ON THE TURBULENCE INDUCED BY NON-BREAKING SURFACE WAVES

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Abstract Upper ocean turbulence is a very relevant process within the context of quantifying the exchange between the atmosphere and the ocean. We present results of a study of turbulence induced by non-breaking waves from detailed observation in a small wave tank facility in the Faculty of Marine Science of the University of Baja California. The experiments were carried out with mechanically generated monochromatic waves in a tank of approximately 12m x 0.5m x 0.3m with a varying steepness (ak) from about 0.02 to 0.18, and detailed measurements of the vertical profile of the 3d velocity field within a water column of about 0.035 m in length. Routine data quality control includes the use of only high beam correlation signal within each of the acoustic beams used by the profiler. A rotation matrix was applied to the velocity data matrix in order to secure that the x, y, and z axes were properly aligned with the wave tank. Rather low wave reflection was obtained through the implementation of a beach at the end of the wave tank. The intermittent character of the turbulence present is shown as a region following the -5/3 power law in the spectrum. Nevertheless, this spectral shape is being observed in most of our experimental results, particularly in those where the wave steepness was not too small. Root mean square values are obtained from the turbulent fluctuations time series to evaluate an integral quantity to characterize the turbulence intensity. This intensity is analyzed in terms of the wave steepness showing a linear relationship. The turbulent kinetic energy dissipation rate is also estimated and the relevance of the velocity spectra directly estimated over a limited number of wavenumber bands is addressed.

This work represents a RugDiSMar Project (CONACYT 155793) contribution and support from CONACYT project CB-2011-01-168173 is greatly appreciated.

TURBULENT FLUCTUATIONS IN THE VELOCITY FIELD

We follow [1] in order to deal with the total observed velocity field and to extract the wave associated signal as well as the turbulent fluctuating component. Spectral analysis of the turbulent fluctuations time series is performed in order to obtain insight of the character of the velocity field. The velocity spectra showed most of the time a region with a -5/3 power law behavior, while intensity associated with the horizontal component showed higher values when compared to those form the vertical components, particularly when considering the range associated with the turbulent fluctuations.

Turbulent Reynolds stresses are also obtained for horizontally and vertically associated fluctuations. In this work, a version integrated over the probed water column show a linear dependency with the wave steepness.

The turbulent kinetic energy dissipation rate is estimated through the vertical shear of both, the vertical and horizontal velocity components. A vertical dependence is noticeable which is to be associated with the wave steepness during each experimental run.

Finally, first attempts to estimate the velocity spectra as a function of the wavenumber will be discussed.

References

[1] F. Veron, W. K. Melville, and L. Lenain. Wave coherent airsea heat flux. *J. Phys. Oceanogr.*, **38**, 788–802, 2008.