UPWELLING VARIABILITY AT JARVIS ISLAND

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ABSTRACT

The interaction of the equatorial undercurrent (EUC) with Jarvis Island results in localized upwelling on the western (upstream) side of the island. Observed fish densities and benthic habitat distributions relate strongly to the upwelling pattern. A simple diagnostic model based on the Bernoulli equation confirms that upwelling depends on the depth of the thermocline and the strength and depth of the EUC, which are modulated by equatorial wind forcing. Strongest upwelling at Jarvis occurs in boreal spring when annual wind forcing leads to a shallow thermocline and shallow and strong EUC. Interannual variations in seasonal upwelling are tied to ENSO; La Niña conditions enhance upwelling at Jarvis by inducing a regional shoaling of the thermocline and the EUC. On intraannual time scales, cessation or reversal of strong westerly wind events in the western Pacific generates Kelvin waves, which are upwelling-favorable at Jarvis. Trade wind relaxations in the central Pacific result in strong eastward surface jets at Jarvis (> 1.00 m s^{-1}); however, these events are downwelling favorable. During periods of EUC-driven upwelling, interactions of the semidiurnal tide with Jarvis result in abrupt cold spikes (1-4°C) that tend to occur at ~12 hour periods. Tidal currents and temperature fluctuate 180° out of phase, such that minimum temperature coincides with maximum eastward current. The presence of internal tides, either locally or remotely generated, likely accounts for the tidal upwelling signal.