The low probability but increased hazard of a "rogue wave" from an unexpected direction

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According to reports by the Captain and crew, the crab fishing vessel *Early Dawn*, while fishing near St. Paul, Alaska, on 14 January 2010, was hit by a wave "at least twice as high as the rest of the waves, if not 2.5 times as high" and propagating at an angle of 45° relative to the predominant waves. The significant wave height at the time of the incident was estimated as $H_s = 4.5 - 5.5\,\mathrm{m}$. The Captain first saw the wave at a distance of approximately 100 metres and issued a warning. Three crew members were able to get to safety, while one crew member working at the stern of the vessel was injured.

Simple models of "rogue waves" that do not specify directionality predict that a wave of the observed height or more could have been expected roughly once every 30 hours. However, the directionality of this wave clearly made it more unusual as well as increasing the potential for injuries and damage to the ship. Here we combine models of rogue wave directionality with the analysis of wave buoy observations and marine weather forecasts to argue that the chance of a wave of at least the observed height and at least the observed deviation from the main direction of the waves had a probability of only 1 in 500 of occurring in a 6 hour period.