Abstract View

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Simulation of the Seasonal Cycle of the Tropical Pacific Ocean

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ABSTRACT

In a general circulation model of the tropical Pacific Ocean forced with climatological seasonally varying winds, equatorial upwelling and downwelling in adjacent latitudes play central roles in closing the oceanic circulation. The transport of the eastward North Equatorial Countercurrent decreases in a downstream direction because fluid is lost to downwelling into the thermocline where there is equatorward motion. Although this fluid converges onto the Equatorial Undercurrent, the latter's transport decreases because of equatorial upwelling. The upwelling, on the other hand, enhances the transport of the westward South Equatorial Current. Seasonally, the Countercurrent and South Equatorial Current are intense during the Northern Hemisphere summer and fall, at which time the thermocline has a pronounced trough near 3°N and a ridge near 10°N, and are weak in the spring when latitudinal thermal gradients are small and when the southeast trades are relatively weak. These variations are out of phase with those of the Equatorial Undercurrent, which is most intense in the spring.

The seasonal changes are associated with considerable variations in the meridional heat transport, especially across 9° N. The heat transport is always towards the winter hemisphere. During the northern winter, Ekman drift in the central Pacific affects the northward transport of warm surface waters. During the northern summer, when the ITCZ is near 9°N and the winds there are weak, the Ekman drift across 9°N is small. The relatively steady southward flow of warm surface waters across 9°N in the far western Pacific now contributes significantly to the southward heat transport. Seasonally there is both this meridional and a zonal redistribution of warm surface waters in the upper tropical Pacific Ocean. The zonal redistribution, from west to east, contributes to high sea surface temperatures in the east in April when the Equatorial Undercurrent surges eastward and attains its highest speed and transport during the period of weak southeast tradewinds. Increased heat flux across the ocean surface at this time also contributes to the warming of the upper equatorial ocean. Seasonal wind variations west of the dateline have little effect on the eastern tropical Pacific in the model.

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