Difficult winter weather in the Netherlands

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Introduction

This short article will discuss a few examples of difficult winter weather in the Netherlands. Because the Netherlands is situated besides the North Sea, the difference in surface temperatures leads to tricky situations. Numerical models and forecasters both have problems in coping these situations. Often very subtle differences and interferences in meteorological parameters can have a large impact on the warning level. Because of the high population density and the complex road traffic system, small disturbances can have large impact. This article will focus on situations during the winter of 2012-2013. One particular case will be discussed in more detail.

Figure 1: a few cms of snow can lead to complete chaos on the Dutch roads.

Warning systematics for winter weather

During the winter 2012-2013 a code orange warning was issued eight times. An orange code has quite an impact and is widely communicated throughout all media. In the schematic below in fig 3, criteria for different warnings are summarized.

Difficult situations that the forecasters experienced were:

- Behaviour of road surface temperature in cases of incoming cloudiness.
- Precipitation on a frozen surface, especially light shallow convective precipitation from the North Sea with relatively high sea surface temperature.
- Freezing rain/drizzle by a vertical temperature profile below zero deg C, no melting layer present.
- How representative are surface and soil temperature measurements during longer periods of snow cover.
- Judging precipitation type from automated observations.

Case 8th December 2012

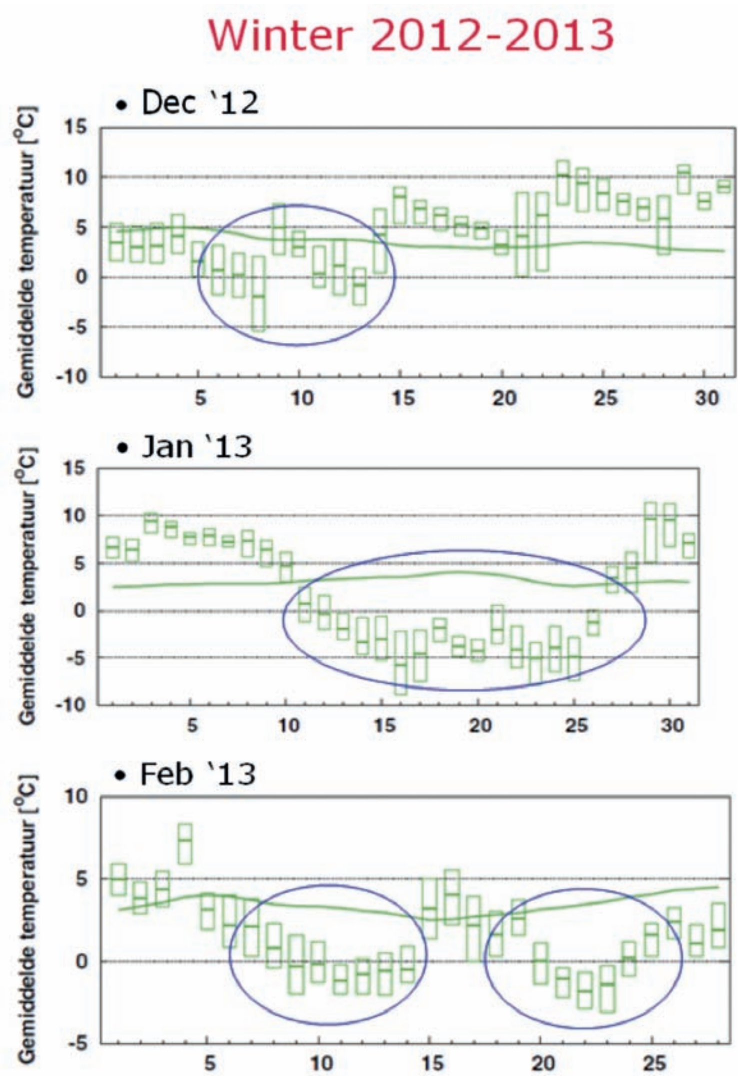
A high-pressure system that dominated for a week was withdrawing towards the Bay of Biscay. The land surface had cooled down due to radiative cooling during nights and low-level cold advection in the last week. Road surface temperatures were below zero, however the the soil temperature 5 cm below surface was +4 C. Because of the withdrawing high, a weak westerly flow started and weak frontal systems started to approach the Netherlands.

In fig. 4, two frontal systems can be distinguished: A weak occlusion and a warm front. Both frontal systems have weak frontal cloud bands bringing just very small precipitation intensities. The light liquid precipitation is very tricky because:

- Numerical models have difficulties picking up such weakly developed systems.
- Weak frontal cloud bands sometimes intensify because warmer maritime air glides up over the cold continental air. This determines the scale of the phenomenon, and hence the warning level. (Fig 3).

Within the meteorological office in De Bilt, forecasters use the Hirlam model (along with Harmonie and ECMWF) In fig. 6 an image is shown of the precipitation type, which is calculated from the Hirlam model fields (see references for more detail).

It can be seen that in this situation, Hirlam expected Freezing rain or Ice Pellets for the NW-half of the Netherlands. However, in this case the model temperatures in the boundary layer were too low.



Forecaster's considerations

• Model(s) show already an error in the boundary layer during the initial phase, so how to translate that information in your thought processes and into your analysis of this situation?

How will this influence :

• Precipitation type and amount? (snow/freezing rain/rain on a frozen surface)

• Development of (road surface) temperature with incoming cloudiness?

• Beginning of December and soil temperatures at 5 cm below surface: +4C

• How to compare model-data and observation and making a good judgement of the situation?

• How to combine all this info into an understandable forecast and warning on provincial level? (colour code warning level)

Figure 2: box plots of mean temperature: Upper and lower lines of the bars indicate the highest and lowest mean temperature measured on one of the KNMI stations. The centre line of the bar indicates the median value. The solid line indicates the climatological moving 5-day average of all KNMI-stations in the period 1981-2010 Four distinct cold spells are indicated with blue ellipses.

Phenomenon	Criteria Warning dangerous weather	Criteria Warning Extreme weather and Weather Alarm
Snow and Ice	• frosty wet roads • accumulation wintry precipitation 0-3 cm/hr	• accumulation of snow >3cm/hr of >10 cm/6 hr • snow or drifting snow with mean wind speed >40 km/hr • slippery roads by freezing rain or ice pallets

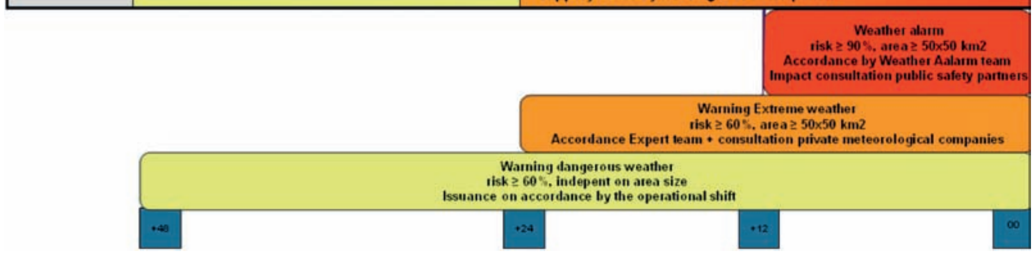


Figure 3: overview of the Dutch warning system. Warning levels yellow: dangerous weather, orange: extreme weather and red: weather alarm.

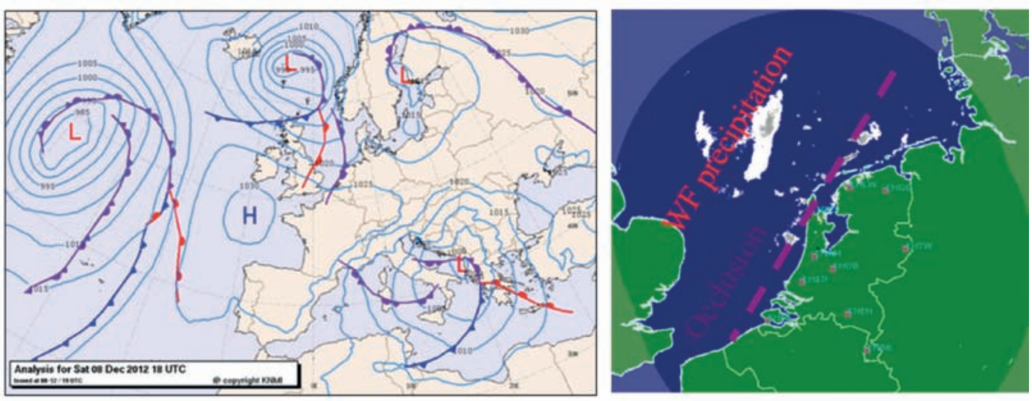
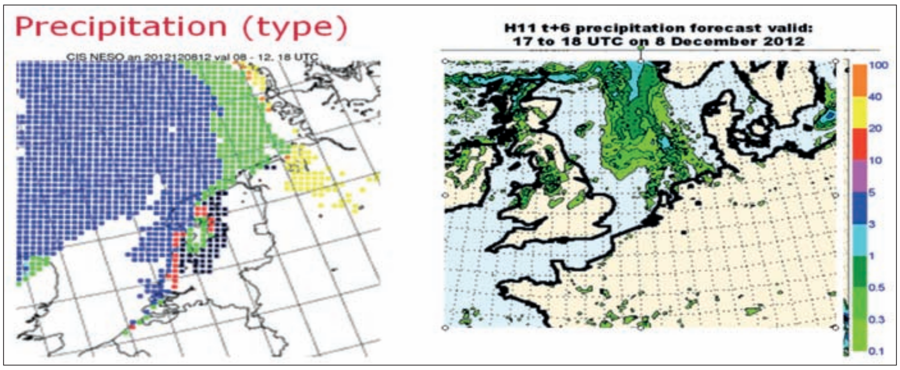


Figure 4-5: analysis 8 December 18 UTC and Radar imagery.

Figure 6-7: precipitation type and cumulative precipitation 8 Dec 17-18 UTC. Blue:Rain, Green: Rain or Snow, Red:Freezing Rain, Black: Ice Pellets, Yellow: Snow.



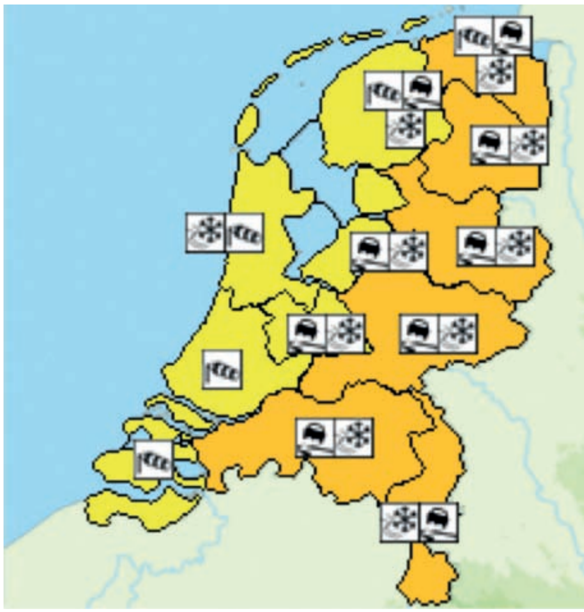
Evaluation and recommendations

In this particular case, the forecasters had quite big difficulties in assessing the meteorological situation. During the shift, all the forecasters on duty made an estimation on the risk of code Orange (fig. 3) The mean outcome of this estimation was approximately 60%.

Incoming cloudiness had initially not much effect on the surface temperature because of a cold/high cloud base. Model surface-temperatures in Hirlam/Harmonie were too cold and remained persistently too cold. Therefore nothing happened in the (near) coastal areas. The forecasters identified this error and therefore only yellow warnings were present for the coastal areas, because of slippery roads due to snow remnants. Further inland, the light liquid precipitation was either supercooled or rain on a frozen surface. This gave reason for the issuing for a code orange. This was mainly due to road observations by the Police and the Road Traffic Centre. This case, but also other cases during this particular winter showed that there is some room for improvement of the working methods of the forecaster. In course of 2013 some of this improvements were already implemented. (fig. 9) The recommendations are listed below:

Figure 8: freezing rain can lead to dangerous situations, especially on roads where channels are close to the road.

Figure 9: issued warning levels during the evening of 8 December 2012.



- In complex meteorological decisions there is a need for systematic assessment, coming to a more objective judgement.
- Small deviations in one of the factors can lead to big errors in forecasts and warning and will be confusing for the general public
- Combine data in a clever way: e.g. road temperatures with radar data in one image. (fig. 9)
- The cloud base temperature determines behaviour of surface temperature.
- Improvement of current road surface temperature model
- Exploring sophisticated displaying tools in order to get an efficient conceptual understanding of what's going on in the atmosphere, e.g. 3D visualisation tool

References:

-Ivens, A.A.M., Forecasting the kind of precipitation in winter. Proc. Symp. Mesoscale Analysis & Forecasting, Vancouver, Canada, 17-19 August 1987, ESA SP-282 (August 1987).