INTERACTIONS OF EASTERN BOUNDARY CURRENTS WITH BASIN-SCALE CIRCULATION

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This project builds on our work during the T/P primary mission, which studied the circulation in the eastern boundary currents of the Pacific Ocean. The goal of work in the T/P Extended Mission is to consider the eastern boundary currents of the Atlantic, with emphasis on the Benguela Current and its interaction with eddies generated in the Agulhas Retroflection.

The overall goal of our research in a number of projects is to investigate the interactions of basin-scale oceanic currents with the boundary currents in the eastern regions of the oceans on a range of scales. In our previous T/P work, altimeter data from Geosat, T/P and ERS-1 were used to define the large-scale seasonal evolution and the detailed development of the circulation in the California Current. Altimeter height fields and satellite SST are overlaid for additional resolution. Figures 1a and 1b show a comparison of the dynamic height and altimeter height/SST fields during a survey off northern California. The altimeter field (combining T/P and ERS-1) is able to define the eddy dipole found inshore of the meandering jet by the survey between 37-38°N. It also shows that the jet resolved by the survey is connected to a larger-scale equatorward jet. Figure 2 shows the height and SST fields from the same August period as in Figure 1b over a larger region, making it clear that the jet flows continuously from as far north as 50°N off British Columbia to 30°N off southern California [Strub and James, 1995, 1997a, 1997b].

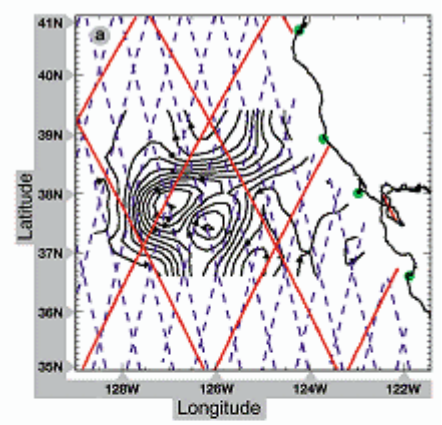
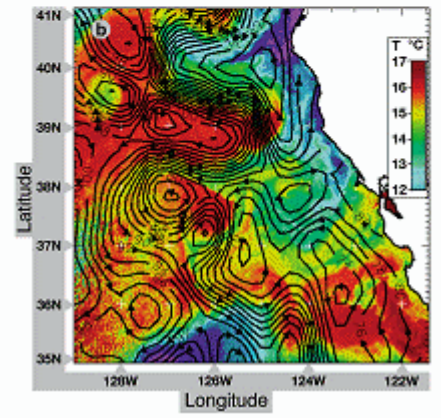


Figure 1

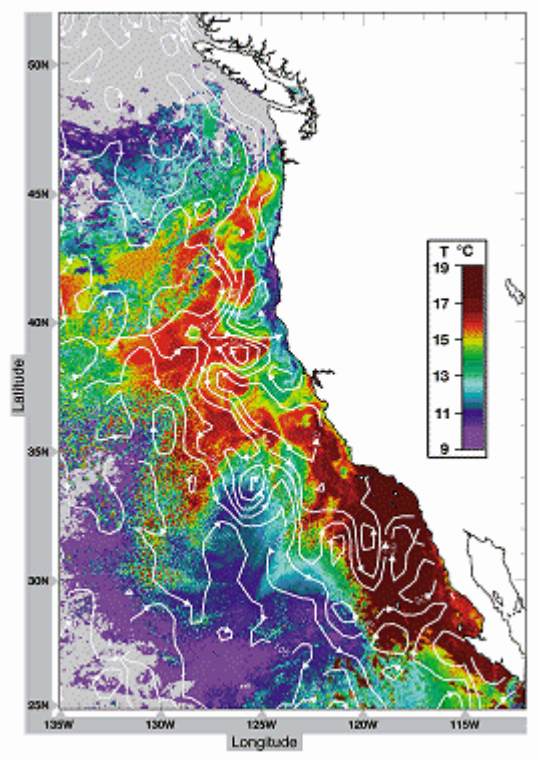
(a) Contours of dynamic height (0/200 db) during a survey off northern California in August 1993, overlaid on the altimeter tracks from T/P (solid) and ERS-1 (dashed);



(b) Contours of T/P plus ERS-1 altimeter heights (plus climatological mean dynamic height) overlaid on satellite SST from the same period.

Figure 2

Contours of T/P plus ERS-1 altimeter heights overlaid on SST from the same time as Figure 1b, over a larger region (August 26 and 27, 1993 for AVHRR, August 26, 1993 for the altimeters)



Meanders in the jet extend 400-500 km offshore and generate both cyclonic and anticyclonic eddies, such as the eddy dipole found by the survey (Figure 1a), the cold and warm eddy pair

offshore of the jet between 39-41°N, 128°W (Figure 1b) and the eddy dipole at 35°N, 125-128°W (Figure 1b). Over the period between October 1992 to December 1993, the altimeter data clearly show that the seasonal jet develops next to the coast and migrates far offshore by fall, contributing eddy kinetic energy to the "eddy desert" in the NE Pacific Ocean [Strub and James, 1997b].

Analyses of Geosat and T/P in the Peru-Chile Current System reveal a different structure north of 35°S: a poleward "Peru-Chile Countercurrent" flowing 100-300 km offshore [Strub et al., 1995]. The region expected to be most similar to that found off northern California (due to wind forcing and coastal geometry) is located at 37°S, around Concepcion, Chile. In Figure 3a, a jet flows equatorward during summer along the temperature front from 34-40°S. Numerous eddies are visible, including eddies of opposite sign on either side of the jet around 35°S. The strong feature at the coast between 36-37°S is an artifact, created by missing data next to the coast. Analysis of the Chilean region is proceeding, including a regional numerical model of the wind-driven circulation.

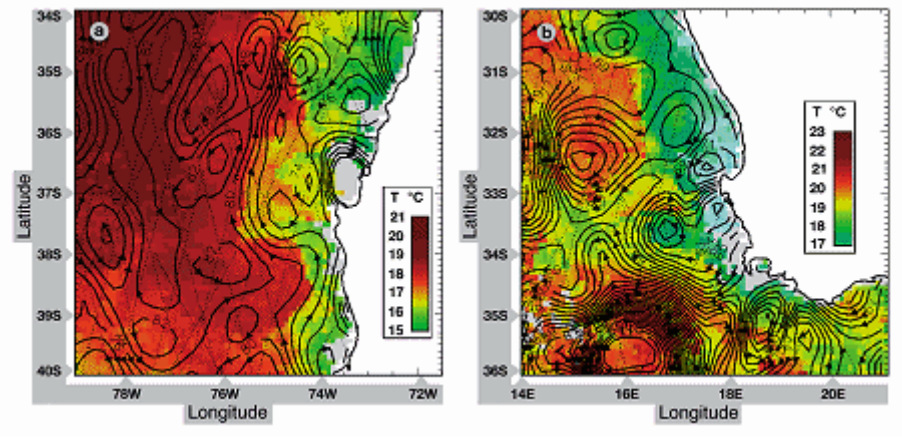


Figure 3
Contours of T/P plus ERS-1 altimeter heights overlaid on SST from (a) off Chile, centered on February 12 1993 ; (b) off South Africa, centered on April 13 1993.

Within the T/P Extended Mission, our emphasis will be on the SE Atlantic Ocean, examining the interaction of the Benguela Current System with the surrounding currents (the South Atlantic Current, the Agulhas Current and the Angola Front). We will also begin to investigate the Canary Current in the NE Atlantic, continuing work in this region in future projects. Work on the Pacific eastern boundary currents will continue within other projects. We will continue to use a combination of satellite sensors, along with available in situ data collected by other programs. We will also compare satellite analyses to existing basin-scale models and apply regional models to clarify the dynamics of the observed circulation features.

For comparison to the other regions, Figure 2b shows an altimeter height field over SST in the southern Benguela region. An anticyclonic eddy is visible in the south (35-36°S, 16°E), typical of warm eddies generated by the Agulhas Retroflection. An eddy pair is present between 32-33°S, inshore (cyclonic) and offshore (anticyclonic) of an equatorward jet. Analysis of Geosat data has shown that anticyclonic eddies sometimes migrate north, combining with cyclonic eddies from the upwelling region next to the coast to form an energetic equatorward jet [Strub et al., 1997c]. While this may look like the California

Current jet, the strengthening by offshore anticyclonic Agulhas eddies has no analog in the Pacific systems. Instead of an eddy desert, the Benguela exists in an "eddy flood plain," quite unlike the other eastern boundary currents.

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