Geophysical Research Abstracts,
Vol. 11, EGU2009-2024, 2009
EGU General Assembly 2009
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Freak waves in Tallinn Bay, the Baltic sea

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We discuss freak wave events recorded in Tallinn Bay, Baltic Sea, in relatively low overall wave conditions. High resolution time series of water surface elevations collected using an ultrasonic echosounder LOG_aLevel® from General Acoustics. The measurement range of the sensor was 0.5–10 m to the water surface with an accuracy of ± 1 mm. The surface water elevation data were collected almost continuously over 30 days (21 June – 20 July 2008) at a recording frequency of 5 Hz. The device was mounted at distance of about 100 m offshore from an effectively non-reflecting shore of the island of Aegna at a depth of $\tilde{2}.7$ m. A part of the experiment was performed in almost calm conditions (significant wave height below 10 cm). The typical significant wave height was 30 cm and reached 60–70 cm during short time intervals.
The analysis of the record revealed several unexpectedly high and steep waves with periods close to the typical periods of the windseas. The most prominent freak wave event was recorded on July 9, 2008 when the significant wave height was about 40 cm and the peak period about 4 s. The height and period of the wave were 1.2 m and 5 s, respectively. The height of the freak wave therefore about 3 times exceeded the significant wave height. The wave arrived without any warning or “hole” ahead of it; instead, it was followed by a deep trough (about 40 cm). The wave was highly asymmetric: its crest reached over 80 cm whereas the typical crest elevation was below 20 cm. We also present several other examples of freak waves, analyze wind wave statistics in June-July 2008, and discuss the distribution functions of wave characteristics.