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Storm Anatol over Europe in December 1999: impacts on societal and energy infrastructure

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Storm Anatol impacted the North Sea and northern Europe on 3-4 December 1999. It brought hurricane force winds to Denmark and northern Germany, and high winds also in Sweden and the Baltic states. For many meteorological stations in Denmark, the wind speeds were the highest on record, and the storm was ranked as a century event. The storm impacts included extensive forest damage, fatalities, hundreds of injuries, power outages, transportation interruptions, as well as storm surge flooding on the west coast of Denmark. At the time of the storm, Denmark was strongly committed to wind energy, and approximately 10 onshore wind turbines were destroyed during the storm. An important industry insurer noted that this was a remarkably low number considering the storm intensity and the large number of turbines (>3500) installed in Denmark. In 1999, offshore wind energy was just getting started in Europe. Denmark had just started an environmental monitoring program at Horns Rev off the Danish North Sea coast in advance of an offshore wind farm that would be installed in 2002. The offshore meteorological mast at Horns Rev survived the storm, but the wave field was significant, and it partially disabled the measurement system.

This contribution takes a closer look at the regional met-ocean conditions during the storm. A brief overview is made of the wind field and available wave measurements from the North Sea. A closer examination is made of water level measurements from around the North Sea to characterize the storm surge and identify possible meteotsunamis and infragravity waves. Offshore accidents are briefly discussed to assess if there had been unusual wave strikes on shipping or platforms. At the time of the storm in 1999, there was a growing awareness in the scientific community of possible changes in sea state conditions in the North Atlantic area and the increasing threat of rogue waves. The offshore wind energy research platform FINO1 near Borkum in the southern North Sea experienced large wave damage during Storm Britta on 1 November 2006. There was a repetition of the wave damage during storms in 2007 and 2013. Storm Anatol in 1999 was a major North Sea storm, and this contribution presents a survey to assess if there was unusual wave phenomena during the event.