Bow Echo event July 14th 2010 in the Netherlands

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I. INTRODUCTION
In this study, the structure of a bow-echo on a squall line is investigated. This paper will assess the synoptic environment in which this squall line evolved, as well as the mesoscale features of the bow echo, including radar-reflectivity and radial velocity. Furthermore a model study on this case has been performed. With a non hydrostatic model (HARMONIE, resolution 2.5 km) the structure of the bow-segment can be visualized, including the RIJ.

II. PRESENTATION OF RESEARCH
On July 14th 2010 a squall line with several bow segments crossed the eastern part of the Netherlands from south to north. This event damaged many houses and trees and one camping site was hit severely fatally wounding two persons. A mile north of the camping site five electric poles went down. It was the first time in Dutch history that high winds were the cause of this. In figure 1 we clearly recognise the characteristic weather pattern over Europe for severe thunderstorm development. On the weather chart of 12 UTC we see a low pressure area just south of Ireland with a cold front moving into NW-France. In the warm sector a line of convergence developed in a zone with high Tw. The 500 hPa-map shows a short wave trough over western France. These were the basic synoptic ingredients for severe convection later this day.

Figure 1 ECMWF-analyses July 14th 2010 12.00 UTC, 500Z and precip. 6-12 z, Groundmap-analyses (produced daily by KNMI)

Mesoscale aspects

Bases on C-radar reflectivity from our Dutch radar composite (based on two radar sites) we were able to recognize the signatures connected to a bow-echo system. Nearest radar site is located 80 km from the area of interest (figure 3 and 4), including the RIJ inflow notch and preferred regions om mesovortices (MV).

Figure 3 C-band radar De Bilt; pseudo coppi (1500m) reflectivity images detailed overview of the area of interests in the east of the Netherlands July 14th 2010 16.30 UTC.
In figure 4 the 0.4 degrees scan at 16.00 UTC gives a clear signature of the forefront of the gust front. In the absolute radial velocity at 2.0 degrees elevation some aliasing can be seen in the area of the strongest RIJ.

In figure 5 we can see the vertical profile based on the scan from radar site De Bilt. In the radial wind (absolute frame) we can see a sharp gradient, shortly after passage of the bow segment, which climbs up in time (elevated RIJ at a certain distance behind the leading edge).

III. THEORETICAL ESTIMATE OF THE CONVECTIVE WIND GUSTS

\[ u_{w} = \sqrt{\text{NAPE} + \text{LOAD} + \text{HMOM}} \]

NAPE = Negative Available Potential Energy, is downdraft equivalent of CAPE
LOAD = precipitation loading
HMOM = maximum horizontal momentum (elevated RIJ)

Based on radiosonde De Bilt Jul 14 th 2010 12 UTC estimate highest wind gusts is in the range 40-55 m/s

Both the NAPE, the Negative Available Potential Energy, is downdraft equivalent of CAPE, and the precipitation loading (LOAD) can be estimated by the information retrieved from a radiosonde. The maximum horizontal momentum that can be incorporated by the downdraft has to be determined directly from upper-air soundings or numerical weather prediction models.

IV. ACKNOWLEDGMENTS

V. REFERENCES