Geophysical Research Abstracts
Vol. 16, EGU2014-6771, 2014
EGU General Assembly 2014

Investigation of wave dynamics in the tropical Atlantic Ocean from satellite altimetry data and Hilbert transform based methods

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Abstract

The intra-annual variability of the tropical Atlantic Ocean is investigated with satellite altimetry Absolute Dynamic Topography data. Three regions of high variability are found. The first region, between 3°N and 11°N, is characterized by the presence of strong propagating eddies linked to the North Equatorial Counter Current retroflection in the vicinity of the Brazilian coast. In the second region, we observed the presence of instability waves centered at 4°N between 40°W and 10°W. The third region, around the Equator, is characterized by the presence of Kelvin waves at the Equator, and Rossby waves centered at 5°S and 5°N.

We explore the characteristics of these waves with Hilbert transform based methods. These techniques allow us to estimate the instantaneous amplitude, period, and speed of the propagations. We show that these quantities are correctly estimated, and are physically valid if the signals are asymptotic, and are decomposed in their high (periods from 2 to $\sim$ 8 weeks), and low (periods from $\sim$ 8 to 52 weeks) frequency asymptotic components. The estimated speed of the propagating waves is 18 cm/s, for the eddies close to the Brazilian coast, 44 cm/s, for the instability waves at 4°N, 207 cm/s for the Kelvin waves at the Equator, 74 cm/s for the Rossby waves at 5°N, and 63 cm/s at 5°S. All of these waves are characterized by the presence of an annual cycle in their instantaneous amplitude, period, and speed.