The Interannual Variability of Carbon Monoxide in the Upper Troposphere-Lower Stratosphere Over the Asian Summer Monsoon Region

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The Asian summer monsoon is an important transport pathway from the surface to the stratosphere; the Asian summer monsoon anticyclone in the upper troposphere-lower stratosphere (UTLS) is linked with a region of enhanced pollution during boreal summer. While a persistent maximum of carbon monoxide (CO) over the Asian summer monsoon region is well observed from satellite observations, the dynamical mechanism underlying this transport pathway is not fully understood. Our study aims to characterize the year-to-year variability of CO in the UTLS over the Asian summer monsoon by analyzing 17 years (2004-2020) of observations from NASA's Microwave Limb Sounder (MLS). We examine the correlation between CO variability at 100 hPa over Southeast Asia during June, July, and August and each of three proposed factors affecting the variability of the CO maximum: surface emissions, convection (using outgoing longwave radiation), and large-scale ascent. Our results show that at 100 hPa, large-scale ascent is a significant contributing factor to the interannual variability of CO as 100 hPa vertical velocity was negatively correlated with CO at 100 hPa over the region of interest ($r < -0.6$). Neither surface emission nor convection was shown to significantly contribute to 100 hPa CO variability, indicating that large-scale circulation is the dominant dynamical mechanism controlling the transport pathway associated with the Asian summer monsoon in the UTLS. Our results therefore suggest that the interannual variability of 100 hPa CO in the Asian summer monsoon region is largely dependent on the strength of large-scale ascent into the stratosphere, rather than the magnitude of surface emissions or strength of convection.