What is a... Meteotsunami?

On June 13, 2013, despite clear skies and calm weather, tsunami-like waves crashed upon the New Jersey and southern Massachusetts coasts. In Barnegat Inlet, New Jersey, three people were injured when a six-foot wave swept them off a jetty and into the water. The waves were captured by National Oceanic and Atmospheric Administration (NOAA) coastal water-level stations from Puerto Rico to New England as well as a Deep-Ocean Assessment and Reporting of Tsunamis (DART) buoy 150 miles offshore. Due to the wave's coincidence with a severe weather pattern and the lack of a detected earthquake or landslide, scientists deemed the event a "meteotsunami."

What is a Meteotsunami?

Meteotsunamis have characteristics similar to earthquake-generated tsunamis, but they are caused by air pressure disturbances often associated with fast moving weather systems, such as squall lines. These disturbances can generate waves in the ocean that travel at the same speed as the overhead weather system. Development of a meteotsunami depends on several factors such as the intensity, direction, and speed of the disturbance as it travels over a water body with a depth that enhances wave magnification.

This weather system generated the June 13, 2013, meteotsunami. Credit: Buddy Denham

Like an earthquake-generated tsunami, a meteotsunami affects the entire water column and can become dangerous when it hits shallow water, which causes it to slow down and increase in height and intensity. Even greater magnification can occur in semi-enclosed water bodies like harbors, inlets, and bays.

Most meteotsunamis are too small to notice, but large meteotsunamis can have devastating coastal impacts (although not to the extreme of the 2004 Indian Ocean and 2011 Japan tsunamis). Damaging waves, flooding, and strong currents can last from several hours to a day and can cause significant damage, injuries, and deaths.

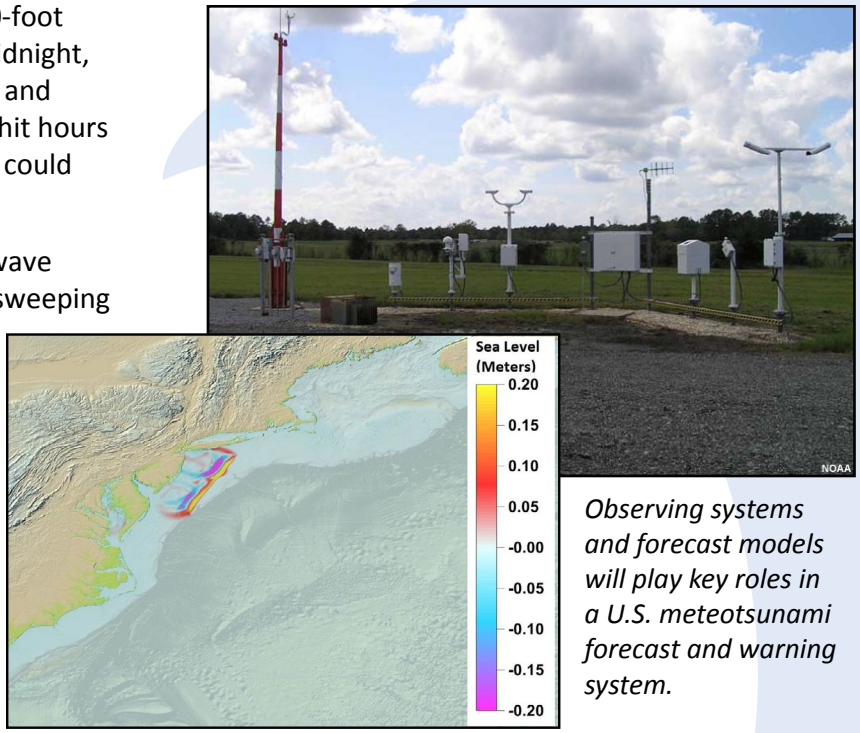
A meteotsunami should not be confused with storm surge associated with tropical storms and other large coastal storms. Storm surge is a wind-driven effect that occurs when strong winds push water onshore, causing water levels to steadily rise over the course of several hours. Recent research has shown that meteotsunamis are more common than previously thought and suggests that some past events may have been mistaken for other types of coastal floods, such as storm surges or seiches, which also tend to be wind-driven.

Where Do Meteotsunamis Happen?

Meteotsunamis are regional in nature. In the United States, conditions for destructive meteotsunamis are most favorable along the East Coast, Gulf of Mexico, and in the Great Lakes, where they may pose a greater threat than earthquake-generated tsunamis. In addition to the 2013 event, notable U.S. meteotsunamis include:

- **May 27, 2012**—Lake Erie: A seven-foot wave hit the shoreline near Cleveland, Ohio, sweeping beach-goers off of their feet and swamping boats in harbors.
- **October 28, 2008**—Boothbay Harbor, Maine: A series of waves up to 12 feet high emptied and flooded the harbor at least three times over 15 minutes, damaging boats and shoreline infrastructure.

- **July 3, 1992**—Daytona Beach, Florida: A 10-foot wave crashed onto shore shortly before midnight, injuring 75 people, damaging 100 vehicles, and causing property damage. If the wave had hit hours later, during July 4th festivities, the effects could have been much worse.
- **June 26, 1954**—Lake Michigan: A 10-foot wave struck the shoreline near Chicago, Illinois, sweeping several people off piers. Seven lives were lost.



Observing systems and forecast models will play key roles in a U.S. meteotsunami forecast and warning system.

Certain parts of the world, such as areas in the Adriatic Sea, Mediterranean Sea, and a few of Japan's gulfs and bays, are prone to meteotsunamis due to a combination of variables such as geography, weather patterns, and bathymetry (size, shape, and depth of the waterbody). The strongest meteotsunami on record struck Vela Luka, Croatia, in June 1978. The event featured 19.5-foot wave heights, lasted several hours, and caused significant damage to the port and boats. Since then, a number of other meteotsunamis with waves exceeding six feet have been observed along the Croatian coast. Ciutadella Harbor (Menorca, Spain) has also experienced significant events. Meteotsunamis in 1984 and 2006 each caused tens of millions of dollars in damage to the harbor and boats.

What Is Being Done to Forecast Meteotsunamis?

Despite the risk they pose and their worldwide occurrence, forecasting meteotsunamis remains a challenge. However, with recent increases in research as well as improved observational networks and forecast models, a reliable forecast and warning system for the United States is within reach.

The United States is still in the early stages of developing a meteotsunami forecast and warning system. Led by NOAA, these efforts include developing a process that outlines when, where, and how meteotsunami warnings should be issued based on high resolution air pressure measurements combined with meteotsunami forecast models.

The National Tsunami Hazard Mitigation Program (NTHMP) recognizes the risk that meteotsunamis pose and supports NOAA's efforts to develop a meteotsunami forecast and warning system. In the meantime, the public should heed warnings issued by local National Weather Service Weather Forecast Offices, which can identify a potential coastal threat based on weather conditions. The NTHMP also encourages program partners to raise public awareness about meteotsunamis.

To learn more about meteotsunamis and the June 2013 meteotsunami, read "An Examination of the June 2013 East Coast Meteotsunami Captured by NOAA Observing Systems," which is available at: http://tidesandcurrents.noaa.gov/publications/NOS_COOPS_079.pdf.

Get more information about the NOAA Tsunami Program at http://www.tsunami.gov/ and the NTHMP at http://nws.weather.gov/nthmp/.