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Convective damping of buoyancy anomalies and its effect on lapse rates in the tropical lower troposphere

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Abstract. In regions of the tropics undergoing active deep convection, the variation of lower tropospheric lapse rates (2.0 km to 5.2 km) with height is inconsistent with both reversible moist adiabatic and pseudoadiabatic assumptions. It is argued that this anomalous behavior arises from the tendency for the divergence of a convective buoyancy anomaly to be primarily offset by the collective divergence of other updrafts and downdrafts within one Rossby radius of deformation. Ordinarily, convective mass flux divergences are at least partially offset by an induced radiative mass flux divergence in the background atmosphere. If mass flux divergences from lower tropospheric convection are balanced mainly by those of neighboring updrafts/downdrafts, it would force the vertical clear sky radiative mass flux of the background atmosphere to be weakly dependent on height. This is observed at several radiosonde locations in the Western Tropical Pacific between 2.0 and the 5.2 km melting level. At tropical locations where SST's exceed 27°C over a region whose horizontal extent exceeds the local Rossby radius, this condition on the vertical variation of the background radiative mass flux partially constrains the range of physically allowed mean temperature and moisture profiles in the lower troposphere.

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