

ABSTRACT

Geospatial Analysis of Atlantic Ocean Eddies and their Implications on the Islands of the Eastern Caribbean

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Oceanic eddies influence physical and biological processes within the marine coastal region, hence they can impact on the economy of small island developing states of the Eastern Caribbean. However, the spatial and temporal distribution of eddies and their characteristics have not been examined in great detail. This study addresses the shortfall in information concerning eddies that are incident on the islands of the Eastern Caribbean through geospatial analysis. Initially a novel wavelet-based technique is applied to identify eddies within daily Maps of Sea Level Anomalies (MSLA). Utilising eddy detections, tracks were generated based on a combination of nearest distance and similarity-based techniques. Eddies are detected with an accuracy of 97.9% when both identification and tracking methods are used.

Eddy identification and tracking was applied to MSLA data obtained over a 23 year period between 1993 and 2015. The spatial distribution of large absolute amplitude (≥ 0.25 metres) eddies are concentrated in a band which runs from north-east of the Amazon River mouth towards the islands of the Eastern Caribbean. The mid-Atlantic region found east of the islands does not experience eddy amplitudes of this magnitude. Seasonal variations in the North Brazil Current, and discharges of the Amazon and Orinoco River contribute to the seasonal changes in percentages of eddies and amplitudes. Cyclonic and anticyclonic eddies originating in the Atlantic Ocean travel with the oceanic currents towards the Eastern Caribbean transporting water that is trapped within the gyres. Shoaling waters of the continental shelf reduce the number of eddies incident on the islands of the volcanic arc. Barbados, however, being on the edge of the shelf is subject to eddy incidents that occur mainly between the months of March and July. Sea levels are changed by up to 0.25 m during an incident and salinity was found to be reduced by 2 parts per thousand, but there is no noticeable change in water temperature. Similar events can occur to the southern islands in the volcanic arc, but less frequently and at reduced amplitudes. While incidents exist in the north bringing some change in sea level, these contain waters from the equatorial North Atlantic Ocean and there is no noticeable change in salinity.

Keywords: Jason Dwaine Tambie; Oceanic Eddies; Maps of Sea Level Anomalies; Wavelet; Tracking; Spatial; Temporal; Eastern Caribbean