Meteotsunamis: Working Toward an Operational Forecasting Capability

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Fourth Symposium on Building a Weather-Ready Nation: Enhancing Our Nation's Readiness, Responsiveness, and Resilience to High Impact Weather Events

Meteotsunamis

- Tsunami-like waves of meteorological vs. seismic origin

- Formation dependent on **intensity**, **direction**, and **speed** of disturbance over water at appropriate **depth**
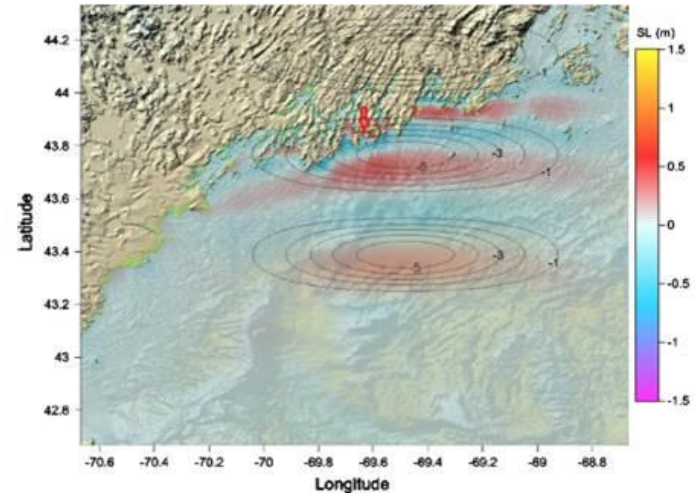
- **NOT** same as storm surge
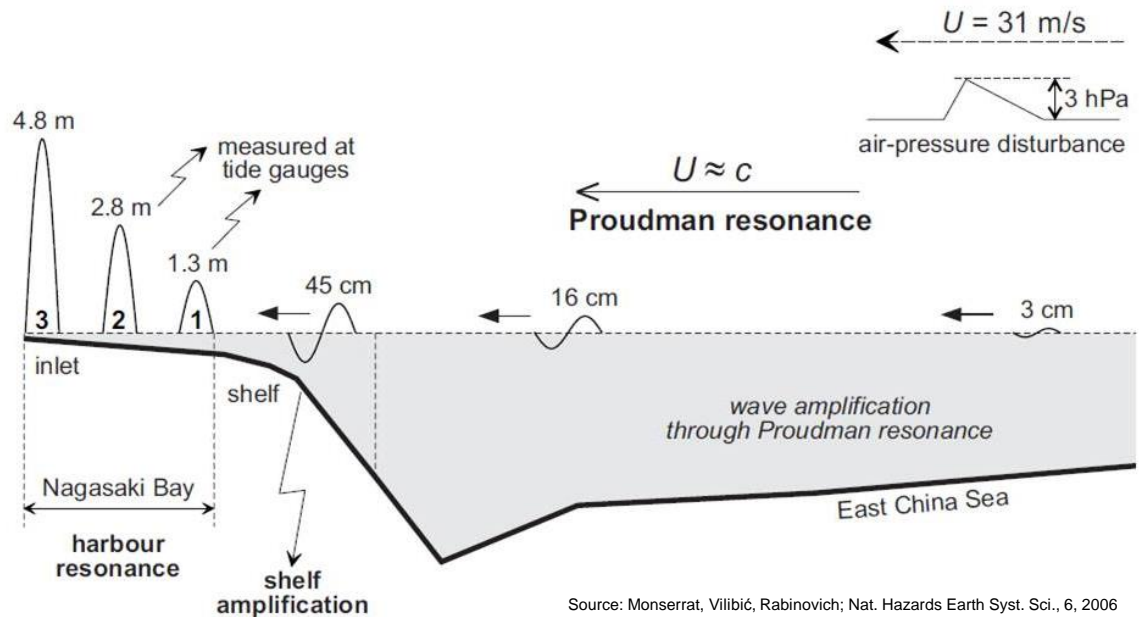
Source: Monserrat, Vilibić, Rabinovich; Nat. Hazards Earth Syst. Sci., 6, 2006

Boothbay Harbor, Maine: October 28, 2008

- Waves up to 12' high emptied and flooded the harbor at least 3 times over 15 minutes, damaging boats and shoreline infrastructure
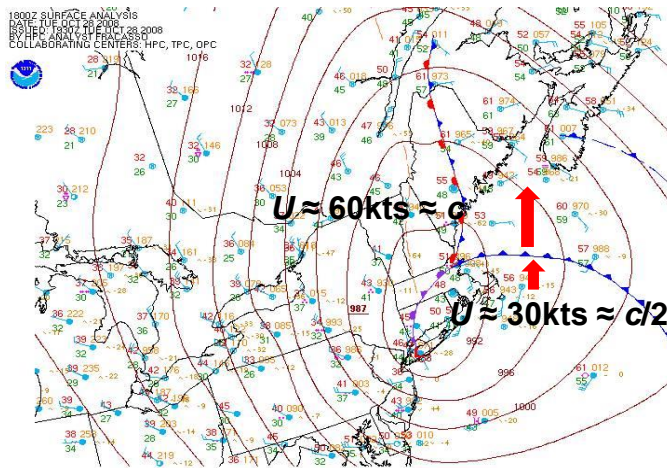
Frontal disturbance accelerates to MT Phase speed approximately 28/15Z

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"

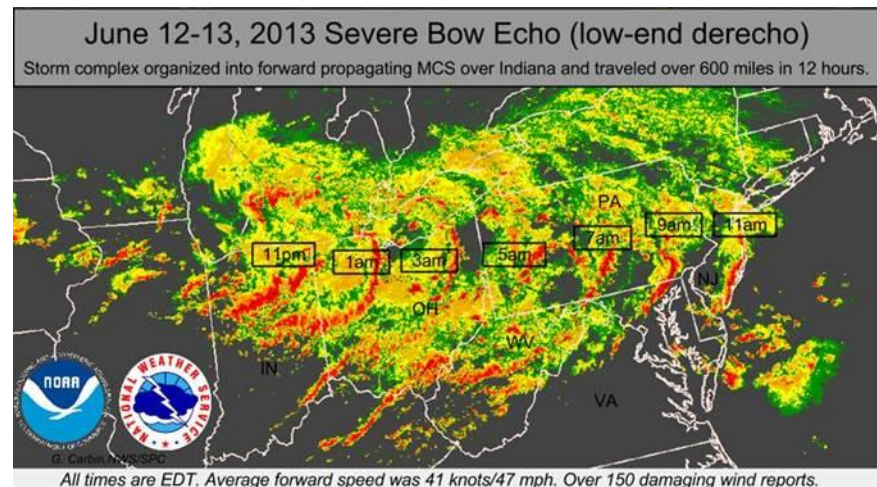https://www.youtube.com/watch?v=QHw2KlC3a2o

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

June 12-13, 2013 Severe Bow Echo (low-end derecho)
Storm complex organized into forward propagating MCS over Indiana and traveled over 600 miles in 12 hours.

All times are EDT. Average forward speed was 41 knots/47 mph. Over 150 damaging wind reports.

2013 Animation

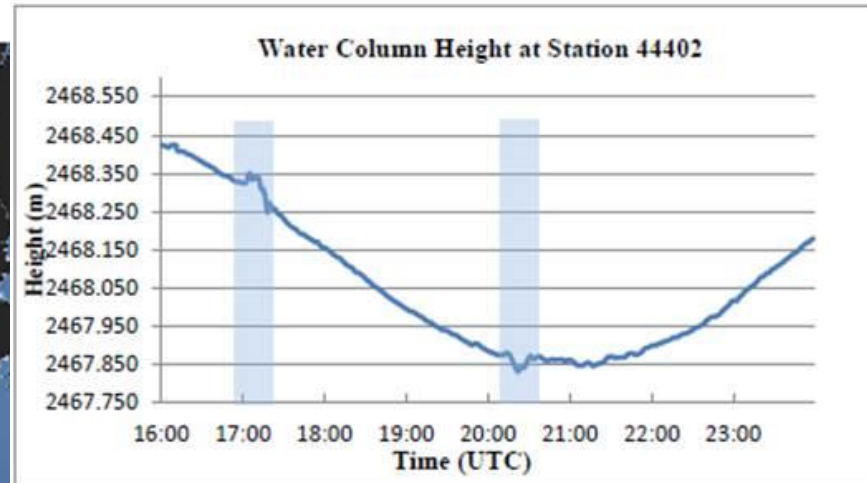**Tsunami Forecast Model Animation of the 13 June 2013 Atlantic Meteotsunami**

RIFT Model by Dailin Wang
Animation by Nathan Becker
NOAA/NWS/Pacific Tsunami Warning Center
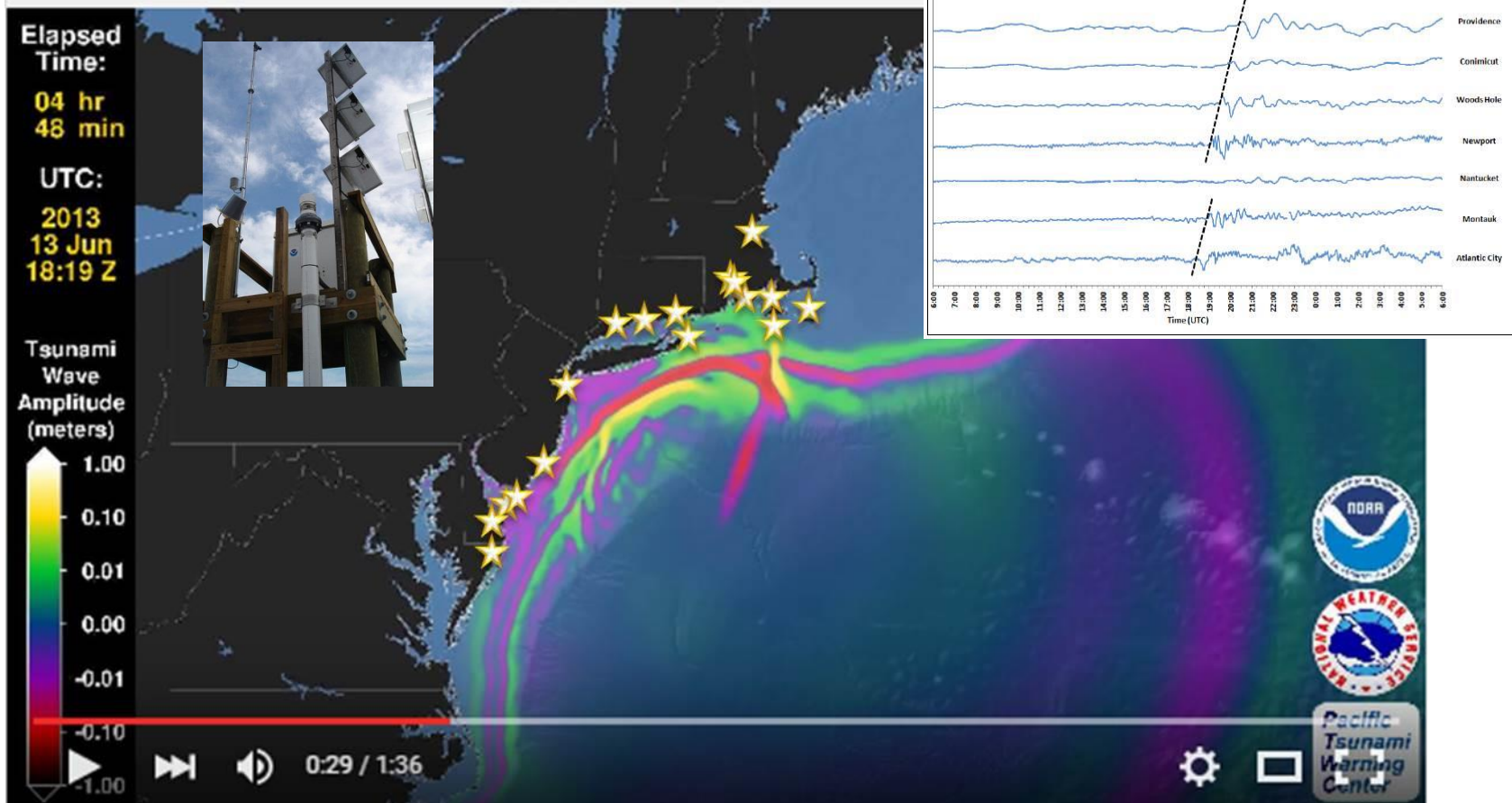
https://www.youtube.com/watch?v=ykABRe5Yt3c

DART Systems
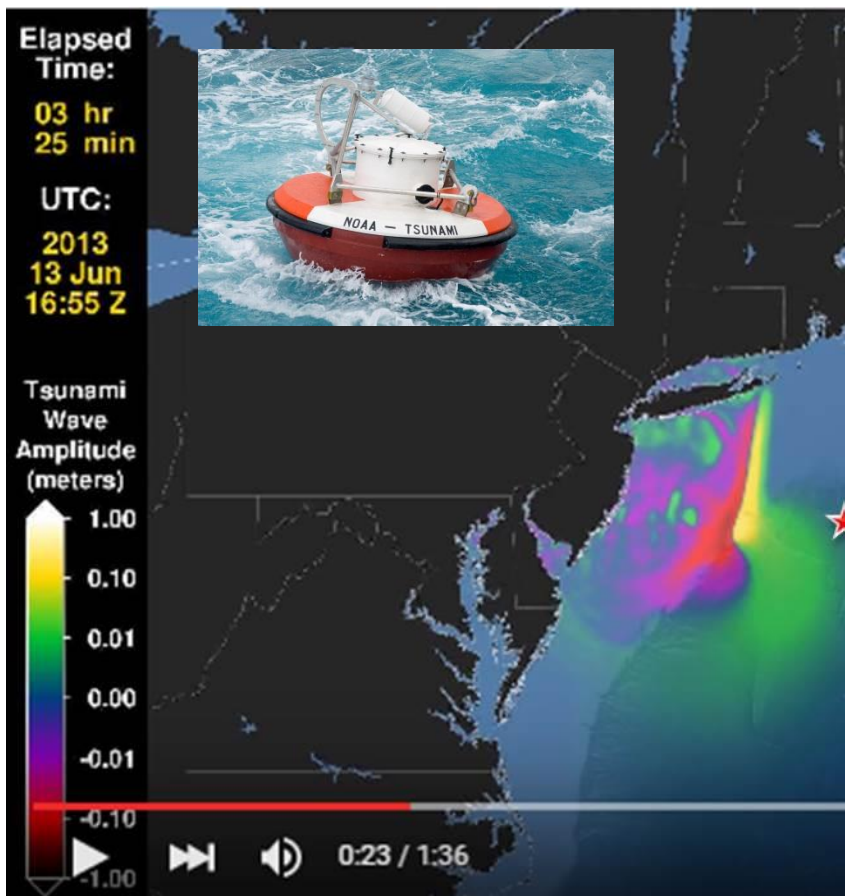
Coastal Water-Level Gauges

Challenges

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

MT Forms   **No MT Forms**

- **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
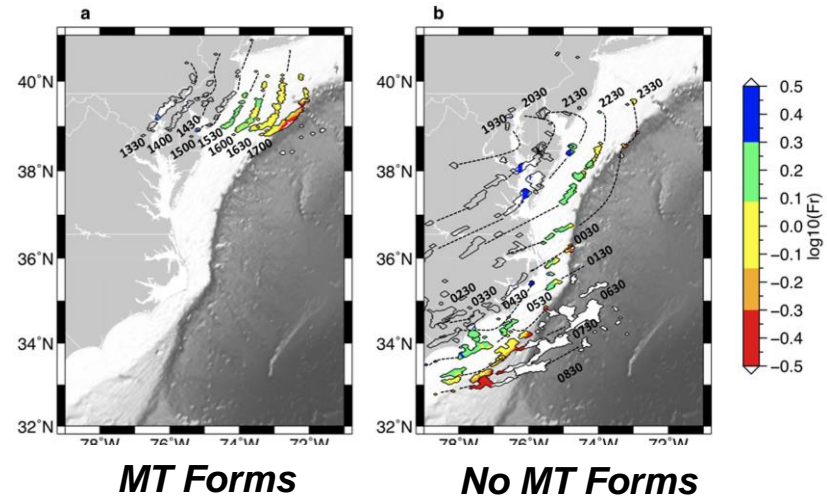
Proposed Protocol:
"Alert on Detection"

- 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)

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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

Q&A

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Meteotsunami Fact Sheet: http://nws.weather.gov/nthmp/meteotsunamis.html