Western Equatorial Atlantic

Overview

The Western Equatorial Atlantic is the region of the Atlantic bounded by the northeast coast of South America and approximately $20^{\circ}N$ (Figure 1). It includes the portion of the Brazilian coast that contains the mouth of the Amazon River.



Figure 1. Bathymetry of the Western Equatorial Atlantic. [Smith and Sandwell, 1997]

Observations

There has been some scientific study of internal waves in the Western Equatorial off the northeast coast of Brazil [Ivanov et al., 1993; Brandt et al., 2002] as well as investigations reported in the Russian scientific literature [Bulgakov et al., 1985; Kuznetsov et al., 1984]

Satellite imagery reveals a combination of internal tide and internal wave signatures beginning more than 500 km off the continental shelf and extending northeast approximately 1300 km into the Atlantic. The satellite images show isolated wave fronts separated by approximately 130 km (Figures 4 and 5) with traditional rank ordered internal waves between the fronts. Similar isolated wave fronts have been observed in sunglint imagery images over the Bay of Biscay [Pingree and New, 1995] and where interpreted as internal tidal signatures. Table 1 shows the months of the year during when internal waves have been observed.

Table 1 - Months when internal waves have been observed in the Western Equatorial Atlantic. (Numbers indicate unique dates in that month when waves have been noted)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
			8	10		1	5	4	5	1	

Brandt et al. [2002] reported analysis of high-resolution velocity measurements carried out by means of a vessel-mounted acoustic Doppler current profiler on 12 November 2000 in the Equatorial Atlantic, at 44°W between 4.5° and 6° N. The data showed the presence of three large-amplitude internal solitary waves. The pulse-like intense solitary disturbances propagated toward north-northeast (24° to 31° from true north), perpendicular to the Brazilian shelf, and were characterized by maximum horizontal velocities of about 2 m/s and maximum vertical velocities of about 20 cm/s (Figure 2). The large magnitudes of the measured velocities indicate that the observed waves represent disturbances evolving in a strongly stratified ocean. The distance separating the waves was about 70 km. Phase velocities were estimated at 2.5 m/s with periods of 11.4 h and 13.8 hours between waves A/B and B/C respectively.



Figure 2. Northward component of the horizontal velocity field as measured on 12 November 2000 at 44°W as function of latitude. The data represent one-minute low-pass filtered velocity data averaged between 30 m and 78 m depth. [After Brandt et al, 2002]

Ivanov et al. [1993] reports on echo sounder measurements of sound scattering layer oscillations collected during 25 April to 12 May 1989 in the Amazon polygon (2°-15°N, 38° - 52°W). They report the wave field in the area as a superposition of many internal waves coming from various directions. Their work focused on examining wave "height". Two hundred eighteen hours (218) hours of data collected over 18 days. Wave heights greater than 5 meters were combined in 3 meter bins (Figure 3). The data were used to develop wave height prediction statistics.



Figure 3. Number of cases of wave height observation measured via echo sounder in the Amazon polygon during April and March 1989. [After Ivanov et al. 1993]

References

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Figure 4. MODIS (Bands 1,3,4) 250-m resolution visible image off the northeast coast of South America acquired on 12 October 2003 at 1335 UTC. The image shows both internal wave packets and isolated wave crests propagating north-northeast into the Atlantic. The isolated crests are believed to be associated with the internal tide. The edge of the wave field at the top of the image is more than 850 km from the shelf break near the mouth of the Amazon River. Imaged area is approximately 400 km x 750 km.





Figure 5. MODIS (Bands 1,3,4) 250-m resolution visible image off the northeast coast of South America acquired on 13 August 2003 at 1605 UTC. As in Figure 4, the image shows the signature of both internal wave packets and isolated wave crests propagating to the north-northeast into the Atlantic. The isolated crests are believed to be associated with the internal tide. Imaged area is approximately 475 km x 575 km. The image is contiguous with Figure 6







Figure 6. MODIS (Bands 1,3,4) 250-m resolution visible image offthe northeast coast of South America acquired on 13 August 2003 at 1610 UTC. The image is contiguous with Figure 5 and shows the evolution of the wave field 850 km to 1250 km away from the shelf break. The signatures of individual wave groups are still visible propagating north-northeast into the Atlantic. Imaged area is approximately 410 km x 690 km.

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An Atlas of Oceanic Internal Solitary Waves (February 2004) by Global Ocean Associates Prepared for Office of Naval Research – Code 322 PO



Figure 7. MODIS (Bands 1,3,4) visible image off the northeast coast of South America acquired on 27 July 2001 at 1340 UTC. Unlike Figures 4 and 5, the image shows only the signature a complex internal wave field propagating to the north-northeast into the Atlantic. No pattern of isolated wave crests is visible. Imaged area is approximately 495 km x 550 km.



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