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VOCALS/Southeast Pacific science confronts coupled models with ship observations

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Air-sea surface fluxes measured in the VOCALS region corroborate buoy surface flux observations that show the upper ocean is gaining ~40 W/m≤ heat due to surface fluxes. This implies sub-surface ocean transport cools the mixed layer and SST, but the mechanism by which it does so remains elusive. Ocean general circulation models do not simulate sufficient ocean transport cooling, compounding warm SST errors. Widespread marine stratocumulus clouds affect the surface heat balance. Clouds have a -120 W/m≤ cooling solar radiative forcing, offset by a 60 W/m≤ longwave warming surface cloud forcing. Cloud fraction is 0.9 along 20^{o}S, yet clouds have a relatively weaker shortwave radiative forcing than the cloud fraction suggests because they clear most in afternoon daylight. Coupled Model Intercomparison Project 3 (CMIP3) simulations have 50% too little longwave and solar cloud forcing in the 20^{o}S, 75-85^{o}W region, corresponding to 50% fewer clouds than observed.