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October 29 2018

# OLD DOMINION UNIVERSITY HF RADAR TEAM







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**OLD DOMINION UNIVERSITY** 

Center for Coastal Physical Oceanography

I D E A FUSION







Ocean View Community Beach Radar Antenna

#### OUTLINE

- High Frequency Radar
  - Introduction
  - Products & Applications
  - Data Access
  - HFR Networks
- Chesapeake Bay Dataset
  - Overview
  - Analysis

# HF RADAR: INTRODUCTION

# SURFACE CURRENT MAPPING



Hourly maps

Spatial coverage dependent on geometry / placement of antennas

Ranges for single antennas High resolution (25 MHz): ~30 km Standard range (13 MHz): ~60 km Long (5 MHz): ~150-200 km







observed wave speed – calculated wave speed = underlying current speed



Freq	λ meters	λ/2 meters	T seconds	C m/s
5	60	30.0	4.4	6.7
13	23	11.5	2.7	3.6
25	12	6.0	2.0	3.0
42	7	3.6	I.5	2.3





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	I I CY				
	MHz	meters	meters	seconds	m
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Bragg Sea Echo	13	23	11.5	2.7	3.
	25	12	6.0	2.0	3.
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Err





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#### DOPPLER SPECTRA



Waves Traveling Toward Antenna

Waves Heading Away From Antenna



## STATION RADIAL MAP

Radial velocities towards/away from the antenna organized into radial cells defined by range rings and 5 degree directional bins

Around each grid point... Combine Radial Vectors (Least Squares Average)



#### **Total Current Velocities**





### HURRICANE ARTHUR



# DATA USE: PRODUCTS & APPLICATIONS

- Search & Rescue
- Oil Spill/Pollution Tracking
- Numerical Models (Validation and Data Assimilation)
- Navigation
- Research

### COAST GUARD SEARCH & RESCUE



#### http://www.noaanews.noaa.gov/stories2009/20090504\_ioss.html

### SHORT TERM PREDICTION SYSTEM DATA FLOW



\*Flow chart provided by Hugh Roarty







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### **HyCOM**

HF Radar

36,000 km<sup>2</sup> \*Slide provided by Hugh Roarty

12,000 km<sup>2</sup>

# SAN FRANCISCO BAY OIL SPILL

- November 7, 2007 8:27am The Cosco Busan hit the Bay Bridge and spilled 58,000 gallons of bunker fuel
- 70 miles of shoreline were affected
- 40% of oil was recovered or evaporated
- Cost: \$3M/day



#### http://cordc.ucsd.edu/about/docs/sfoilspill\_20071107/sfbaytrajsub2\_inside.mov

Cosco Busan Oil Spill Assessment Meeting Notes January 17, 2008 Oakland, CA

# WATER QUALITY APPLICATIONS

Investigate sources of bacteria and pathogens that lead to beach closures

Assessing Coastal Plumes in a Region of Multiple Discharges: The U.S.-Mexico Border Sung Yong Kim, Eric J. Terrill and Bruce D. Cornuelle Environ. Sci. Technol., 2009, 43 (19), pp 7450-745



# NOAA TIDAL CURRENT PREDICTIONS

In 2014 NOAA CO-OPS added tidal current predictions based on harmonic analysis of HF radar surface currents to their Chesapeake Bay PORTS website.

Other PORTS with HFR derived tidal current predictions:

- New York Harbor
- San Francisco Bay

#### Chesapeake Bay HF Radar Surface Currents



http://tidesandcurrents.noaa.gov/hfradar/Hfscm.jsp?port=CHES

### DATA ACCESS

# GRIDDED TOTAL VECTOR DATA IS AVAILABLE AT THESE LOCATIONS:

• <u>http://hfrnet.ucsd.edu/thredds/catalog.html</u> (National product)

- <u>http://tds.marine.rutgers.edu/thredds/cool/codar/cat\_totals.html</u> (Rutgers regional product)
- ERDDAP (<u>https://coastwatch.pfeg.noaa.gov/erddap</u>)

# HFR NETWORKS

## **GLOBAL STATION LOCATIONS**





"International" are other countries in North America that have site data included/displayed in the U.S. HFRNet.



http://cordc.ucsd.edu/projects/mapping/maps/



- 41 High Frequency Radar Stations
  - 17 long range
  - 9 standard range
  - 15 high resolution
- Operated by
  - Rutgers University
  - Old Dominion University
  - University of Massachusetts Dartmouth
  - University of Connecticut
  - Woods Hole Oceanographic Institution
  - 10+ years of coverage extending across the region

# **REGIONAL OPERATIONS**

## **Current Reported Outages**

Site	Reason	Notes	Last Radial Time	Estimated Repair Date	Last Updated
SPRK	operations	Had to remove antenna because of Army Corps beach work.	2018-08-30 16:00:00	2018-09-13	2018-10-27 17:02:42
мусо	power	Power was cut on September 7. WHOI estimates power to be back on by end of September.	2018-09-02 11:00:00	2018-09-30	2018-10-27 17:04:53
CORE	unknown	data loss due to site overheating then site suffered storm damage from Florence	2018-09-11 12:00:00	2018-09-25	2018-10-27 17:06:27
BISL	communications	communication problems, frequent delays in transfer of radial files	2018-10-03 23:00:00	2018-10-17	2018-10-15 09:05:06
MISQ	power	There was a fire at the site. Doesnt appear equipment was damaged but power is out.	2018-10-19 20:00:00	2018-11-02	2018-10-22 09:37:19

# OUTAGE ANALYSIS

Code	Description	Count	Length (days)
<mark>500</mark>	Power	<mark>37</mark>	<mark>251.4</mark>
<mark>300</mark>	<b>Communications</b>	<mark>37</mark>	<mark>292.2</mark>
100	Hardware	29	725.1
200	Computer/Software	25	350.8
400	Site Operation and Maintenance	18	387.5
999	Unknown	11	48.8

### **HF Radar Operator Website**

Log Out Outages Site Checks Site Management My Account Admin

View Status of All Sites

#### **Manage Sites**

Station	Status	Use For Totals	Preferred Pattern Type	
ASSA	Active	Yes ᅌ	Measured ᅌ	Save Changes
ASVT	Inactive	No ᅌ	Ideal ᅌ	Save Changes
CEDR	Active	Yes ᅌ	Measured ᅌ	Save Changes
LISL	Active	Yes ᅌ	Measured ᅌ	Save Changes
SUNS	Active	Yes ᅌ	Measured ᅌ	Save Changes
VIEW	Active	Yes ᅌ	Measured ᅌ	Save Changes
CPHN	Active	Yes ᅌ	Measured ᅌ	Save Changes

## ODU STATIONS



Atlantic Stations - Long Range 5MHz

- ASSA Assateague Island (2006 )
- CEDR Cedar Island (2007 )
- LISL Little Island Park (2009 ) VA Beach

Chesapeake Bay - High Resolution 25 MHz

- CBBT Bay Bridge Tunnel (2007-2015)
- VIEW Ocean View (2007 )
- CPHN Cape Henry (2008 2018)
- SUNS Sunset Beach Resort (2010 )









# CHESAPEAKE BAY SURFACE CURRENTS



HF RADAR STATIONS IN THE LOWER CHESAPEAKE







### DATA AVAILABILITY

Total Maps: April 2007 – present

- CBBT Bay Bridge Tunnel (2007-2015)
- VIEW Ocean View (2007 )
- CPHN Cape Henry (2008 2018)
- SUNS Sunset Beach Resort (2010 )

http://www.ccpo.odu.edu/currentmapping/datasetinfo.htm

#### TIDAL ANALYSIS



M<sub>2</sub> major axis amplitudes

% variance explained by the tidal component

Analysis period: April 2009-November 2015



The percent of the total current velocity variance not explained by the tide plotted with cumulative wind variance in low periods (2-7 days) at CBBT station 8638863. Radar currents are a spatial average over the grid.



# MONTHLY AVERAGE ACROSS ALL YEARS





# **QUESTIONS?**

# http://www.ccpo.odu.edu/currentmapping/





