

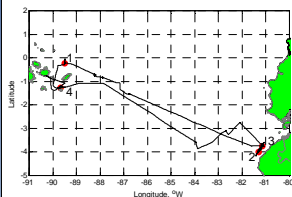
STRUCTURE OF OCEAN CIRCULATION BETWEEN THE GALAPAGOS ISLANDS AND ECUADOR

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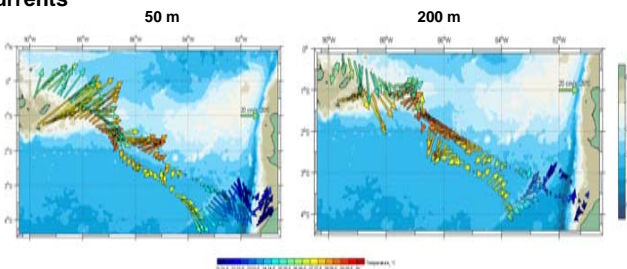
Introduction

This poster describes the circulation and transport patterns observed by *R/V Knorr* from March 27 to April 5, 2009, relates the latter to sea level differences between the Galapagos and Ecuador. The ship track is shown below. Data included shipboard ADCP measurements, profiles of water properties collected by CTD, sea level data from Santa Cruz (Galapagos Islands) and La Libertad (Ecuador).

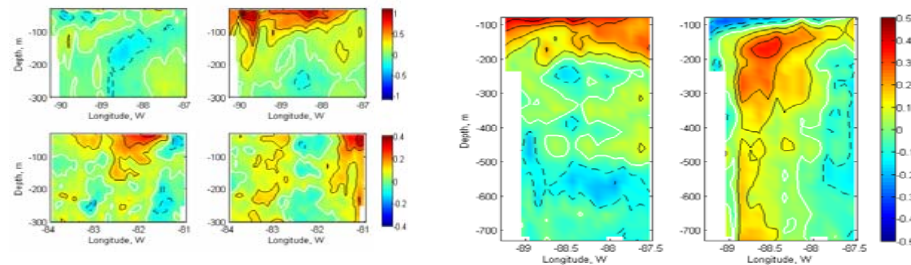


Cruise track (black line) and hydrographic stations (red dots) occupied by *R/V Knorr*, 27 March-5 April 2009.

Currents



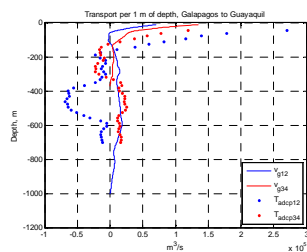
The color of the arrows corresponds to the temperature at the sea surface. The vertical bar at the right is the scale used for ocean depth. Data were binned into 0.2° longitude by 0.1° latitude bins.



(Upper) Galapagos coastal currents.
 (Lower) Ecuador Coastal Currents.
 (Left) Across Stream flow.
 (Right) Along Stream Flow.
 Contour Interval is 0.1 m/s. Data have been averaged by 0.1° longitude bins.

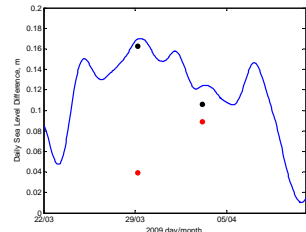
Undercurrent to the east of the Galapagos. Data have been averaged by 0.1° longitude bins.
 (left) Cross stream (toward 080°T) flow.
 (right) Alongstream flow (toward 170 °T).

Transports



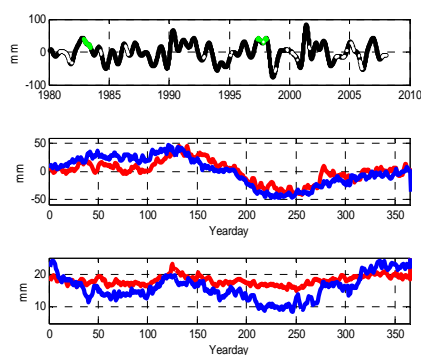
The geostrophic transports obtained from CTD measurements are compared with those directly measured by CTD. Blue (red) is used for stations 1 and 2 (3 and 4).

Sea Level and Ocean Transport



The blue line represents the sea level difference between the Galapagos and Ecuador. The red dots represent the steric height differences between CTD station pairs and the black dots represent the sea level difference required to geostrophically balance the mean velocity in the upper layers as measured by the ADCP.

Can Sea Level Differences represent Cross Hemisphere Ocean Exchanges?



(Upper) Sea level difference, Santa Cruz (Galapagos) minus La Libertad (Ecuador), 1978-2008. Data have been smoothed to remove monthly variability. Green indicates periods of maximum sea level elevation (El Nino). White dots indicate periods when sea level data is missing.

(Middle) Daily mean sea level at Santa Cruz (red) and La Libertad (blue).

(Lower) Standard error of the daily mean sea level for Santa Cruz (red) and La Libertad (blue)

Summary

- (1) The Equatorial Undercurrent was observed as a shallow (200 m), 300 km wide northeastward surface flow immediately to the east of the Galapagos. Subsurface salinity maxima, thermoclast thicknesses, and dissolved oxygen at 100 m identified these waters as originating in the Equatorial Undercurrent. The observed transport, 7-11 Sv, agreed well with the 6.6 Sv of transport of the Equatorial Undercurrent to the west of the Galapagos (92°W).
- (2) A Galapagos Undercurrent was observed to flow southward under the northeastward surface current over the slope to the east of the Galapagos. This Galapagos undercurrent was at least 600 m thick, 100 km wide, and had an observed transport of 7-8 Sv.
- (3) The Ecuador Coastal Current was observed at the Ecuador coast as a shallow (<200 m) flow which extended offshore 100 km with strongest flow, 0.33 m/s, near the surface.
- (4) The beginnings of the Peru-Chile countercurrent was observed immediately to the west of the Ecuador Coastal Current as eastward and southward currents.
- (5) Transports between the Galapagos and Ecuador estimated from integral of the surface currents agreed well with the observed sea level differences.
- (6) Although the correlation of the sea level differences with large scale climate indices (Niño3 and the Southern Oscillation Index) was significant, a large amount of the sea level variability was not explained.
- (7) The seasonal variability of the sea level difference indicated that sea level was 2 cm higher at the Galapagos during late winter and early spring which should contribute to a seasonal pattern of eastward and northward acceleration of regional surface circulation and might be associated with northward surface flow of Equatorial Undercurrent waters just to the east of the Galapagos Islands reported here.



Acknowledgements

ADCP data were processed and quality controlled by Jules Hummon, University of Hawaii. 2009 hourly sea level data for La Libertad were provided by the Ecuador Navy. Tetyana Margolina and Thomas Rago assisted with data analysis and preparation of the poster.