Surface Currents in the Coastal Ocean Outside Chesapeake Bay

Ms. Teresa Updyke, Dr. Larry Atkinson Oct 16 2012



HF Radar Data

 Surface currents measured by 3 long range HF Radar stations operating at 5 MHz

August 18 2011 21:00 September 14 2011 06:00 UTC

(coincides with a separate project)



5 MHz Tx Antenna 5 MHz Rx Antenna

Area of Focus



Radial Coverage Maps







Unfiltered Time Series



Low Pass Filtered Time Series



Radial Comparisons with Buoy 44014 ADCP

IDEAL PATTERN RADIALS

Station	Distance (km)	Ν	R ²	RMS Difference (cm/s)
CEDR	3.3	350	0.70	12.2
LISL	2.6	488	0.61	12.2
DUCK	1.4	596	0.76	13.9

MEASURED PATTERN RADIALS

Station	Distance (km)	Ν	R ²	RMS Difference (cm/s)
CEDR	3.3	347	0.72	12.7
LISL	2.6	484	0.64	11.9
DUCK	1.4	602	0.75	13.4



CEDR-DUCK Baseline

IDEAL PATTERN RADIALS

MEASURED PATTERN RADIALS



Location Separation: 3.2 km RMS Differences 24.2 and 22.8 cm/s

Total Velocity Comparisons with Buoy 44014 ADCP

U COMPONENT

Туре	Ν	R²	RMSD (cm/s)
Ideal	543	0.65	11.6
Measured	541	0.64	11.6

V COMPONENT

Туре	Ν	R ²	RMSD (cm/s)
Ideal	543	0.49	16.8
Measured	541	0.54	16.1

COMPLEX CORRELATION (Kundu 1976)

Туре	Amplitude	Angle
Ideal	0.60	8.2
Measured	0.60	9.1

$$r = \frac{\left\langle W_1^*(t)W_2(t) \right\rangle}{\left\langle W_1^*(t)W_1(t) \right\rangle^{\frac{1}{2}} \left\langle W_2^*(t)W_2(t) \right\rangle^{\frac{1}{2}}}$$
$$W(t) = u(t) + iv(t)$$

Total Velocity Vector Comparisons with Buoy 44014 ADCP





Major Axes of Subtidal Flow



Correlation of Subtidal Current Velocity with Wind Speed



Particle Trajectories



Trajectories for three particles. Starting time is August 18 2011 14:00 UTC. The particles move out of range at Aug 27 14:00, Aug 26 10:00 and Aug 27 11:00 for the blue, green and red tracks respectively.

Summary

- Comparison of HFR radials and totals to ADCP yielded R² values 0.49-0.75 and root-mean-squares differences of 11.9-16.9 cm/s (in line with other studies)
- Radial comparisons at the middle of the baseline between DUCK and CEDR were more weakly correlated
- Analyses with ideal and measured pattern radials produced similar results
- Major axis of flow was directed along-shelf within the study area except just outside Bay mouth where it was across-shelf during this time period
- Low pass filtered north-south winds were well correlated with the eastwest component of local subtidal current outside the Bay mouth

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Antenna Patterns



CEDR LISL DUCK