

Dynamics of Short Waves Spectrum Measured by Remote and Contact Sensors from an Oceanographic Platform

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Abstract—The paper presents the results of the experiment CAPMOS'05 performed on an offshore oceanographic platform in the Black Sea. Microwave radiometer measurements were applied for gravity-capillary wave spectrum retrieval using the original techniques. The spectrum components evolution under unstable wind conditions was investigated. It was demonstrated that the spectral components in the vicinity of the curvature maximum are the most sensitive to the wind velocity variations.

Index Terms—Microwave radiometry, remote sensing, sea surface.

I. INTRODUCTION

SHORT gravity and gravity-capillary waves play very important role in ocean-atmosphere interaction affecting the momentum exchange through wind waves generation and dissipation. At the same time, short waves affect the electromagnetic waves emission and scattering from a sea surface, and this effect is used in satellite radiometers and scatterometers for remote measurements of winds over ocean. The relations between wind, waves and emitted/scattered signal are extremely complicated and can hardly be described unambiguously by any theoretical model. Therefore experimental measurements of the ocean-atmosphere interaction parameters under various meteorological conditions are of high importance.

The paper presents the results of the experiment CAPMOS'05 performed on an offshore oceanographic platform in the Black Sea in June 2005. The experiment aimed at air-sea coupling investigations by means of direct and remote measurements was carried out in frames of the project CAPMOS ("Combined Active / Passive Microwave Measurements of Wind Waves for Global Ocean Salinity Monitoring") sponsored by INTAS (International Association for the promotion of co-operation with scientists

from the New Independent States of the former Soviet Union). The project joined several research teams from Russia, Ukraine, Denmark and Italy experienced in experimental study of ocean and atmosphere. The major goal of the experiments was to compare the results of synchronous active and passive microwave measurements of waved sea surface, focusing on the ocean wave spectrum retrieval.

The task of wave parameters measurement in an open sea is a considerable challenge, especially for short gravity-capillary waves. Traditional wave gauges are not usable for very short wave measurements because of disturbances introduced by a gauge itself. The problem may be solved by applying remote techniques, either optical or microwave radar. In the following sections a novel approach for the short gravity-capillary wave spectrum retrieval from radiometric measurements is described. The dynamics of retrieved spectral components under unstable wind was traced.

II. THE EXPERIMENT

The experiment CAPMOS'05 was performed on an offshore oceanographic platform (Fig. 1) located about 600 m to the south of Crimea coast near Katsiveli, Ukraine. The sea depth at the site is 28 to 32 m, so the deep water and long fetch conditions were ensured for prevailing winds from the south, south-east and south-west. More details about the experiment can be found in [1].

This paper describes the results obtained with microwave radiometers. List of radiometers enabled during the experiment included S-band radiometer (V-pol.), K-band polarimeter (3 Stokes parameters), Ka-band polarimeter (3 Stokes parameters), W-band radiometer (V- and H-pol.), and thermal infrared band (IR) radiometer. Corresponding wavelength ranged from 8 cm down to 8 μ m.

All the radiometers were mounted on an automatic rotator (Fig. 2), which made it possible to change the angle of observation in both azimuth and elevation planes. The rotator with radiometers was mounted on a boom 4 meters long, to reduce the reflected radiation from the platform itself as well as a wave pattern distortion; the boom was mounted on the lowest deck at 4 meters above the surface on the south side of the platform looking to the open sea. On

Manuscript received April 18, 2008. This work was supported by INTAS under project 03-51-4789 and in part by RFBR under projects 05-05-64451 and 08-05-00890.

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