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Laboratory recreation of the Draupner wave and the role of breaking in crossing seas

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Freak or rogue waves are so called because of their unexpectedly large size relative to the population of smaller waves in which they occur. The 25.6 m high Draupner wave, observed in a sea state with a significant wave height of 12 m, was one of the first confirmed field measurements of a freak wave. The physical mechanisms that give rise to freak waves such as the Draupner wave are still contentious. Through physical experiments carried out in a circular wave tank, we attempt to recreate the freak wave measured at the Draupner platform and gain an understanding of the directional conditions capable of supporting such a large and steep wave. Herein, we recreate the full scaled crest amplitude and profile of the Draupner wave, including bound set-up. We find that the onset and type of wave breaking play a significant role and differ significantly for crossing and non-crossing waves. Crucially, breaking becomes less crest-amplitude limiting for sufficiently large crossing angles and involves the formation of near-vertical jets. In our experiments, we were only able to reproduce the scaled crest and total wave height of the wave measured at the Draupner platform for conditions where two wave systems cross at a large angle.