Geophysical Research Abstracts
Vol. 13, EGU2011-3854-1, 2011
EGU General Assembly 2011

Relative role of subinertial and superinertial long waves in the continental shelf response to the landfall of a tropical cyclone

Alexander Yankovsky and Ziming Ke
University of South Carolina, Department of Earth and Ocean Sciences, Columbia, SC, United States
(ayankovsky@geol.sc.edu, +1 803 777 6610)

A set of numerical experiments has been performed in order to analyze a long-wave response of the coastal ocean to the translating mesoscale atmospheric cyclone crossing the continental shelf and approaching the coastline at the close to normal angle. The model is forced by a radially-symmetric atmospheric pressure perturbation with a corresponding gradient wind field. The cyclone's translation speed, radius, and the continental shelf width are considered as parameters, whose impact on the long wave period, modal structure and amplitude is studied. Subinertial continental shelf waves (CSW) dominate the response under typical forcing conditions and on the narrower shelves. They propagate in the downstream (in the sense of Kelvin wave propagation) direction. Superinertial edge wave modes have higher free surface amplitude and faster phase speed than the CSW modes. While potentially more dangerous, edge waves are not as common as subinertial shelf waves because their generation requires a wide, gently sloping shelf and a storm system translating at a relatively high ($\sim$10 m/s or faster) speed. Relatively smaller size of an atmospheric cyclone also favors the edge wave generation. Edge waves with the highest amplitude (up to 60% of the forced storm surge) propagate upstream. They are produced by the storm system with an Eulerian time scale equal to the period of a zero-mode edge wave with the wave length of the storm spatial scale. When the storm trajectory deviates from the normal approach, most of the edge wave energy propagates in the direction of the alongshore component of the storm translation velocity. Large amplitude edge waves were generated during Hurricane Wilma's landfall (2005) on the West Florida shelf with particularly severe flooding occurring upstream of the landfall site.