Numerical modeling of wave propagation on the coral reef based on high resolution 3D topography

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Coral reefs commonly act as natural barrier against swell wave impact. Conventionally, reefs efficiently attenuate storm waves. However, recent studies have indicated that during energetic typhoon swells, generation of infragravity waves can lead to hazardous conditions where the reef does not act like a protecting barrier anymore. In order to know the wave behavior near and over the reef, high-resolution 3D topographic data is required for the numerical calculation. However, most of the previous studies result from one- or two-dimensional numerical calculations based on low-resolution topographic data. This is mainly due to the challenging environment for conducting bathymetry/topography surveys in the vicinity of the reef. Hence, it was difficult to discuss the wave processes under the influence of the microtopography. In this study, we developed high resolution and complete set of the 3D topographic data (girid size: 1 m) from land to about 95 m water depth at the east coast of Kudaka Island, Okinawa Prefecture (an area of approximately 3 ×5 km) by UAV topographic and multibeam bathymetric surveys. Based on the terrain data with 5 m mesh size, we conducted two-dimensional wave-by-wave calculations with the Boussinesq-type wave model, BOSZ. The results show that the deformation and propagation mechanisms of the waves near the reef are highly controlled by microtopography features such as the differences in slope angles and the presence of spurs and grooves.

Keywords: Wave, Storm wave, Coral reef, Multi-beam survey, UAV, Numerical simulation

