Water masses and circulation in Northern Sofala Bank

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Introduction

Sofala Bank is the largest shelf in the Eastern Africa, it is over 500km long, wide in the south, where it attains about 200 km, and narrowing towards the North to about 15km, and it is shallow with an average depth of about 50m (Figure 1). It is highly productive shelf, with nutrients supplied by the rivers and adjoining abundant mangrove swamps. It is an important fishery area, being the shallow water shrimp the most economically valued fishery, and composed mainly by two species: *Pneus indicus* and *Metapenaeus monoceros* (Silva, 1989). The annual catches of shrimp are about 7000 tons, aimed mostly for exportation, thus contributing considerably for the growth of Mozambican economy.

The peneid shrimp spawn in the open sea during the dry season, the eggs and larvae drift to the sheltered mangrove swamp and estuaries where they grow, and hence the currents are important for their successful migration to the safer nursery ground (Gammelsrød and Hoguane (1995). The present report describes the circulation based in oceanographic data and presents re result of drifters deployed in Sofala Bank, as a contribution to understanding the role of the currents in the life cycle of shrimp.

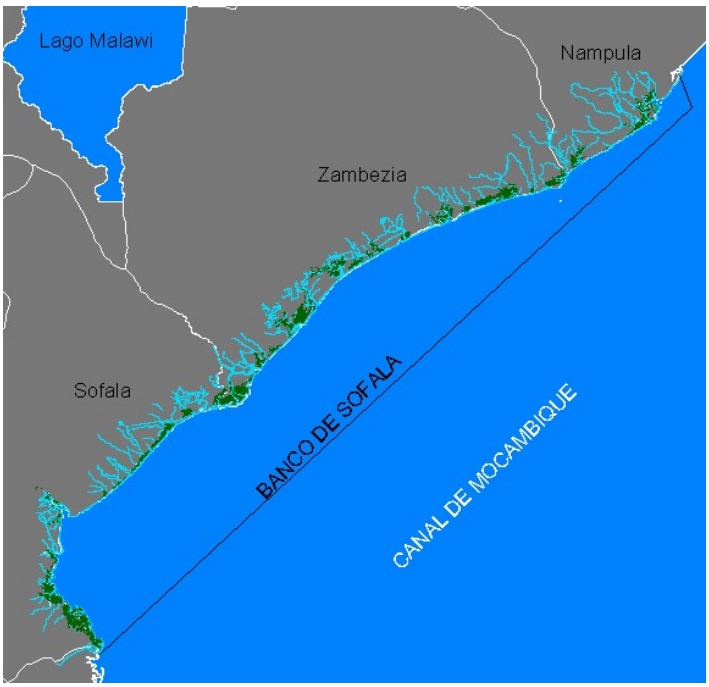

Figure 1: Sofala Bank

Water masses in between the mainland and islands in northern Sofala Bank

Four cross-sectional sections (Figure 2) were set in Ilhas Primeiras during 3-4 December 2007, before the rainy season. In each section CTD profiles were made. The main purpose was to determine the water masses and the density driven circulation during the dry season. The water temperature varied from 26^{o}C to 29^{o}C, being warmer near the coast, probably due to the shallowness. Salinity varied from 35.2 to 35.8. Most of the area was influenced by higher salinity water (~35.5) due to higher evapo-transpiration rates in mangrove swamps. The water column is mixed. In Sections B and D is evident the intrusion of open seawater, characterised by low temperature, through the outer stations under the warm and saline coastal water (Figure 3-6).

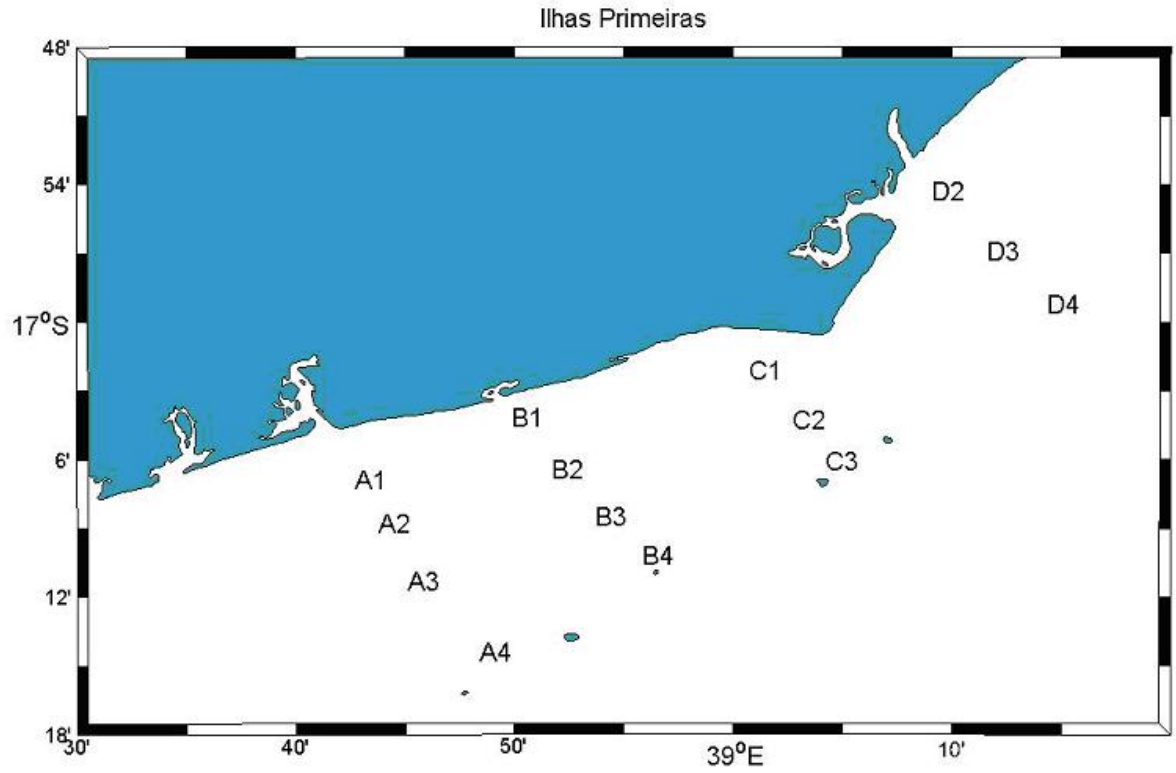

Figure 2: Station network in between the mainland and islands, in northern Sofala Bank

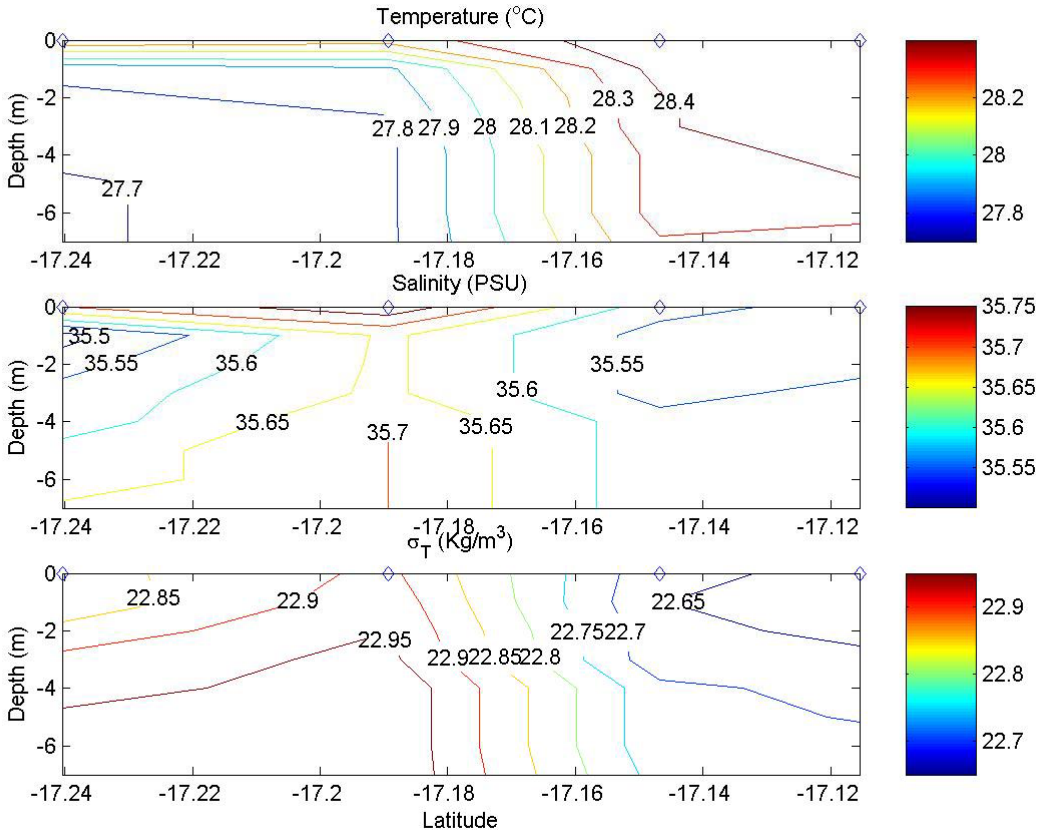

Figure 3. Section A, between the mainland and islands in northern Sofala Bank, 3 December 2006

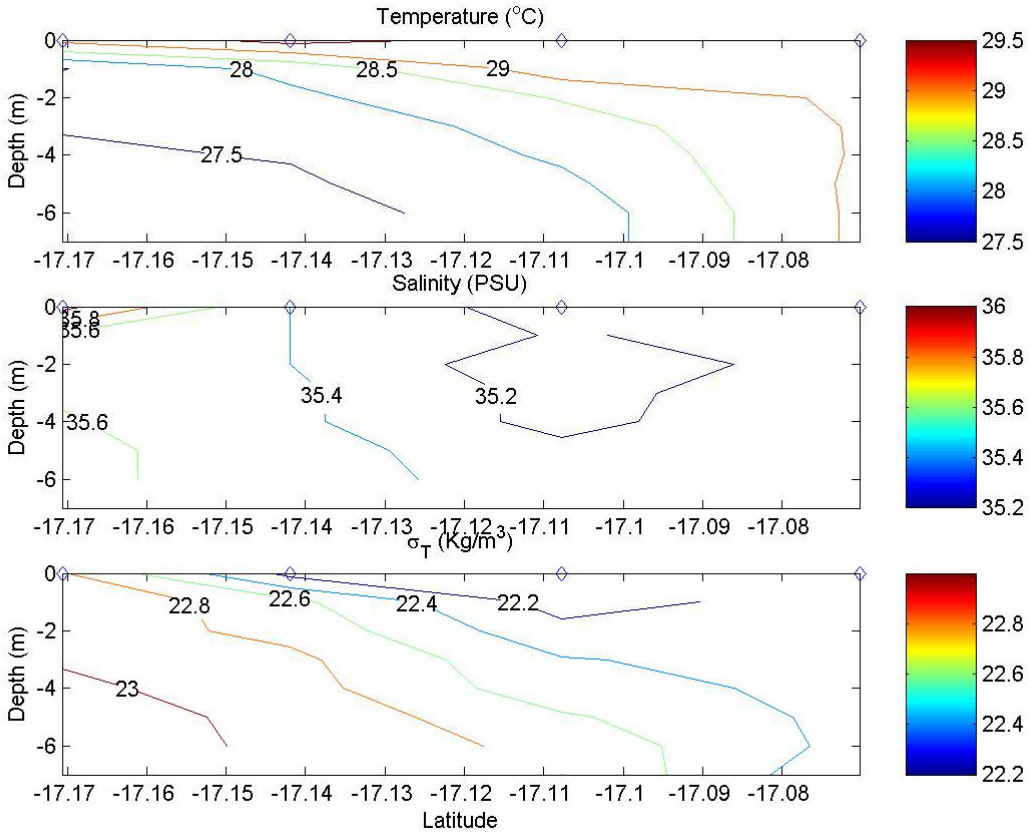

Figure 4: Section B, between the mainland and islands in northern Sofala Bank, 3 December 2006

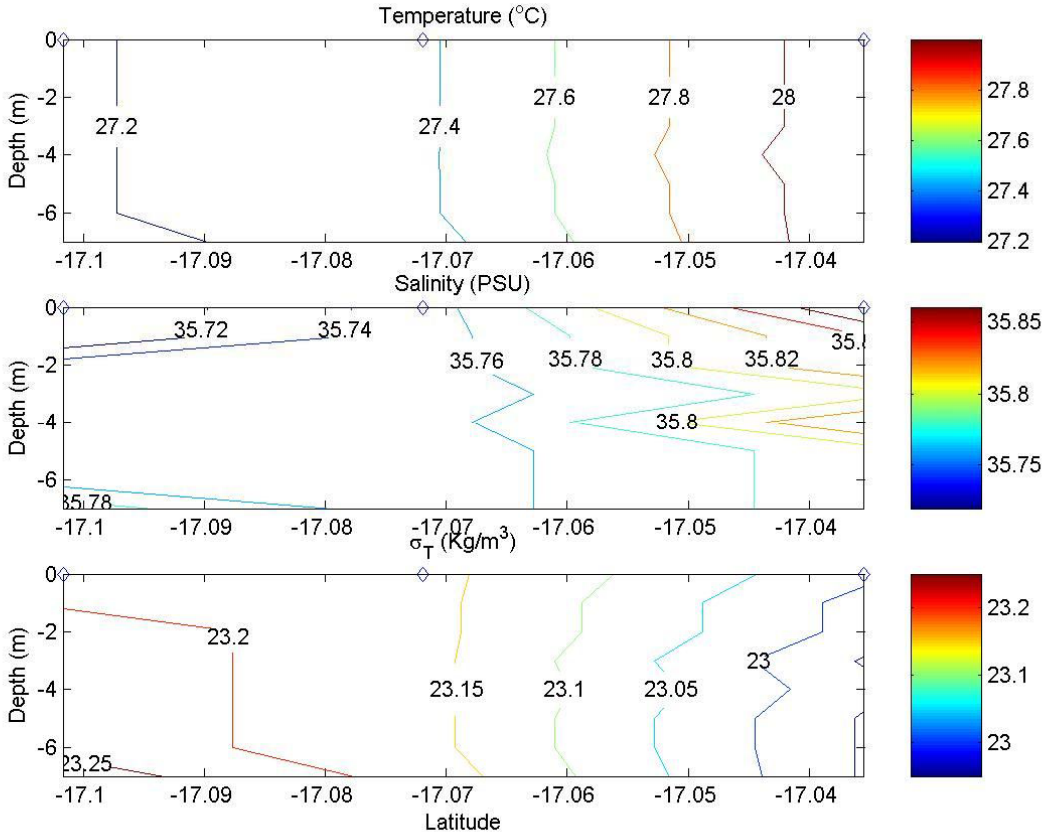

Figure 5: Section C, between the mainland and islands in northern Sofala Bank, 4 December 2006

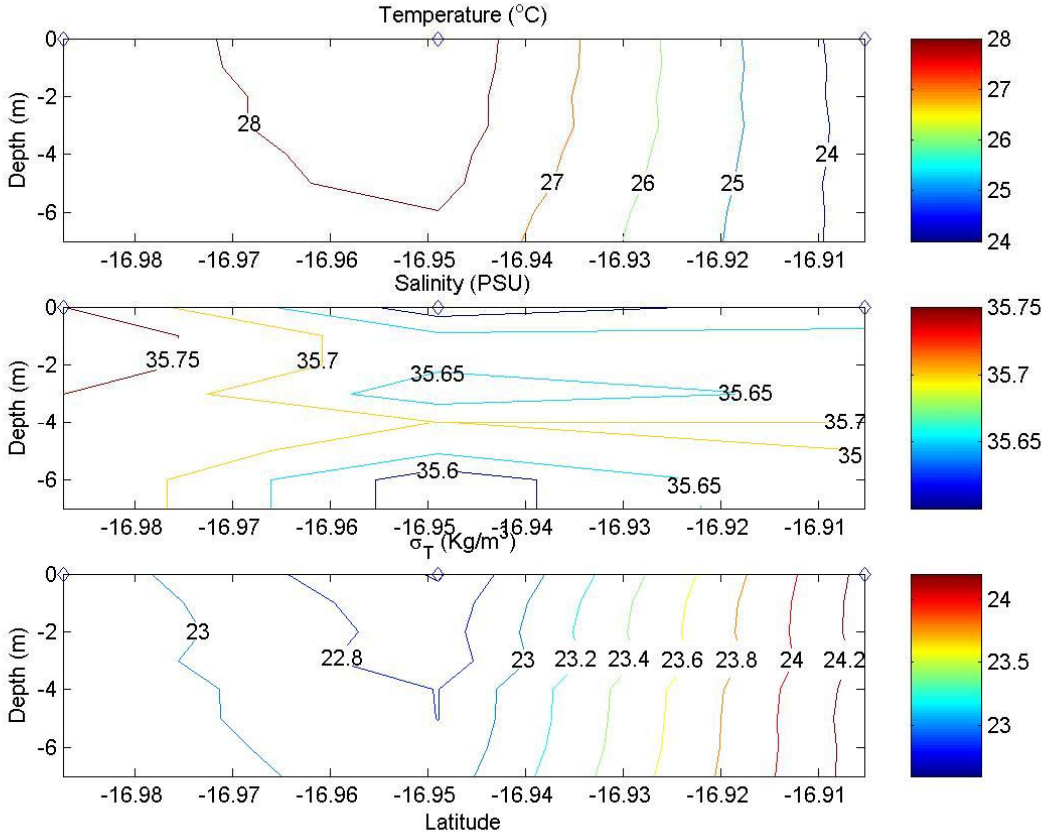

Figure 6: Section D, between the mainland and islands in northern Sofala Bank, 4 December 2006

Density driven circulation in between the mainland and islands in the northern Sofala Bank

The density pattern of the water between the mainland and island was characterized by one cell of low density water in the embayment between the mainland and island (Figure 6). The islands prevent the spread of water into the open sea, resulting in circular motion. This seems to be a normal situation during the dry season. The resulting density driven circulation is clockwise (Figure 7). This circulation may be important in retention of larvae within the coastal water, and increases the probability for their successful migration into the nursery grounds.

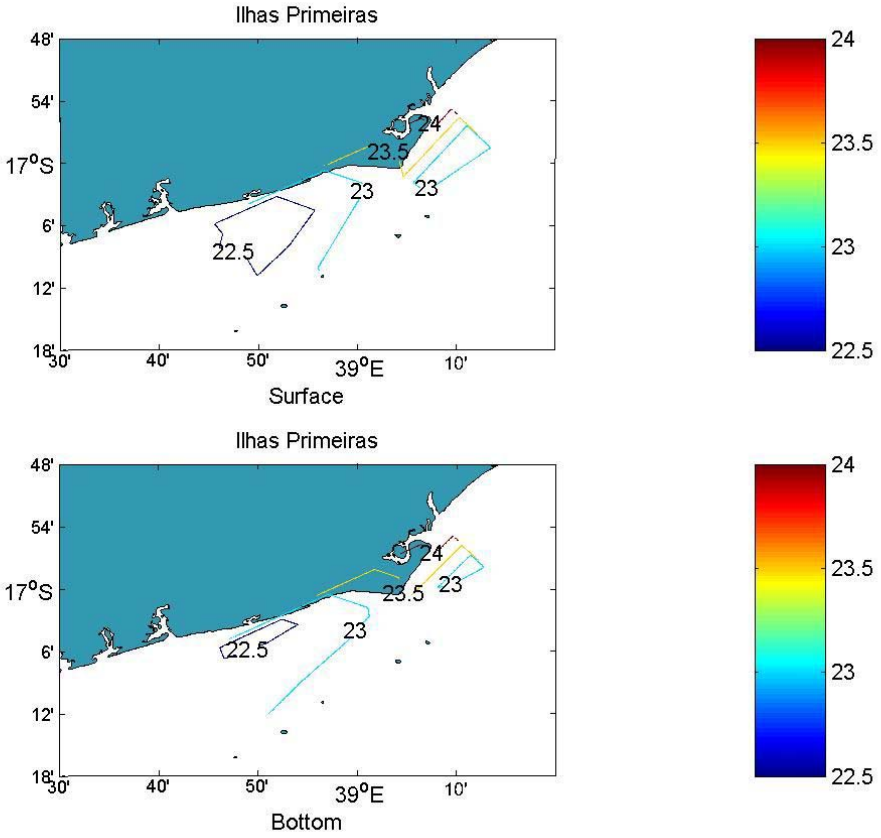

Figure 7: Density distribution between the mainland and islands in Northern Sofala Bank, 3-4 December 2006.

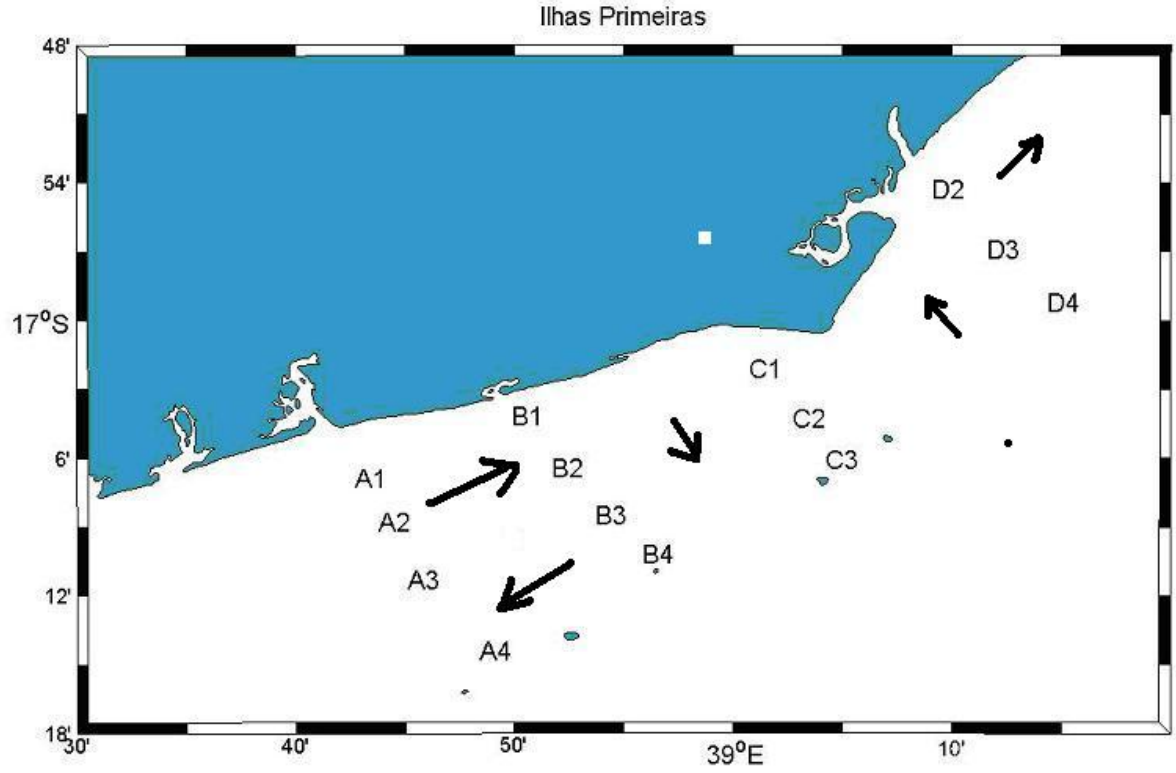

Figure 8: Schematic representation of the density driven circulation between the mainland and islands in Northern Sofala Bank, 3-4 December 2006.

Drifters

A number of Argos drifters were deployed in Sofala Bank to trace the surface currents. A trajectory of two drifters is mapped over Sofala Bank. The drifters were standard spherical WOCE/TOGA mixed layer drifters (diameter 30 cm), fitted with a holey sock drogue at 15m. The drogues have a length of 7m and a diameter of 1m. The positions of the drifters were given every forth to sixth hour by satellite tracking (Plate 1 and 2). The maps are based on the GEBCO bathymetry and plotted by the OCEAN MatLab package. Smoothing of some of the Float time-series was performed using simple running average over 13 data points, corresponding to about 3 days.

Drifter 14559 was deployed in 31st October 2007, near the Zambezi month, it drifted southwards at approximately 8 cm s^{-1} (Figure 9). An earlier deployment in Sofala Bank, Drifter F234 deployed in 29th of March 2000, at the shelf brake near the 1500m isobaths, drifted Eastwards up on the shelf, and then drifting slowly northwards, with an average speed of about 3 cm s^{-1}, before it stranded near Quelimane about a month later (Figure 10).

Plate 1: View of an Argo drifter in preparation for deployment in between the mainland and islands in Sofala Bank, December 2007.

Plate 2: View of an Argo drifter deployed in between the mainland and islands in Sofala Bank, December 2007.

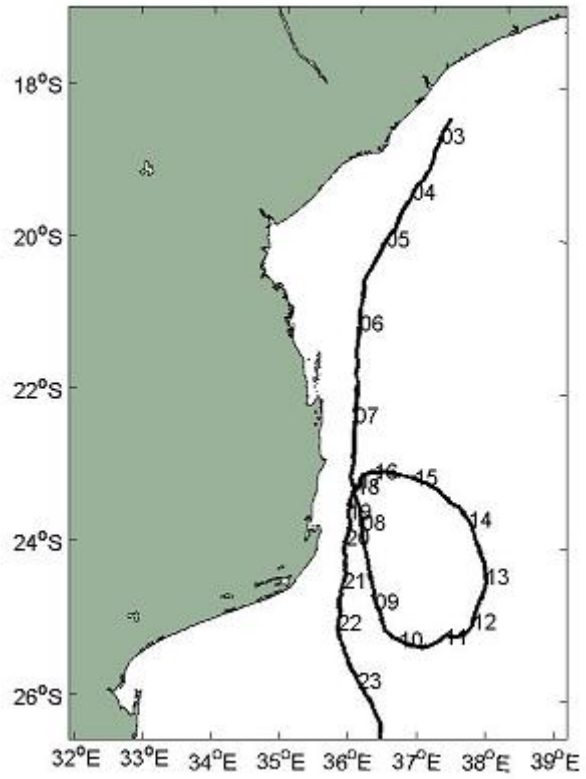

Figure 9: Trajectory of drifter 14559. Numbers are days in October 2007.

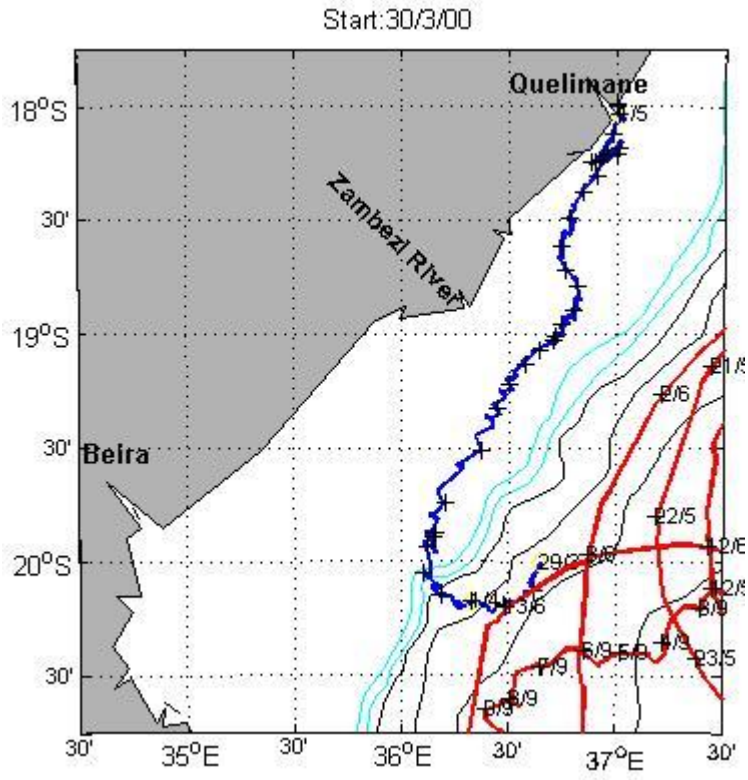

Figure 10: Trajectories of Float F377 (red) and F234 (blue). One position for every day is marked by + (March-June 2000).

Concluding Remarks

Currents in Sofala Bank seem to vary with season, being northwards during the flood season and southwards during the dry season. However, there is a need to pursue further studies with drifters before a reasonable judgement on the circulation is made. The density driven circulation in between the mainland and island seems to be characteristic of the dry season, in such a case it favours the retention of fish eggs and larvae in the coastal water from where are transported by tides to the adjoining mangrove swamps. We need to conduct a survey during the flood season to disclose the circulation due to the influence of freshwater from the river (ROFI system).

Acknowledgement

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