OCEAN SURFACE BACKSCATTERING AT EXTREMELY LOW GRAZING ANGLES OBSERVED BY C-BAND POLARIMETRIC DOPPLER WEATHER RADAR: DOPPLER SPECTRUM ANALYSIS

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INTRODUCTION

Ocean surface backscattering at extremely low grazing angles has been examined numerically [1, 2] and experimentally with X-band polarimetiric radar [3, 4], with C-band Doppler radar [5, 6], and so on. However, the Ocean surface model has not clearly defined to interpret the radar backscattering. We analyze our ocean observation results by a C-band polarimetric Doppler radar at an extremely low grazing angle, to try to interpret the backscattering mechanisms on the ocean surface.

RADAR

A C-band (5.34 Ghz) multi-parameter radar has been operated in the Okinawa Subtropical Remote Sensing Center, National Institute of Information and Communications Technology (NICT), Japan. It is a full-polarimetric radar with Doppler measurement capability, located on the top of a mountain in the center of the Okinawa Island (128.06ºE, 26.59ºN, 360m above sea level), Japan. It observes precipitation in sub-tropical maritime climate region, to study methodology of precise estimates of rainfall rates and classifying precipitation particles [7]. The radar has two Klystron transmitters of 250 kW for transmission of alternate polarization (horizontal or vertical) signals by pulse to pulse, and two receivers for reception of both horizontal and vertical polarizations of backscattering echo from the targets. It has a typically 200 km coverage with the parabolic antenna of 4.5 m diameter (the beamwidth of 0.9 degree), transmitting 2.0/1.0/0.5 μsec pulses. Its spatial resolution, therefore, is a few kilometers in azimuth and a few hundred meters in range.

OCEAN OBSERVATION

The Okinawa Island is relatively small, roughly 100 km in south to north and 20 km in east to west, with the highest point is at about 500 m above sea level (to the northeast of the radar). Located at 360 m above sea level, the radar has good view of the surrounding ocean. Therefore, we decided to utilize the radar for observation of not only rainfalls but ocean surfaces. We have observed ocean surfaces in different wind conditions, since February 2007, taking a Plan Position Indicator (PPI) scan at extremely low grazing angles. The grazing angle was chosen to be 0.5º, so that the radar covered 20 to 100 km in the range. The preliminary results showed that the radar cross-section was larger as the wind speed became larger. Downwind side of the island showed smaller radar cross-sections, as the island seemed to block the wind [8].

DATA ANALYSIS

In the last IGARSS, we presented detailed quantitative analysis of observed radar cross-sections and Doppler velocities versus the radar range, depending on the wind speed and direction. Also examined were dependency of the radar cross-section on polarimetric channels: HH (transmitting horizontal polarization and receiving horizontal polarization), HV, VV [9]. The very high Doppler velocities of about 4 m/s was observed in the upwind case (the wind speed is about 10 m/s), but we couldn't interpret what kind of movement of the ocean waves makes the velocities. In this paper , to understand the phenomena we try to analyze the Doppler specra, its numbers and shapes, rather than the estimated speed.

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