Radar Measurement of Waves and Currents in the Nearshore Zone

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LONG-TERM GOALS

My long-term goal is to contribute to our understanding of the upper ocean and lower atmosphere through the development and application of microwave, acoustic, and optical remote sensing techniques.

OBJECTIVES

The objective of this effort is to establish whether interferometric radar techniques can provide useful estimates of nearshore currents and of surface displacements (wave heights) within and beyond the surf zone.

APPROACH

Our approach is to observe an area of the nearshore with the Focused Phased Array Imaging Radar (FOPAIR), an X-band imaging Doppler radar, and to employ techniques similar to those of interferometric synthetic aperture radars to estimate surface currents and wave heights. Surface velocities are obtained through cross correlation of radar echoes separated in time, while surface displacements are obtained through correlation of echoes separated in space (i.e. from vertically spaced antennas). Our measurements are to be compared to those of submerged current and pressure sensors deployed within and near the radar's field-of-view. A pilot experiment in Fall 2000 includes collaboration with Britt Raubenheimer, Steve Elgar (WHOI), and Bob Guza (SIO) who are engaged in swash-zone and surf-zone studies using fixed and drifting sensors.

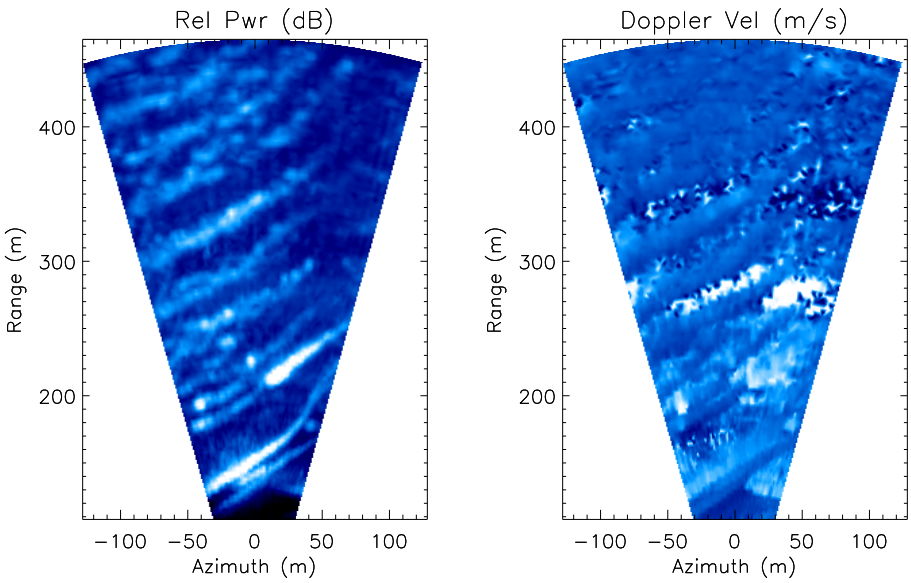

Figure 1: Sample power (left) and Doppler velocity (right) images of the surf zone and beyond North of the Scripps pier.

WORK COMPLETED

During summer 2000 preparations for the Fall 2000 pilot study were completed. As of 3 October, the FOPAIR radar has been deployed atop the Center for Coastal Studies building near the foot of the pier at Scripps Institution of Oceanography. There, graduate student Gordon Farquharson is responsible for the radar's successful operation. A swash-zone study (B. Raubenheimer, S. Elgar) and surface drifter tests (B. Guza) are underway to the North of the pier.

RESULTS

Figure 1 shows one snapshot radar image of the surf zone and beyond obtained on 4 Oct 2000. Here the radar is oriented towards the Northwest. The surf zone extends approximately from 100 m - 250 m range. Breaking wave fronts are evident in the power image (brightest features) while surface velocities between -5 m/s (black) and +5 m/s (white) are shown in the Doppler image. The highest velocities near 300 m range may reflect projected phase velocities of steepening waves. This illustrates that the proper classificaton and averaging of radar measurements is a critical task to be dealt with in the data analysis.

IMPACT/APPLICATIONS

The imaging radar measurements of the surf zone made here are unique, and the displacement maps we plan to produce will be the first of their kind made in the surf zone. Once validated

through comparison with in-situ sensors, these data products should prove extremely useful in the study of nearshore dynamics.

TRANSITIONS

We have coordinated our measurements efforts with a aircraft sensor campaign (R. Fiedler, NRL) also aimed at retrieving nearshore parameters from remotely sensed data. Two overflights have been scheduled for 23 and 24 October. Surface Doppler velocities collected by FOPAIR will be made available for that program.

RELATED PROJECTS

1 - Video PIV techniques for estimating alongshore currents in the swash zone are under investigation by T. Holland (NRL) with whom we intend to share our observations.

2 - The radar techniques employed in this work are similar to those employed by airborne interferometric SARs. Under separate ONR support, we are developing such a radar system that may be applied to nearshore remote sensing problems.