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Observations on shelf currents and drag coefficient evolution during Hurricane Ivan

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Hurricane Ivan crossed the Gulf of Mexico as a category 4/5 storm on the Saffir-Simpson scale before making a landfall along the Alabama /USA coast. The hurricane passed directly over an array of fourteen Acoustic Doppler Current Profilers (ADCPs) deployed along the outer continental shelf and upper slope in the northeastern Gulf of Mexico by the US Naval Research Laboratory. A response of the currents on the outer continental shelf as recorded by six ADCP moorings was found to be dominated by time-dependent Ekman dynamics. As the hurricane was approaching the vertical current structure consisted of overlapping surface and bottom boundary layers before transitioning to a dominant surface boundary layer as the wind stress reached its maximum. Such a predictable behavior of the currents allowed us to estimate the drag coefficient (C_d) from the ADCP observations when the extreme wind forcing was present (wind speeds greater than 20 m/s). The drag coefficient increased monotonically and peaked ($\sim$2.15 *10 ˆ(-3)) at a wind speed of 34 m/s before decreasing for higher wind velocity. This tendency of the coefficient to decrease under extreme winds is consistent with results from other recent studies.