Nationwide Coastal Intelligence:
IOOS High Frequency Radar Products

Jack Harlan, Ph.D.
IOOS HF Radar Network Program Manager
Jennifer Bosch, Ph.D. - IOOS
U.S. Integrated Ocean Observing System (IOOS®)

Policy Neutral, Stakeholder Driven, Scientifically Based
Growth of IOOS HF Radar Network

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

Continual growth a result of commitment to network by IOOS partners

State of CA 44 radars funded Start 2006

Integration of Existing Research Systems
HFRNet Data Infrastructure

~140 Sites Ingested
9 Regional Portals
3 National Data Nodes
HF Radar Technology

Latest Generation CODAR
Combined Transmit/Receive

~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
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 - NC EP WC OFS)
96 hr: Without HF Radar
36,000 Km² Search Area

96 hr: With HF Radar
12,000 Km² Search Area
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
Developing New Products

- Tsunami Detection
- Significant Wave Height
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.

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

Meteotsunami Focus
HF Radar Measures
Tsunami-Induced Currents
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
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