Geophysical Research Abstracts
Vol. 13, EGU2011-10164-2, 2011
EGU General Assembly 2011

Contribution of island asymmetry and neighboring islands to the formation of oceanic wakes: a quasi-geostrophic study of near- and far-field implications

Rui Caldeira (1,2), Alain Chelius (3), Maxime Schmerber (3), and Pablo Sangrá (4)

(1) CIIMAR - Interdisciplinary Centre of Marine and Environmental Research, Porto, Portugal (rcaldeira@ciimar.up.pt), (2) CCM - Center for Mathematical Sciences, Universidade da Madeira, Portugal, (3) ENSEIRB-MATMECA - Ecole d'Ingenieurs en Modelisation Mathematique et Mecanique, Talence, France, (4) Universidad de Las Palmas de Gran Canaria, Departamento de Fisica, Las Palmas, Spain

Often laboratory and numerical idealized studies use a cylinder-like island to induce the wake formation, whereas most 'realistic' studies use a close representation of the complex oceanic bathymetry. Herein, apart from considering flow around a cylinder, two-asymmetric idealized islands, inspired by the realistic configuration of the Madeira Archipelago, was used to study: (i) the impact of island asymmetry; as well as to study (ii) the impact of the presence of a neighboring island, in the formation of oceanic wakes. To study the flow perturbation caused by the island, the non-dimensional, quasi-geostrophic equations were used. Data from remote sensing and shallow-water laboratory simulations also helped interpret the numerical results. Results from the numerical simulations showed that for several low Re regimes ($20<Re<500$), the Madeira (one) Island case induced the formation of asymmetric wakes, however this asymmetry was strengthen by the presence of a secondary, neighboring island. Suppression of anti-cyclonic eddy shedding, in the near-field, occurred with the introduction of the second island. The neighboring island had an effect of further altering the stability of the flow behind the larger island. Eddy shedding occurred at different critical Re regimes when considering the different directions of the incoming flow, for the two-island cases. In fact, remote sensing data suggests the dominance of cyclonic eddies forming leeward of Madeira Island region. A complementary far-field numerical study of the oceanic wake, helped determine the possible fate of island-induced oceanic eddies. Results from this far-field study showed asymmetric eddy growth as well as asymmetric eddy decay. There is also a loss of vorticity associated with eddy stretching, particularly affecting the long-term integrity of anti-cyclones. Results from laboratory studies suggested inertial instability as the main cause for the anti-cyclonic fast decay at low Re. Eddy core displacement occurs during the far-field travel. Anticyclonic eddies (born in the east flank) propagate westward; whereas cyclonic eddies (born in the west flank) propagate eastward.