Ocean Sci. Discuss., 3, S308–S312, 2006
www.ocean-sci-discuss.net/3/S308/2006/

Ocean Science
Discussions

OSD

3, S308–S312, 2006

Interactive
Comment

Interactive comment on "Temporal and spatial characteristics of sea surface heightvariability in the North Atlantic Ocean" *by* D. Cromwell

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Received and published: 7 August 2006

Comment on Temporal and spatial characteristics of sea surface height variability in the North Atlantic Ocean by D. Cromwell

This is an excellent remote sensing paper. Some new and interesting results are derived from altimeter data covering the period from October 1992 to January 2004 for the North Atlantic Ocean. The data set is about as long as possible at present which makes the results timely and significant and the manuscript represents a significant contribution to the remote sensing literature. I find Fig. 4. and Fig. 7. particularly interesting. Having said that I would like to draw attention to some research cruise data with publications also using the same altimeter data from the ERS/TOPEX/Poseidon satellites. In 1992, RRS Charles Darwin, deployed Argos buoys in the Azores Current

(34°N) or region of increased energy around 32-36°N (Table 3, Cromwell (2006), or Figures 22 and 24 of Pingree (1997)). SeaSoar/ADCP/CTDs /LADCP/T5s were also used. In 1993, RRS Charles Darwin surveyed an eddy in the near zonal band of low variance at 22-27°N (Table 2). The westward propagating eddy called Swesty was followed continuously with Argos buoys for >500 days (Pingree 1996). In Pingree and Garcia-Soto (2004), Swesty-like westward propagating signals along 25.6°N (see also last sentence) were examined using 9 years of altimeter and 5 years of SeaWiFS data. In 1995, RRS Charles Darwin deployed a total of 10 drogued ARGOS buoys, 5 subsurface ALACE floats, and 6 current meters (also measuring temperature) in a westward propagating eddy (called Storm, 300km scale) near 33°N, 35°W. Measurements were made from 0 to 3000 m. In 1996, HMS Hecla conducted a complete section across the Atlantic Ocean near 33°N with CTDs and deep XBTs (T5s) and deployed a further 2 PALACE and 2 ARGOS buoys in Storm, which crossed the Mid Atlantic Ridge and was tracked with floats for 300 days. Further biological, productivity and physical studies of the Azores Current and a cyclonic Storm eddy were conducted from BIO Hesperides in 1999. So what are the important differences between the findings of Fig. 7. and those in the review article on in situ measurements and IR/altimeter /SeaWiFS data (Pingree et al., 1999) where interpretations are also given or in the papers referenced below? Is it more than terminology, i.e. oceanographers usually use ‘eddy’ and have the vertical structure, CFDs/GFDs seem to prefer R.W. Has anyone found (i.e. in situ measurement programme) a plane westward propagating Rossby Wave (the structure generally given in remote sensing papers) in the Eastern North Atlantic Ocean? How does the east velocity component for the remote sensing ‘Rossby’ Waves compare with the north component in the region of Fig. 4? Analysis of the current meter data in the region with records up to 2 years long are given in Pingree and Sinha (2001). Westward propagation was also considered for 35.5°N; 2 RAFOS, 2 ARGOS buoys, 2 ALACE, and several current meter moorings were deployed in 1992/93/94. The poleward continental slope flow was also measured with current meters and related to altimeter data and climate. One ARGOS buoy followed the winter tongue of warm water along the continental shelf edge west of UK for 1600 km under conditions of extreme negative winter NAO index in the winter of 1995/1996. Again, Fig. 1 is most impressive, but note regions can be found where correlations between NAO index and North Atlantic structure using altimeter data (see Table 4) are high and are also significantly lagged, see Figure 18 of Pingree (2002), for example. Also in Figure 18, the Navidad or "N" marks the times when the Eastern Bounday off W Europe was more tilted. For west of Biscay, between 1992 and 2002, the set up came in 2 main pulses January 1996 and November/December 1997, separated by 2 years. Is this evident in from Fig. 1? Some of these ideas and results are developed a little further in Pingree (2005) for the eastern boundary region from West Africa and along west Europe and then further west to Irminger/Labrador Basins. 2 year, 4 year and 8 year period oscillations were examined with mention of a hinge or pivot region (node) near the MOC latitude (see above, for near annual westward propagation at 26°N). Some regions were not considered, for example eastward Kelvin Wave propagation along the equator and westward propagating Rossby Waves at 3-4°N and 3-4°S. The biological consequences (Ocean Colour, SeaWiFs, for example) meant that there were 2 phytoplankton blooms a year in the reflection region in the east (see, Pingree, Kuo, Garcia-Soto, 2002). Another westward propagating semi-annual Rossby Wave (i.e. with some plane wave character or enhanced north velocity component) but of higher wavenumber (x10) was found between 30-35°N. Its amplitude was about 2 cm (x10 smaller than regular Storm eddies of alternate sign), see Pingree and Sinha, 2001). Robin Pingree (MBA/PML/UoP) 08.08.2006 Professor (of Ocean Colour and Climate) References (ordered by publication year)

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Interactive comment on Ocean Sci. Discuss., 3, 609, 2006.