

Monster Waves Threaten Rescue Helicopters

By Senior Chief Ken Freeze, U.S. Coast Guard, (Retired)

It “looked as if we were going into the White Cliffs of Dover,” said Captain Ronald Warwick, master of the *Queen Elizabeth II*, describing the monster wave his vessel encountered during a North Atlantic storm in February 1995.

Towering waves that seemingly come out of nowhere to crush a ship on the high seas have been the stuff of legends and myths, but the one the *QE2* steamed through was no myth: it was a wall of water almost 90 feet high.

More recently, in February and March 2001, respectively, 90-foot South Atlantic monsters smashed the bridge windows on the cruise ships *Bremen* and *Caledonian Star*. The wave that struck the *Caledonian* left it drifting without navigation or propulsion for two hours.

Marius Gerber, Professor of Applied Mathematics at Stellenbosch University in South Africa, showed that changes in wave direction forced by a narrow, fast current can raise wave heights considerably in certain areas of the current. His calculations also suggest that such waves would

have a distinctive shape, displaying a steep forward face preceded by a deep trough. Mariners who have experienced extreme waves have described such troughs as “holes in the sea.”

Monsters and Rogues

These waves, colloquially called “monsters” or “rogues” but which oceanographers now refer to as “extreme waves,” have long been dismissed as, at best, extremely rare. Now, it appears that such waves are much more common than even fiction writers might suspect.

Some experts now believe that such waves, rising as high as a ten-story building, could be a leading cause of large ship sinkings. Severe weather has played a role in sinking more than 200 large supertankers and container ships during the last two decades and extreme waves are believed to be the major cause in many such cases.

Might they also be behind several Coast Guard rescue helicopter crashes? A Sikorsky HH-3F that crashed off Hinchinbrook Island in the Gulf of Alaska

on 7 August 1981 killing the crew of four and an Aérospatiale HH-65A that crashed with the loss of four crewmen off the coast of Northern California coast on 8 June 1997 would seem to fit in this category. Both were lost in the type of conditions researchers now know can lead to the generation of extreme waves.

Satellites Discover Smoking Gun

In December 2000, the European Union initiated a scientific project called MaxWave to confirm the widespread occurrence of extreme waves, build a model showing how they occur, and consider their implications for ship and offshore structure design criteria. As part of MaxWave, radar data from the European Space Agency’s European Remote Sensing (ERS) satellites were first used to carry out a global extreme wave census. Then came the most amazing evidence: with just three weeks of data from around the world, the MaxWave team identified more than ten individual giant waves more than 25 meters (81 feet) in height. The Agency is continuing its studies of the phenomena.

On another front, objective radar evidence from the North Sea’s Goma oilfield recorded 466 extreme waves in 12 years. Until these recordings, scientists believed such large deviations from the surrounding sea state should occur only once every 10,000 years.

“Recent research shows that there are three [extreme] waves a week, somewhere around the world, and [that] these are not necessarily in rough weather. The interesting thing is that we do not see these waves on [our] wave measuring buoys, but we know they are there,” said David Feit, Chief of Ocean Forecast Branch for the National Oceanic and Atmospheric Administration (NOAA) Ocean Prediction Center.

Feit puts the waves in two categories, non-dispersive and dispersive. “A non-dispersive wave is one you can see coming at you. It travels for 6 to 10 miles before it



During rescue operations off Hinchinbrook Island in the Gulf of Alaska on 7 August 1981, a Sikorsky HH-3F helicopter crashed in heavy seas, killing four crew members.

dissipates. [But] the dispersive wave is the one that gets you," he said. "It is a wave that suddenly seems to come from nowhere and goes away just as quickly. These waves are the result of the interactions of many different elements taking place at the time and are as forecastable as where the next lightning strike might occur."

Wave Incidents Go Unreported

"I believe that many boat casualties caused by these waves go under-reported in Coast Guard investigations," he said. "For instance, a dispersive wave hits the main cabin of a small fishing boat and results in flooding of the engine room or electrical failure. In the end, the Coast Guard investigation [cites] mechanical failure as the cause of the causality and not the wave."

The rule-of-thumb, Feit said, is that "Wind speed in knots blowing over a large fetch [long distance] for a very long time, divided in half equals wave height. So, in general, 50 knot winds will generate 25-foot waves given enough time." But then there is what is called significant wave height. "When one looks out towards the horizon, one sees waves that are approximately equal to the average of the highest one-third of the waves, which is called significant wave height. About one out of 10 waves will be that height. About one out of even 1,000 waves, however, will be double that height. And if you are out on the ocean for four or five hours, you'll probably see that 1,000th wave," he said.

Worldwide, an estimated two large ships sink every week for undetermined causes. Such sinkings are routinely attributed to "bad weather."

Could a Monster Wave Down a Helicopter?

Asked to speculate on the chances of a helicopter being hit by a monster wave while hovering at 50 to 100 feet for anywhere from 20 minutes to an hour while hoisting people aboard during a storm, Feit replied: "I wouldn't want to give a number, but from what we know now, there is a chance. I can't quantify it, but it is possible."

"It's Coast Guard policy to do everything we can to avoid saying pilot error and we always look at environmental issues," said Cathie Zimmerman, Deputy Chief of Coast Guard Flight Safety in Washington, D.C. But she admitted that both failing to maintain sufficient altitude and being engulfed in an extreme wave would appear to be the same when other information or witnesses are absent. So how can accident investigators determine whether the pilot "... failed to maintain sufficient altitude above the water surface" or whether the helicopter was engulfed by an extreme wave?

Zimmerman could not confirm whether investigators had considered the possibility that extreme waves caused the earlier HH-3F or HH-65A accidents.

The loss of an HH-60J off the Alaska Peninsula in December 2004, however, may be changing things. Although the investigation is not yet final, Zimmerman said that investigators are looking at an extreme wave as a possible cause. "In this case we have the reports of the helicopter crew that survived the crash as well as witnesses on another helicopter and from the ship," she said, "This crash really got

everyone's attention." She added that the Coast Guard issued a service-wide warning about waves and sea conditions to all its air stations shortly after the crash.

WaveAtlas

A new project called WaveAtlas is using two years worth of data to carry out statistical analyses and create a worldwide atlas of extreme wave events. Some patterns have already emerged. Extreme waves are often associated with areas where ordinary waves encounter ocean currents and eddies. The strength of the current concentrates the wave energy, forming larger waves. The data also show extreme waves occurring well away from currents, often occurring in the vicinity of weather fronts and low pressure areas.

For eons, mariners plying the world's oceans have known the dangers waves posed to their safe return. With today's high-tech tools, aviators are also learning that under the right circumstances, those waves can also threaten their craft as well. Perhaps in the near future, the standard weather briefing given to all Coast Guard and Navy helicopter crews before a mission will not only cover the dangers facing them in the sky, but also include those that might reach up and grab them from the surface of the ocean below.

Senior Chief Freeze retired from the Coast Guard in 1993 after 20 years as a public affairs specialist. During his career he spent six years on flight status flying out of New Orleans and nearly every Coast Guard air station on the West Coast.

"Reprinted from *Proceedings* with permission; Copyright © 2006 U.S. Naval Institute/www.usni.org."