SIR-C/X-SAR observations of convergent fronts in the Central Equatorial Pacific

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Abstract.

The surface front separating cold equatorial water from warmer tropical water at 2-7N in the Central Pacific was studied twice for one week in April and October 1994 between 115W and 155W with the SIR-C/X-SAR synthetic aperture radar, with supporting NOAA satellites infrared images.

During the October flight (the peak of the equatorial upwelling season), zonal linear features of enhanced backscatter intensity were observed at all wavelengths, and corresponded closely to the thermal front seen in the infrared images. A striking example of such feature is seen in an X-band real time image (Fig. 1). On some data takes, several linear features were found at different latitudes, suggesting that the front may not have been unique. The motion of the front estimated from successive daily images was consistent with the westward propagation found by previous studies. In contrast, no fronts were observed in the images taken during the April flight, which were dominated by the surface signature of rain cells.

The front was also visible as brightness changes in AVHRR images of the sun glint, and photographs of the glint taken from the Space Shuttle show the equatorial front as a quasi-linear feature, often darker than surrounding water.

These observations are consistent with *in situ* data collected during the Tropical Instability Wave Experiment in 1992 and 1995, which indicated that the temperature front was 1.2°C over 1 km or less, and was confined to the ~100 m thick mixed-layer. Fine-structure was observed, suggesting northward subduction of cold, high salinity equatorial water, beneath warmer less saline ITCZ water. A 40 km drifter array deployed on the cold side of the front became aligned with the front in less than 3 days. The velocity averaged over five frontal crossing showed a 10 km-wide westward jet of 90 cm/s and a cross-frontal convergence of 15 cm/s, both confined above the thermocline.

During these cruises, whitecapping was frequently enhanced over a band ~100 m wide near the front, presumably due to surface wave refraction by the velocity gradient. The linear features observed in the SAR images correspond presumably to these bands of enhanced whitecap.

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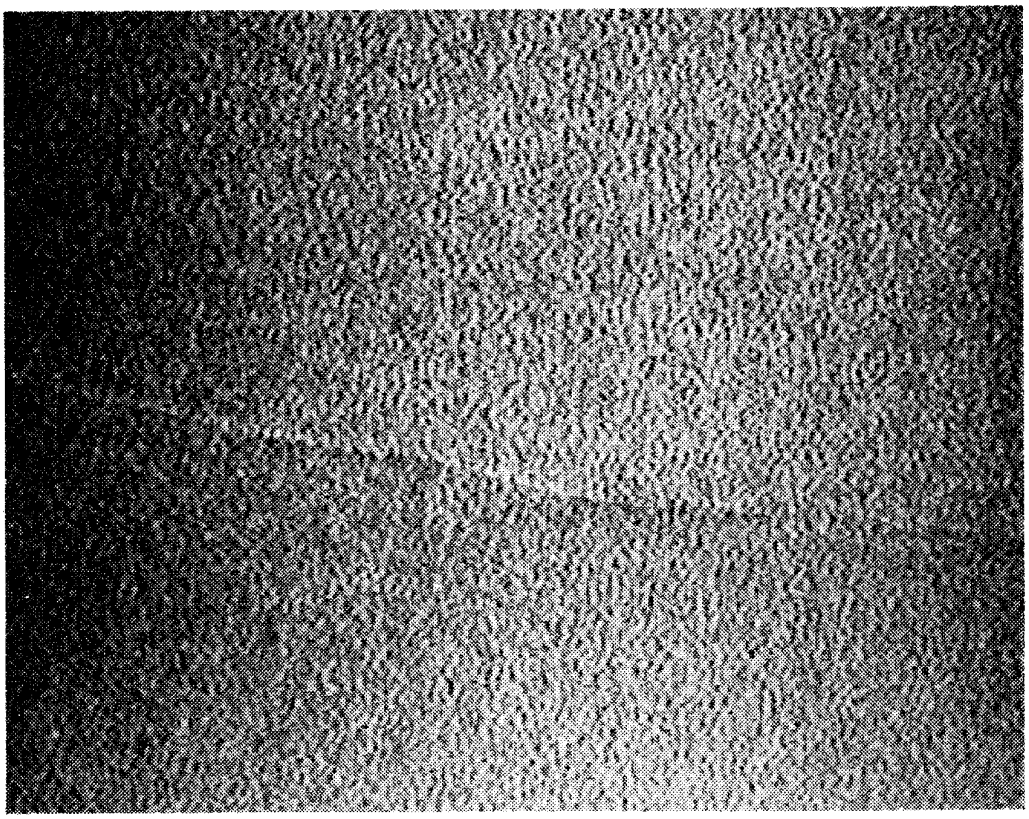

Fig. 1. Example of X-SAR image of the equatorial front during the SLR-2 flight from the real-time X-SAR processor, at 04:28:53:22 mission elapsed time.