Nationwide Coastal Intelligence: IOOS High Frequency Radar Products

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U.S. Integrated Ocean Observing System (IOOS®)

Policy Neutral, Stakeholder Driven, Scientifically Based

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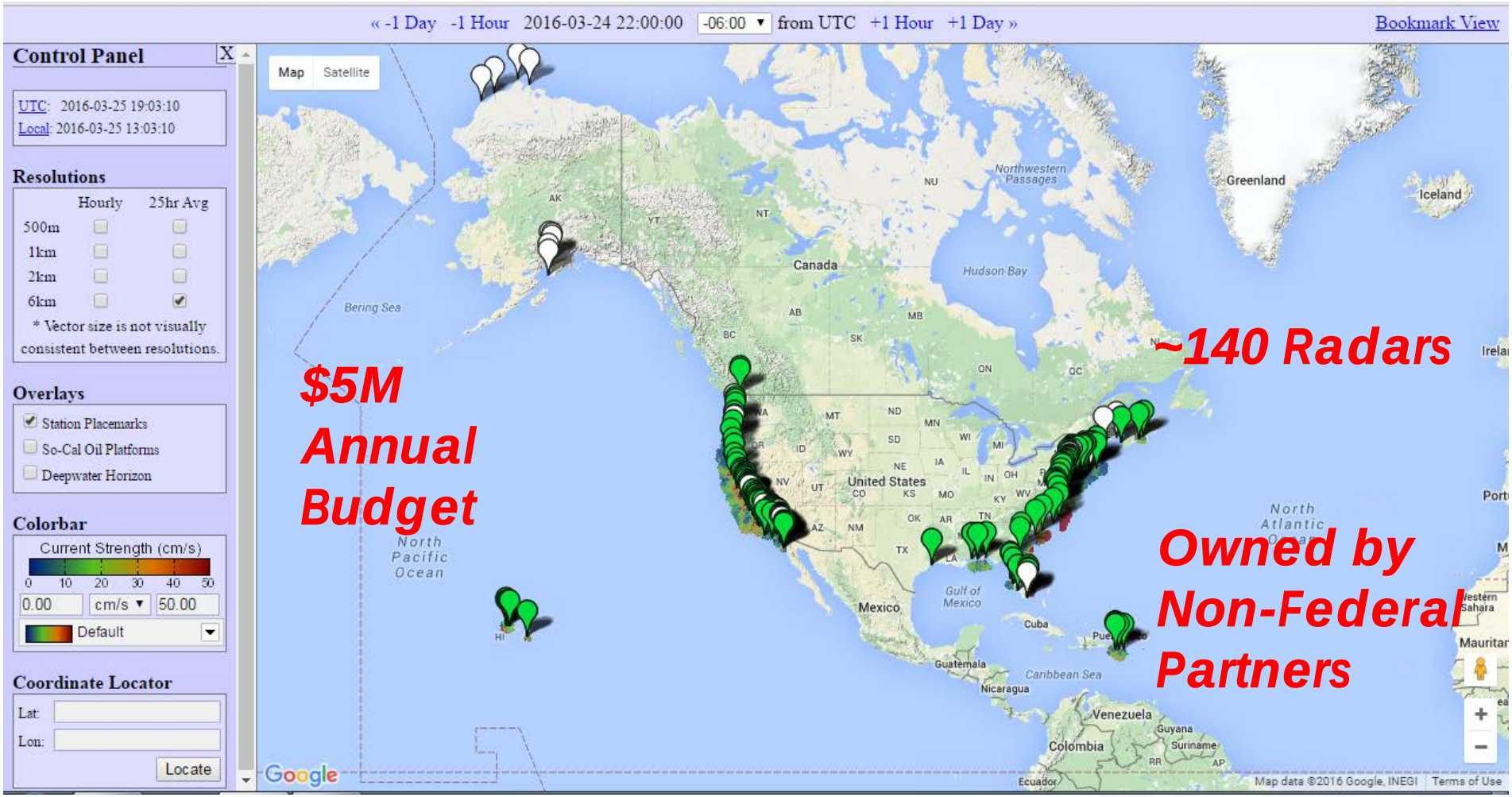
HFRNet Radar Locations



$5M Annual Budget

~140 Radars

Owned by Non-Federal Partners

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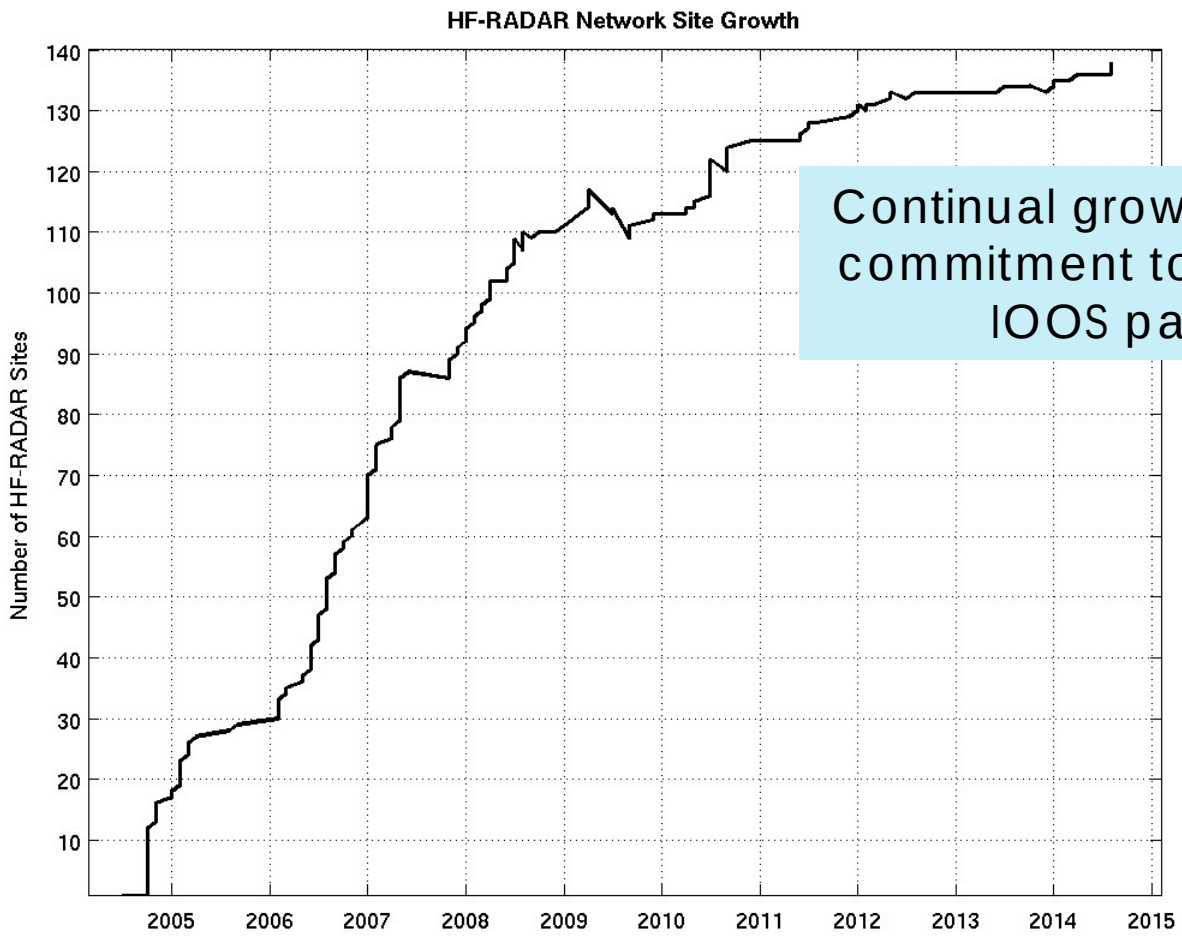
Growth of IOOS HF Radar Network



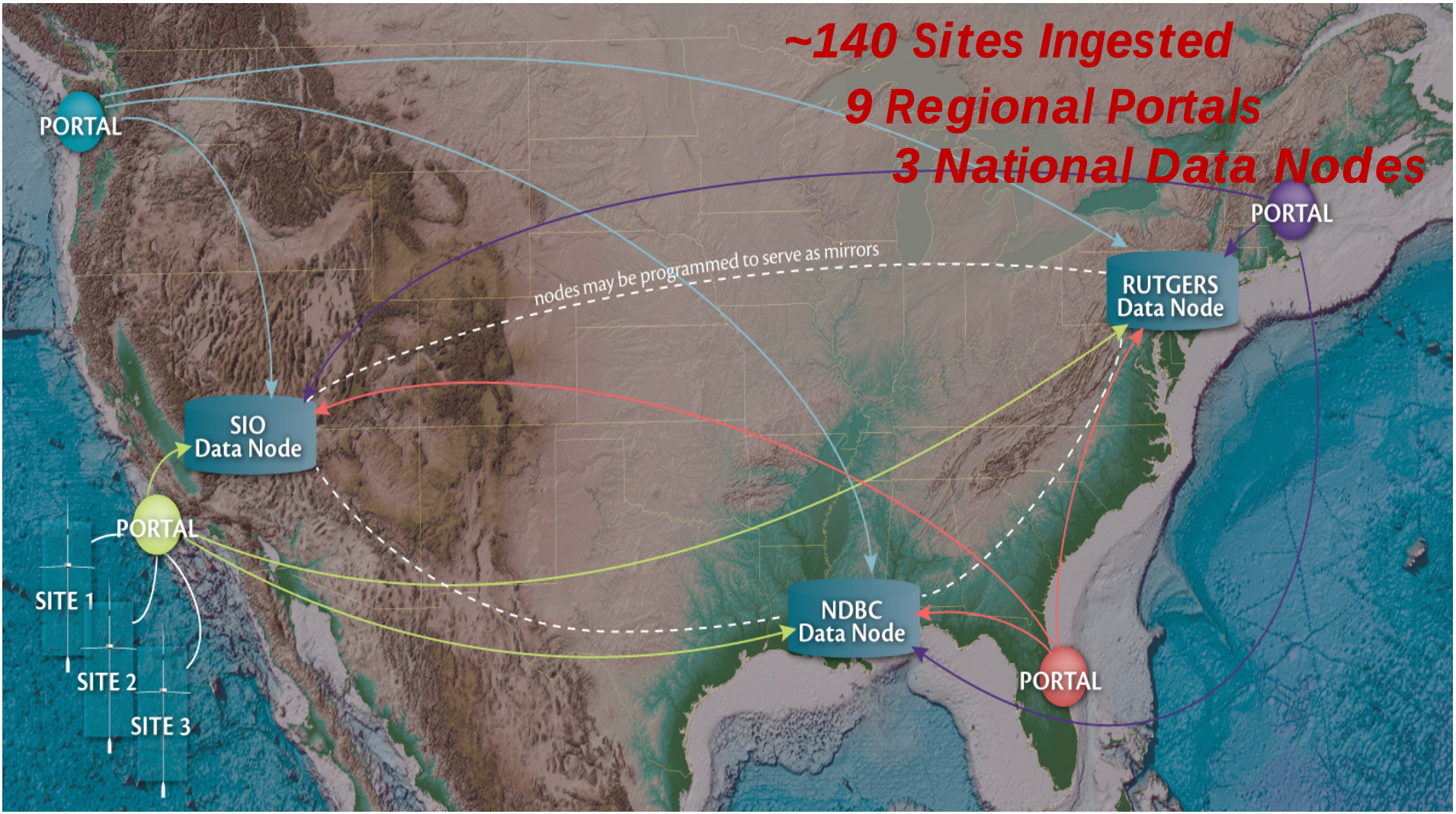
Continual growth a result of commitment to network by IOOS partners

State of CA
44 radars funded
Start 2006

Integration of Existing Research Systems

Operational budget line established for U.S. O&M $5M/yr

HFRNet Data Infrastructure



HF Radar Technology

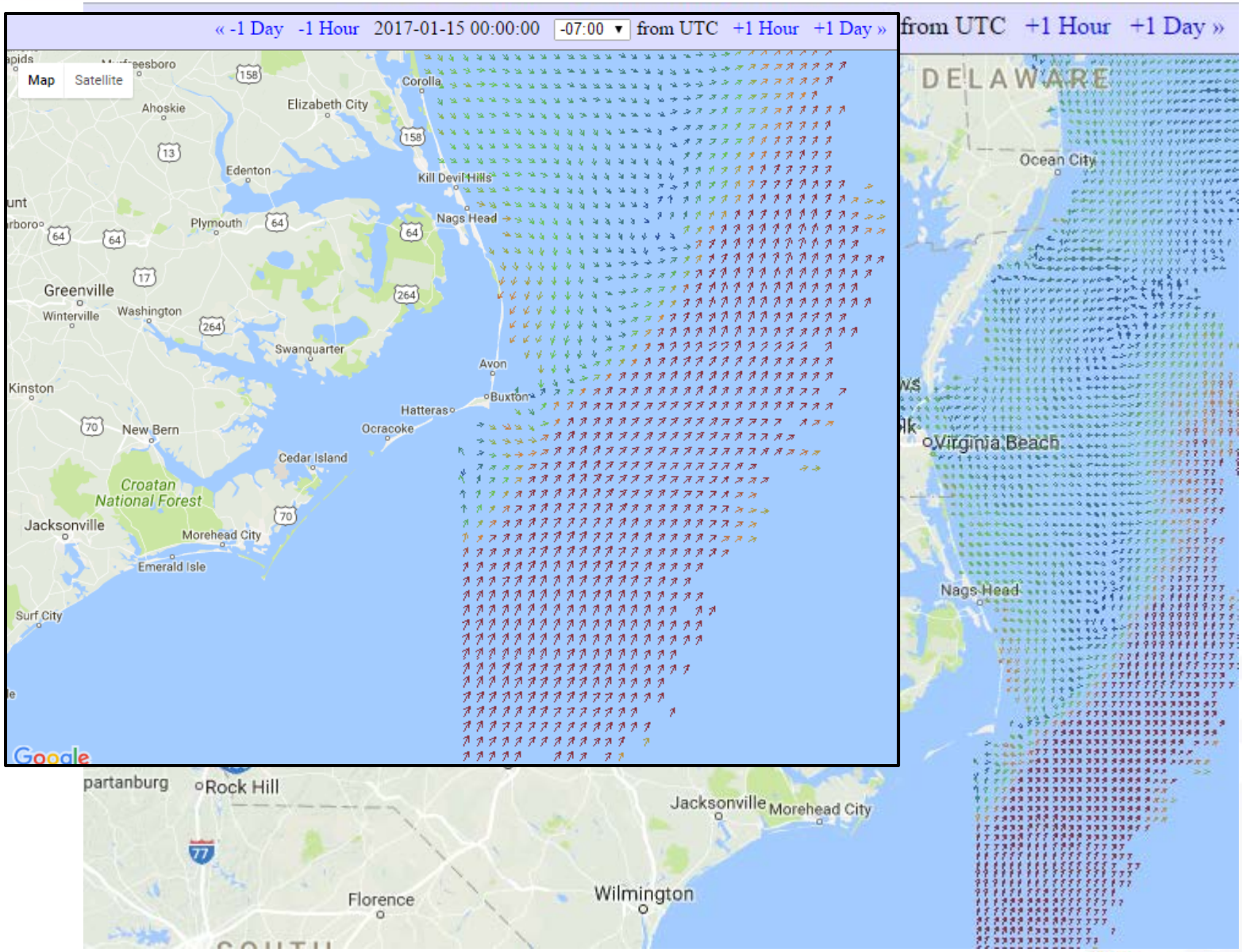
~90% of HFRNet are CODARs

What It Does

- Provides **Maps of Ocean Surface Currents**
- Speed and Direction
- Covering Thousands of Square Kilometers
- Near-real-time
- Hourly
- 0.2 km to 6 km Spatial Resolution*
- Up to 200+ km offshore

*depending on radar transmit bandwidth

Example Real-time Map



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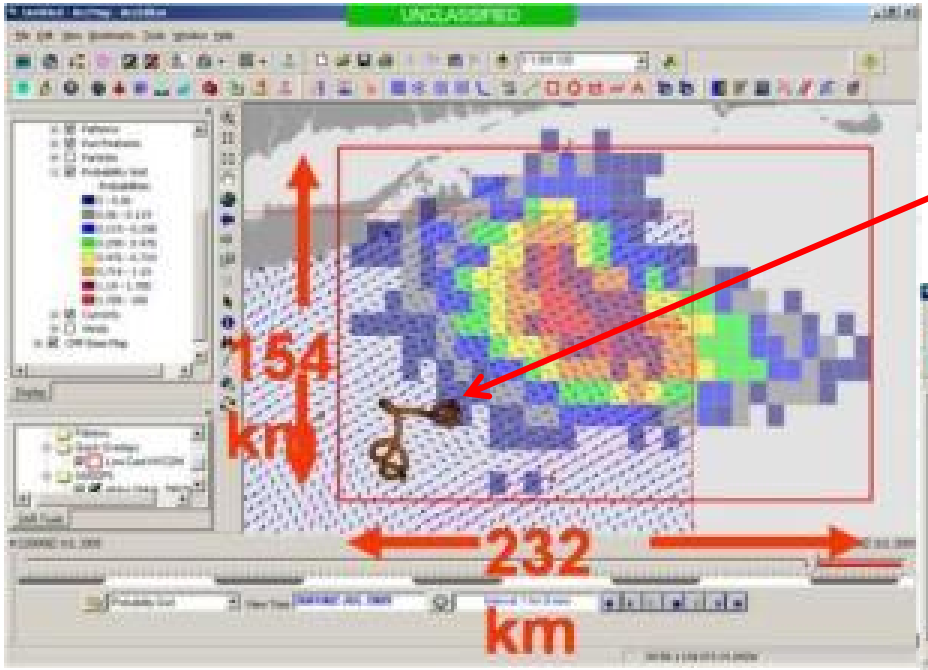
Existing & Planned Products

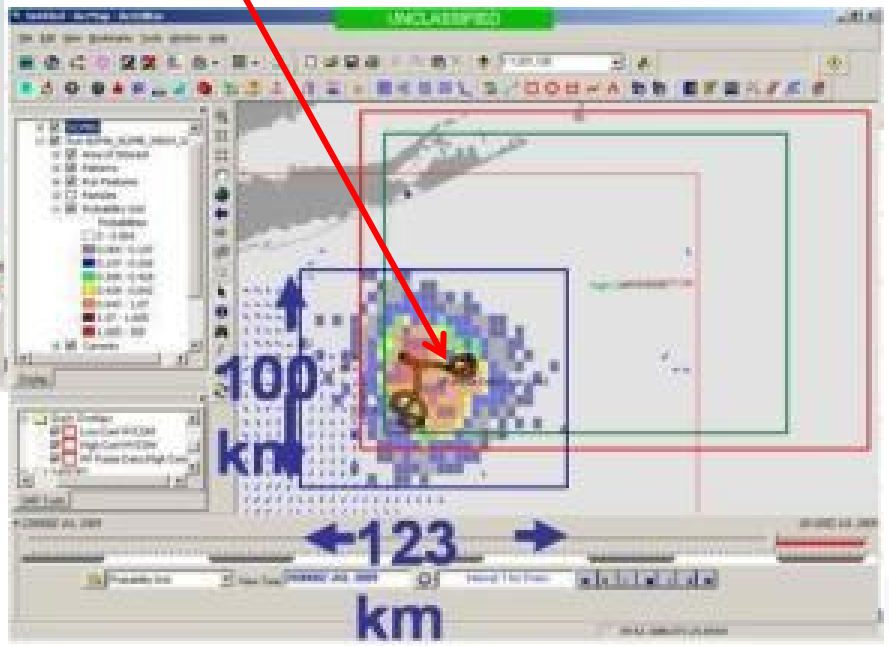
- Search & Rescue (***Operational*** – US Coast Guard)
- Oil Spill Response (***Operational*** – NOAA NOS OR&R)
- Marine Navigation (***Operational*** - NOAA NOS CO-OPS)
- AWIPS (***Operational*** – NOAA NWS)
- Coastal Monitoring (***Operational*** - State, Local)

- Tsunami Detection (***Development*** – NTWC/IOOS Project)
- Significant Wave Height (***Development*** – NWS & IOOS)
- Hydrodynamic Modeling (***Development*** - NCEP WCOFS)

Search & Rescue: US Coast Guard



Actual Drifter Location



96 hr: <u>Without HF Radar</u>
36,000 Km² Search Area

96 hr: <u>With HF Radar</u>
12,000 Km² Search Area

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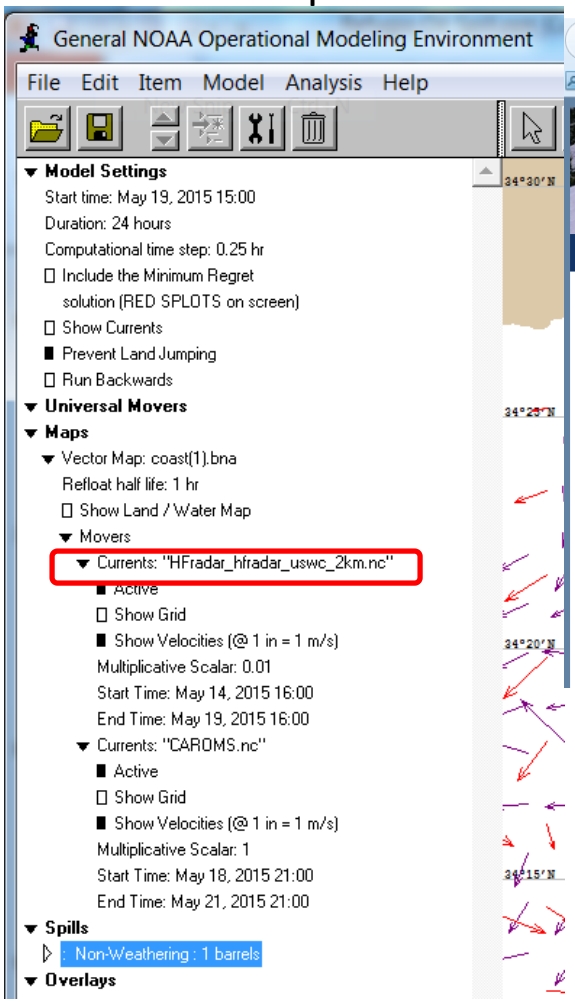
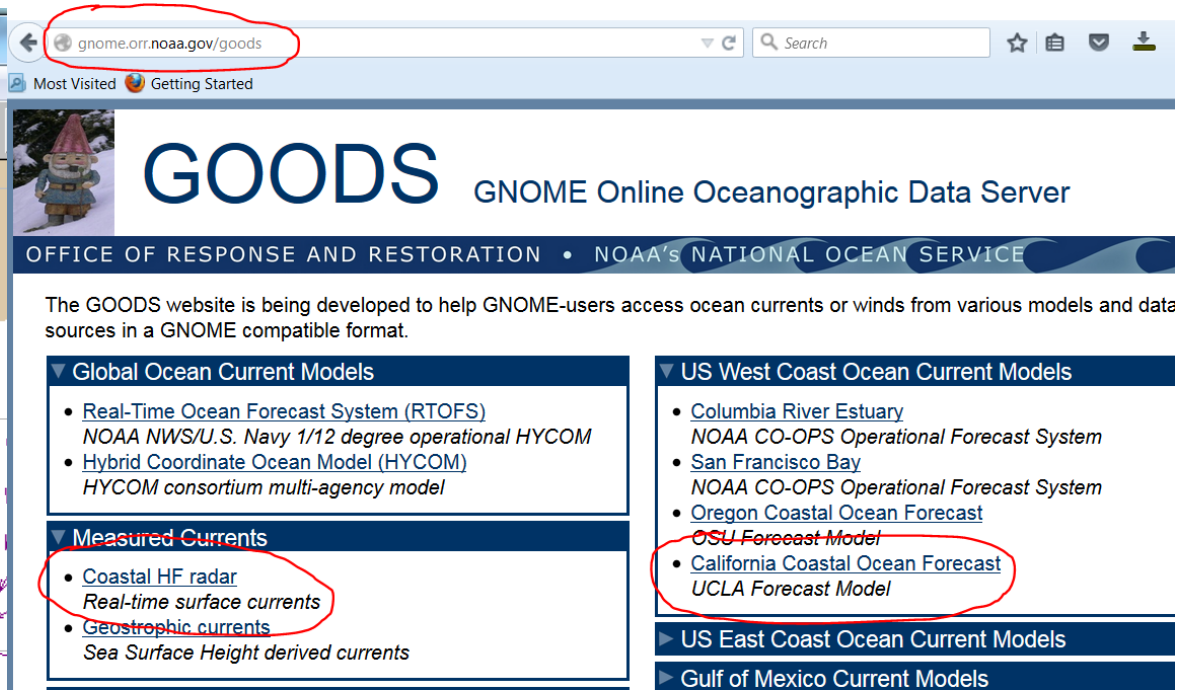
Oil Spill Response: NOS/OR&R

GNOME Transport Model





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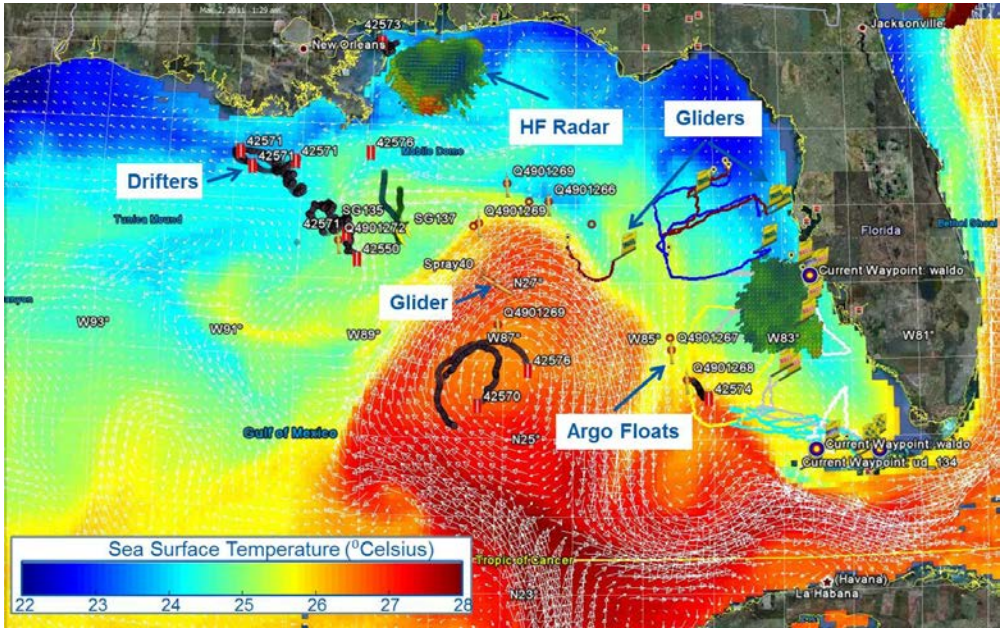
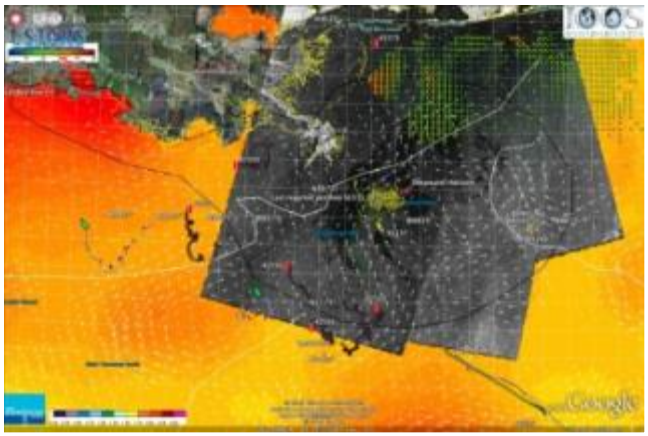
Spill Response: Deepwater Horizon 2010

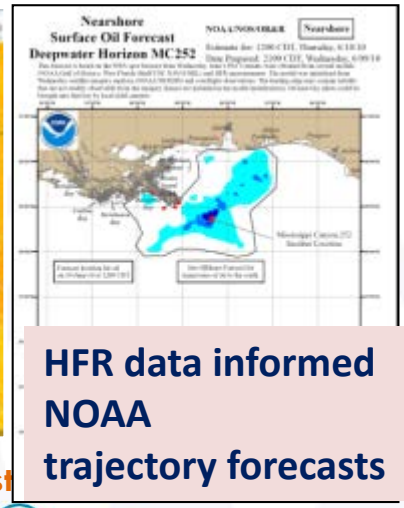
U.S. IOOS partnership demonstrated ability to:

- Quickly deploy technologies: Gliders and HF radar, saving resources/improving safety
- Models/Imagery ingested into NOAA/Navy models
- Data assimilation improved spill response decision-making and public understanding





HFR validation of SABGOM Forecast with satellite detected oil slicks



HFR data informed NOAA trajectory forecasts

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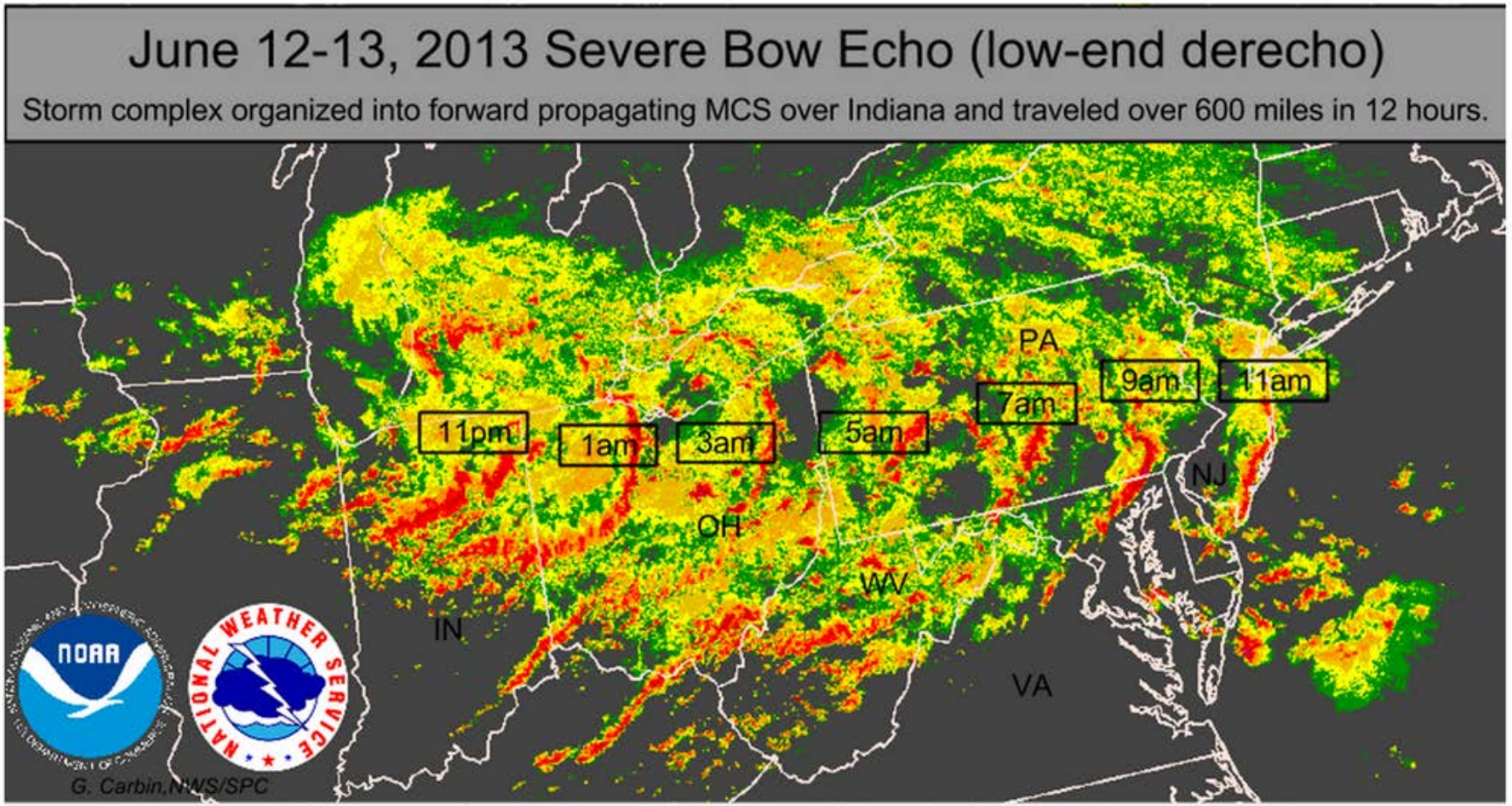
Developing New Products

- **Tsunami Detection**
- **Significant Wave Height**

Tsunami Detection: Meteotsunami



A radar image of the storm complex that may have caused the tsunami.

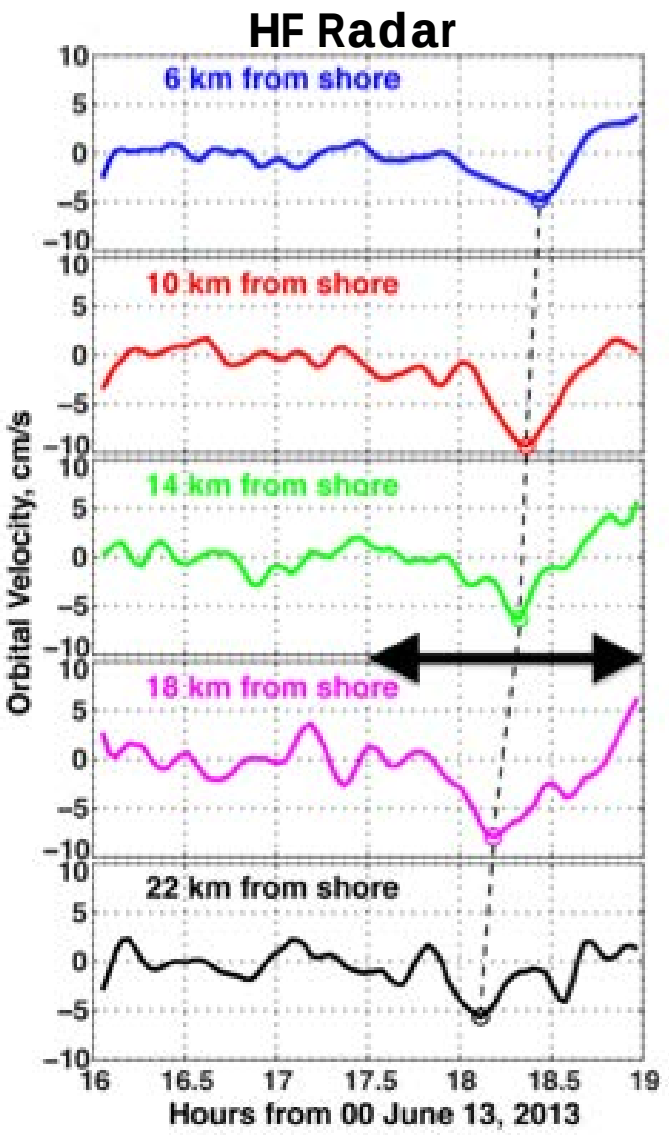
Tsunami Detection: June 2013 Meteotsunami

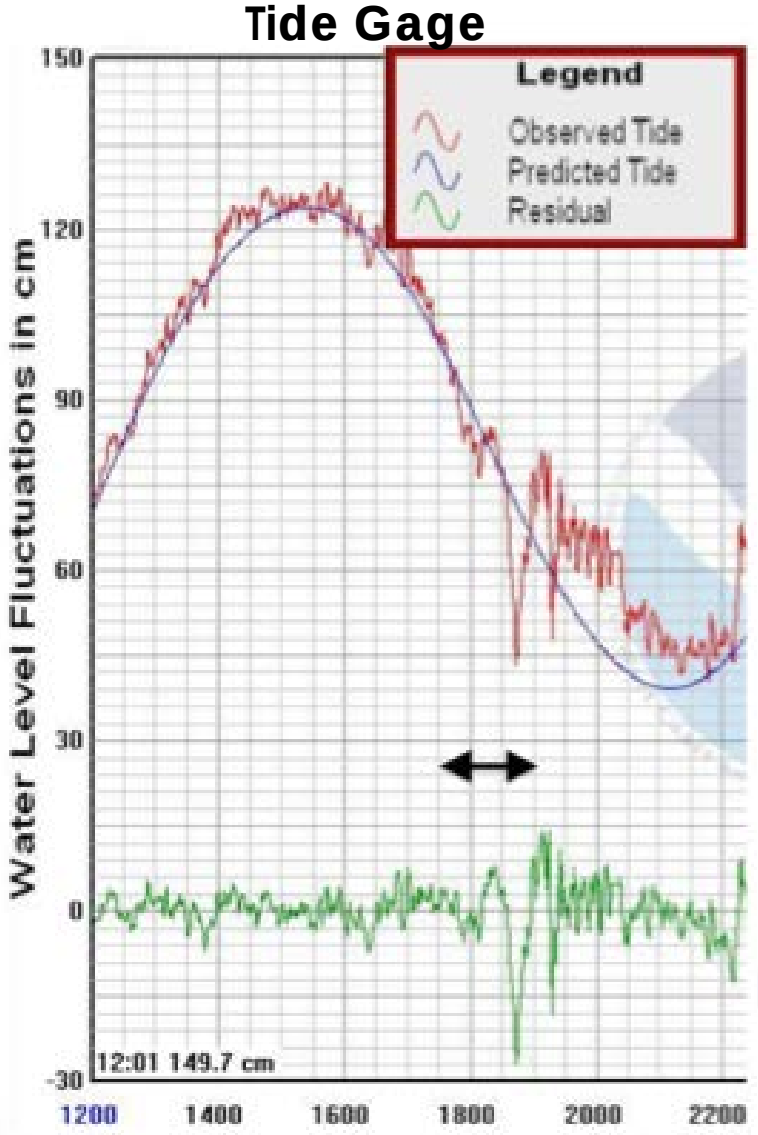
Wave generated traveled Eastward offshore

Strong reflection from shelf edge comes back, hits shore

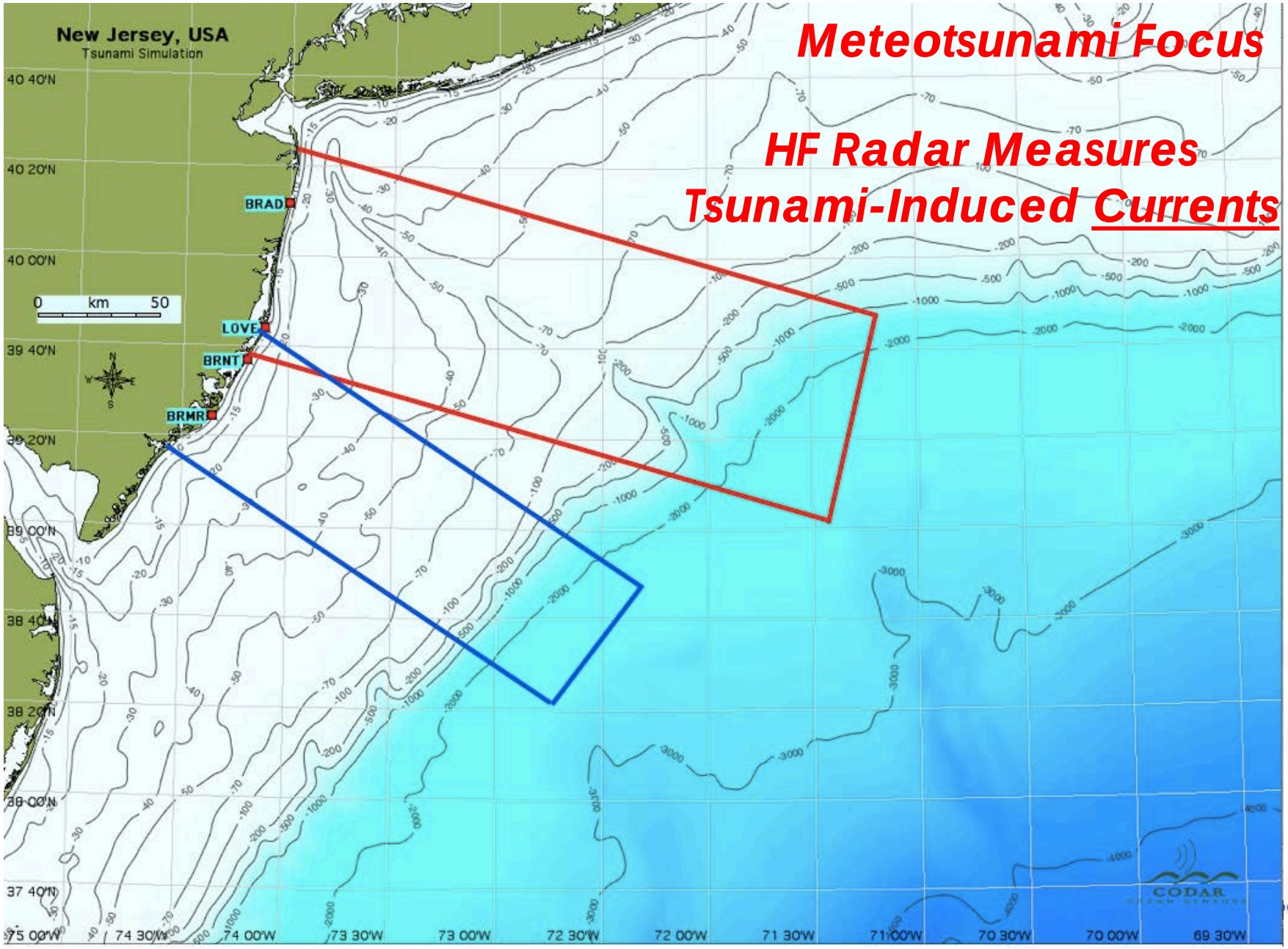
CODAR saw the event 43 minutes before coastal arrival

↔ = time of tsunami





Tsunami Detection: NWS Tsunami WC, CODAR



Wave Measurement: NWS & IOOS

Many studies over 30+ yrs, but none quasi-operational.

*2011: NDBC/CDIP Buoys vs HF radar**

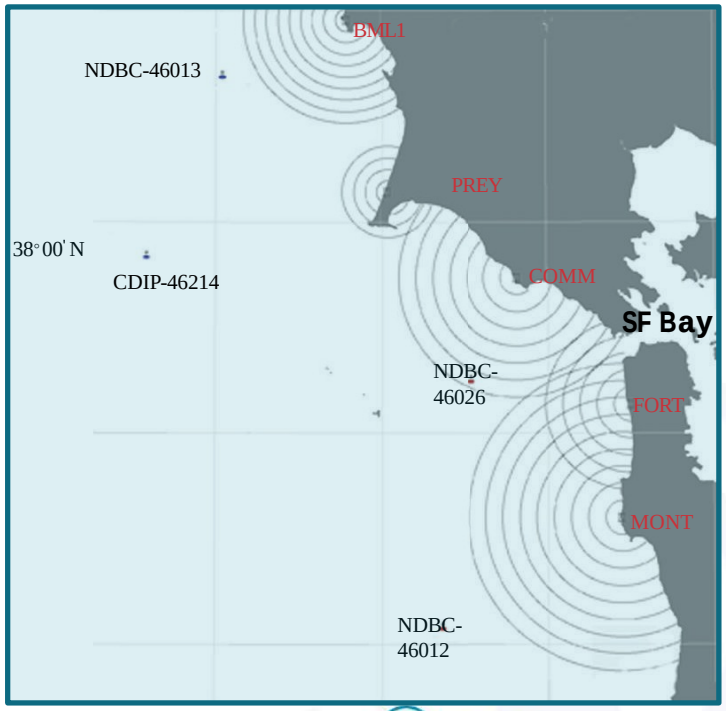
4 Buoys, 5 Radars

15-26 month datasets

Significant Wave Height

Mean RMS Difference Buoy vs HF Radar: 53 cm

Mean RMS Difference Buoy vs Buoy: 50 cm



*Long et al, 2011, Jnl of Sensors

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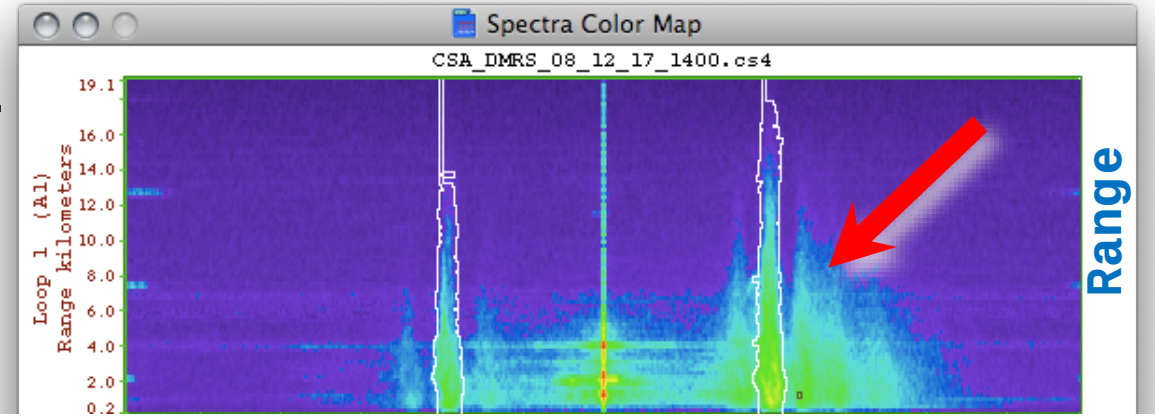
Background: Doppler Spectrum & Wave Info

-Derived from 2nd order peaks in Doppler spectra (red arrow)



Limitations

- 2nd order echo peaks too weak
- Extreme Currents
- Shallow water effects

Summary

- **CURRENTS - Operational**
  - Mature Technology for Measuring **Ocean Current** Velocities over Large Coastal Areas
  - Numerous Mission-Critical Applications
  - Hourly, Near-real-time
  - Robust data management
- **TSUNAMI & WAVES - Under Development**
  - Tsunami: NWS, IOOS, CODAR Ocean Sensors Ltd
  - Waves: Possible Pilot Project - NWS, IOOS