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Influence of hurricane wind field in the structure of directional wave spectra

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Extensive field measurements of wind waves in deep waters in the Gulf of Mexico and Caribbean Sea, have been analyzed to describe the spatial structure of directional wave spectra during hurricane conditions. Following Esquivel-Trava et al. (2015) this analysis was made for minor hurricanes (categories 1 and 2) and major hurricanes (categories 3, 4 and 5). In both cases the directionality of the energy wave spectrum is similar in all quadrants. Some differences are observed however, and they are associated with the presence and the shape of swell energy in each quadrant. Three numerical experiments using the spectral wave prediction model SWAN were carried out to gain insight into the mechanism that controls the directional and frequency distributions of hurricane wave energy. The aim of the experiments is to evaluate the effect of the translation speed of the hurricane and the presence of concentric eye walls, on both the wave growth process and the shape of the directional wave spectrum. The HRD wind field of Hurricane Dean on August 20 at 7:30 was propagated at two different velocities (5 and 10 m/s). An idealized concentric eye wall (a Gaussian function that evolve in time along a path in the form of an Archimedean spiral) was imposed to the wind field. The white-capping formulation of Westhuysen et al. (2007) was selected. The wave model represents fairly well the directionality of the energy and the shape of the directional spectra in the hurricane domain. The model results indicate that the forward movement of the storm influences the development of the waves, consistent with field observations. This work has been supported by CONACYT scholarship 164510 and projects RugDisMar (155793), CB-2011-01-168173 and the Department of Physical Oceanography of CICESE.

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