Abstract View

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Zonal and Seasonal Variations of the Near-Surface Heat Balance of the Equatorial Pacific Ocean

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ABSTRACT

This study calculates a detailed climatological inventory of the oceanic heat balance in the equatorial Pacific. The gridded climatology of Weare et al. is used as an estimate of net surface heating. Zonal and meridional/vertical advection are estimated in a manner similar to that of Wyrtki, using the gridded climatologies for wind stress (Wyrtki and Meyers) and sea surface temperature (Reynolds), plus estimates of zonal transport. In addition, the meridional diffusion of heat into the cold tongue has been estimated from the work of Hansen and Paul and the terms of the heat flux has been examined for consistency with expectations about the remaining, vertical diffusion process. The effects of using the alternate climatologies of Esbensen and Kushnir and Reed for the net surface heating are also calculated.

The total advective heat flux divergence is calculated to be −27 ± 7, −91 ± 17 and −48 ± 17 W m^2, respectively, in the western, central and eastern equatorial Pacific with meridional advection and upwelling removing about three times as much heat as zonal advection. The advective contribution are in approximate agreement with Wyrtki's "likely case" estimates for the 100°W–170°E longitude zone. The contribution from zonal advection, meridional advection and meridional diffusion are found to be greatest during the Boreal fall, winter and fall–winter seasons, respectively.

Depending on the climatology used for the net surface heat gain, the assumption of a uniform meridional diffusivity of $2 \times 10^4\ m^2\ s^{-1}$ leads to physically unrealistic residual flux divergences that imply a heat gain from vertical turbulence in the central Pacific or that vertical turbulence removes much more heat from the western and eastern Pacific than from the central Pacific. Total neglect of the meridional diffusion exacerbates the problems. Increasing the meridional diffusivity to $6 \times 10^4\ m^2\ s^{-1}$ in the central Pacific, consistent with direct estimates by Hansen and Paul, gives zonally uniform, negative residuals that are physically consistent with existing measurements of equatorial turbulence. With the model so tuned, the "best guess" heat balance in the central Pacific involves significant contributions from all terms, in the western Pacific between surface heat gain from the atmosphere and losses due to vertical diffusion, and in the eastern Pacific between surface gain and losses due to meridional advection (upwelling)

and vertical diffusion.

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