Bay of Biscay

Overview

The Bay of Biscay is located in the northeast Atlantic Ocean and is bounded by the western coast of France and the northern coast of Spain (Figure 1). The Bay is characterized by a broad and irregular continental shelf.



Figure 1. Bathymetry of the Bay of Biscay. [Smith and Sandwell, 1997]

Observations

There has been considerable study on internal waves in the Bay of Biscay; both those that occur along the continental shelf break and those in the central Bay approximately 120 to 150 km from the shelf edge. The shelf break internal waves have been well characterized by Pingree and Mardell [1985] and Pingree et al. [1986] with amplitudes (peak to trough) of up to 40 m. The internal waves at the shelf break produce complex surface pattern, due to varying topography and irregular edge of the shelf break in the northern Bay.

New and Pingree [1990, 1992] and New and daSilva [2002] have investigated internal waves in the Central Bay. These waves, with amplitudes of up to 80 m, are thought to be locally generated [New and Pingree 1990] through a reflection of tidal energy that re-emerges at the surface near where internal waves have been observed in the central Bay.

Like other sites in the north Atlantic, (New York Bight, Northwest Africa) both types of internal waves in the Bay are believed to occur only during the summer and early fall (June though September) when a well-developed thermocline is present (Table 1).

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
					4	4	3	1	1		

Table 1 - Months when internal waves have been observed in the Bay of Biscay. (Numbers indicate unique dates in that month when waves have been noted)

References

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http://topex.ucsd.edu/marine_topo/mar_topo.html

51°N

Figure 2. SEASAT (L-Band, HH) SAR image of the Bay of Biscay acquired on 20 August 1978 at 2140 UTC (Rev 785). The image is a composite of scenes individually processed by DRA (optically) and DLR (digitally). The image shows a complex pattern of internal wave signatures at the continental shelf in the northern Bay. A similar pattern is visible in Figure 4. Imaged area is approximately 97 km x 145 km.





Figure 3. The location of internal wave packets observed in 4 ERS SAR images (14 July 1999, 3 September 1999, 15 August 1999, and 22 July 1994). Internal wave occurrences fall into in two categories 1) waves generated along the shelf break that propagate either toward shore or to the southeast away from the shelf (between the shelf and 120 km distant) and 2) locally generated 120 - 150 km away from the shelf in the central Bay waves that propagate to the southeast. [After New and daSilva, 2002]



Figure 4. ERS-1 (C-Band, VV) SAR image of the Bay of Biscay acquired on 18 June 1992 at 1113 UTC (orbit 4834, frame 2655). The image shows a complex internal wave pattern at the continental shelf in the northern part of the Bay. A similar pattern is visible in Figure 2 and the line drawing in Figure 3. Imaged area is 100 km x 100 km. ©1992 ESA. [Image courtesy of Werner Alpers University of Hamburg, Hamburg, Germany]



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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 5. ERS-2 (C-Band, VV) survey image of the southeast Bay of Biscay acquired 22 June 2003 at 1053 UTC (orbit 42719, frame 2709). The image shows internal wave generated at the shelf and propagating shoreward. The image covers part of the same area as shown in Figure 6 (acquired on 19 June 2003). Imaged area is 100 km x 100 km. ©ESA 2003.



51°N

Figure 6. MODIS (Bands 1,3,4) 250-m resolution visible image of the southeast Bay of Biscay acquired 19 June 2003 at 1115 UTC. The image shows internal wave generated at the shelf propagating shoreward. Imaged area is approximately 174 km x 236 km.



54°N 51°N 48°N 45°N 42°N 12°W 9°W 6°W 3°W 0°

Astronaut Figure 7. photograph (STS028-152-128) acquired on 10 August 1989 at 1452 UTC. The image shows internal wave signatures in the Bay of Biscay propagating south towards the coast of Spain. Imaged area is approximately 125 km x 85 km. [Image Courtesy the Earth Sciences and Image Analysis Laboratory, NASA Johnson Space Center (http://eol.jsc.nasa.gov)]



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Figure 8. ERS-1 (C-Band, VV) SAR image over the southeast Bay of Biscay acquired on 5 August 1992 at 2225 UTC (orbit 5528, frames 873, 891, 909). The image shows the signatures of internal waves propagating toward the southeast and southwest. Imaged area is 100 km x 300 km. ©ESA 1992. [Image courtesy of José da Silva Instituto de Oceanografia, Lisbon, Portugal]



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