Radar Probing of Steep Gravity Waves. Wave Tank Experiment.

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Abstract – **Results of wave tank experiment on radar probing of steep gravity waves are discussed. It was shown that Ka-radar backscatter signal from cm –dm steep surface waves is connected with gentle breaking and parasitic capillary ripples generation; backscatter signal from dm-m surface waves is connected with strong breaking and free ripples generation.**

Keyword – **Radar measurement, surface waves**

I. Introduction

Understanding of mechanisms of radar backscattering formation is very important for development of radar scattering models and for interpretation of results of ocean radar remote sensing, in particular, for estimation the amplitudes of long waves, ocean currents, characteristics of surfactant films, etc.

II. Results of the Experiment

Wave tank experiments were carried out to study an influence of gentle and strong breaking of surface waves on the Ka-radar signal at moderate angles of observation (resonance or Bragg scattering mechanism). The scheme of the experiment realized in the Oval Wave Tank of the Institute of Applied Physics RAS (see, Fig.1) is shown in Fig.2. Gentle breaking occurs for centimeter-to-decimeter-scale gravity-capillary waves (GCW), which at high enough steepness can generate so-called parasitic capillary ripples (millimeter-scale waves) on the forward slope of the basic wave (see, [1] and cited literature). The schematic profile of the steep wave with parasitic capillary ripples is presented in Fig. 3. A typical Doppler spectrum of Ka-band radar demonstrates a maximum at a frequency corresponding to the phase velocity of the Bragg waves (see, Fig.4). The phase velocities of the ripples and of the basic waves were measured at different frequencies and different amplitudes of the basic waves and corresponding dependencies are presented in Fig.5,6. It is obtained that parasitic capillary ripples connected to the basic waves of 3-5 Hz are quasi-stationary, i.e. the phase velocities of the ripples and of the carrying GCW are close to each other (see, also [1]), and the critical (threshold) steepness of the carrying GCW corresponding to ripple generation and to sharp growth of radar backscatter intensity is about 0.1 in a wide range of the carrying wave frequencies. The latter is demonstrated in Fig.7,8. Since the intensity and the velocity of capillary ripples are determined by the characteristic of the basic waves, the ripples are often characterized as “bound waves” in order to distinguish them from free waves.

Fig.1 Oval Wave Tank

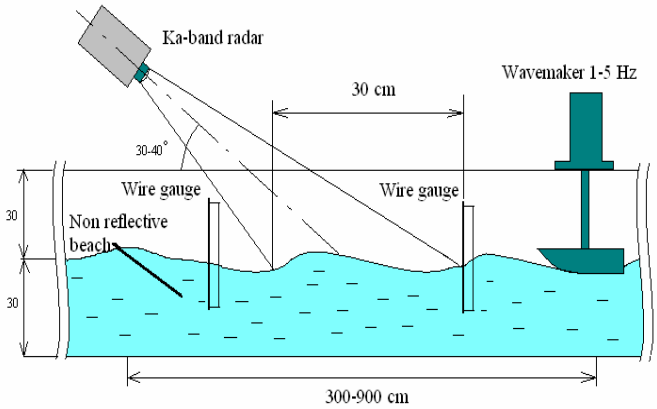

Fig.2. Laboratory set.