Surface drifter trajectories highlight flow pathways in the Mozambique Channel

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1. Introduction

• The circulation in the Mozambique Channel is dominated by strong mesoscale turbulence and characterized by a high level of spatial and temporal variability.

• Strong currents (> 1 m s⁻¹) generated by anticyclonic eddies along the western boundary of the channel, highlights the dominance of the geostrophic current component.

• The complex and transient nature of the mesoscale eddy field, as well as the contribution of wind-driven Ekman currents make it difficult to recognize pathways of near surface flow in the channel.

2. Objectives

• Measure the integrated surface circulation of the Mozambique Channel from Lagrangian drifters.

• Track the passage and behavior of mesoscale eddies to visualize near surface flow pathways in the Mozambique Channel.

• Ground-truth altimeter derived geostrophic current measurements

• Establish potential transport routes and avenues of connectivity for biota between geographically isolated regions of the Mozambique Channel.

3. Materials and Methods

• The surface circulation in the Mozambique Channel is described from the trajectories of 82 SVP (Surface Velocity Program) drifters present in the channel between 2000 and 2010.

• Sub-surface drogue centered at 30 - 15 m.

• GPS position, date and time reported every 4-6 hours via satellite.

• Drifter trajectories superimposed on corresponding maps of 1/3° resolution Delayed Time Mean Sea Level Anomaly.

Data sources

All images


Drifters

www.ssvd.mma.gov.ph/home/didaar/data.php

4. Results

4.1 Advection in eddies

4.2 Horizontal mixing of surface water in dipole eddies

4.3 Drifter pathways in the Mozambique Channel

4.4 Frontal zone transport

5. Conclusion

• Several drifters moved around the channel in only the frontal zones between eddies without becoming entrained in the eddies themselves.

• Drifter velocity in frontal zones was strongly linked to the sea level anomaly (SLA) gradient.

• Connectivity between the East Madagascar Current and the Mozambican shelf (Figure 8) was facilitated by frontal zone transport.

• Transport durations north-westwards across the channel ranged from 41 to 219 days.

• Connectivity between the East Madagascan Current and the Mozambican shelf (Figure 8) was facilitated by frontal zone transport.

• Surface water inside eddies can remain isolated for extended periods several weeks to months and thus be transported southwards through the Mozambique Channel.

• Horizontal mixing of surface water between counter-rotating eddies during strong wind events implies the occasional dominance of Ekman layer dynamics over geostrophy and vertical eddy circulation.

• Drifter data highlight the importance of the interlinked flow outside of mesoscale eddies i.e., frontal zone jets and the less vigorous ‘interstitial’ waters.

We therefore hypothesize that pathways for biological distribution that link the shelf regions, islands and atolls of the Mozambique Channel are created by the frontal zones between eddies and the associated ‘interstitial’ waters. The availability of these pathways depends on the eddy configuration in the channel at any given time.