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Air-Sea momentum fluxes under conditions of combined wind-sea and opposing swell

Francisco Ocampo-Torres and Héctor García-Nava
CICESE, Physical Oceanography, Ensenada, Mexico (ocampo@cicese.mx, 52646 1750568)

Direct measurements of the momentum exchange between the ocean and the atmosphere were acquired from a spar buoy under conditions of mixed wind-sea and swell. In this particular experimental site, offshore winds generally occurring during winter season generate waves locally opposing the swell arriving from distant storms in the southern Pacific and Antartic Oceans. The experimental field campaign was carried out in early 2005 in the Gulf of Tehuantepec (INTOA Experiment), Mexico. Observations of the drag coefficient are consistently higher than those described by traditional bulk formulae as a function of the wind speed. The influence of counter swell is investigated, and for low wind speeds, some indications of enhanced drag coefficient are associated with the direct interaction of long waves with the air flow. For moderate to strong winds, although the drag coefficient is systematically higher than typical results, it is lower than that predicted by pure wind-sea conditions. Interactions between wind-sea and swell might be influencing a decrease in the sea surface roughness at the relevant wave scales. Attempts to describe the momentum fluxes as a function of the significant slope of the locally generated wind-sea ($H_{sea}/L_{p_{sea}}$) are to be addressed. Further analysis of higher order spectra of the sea surface elevation suggests that non-linear interactions between the main components of wind-sea and swell are exciting components at higher frequencies, corresponding to the sum of the frequencies of the fundamental components.