

Investigation and classification of spume droplets production mechanisms at hurricane winds

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Sea sprays are typical element of the marine atmospheric boundary layer of important environmental effect. There are still significant uncertainties in estimations of these effects due to insufficient knowledge on the sea spray generation function. The reason for that are difficulties of direct measurements and insufficient knowledge about the mechanisms of the spume droplet's formation. This study is concerned with the laboratory experiments for identification of mechanisms due to which a strong wind tears off water from the crest of the waves made at the high-speed wind-wave flume of IAP RAS. In order to obtain statistical data for the events on the surface, leading to the spray generation a high-speed video-filming was made using a horizontal and vertical shadow methods at rates of up to 10,000 fps in a wide range of wind speeds (20 - 35 m/s). Classification of phenomena responsible for generation of spume droplets was made. It was observed for the friction velocities from 0.8 to 1.5 m/s that the generation of the spume droplets is caused by 3 types of local phenomena: breaking of "projections" see e.g.[1], bursting of submerged bubbles [2,3] and bag breakup - it begins with increase of small-scale elevation of the surface, transforming to small "sails" then inflated to a water film bordered by a thicker rim and at last blows up, so the droplets are produced from rupture of the water film and fragmentation of the rim (the first report on the observation of a new mechanism of spume droplets', similar to bag-breakup regime was made in [4]). Statistical analysis of number of these phenomena at different winds showed that the "bag-breakup" is the major mechanism of spume droplets generation at strong and hurricane winds. Statistical distributions of observed "bags" geometrical parameters at different airflow velocities were retrieved from video-filming using specially developed software which allowed semi-automatic registering of image features.

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