

## A Low-Level Returning Flow of the Meridional Circulation in the Tropical Eastern Pacific

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In conventional wisdom, the meridional circulation dominating the tropical eastern Pacific consists of four branches: an ascending branch coinciding with the ITCZ, a descending branch residing south of the equator, a cross-equatorial inflow toward the ITCZ near the surface, and a returning outflow away from the ITCZ in the upper troposphere. Many refer this to as a "local Hadley cell". A recent analysis of observations from the field campaign of EPIC2001, TAO service ships, and Galapagos wind profilers indicates that this traditional Hadley-cell view of the large-scale circulation in the eastern Pacific might be subject to modification. The observations suggest that there is a northerly returning flow from the ITCZ at the level just above the top of the marine boundary layer. This low-level returning flow is not a steady-state feature but can be surprisingly strong when the convection in the ITCZ is relatively shallow, which is not uncommon. The significance of this low-level returning flow lies in its transport of moisture to the arid region south of the equator and its role in momentum entrainment into the boundary layer. Global models' inability to reproduce this low-level returning flow can lead to inaccurate simulations of water vapor distribution in the dry region of the southern oceans and surface winds in the ITCZ/cold tongue complex. The water vapor issue is crucial to its feedback to climate variation. The surface wind issue is critical to the strength and positions of the ITCZ/cold tongue and to the onset of the North American Monsoon.