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Momentum fluxes between ocean and atmosphere for offshore wind conditions in the Gulf of Tehuantepec under the presence of opposing swell

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Recent measurements carried out in the Gulf of Tehuantepec (México) to directly determine momentum fluxes are analyzed for offshore winds (known as Tehuano events) and for conditions of opposing swell. A 40 day field campaign produced over 1800 estimates of momentum flux through the eddy correlation of wind components method. During Tehuano events the sea state was dominated by locally generated waves, while swell was dominating during practically all the rest of the time (swell arrives from the South in the study area). Measurements were carried out with an air-sea interaction spar (ASIS) buoy deployed at 15oN and 96oW in a region of about 60m depth. Instrumentation at the buoy included an array of capacitance wave staffs, sonic anemometer, a motion package, pressure sensor, and rain gauge, humidity sensor, as well as air and water thermistors. Besides the ASIS buoy, two HF radar sites (phase array type) were in operation and three acoustic Doppler current profilers with directional wave measurement capacity were deployed at the coastal region in sites of about 20m depth. The direction of the wind stress vector was calculated and variations with respect to the mean wind direction were found, especially for light to moderate wind conditions when the relative direction of the wind stress was up to +/-60o. The influence of opposing swell is described in detail and it is suggested that swell indirectly induced turbulence can account for the encountered high drag coefficient values, in particular for cases of moderate to strong winds. Even for swell dominated cases, turbulence scales described as universal by Myake et al were found to match our results under moderate to strong wind conditions (U>5m/s). For lighter winds however, the presence of swell modified those scales. Although smooth flow conditions were hardly found, the drag coefficient decreased for increasing wind from 1m/s to about 7m/s. It is believed the drag coefficient enhancement found is due to the presence of swell for

these conditions of light winds.