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Thermodynamic Contribution to Lightning Activity in the Fourth Chimney

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Lightning activity over oceans is normally greatly suppressed in comparison with continents. The most conspicuous region of enhanced lightning activity over open ocean is found in the equatorial Pacific (150°W) in many global lightning climatologies (OTD, LIS, WWLLN, GLD360, RHESSI, Schumann resonance Q-bursts) and is associated with the South Pacific Convergence Zone (SPCZ). This oceanic lightning anomaly completes the zonal wavenumber-4 structure of continent-based lightning maxima (with nominal 90-degree longitudinal separation between sources), and so is appropriately named “the fourth chimney”. This region is now under continuous surveillance by the Geostationary Lightning Mapper (GLM) on the GOES-17 satellite (at 137°W). This total lightning activity is compared with Convective Available Potential Energy (CAPE) from ERA-5 reanalysis. These CAPE values are correlated with values extracted from thermodynamic soundings at proximal stations Atuona, Rikitea and Tahiti. The shape of the regional climatology of CAPE resembles that of the SPCZ and is oblique to the equator. The total lightning flash rate is positively correlated with CAPE, and lightning locations are found preferentially in regions of elevated CAPE on individual days. The diurnal variation of total lightning for January exceeds a factor-of-two and shows a phase at odds with the usual behavior of oceanic lightning near continents.