Meteotsunamis: Working Toward an Operational Forecasting Capability

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Meteotsunamis

- Tsunami-like waves of meteorological vs. seismic origin
- Formation dependent on intensity, direction, and speed of disturbance over water at appropriate depth
- NOT same as storm surge

Source: Monserrat, Vilibić, Rabinovich; Nat. Hazards Earth Syst. Sci., 6, 2006
- Waves up to 12’ high emptied and flooded the harbor at least 3 times over 15 minutes, damaging boats and shoreline infrastructure

Frontal disturbance accelerates to MT Phase speed approximately 28/15Z

Wave heights were reproduced by tsunami forecast model and atmospheric gravity wave source

- Case validated tsunami model application but...
  - Very difficult to depict/predict in real time
  - Hard to distinguish from “bad weather”
June 13, 2013

- New Jersey and southern Massachusetts coasts
- Barnegat Inlet, New Jersey: 3 people injured by 6-foot wave that swept them off jetty into water
- Waves recorded on water-level stations from Puerto Rico to New England and tsunami buoy
- Caused by weakening, low-end derecho
- Alerts possible based on shelf effect

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Tsunami Forecast Model Animation of the 13 June 2013 Atlantic Meteotsunami

RIFT Model by Dailin Wang
Animation by Nathan Becker
NOAA/NWS/Pacific Tsunami Warning Center

https://www.youtube.com/watch?v=ykABRe5Yt3c
Coastal Water-Level Gauges
Challenges

- **Forecasting**—Meteotsunami (MT) formation tightly constrained by depth, translational speed of disturbance, and direction; requires extremely accurate mesoscale forecast

- **Detection**—Even if MT forms, network of observation systems not dense enough to detect MT disturbance

- **Messaging**—Potential for confusion with wind-driven storm surge and normal seiche activity
Proposed Protocol: “Alert on Detection”

- WFO monitor medium-range numerical weather prediction (NWP) to ID candidate disturbances
- WFO contact National Tsunami Warning Center (NTWC) if candidate disturbance within ~24hrs of formation to discuss
- WFO include potential for MT in Area Forecast Discussions and/or Special Weather Statements
- Inside 12 hours, NTWC monitor tsunami detection networks; DART buoys placed in event mode, coastal gauges closely monitored
Proposed Protocol: “Alert on Detection”

- If detection made, NTWC alert local WFOs and provide *estimates* of amplitude and travel time to coastal locations.
- WFOs may issue *alerts* if warning criteria met (e.g., coastal flood warning).
Future Development

1. More accurate and timely “alert on detection” capability
   - MT source inversion techniques
   - MT historical libraries/simulations
   - Denser detection network (HF Radar, moored buoys)

2. Work toward “alert on forecast” capability
   - High-resolution mesoscale maritime NWP
   - Sophisticated MT detection algorithms
   - High-density sea level pressure detection network over coastal margin
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Meteotsunami Fact Sheet: http://nws.weather.gov/nthmp/meteotsunamis.html