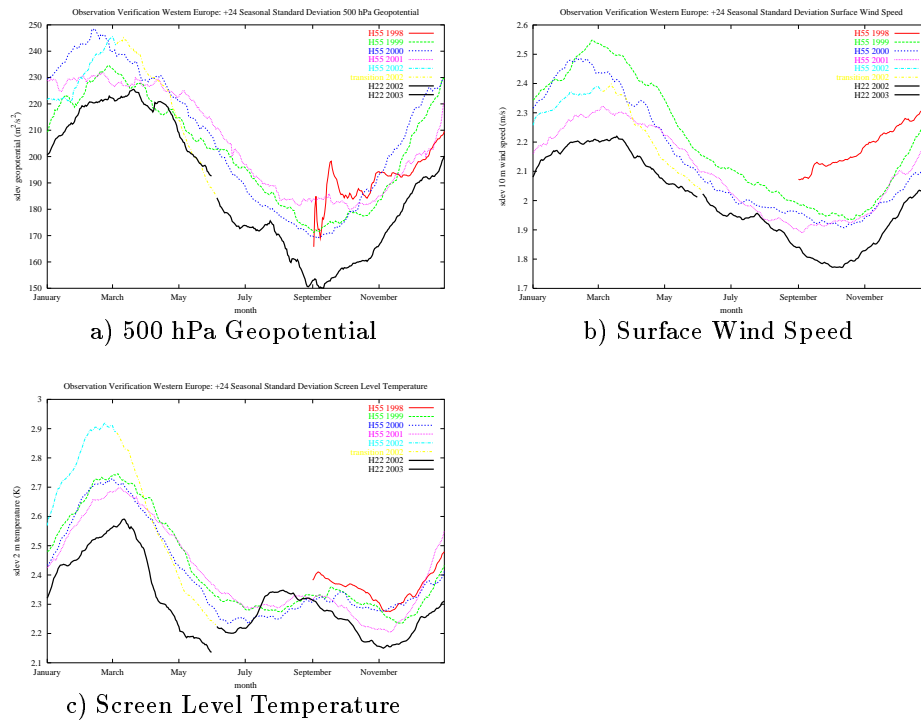


Figure 3: Standard Deviation of Forecast minus Observed over the years

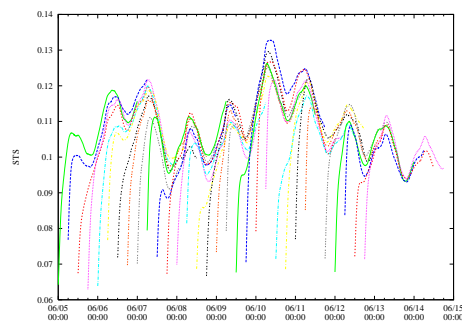
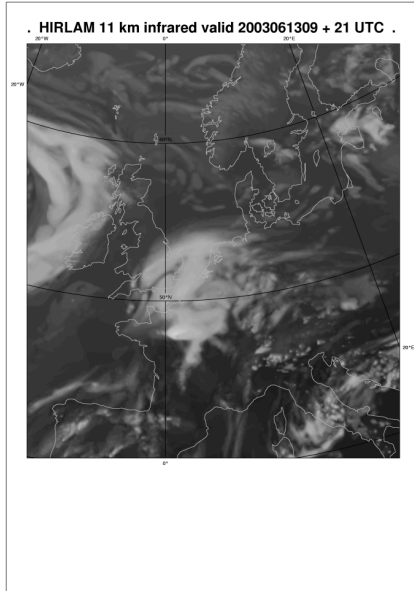
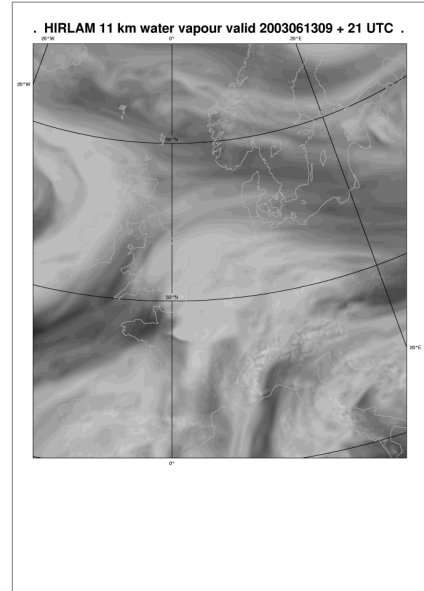


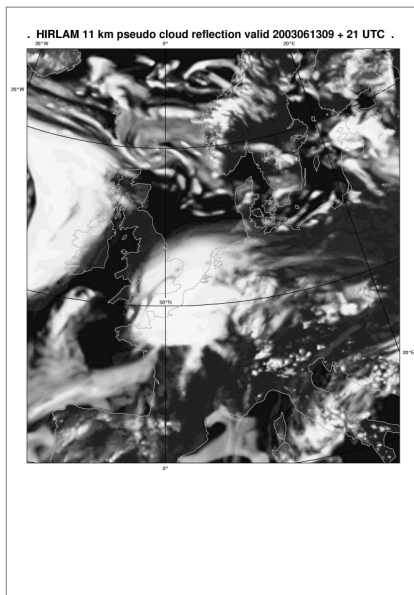
Figure 4: Spin-up of cloud water in consecutive HIRLAM runs



a) Simulated Meteosat Infrared



b) Simulated Meteosat Water Vapour



c) Simulated Meteosat Cloud Reflectivity

Figure 5: Pseudo Meteosat Imagery

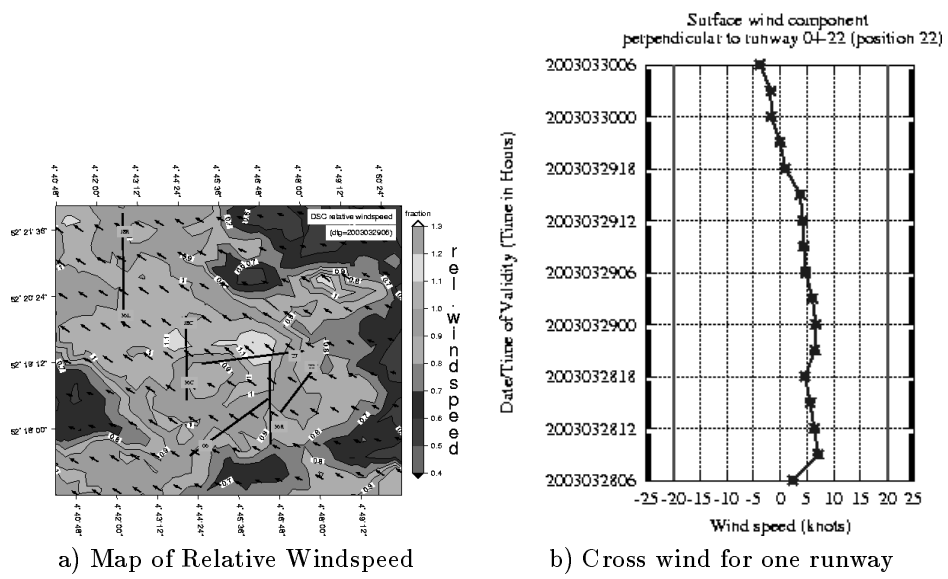


Figure 6: Downscaling of Surface Wind at Amsterdam Airport Schiphol