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Assessing extreme events for energy meteorology: media and scientific publications to track the events of a North Sea storm

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Abstract

Important issues for energy meteorology are to assess environmental conditions for normal operating conditions and extreme events for the ultimate limit state of engineering structures. Autumn and winter storms are a challenge for onshore and offshore energy infrastructure in northern Europe, and sometimes cause damage and disruptions. The incidence of extreme storms has increased over the past 20 years, leading to increased pressure on energy infrastructure. This paper summarizes the events of a storm from October 30 to November 2, 2006 using media reports, government publications, and scientific articles to create an overview of the meteorology and infrastructure impacts.

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Keywords: North Sea storm; Britta; storm surge; gust; wind turbine

1. Introduction

Energy meteorology needs accurate assessments of meteorological conditions both for normal operating conditions and also for extreme events that may place infrastructure at risk and necessitate costly repairs. Weather

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conditions vary from place to place, and also there are differences in the way that different branches of the energy industry address weather events. Typical weather extremes that affect societal infrastructure – including energy – include storms, inland floods, coastal storm surges, heat waves, and heavy snowfall. Infrequently, lightning, tornadoes, and wind gusts may be a problem in some locations. In Europe, autumn and winter extra-tropical storms are often the most serious weather events that can lead to disruptions of energy infrastructure on a large regional scale [1].

In many cases, energy infrastructure is constructed according to design guidelines that prescribe the normal and extreme environmental operating conditions at a particular site [2]. Design guidelines are based on meteorological station data or other information that has been collected over an extended time period. However, this may lead to problems if there are long term changes in weather patterns that might arise from interdecadal climate variability or climate warming effects [3]. While it is difficult to ascribe single extreme weather events to climate warming [4], recent years have seen increases in certain high impact weather events that are relevant for energy infrastructure. For example, there have been a number of maximum temperature records broken over the past two decades for average summertime temperatures in large parts of Europe. In 2006, this had an important impact on French and German nuclear power stations, whose operation requires large amounts of cooling water within certain temperature thresholds [3]. As well, since the late 1990s there has been an increase in the number of powerful winter storms that have passed across Europe, resulting in societal infrastructure damage and high insurance losses [5,6,7]. Certain branches of the energy industry, like the new initiatives in offshore wind energy, may be more susceptible to these environmental trends [8].

This paper presents an overview of a severe autumn storm that passed over northern Europe on Oct. 30–Nov. 2, 2006. The storm was given name ‘Britta’ by the German weather service [9], ‘Allerheiligenvloed’ in the Netherlands [10,11,12] and ‘Borgny’ in Norway [13]. ‘Britta’ is most often used in present literature.

2. Winds and Gusts

The Britta storm passed across northern Europe with high winds from Ireland to Poland and low temperatures from an outbreak of polar air that stretched from Scandinavia to the Mediterranean. The trajectory of the low pressure center passed north of Scotland, across western Norway and northern Denmark, and then through the Baltic. Details of the path and evolution of the low pressure center in the Atlantic are presented in several reports [9,11,14], and the division of the low pressure center in the Baltic is presented in other sources [15,16]. The storm followed a path across the northern edge of the North Sea that is recognized to be particularly damaging for maritime infrastructure because of large waves. The wave field develops in the strong north winds of the long uninterrupted fetch that occur behind the propagating low pressure center [5,17]. The offshore wind field was recorded by the Quikscat satellite scatterometer and reveals the spatial extent and maximum wind speeds over the North Sea at the

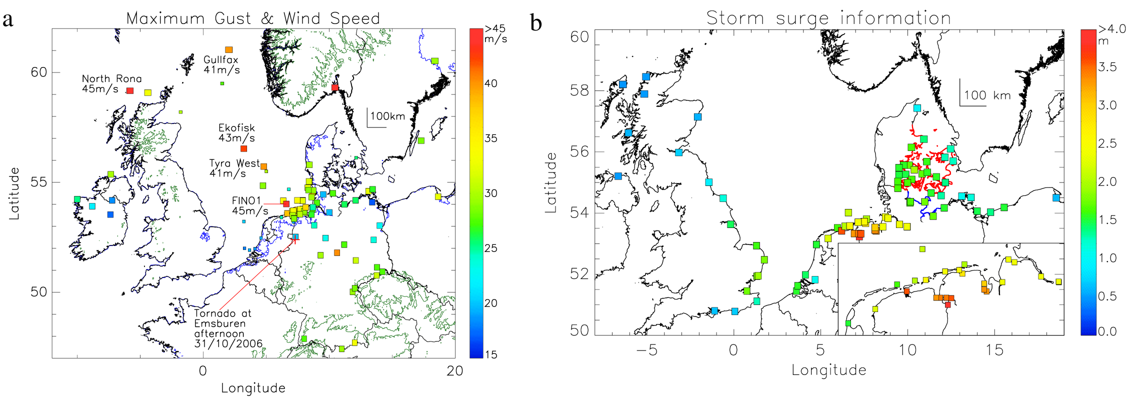

Fig. 1 (a) maximum wind gusts and (b) maximum storm surge reported during the Britta storm of Oct. 31–Nov. 1, 2006.