Taking the Surprise Out of the Freak Wave

In the Fall of 1991, an infamous Nor’easter took New England by storm and by surprise, possibly becoming the worst tempest of all time and earning the name, the Perfect Storm. Researchers, the Coast Guard and fisherman later learned that the natural calamity was actually the result of two storms bumping into one another to create monster waves that not even the bravest surfer could love.

Big waves are big news—the recent tsunami is testimony to that. But tsunamis are not freak or rogue waves—another kind of wave known for its extraordinary height, abnormal shape, but completely unanticipated. And it is this particular natural phenomenon that is of great interest to Rosenstiel School researchers. Thanks to some of the best technology available, Rosenstiel School is at the forefront in developing freak wave models, monitoring what used to be considered merely nautical myth, and working to create a warning system to protect those out at sea.

Whether it’s wind-driven waves, currents, ocean bottom topography or inclement weather, these factors can all play a role in freak wave development. With the advent of satellite imagery, only recently have scientists begun to get a sense of how frequently these rogue waves occur, estimating that worldwide approximately one to two ships are lost or damaged every week. These walls of water come without warning, able to sink or damage supertankers and container ships effortlessly. Obviously, with a growing cruise ship industry, a family of Navy ships at sea for longer periods of time, and increasing international trade busying both the open seas as much as world-wide ports, this is an issue of great import.

Developing Models that Answer Questions

One of the most preliminary measures to this research is understanding rogue wave mechanics. At Rosenstiel School, the Air-Sea Interaction Saltwater Tank (ASIST) helps researchers from around the world study a variety of processes having to do with waves. The unique ASIST facility provides a well-controlled environment and state-of-the-art technology to reproduce waves, with the capability to alter variables, such as temperature, air and water turbulence, so that scientists can methodically evaluate outcomes. Additionally, the scientists compare these findings to what they see in the real world to ensure accuracy and build models that will have real predictive value down the road. In fact, Rosenstiel researchers have found a promising approach using special wave models that replicates how waves move and that could forecast these waves days in advance to help mariners avoid freak waves—something shipping, fishing and marine insurance companies would likely welcome.

Remote Sensing Helps Track Waves

Rosenstiel School has the only facility in the United States that receives and analyzes satellite data for real-time environmental monitoring from the southeastern United States to northern South America. Its Center for Southeastern Tropical Advanced Remote Sensing (CSTARS) allows researchers to process and communicate satellite data within 30 minutes. It is exactly this technology that has enabled researchers to prove the prevalence of freak waves. In places, like the nearby Gulf Stream and the Brazil current, having a constant eye on the turbulent, unpredictable patterns will help scientists and mariners better understand this natural phenomenon.

As part of the MaxWave project, Rosenstiel School is building a WaveAtlas that will map the occurrence of rogue waves to be used as a basis for ship routing and offshore construction planning. Additionally MaxWave will help us better understand what causes these extreme waves and in what kinds of weather conditions.

The Future: Preparation and Warning Systems

Rosenstiel School researchers are focused most on the applications of understanding rogue waves better. In addition to building a forecast system that can illuminate the likelihood of rogue waves anywhere in the globe, another researcher is working with the real-time imagery to develop an early warning system, similar to the hurricane warning systems, ultimately providing reports that inform the public that for a certain period of time, conditions are conducive to freak waves in a specific oceanic quadrant. The freak waves will certainly continue, and Rosenstiel School research will help people around the world better prepare and avoid them, staying out of harm’s way.