

The upward branch of the Brewer-Dobson circulation: constraints from water vapor and carbon monoxide tropical tape recorders

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The vertical distributions of water vapor and carbon monoxide in the tropical lower stratosphere are controlled largely by their mixing ratios near the tropopause and by ascending motions of the Brewer-Dobson circulation. The upward propagation of seasonal variations imprinted on H₂O and CO vertical profiles, often referred to as the tropical tape recorder, can be used to derive the mean vertical velocity, w^* , in the lower stratosphere. We used Aura Microwave Limb Sounder observations of the tropical tape recorders from 2004 to 2011 to establish a time series of w^* from 85 to 15 hPa pressure (about 18 to 28 km altitude). The overall mean vertical profiles of w^* are consistent with calculated velocities based on net radiative heating and cooling rates. Variations in w^* above 22 km are dominated by the quasi biennial oscillation. The annual cycle is generally smaller in amplitude than the QBO, with maximum upward motion during the November-January period. Interannual variations are nearly as large as the annual cycle, and these are correlated with tropical mean outgoing longwave radiation. Our results suggest a link between tropospheric clouds, stratospheric radiative cooling, and the mean rate of ascent in the tropical lower stratosphere.