

# SEACOOS MINI-WAVES EXPERIMENT

February-April 05

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**Synopsis:** Phased-array high frequency (HF) radar offer promise in not only resolving the surface velocity field, but also in observing the spatial variability of significant wave heights and properties of the directional waves. Briefly, significant wave heights are proportional to the 2<sup>nd</sup> order returns in the Doppler spectra normalized by the 1<sup>st</sup> order returns as per Barrick (1977) and Wyatt (1988). Directional wave properties may also be obtained through the inversion of a nonlinear integral equation using the 2<sup>nd</sup> order returns (Wyatt 1999). As Wyatt points out there are several methods using HF radar data from phased arrays. For the sake of brevity, we will not go through the details, rather all studies stress the importance of having in situ measurements to calibrate these empirical approaches.

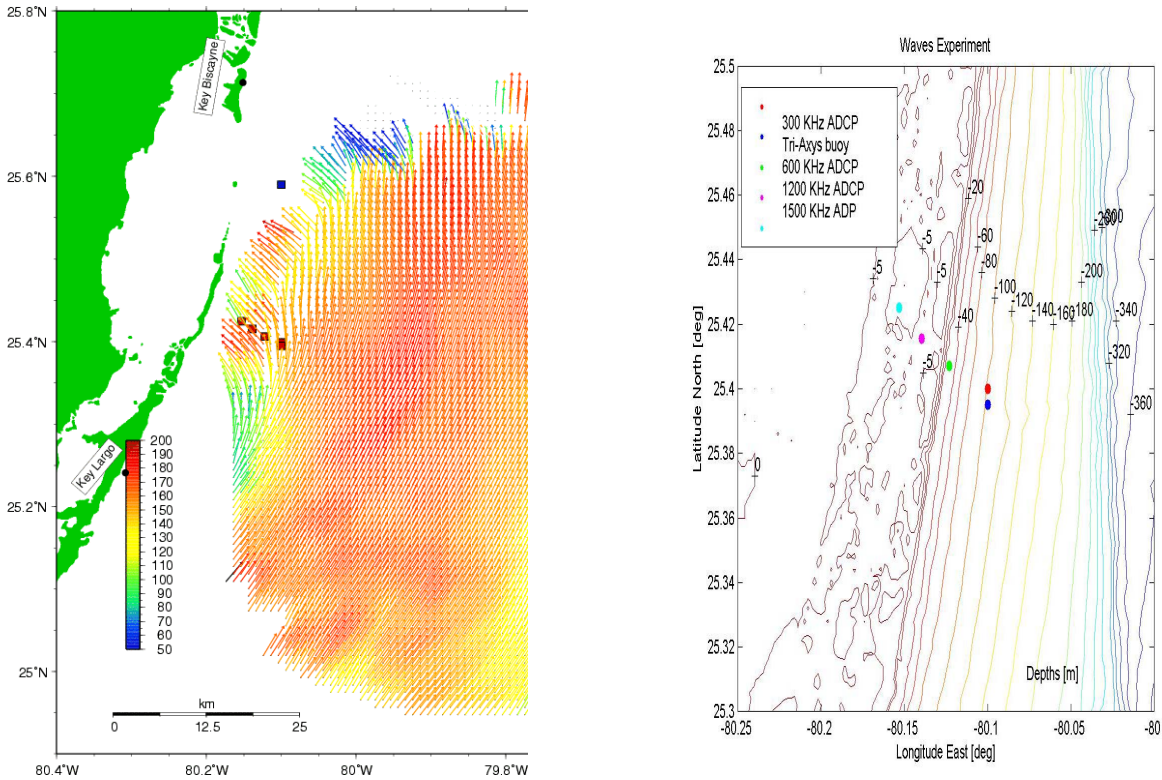
**Goal:** The overarching goal of this experiment is to directly measure the wave field including the 2-D wave spectra in the 3-site Wellen Radar (WERA) domain in a regime with strong horizontal velocity shear and a large cross-shelf topographical gradient. In this context, the objectives are twofold:

1. To compare significant wave height and directional wave properties from the WERA HF radar to those from in-situ measurements from moored ADCPs and a TRIAXYS directional wave buoy; and,
2. To establish parameter ranges over which the various platforms are useful for observing directional wave spectra.

A key aspect will be to provide these observed wave parameters to NOAA to assess their operational forecast needs in South Florida where in-situ wave information is not available.

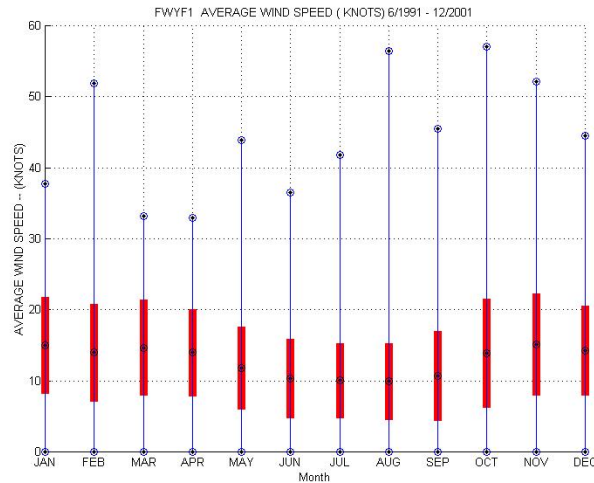
**Experiment Plan:** The WERA HF radar domain as currently operating covers much of the Florida Straits from Key Largo, FL to Miami, FL (Fig. 1). However because of the large spacing between the shore stations, the inner-shelf coverage is limited to the area between  $\sim 25.3$  N and 25.55 N. This region has dual-radar coverage that should allow extraction of the full directional wave spectrum. For the purposes of this experiment the maximum available bandwidth of the WERA will be transmitted in order to achieve spatial sampling resolutions of  $\sim 500$  m. The strong horizontal current shear in this region as well as the cross-shelf topographic variability causes a spatially variable wave climate. This will enhance the scientific value of this SEACOOS related study in assessing radar and moored ADCP-derived wave properties undergoing both depth and current-induced refraction and shoaling.

A 300 KHz ADCP (B. Johns) will be moored in 100 m of water in close proximity to the TRIAXYS wave buoy (P. Work) to provide local current profiles. A 600 KHz ADCP with a directional wave package (G. Voulgaris) will be deployed 20-40 m deep. A 1200 KHz ADCP with a directional wave package (G. Voulgaris) will be deployed in 5-10 m of water. Additionally a 1500 KHz ADP (B. Haus) will be deployed on a < 5 m deep shoal. The moorings will be aligned along a cross-shelf transect because the mean flows tend to be aligned with the topography in this region.



**Figure 1.** Subset of the WERA observed surface velocity in (left panel:  $\text{cm s}^{-1}$ ) on YD 194 15:00 GMT where the approximate mooring locations are given by red squares and the Fowey Rock CMAN station is given by a blue square, and an expanded view of mooring locations relative to bottom topography (right panel: m) where the mooring locations are color coded.

**Timeline:** The Southeast Florida climate exhibits stronger mean winds from October through April (Fig. 2). During this period, both the wind direction and velocity tend to vary with cold frontal passages that provide a wide range of conditions over which to compare the measurements. Conducting the experiment during the late-winter to spring (Feb 05 – April 05) reduces the complications associated with offshore operations during hurricane season. A tentative schedule would be to stage the instruments in Jan 05, deploy in Feb 05, and recover them in April 05. The R/V Walton Smith schedule in Jan-Feb 05 has not been set yet so an exact deployment and recovery times are not known. In addition to shipping and mooring hardware costs, approximately four days of ship-time will be required to deploy and recover the moorings, therefore the experiment should continue as long as schedules and battery life allow. The four ADCPs will be battery operated and self recording, while the TRIAXYS buoy will send data via a satellite link to the GT.



**Figure 2.** Climatological mean and standard deviation of wind speed recorded at the Fowey Rocks CMAN station. Maximum value recorded during each month also is shown.

**Budget:**

	FY05
GA Tech Budget (equipment,shipping)	\$5
RSMAS (2-days Ship Time)	\$16.3
Divers	1.2
Misc Supplies (Moorings)	\$2.5
UM Budget	\$20K

The budget is primarily for two days of ship time and diver support at RSMAS to deploy and recover the GT TRIAXYS wave buoy and upward looking ADCPs from USC and UM. We are exploring the possibility of using a small boat for deployment, although during the winter months, we may have to use the R/V Walton Smith for deployment and recovery of the wave and current moorings. The GT budget is \$5K. USC did not request any funds as UM will provide the diving support in deploying and recovering the instruments. Miscellaneous supplies are extra batteries, moorings and hardware.

**References:**

D.E. Barrick, "Extraction of wave parameters from measured HF radar sea-echo Doppler spectra," Radio Science, vol. 12(3), 1977, pp. 415-424.

Wyatt, L. R., "Significant waveheight measurement with HF radar," J. Rem. Sensing, vol. 19(6),1988, pp. 1087-1095.

Wyatt, L. R., S.P. Thompson, R.R. Burton, "Evaluation of high frequency radar wave measurement," Coastal Engineering, 37, 1999, pp. 259-282.