Assessing Extreme Events for Energy Meteorology:
media and scientific publications to characterize a North Sea storm

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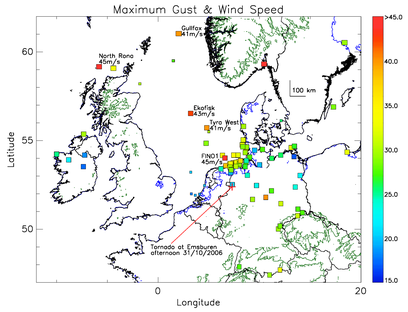
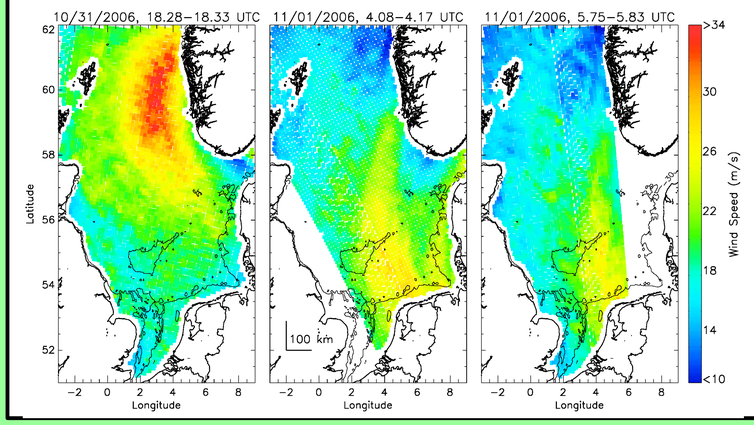
Abstract:

Important issues for energy meteorology are to assess meteorological conditions for normal operating conditions and extreme events for the ultimate limit state of engineering structures. For the offshore environment in northwest Europe, energy meteorology encompasses weather conditions relevant for petroleum production infrastructure and also the new field of offshore wind energy production. Autumn and winter storms are an important issue for offshore operations in the North Sea. The weather in this region is considered as challenging for extreme meteorological events as the Gulf of Mexico with its attendant hurricane risk. The rise of the Internet and proliferation of digital recording devices has placed a much greater amount of information in the public domain than was available to national meteorological agencies even 20 years ago. This contribution looks at reports of meteorology and infrastructure damage from a storm in the autumn of 2006 to trace the spatial and temporal record of meteorological events. Media reports give key information to assess the events of the storm. The storm passed over northern Europe between Oct.31–Nov. 1, 2006, and press reports from the time indicate that the most important feature of the storm was a high storm surge. This impacted a section of the Dutch and German North Sea coast and then later caused record flooding in Denmark and eastern Germany in the southern Baltic Sea. Extreme wind gusts were also reported that were strong enough to cause damage to roofs and trees. There was even tornado recorded near the Dutch-German border. Offshore, there were a series of damage reports from ship and platforms that were linked with sea state, and reports of rogue waves were explicitly mentioned. Many regional government authorities published summaries of geophysical information related to the storm, which form part of a regular series of online winter storm reports that started as a public service about 15 years ago. Depending on the issuing authority, these reports include wind speed and atmospheric pressure for a number of stations. However, there is also important ancillary information that includes satellite images, weather radar images, sea state recordings, and coastal surveys. When collated together, the literature survey gives good view of events related to the autumn storm. The key information from media reports is backed up by quantitative numbers from the scientific literature. For energy meteorology in the offshore environment, there is an outline of extreme wave events that may be important to help define the ultimate limit state of engineering structures and the return periods of extreme waves. While this contribution focusses on events from an old storm in the autumn of 2006, more severe regional storms have occurred since then, and the scientific literature indicates that these may be linked with climate warming. Literature surveys may help to fully define extreme meteorological conditions offshore and benefit different branches of the energy industry in Europe.

Wind Speed and Gusts

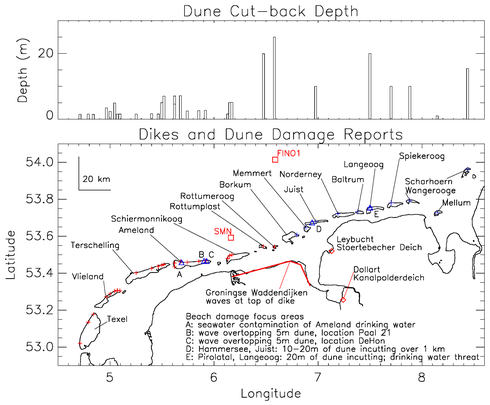
Wind speeds during the maritime storm in northern Europe were measured by the Quikscat scatterometer during two overpasses each morning and evening. The snapshots show a field of hurricane strength winds moving from north to south across the North Sea. Onshore, the storm was noted for extreme gusts in coastal areas of the Netherlands and Germany. There was also tornado event near the Dutch-German border.

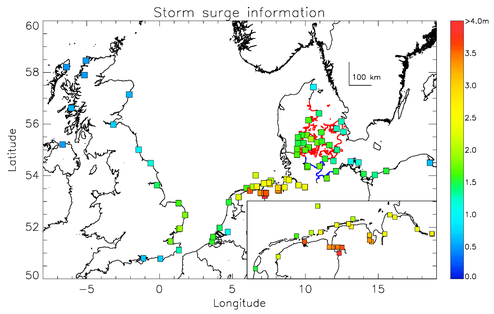


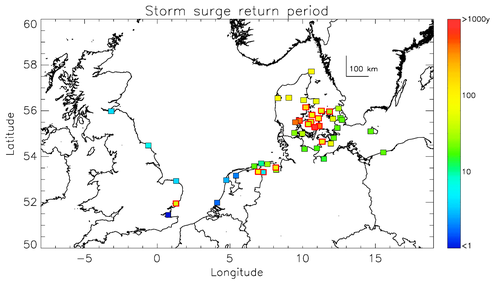


Storm Surge and Beach Damage

A high storm surge in the North Sea and Baltic Sea was highlighted by the media at the time. The surge was the highest ever recorded for certain North Sea stations near the Dutch-German border. Dikes along some coastal sections in the northern Netherlands were close to being overtopped by waves. In the Danish Belt region at the entrance to Baltic Sea, the storm surge – while lower than in the North Sea – caused serious flooding with significant economic impact. The last comparable storm surge in this region was in 1874, and the coastal infrastructure in Denmark was not equipped handle a 100-year flood. Beach surveys carried out after the event revealed significant dune losses in the East Frisian islands with dune incutting of 10-30m in some cases. The freshwater supplies on certain islands were threatened. Beach damage was also reported in Denmark and Poland.

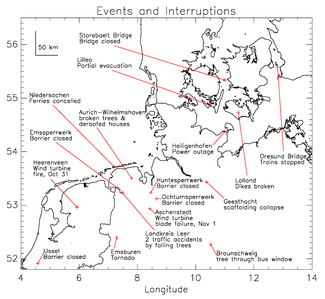


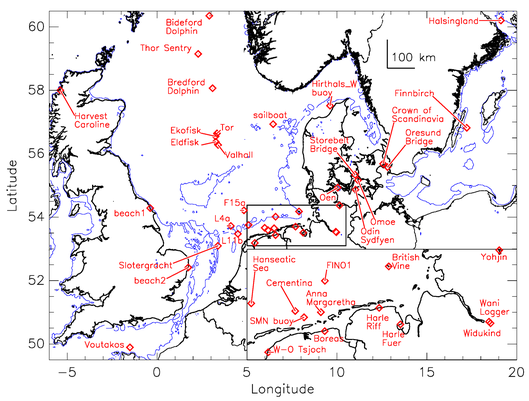


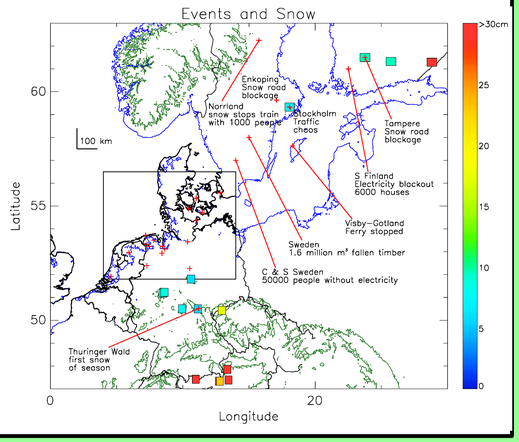


Damage to Energy and Societal Infrastructure

The storm had an important impact on the infrastructure of northern Europe. Media reports focused on the impact of wind gusts for damage to buildings and fallen trees. Some traffic accidents were reported. In Sweden and Finland, there was a snow storm that interrupted transportation links and caused large scale power outages. A series of intense rain bands passed over Germany, and there were high snowfalls in regions over 500m in elevation. The popular press also reported on remarkable events offshore, with a drifting oil rig (broken tow line) off the Norwegian coast, a triple capsize of a Dutch lifeboat in huge coastal waves, and ship sinking in the Baltic Sea. After the storm, other reports revealed ship and platform damage linked with high waves. For wind energy, the storm resulted in serious damage to two onshore turbines in the Netherlands and Germany.







Large European Power Outage from the Cold Air Outbreak

Temperatures during the storm dropped dramatically in northern and central Europe. During planned infrastructure changes on Nov. 4, 2006, the European electrical network was overloaded, and there were blackouts in many countries that lasted for 40 minutes.