The Flood of Feb 1, 1953 and HIRLAM

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Abstract

The Flood of 1953 is the largest meteorologically induced natural disaster of the 20th century in Western Europe. In this article I describe the synoptic situation, the forecast and warnings that were given out by KNMI in 1953 and what can be achieved by using a contemporary version of HIRLAM as it is currently used operationally in the Netherlands.

1 History

The meteorological cause of the Flood of 1953 was a low developing during the last days of January on the Atlantic Ocean until it suddenly gained in depth and severity north of Scotland in the afternoon of Friday, January 30th.

Even this would normally not result in great danger for the Netherlands, as most of the lows that far north will end their life at Trondheim. This one, however, made a sharp turn southwards between Scotland and Norway and moved slowly in the direction of the German Bight, still gaining strength.

The resulting northwestern gale that lasted for about 18 hours over the North Sea caused a large sea surge on the southwestern shores of the Netherlands; the poor condition of some dikes completed the disaster, in which 1835 people drowned.

Actually, the storm and the surge were pretty well forecast: Already at 10 o'clock in the morning on Saturday (31st of January) a high water alert left KNMI. Unfortunately, only a handful of those responsible for measures against flooding received the warning.

2 Objectives

The major reason for the poor reception of the warnings was the fact that they were issued during the weekend; therefore, it is useful to know whether with today's means these warnings could have been given on Friday.

I have put this question into the form: Would a HIRLAM forecast using the currently operational HIRLAM from Friday, January 30th, 06 UTC be good enough to lead to warnings comparable to those given out by the KNMI meteorologists on Saturday, January 31st ?

There is a strong indication that they were not very concerned by the developments on Friday, see [1].

3 Observations and lateral boundary conditions

Obviously, a rerun of a case with HIRLAM is only possible if observations and boundary conditions for the time period are available. In [1] Van den Dool et al. describe what effort was expended to search for, quality check and encode the observations from early 1953.

In the second half of 2002, ECMWF succeeded in actually performing a rerun with their global model [2] from January 20th until Febrary 9th, 1953 on a T159 resolution, based on these observations.

Therefore, by the end of 2002, both ingredients were present to actually run HIRLAM forecasts for that period.

4 Running HIRLAM

As the aim of these HIRLAM forecasts is to assess the usefulness of the current HIRLAM setup in the Netherlands for this historical case, I tried to copy the operational setup at KNMI as accurately as possible.

The HIRLAM version used is 5.1.2 as that comes closest to our operational version (5.0.6 with the technical changes that are also in 5.1.2). The grid is 406x324 at a 0.2x0.2 degree resolution, with edges over eastern Canada, the Ural, the North Pole and the Sahara. Vertical resolution is the standard 31 layers.

I also reproduced the 3 hourly analysis cycle (which would turn out to be significant, see below). The forecasts for the main hours (00, 06, 12 and 18 UTC) are run out to 48 hours, the others (03, 09, 15 and 21 UTC) have a 6 hour length.

5 Meteorological results

The main meteorological result is shown in Figure 1. This is the +42 forecast valid at Feb 1, 1953, 00 UTC, i.e. the forecast that started from the Friday, January 30th, 06 UTC analysis.

All synoptic features of the event are clearly visible: the low over Denmark (though farther north-east than in reality), the north-west orientation of the isobars over the North Sea, the wind force up to 12 Beaufort and the high west of Ireland.

Figure 2 gives the +36 forecast that would have been presented 6 hours later (i.e., the one started from the analysis of Friday, January 30th, 12 UTC). It is clear that the same overall synoptic features are present, and the low over Denmark is now positioned more in the direction of its correct location over the German Bight.

6 Discussion

Why are these forecasts so good ? In the end, the quality of the boundary conditions was poorer than in our operational runs (lower resolution) and certainly far fewer observations were present in the reconstructed files than is nowadays routine.

Part of the explanation could be the presence of ships on the Atlantic Ocean that launched radiosondes twice a day (these ships were necessary anyway to guide intercontinental flights over the Atlantic). This would at least give acurate vertical information over a large area where currently no vertically consistent observations are done.

Curiously, radiosondes in those days were not launched at 00 and 12 UTC, but at 03 and 15 UTC, so a 3 hour analysis interval is crucial to use this information optimally.

7 Storm surge

Figure 3 gives the sea surge levels at Vlissingen, starting at Saturday, January 31st 00 UTC: The +'s are the observations, the dashed line is the level forecast based on the Friday 06 UTC HIRLAM run and the solid line is the level forecast based on the 12 UTC HIRLAM run. The dotted straight line at 3.70 meters gives the level for alarm; the dotted curve is the astronomical tide.

So the 06 UTC HIRLAM forecast let to a level forecast that exceeded the alarm threshold by 30 cm, the 12 UTC HIRLAM forecast gave a level forecast up to a meter above that threshold. The observation at Vlissingen for Feb 1, 00 UTC was +4.55 meter.

Note that this storm surge is an integrated effect of the wind over the North Sea over a time period of about 24 hours, so it is not enough to have only the final forecast correct - those in between also have to be of good quality.

8 Conclusions

With a contemporary version of HIRLAM, the operational setup as used at KNMI and the observations as they were used in 1953 it is possible to alert the general public and those in charge of dike protection 24 hours earlier than was possible in 1953.

It turns out that this storm was not particularly hard to predict, as opposed to, e.g., the December 1999 storms.

9 Acknowledgements

I would like to thank those at NCAR who made this rerun possible by their work on collecting, quality checking and encoding the observations from this period.

I also want to express my thanks to those at ECMWF who performed reruns with the global model of which I used fields for lateral boundary forcing HIRLAM (Sakari Uppala and Ernst Klinker).

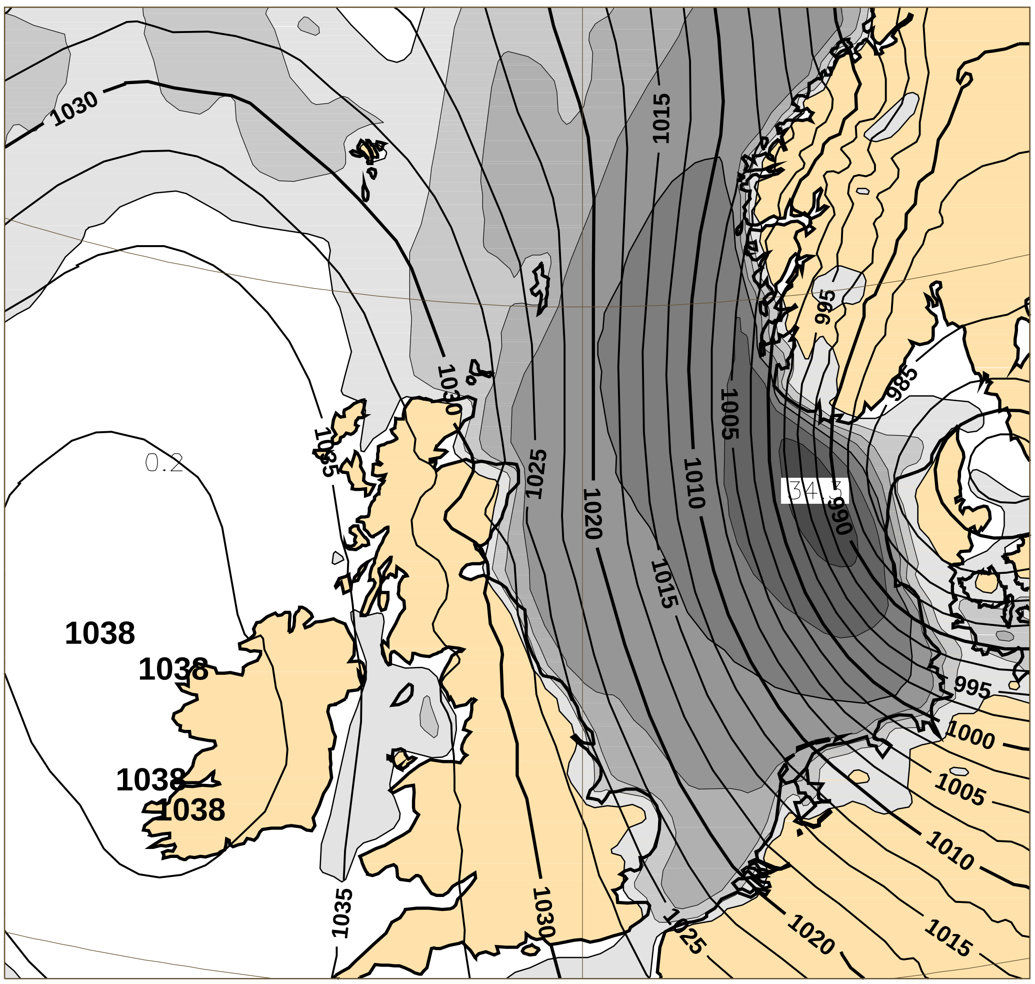
At KNMI Hans de Vries performed the storm surge computations and Sander Tijm produced the HIRLAM figures.

References

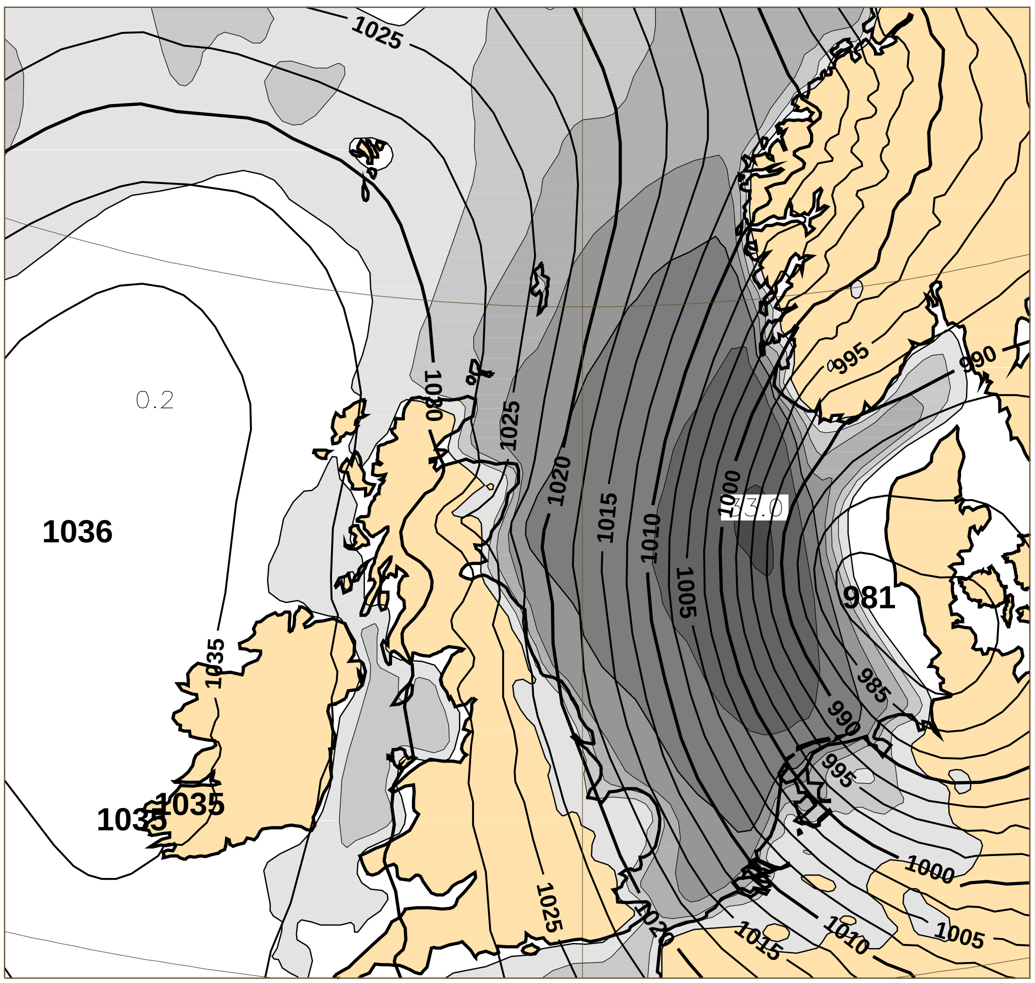
[1] Dool van den, H.M., R.E. Kistler, S. Saha and J.F. den Tokelaar, *2001: Reanalysis and Reforecast of Jan 31 - Feb 1 1953 North Sea Gale*, Climate Prediction Centre, Washington

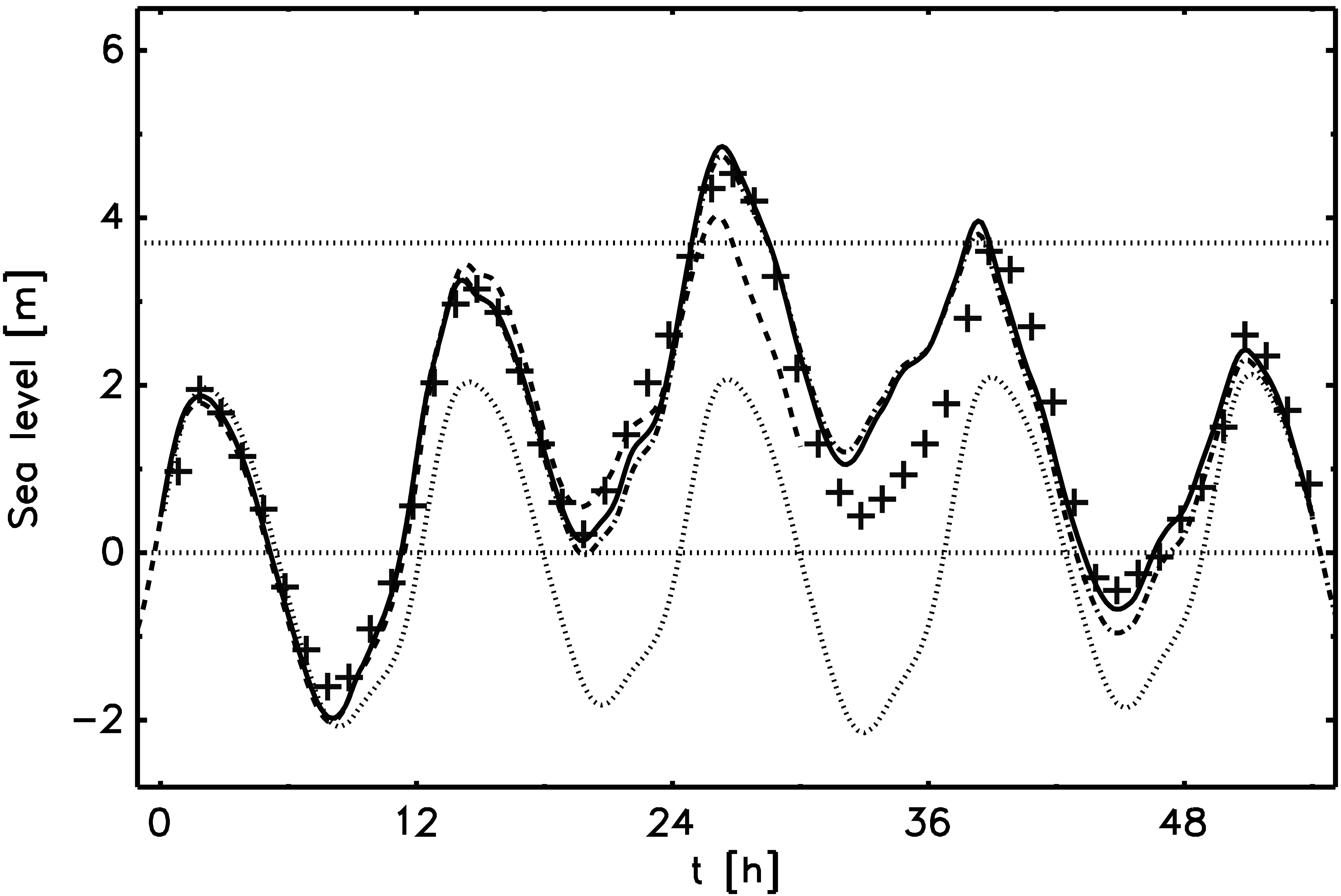
[2] Uppala, S, *personal communication*

+42 forecast Hirlam 22 km geldig voor 01-02-1953, 00 UTC



+36 forecast Hirlam 22 km geldig voor 01-02-1953, 00 UTC




6
4
2
0
−2
Sea level [m]
0
12
24
36
48
t [h]