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14. ABSTRACT A dual-polarized, coherent, X-band microwave radar called RiverRad was deployed at the Coastal Engineering Field Research Facility at Duck, NC in April, 2008. The purpose of the deployment was to utilize this calibrated radar to calibrate a marine radar operated by Oregon State University (OSU) on a long-term basis at Duck and to study microwave backscatter in the surf zone. Data from RiverRad were compared with those from the marine radar and with imagery from several video systems also deployed at Duck by OSU on a long-term basis. Besides providing accurate calibration of the marine radar, RiverRad data also showed that HH polarized backscatter from the surf zone is frequently equal to or larger than that of VV when averaged over several minutes. Scattering from whitecaps was studied using a volume scattering model and found to produce HH and VV backscatter at nearly equal levels. The origin of the high HH values is still under investigation.					
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Final Report for the ONR Project “Collaboration with Oregon State University at Duck, NC

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Our RiverRad X-band, coherent microwave radar was operated at Duck, NC along with OSU’s marine radar and video cameras during the month of April, 2008. Figure 1 below shows RiverRad on the dunes at Duck with the marine radar in the background. Figure 2 shows RiverRad from the other side with the ocean in the background.



Figure 1.

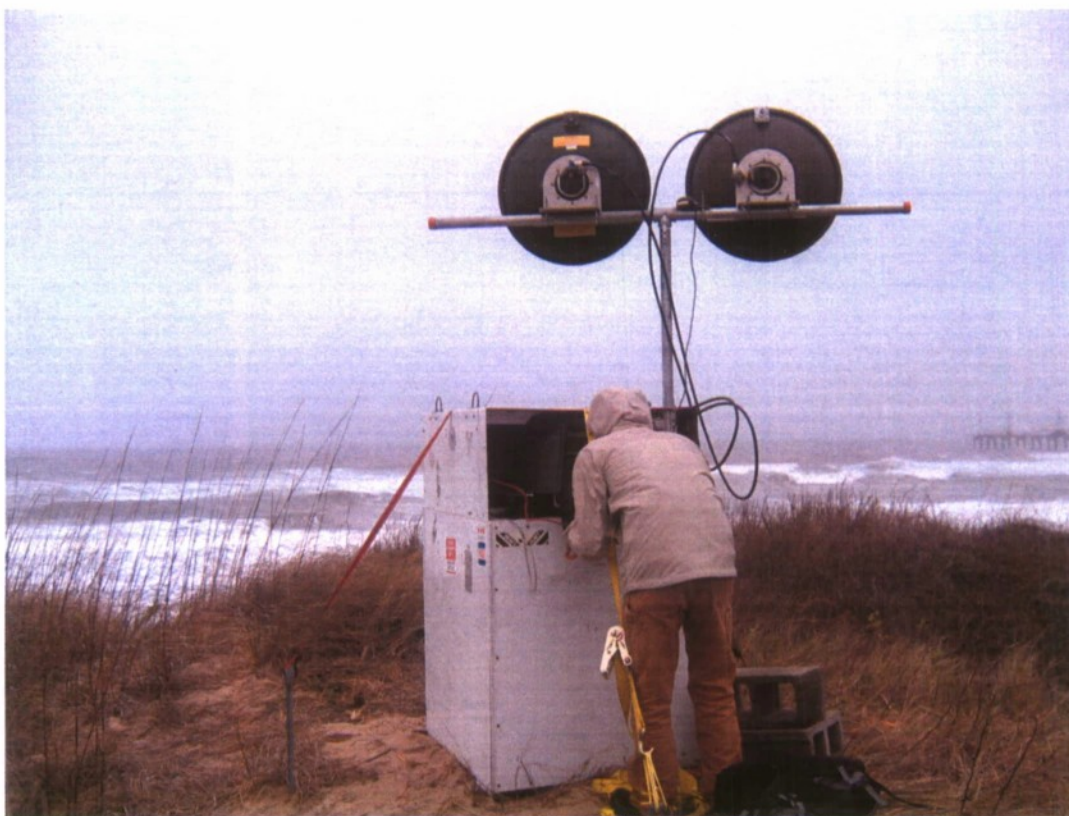


Figure 2.

RiverRad successfully collected data at both HH and VV polarizations and provided calibration references for the marine radar as planned. The marine radar was calibrated by observing the same scene as RiverRad for a period of time and adjusting its average cross sections to match those of RiverRad.

The data collected during this experiment are documented in the following figures. Figure 3 shows cross sections (σ_o , left column) and scatterer velocities (V_h , right column) measured by RiverRad in the nine azimuth directions it was set to measure. The top row shows return at VV polarization while the bottom row shows return at HH. The green vertical line is the Duck pier.

Figure 4 shows the various quantities plotted versus range when RiverRad's antennas were pointed directly offshore. The top row shows V_h (left) and σ_o (right) averaged over about two minutes. The results clearly show that on average HH cross sections are larger than VV in the surf zone. This is directly opposite that usually observed in the open ocean. Average velocities, on the other hand, were comparable at HH and VV near shore but showed HH larger than VV farther out. The bottom row shows Doppler offsets and cross sections from an individual scan, ie, averaged over only about 1.5 seconds. The Doppler offsets produced the velocities that were averaged to produce the plot above it. The cross sections in the right bottom plot clearly show the waves progressing toward shore and the increases in cross section that occur near wave crests.

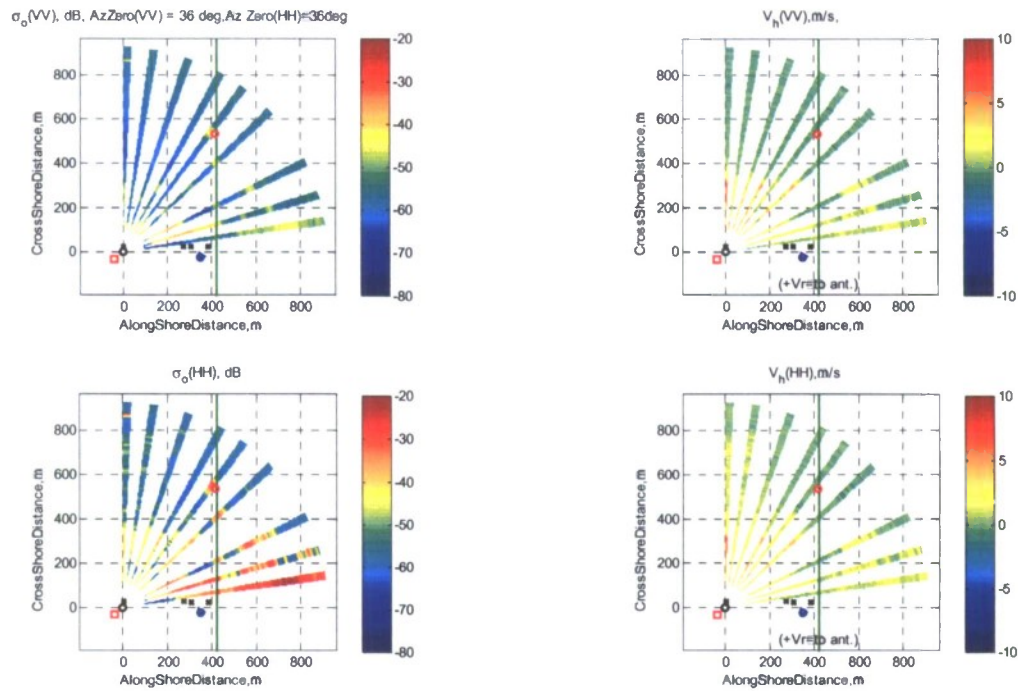


Figure 3.

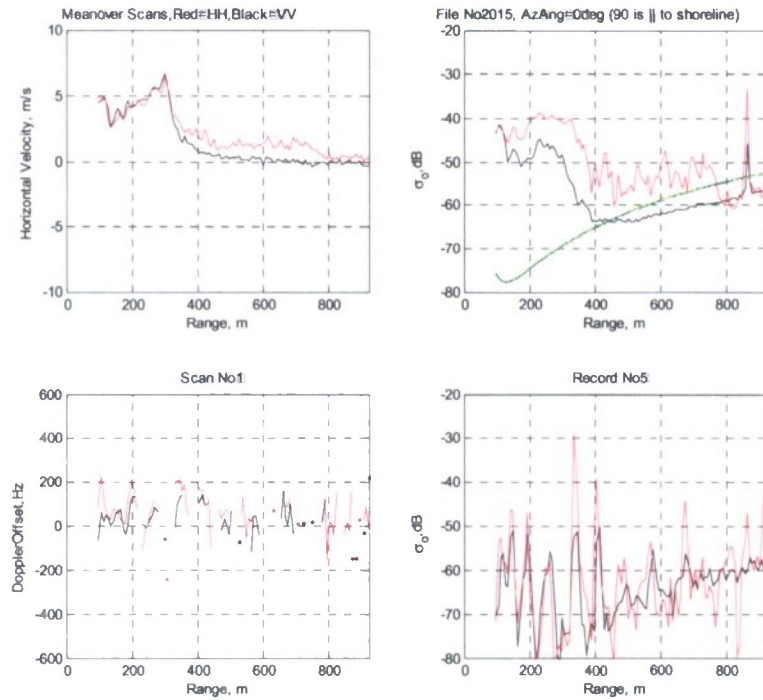


Figure 4.

Some aspects of these results, those related to whitecaps, formed the basis of Patricio Catalan's PhD thesis. He aligned camera frames with return to the marine radar and RiverRad to determine the nature of the radar return during whitcapping. He showed that in these regions HH and VV cross sections were nearly equal and explained this result as a result of volume scattering from the spray droplets formed by the breaker. A short version of this work was published in the proceedings of the ICCE conference. This paper is attached to this report.

Clearly volume scattering cannot explain, notably, those where HH backscatter exceeds VV and we are working on this aspect of the data now. The mechanism of this scatter must be determined if accurate currents are to be obtained from the RiverRad data. We are also working with the data in Patricio's thesis to distil it into journal articles. At present two journal articles are planned to document this work.