Transport of Carbon Monoxide to the Upper Troposphere and Lower Stratosphere through Active Convection in Asian Summer Monsoon at Daily Timescales

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The Asian summer monsoon (ASM) has been established as a dominant transport pathway for pollutants from the surface to the upper troposphere and lower stratosphere (UTLS) where they can have major impacts on atmospheric chemistry, the radiative balance, and ozone levels. The seasonal cycle of this transport pathway has been well established, yet its exact mechanisms are not fully understood. This study investigates the role of daily convection compared to large-scale ascent on vertical transport. We used a model experiment with tagged CO, which allowed us to isolate the transport pathways for the two dominant source regions, South and East Asia, and visualize and analyze them independently. We used data from the monsoon's active season, removing seasonal cycles and detrending to isolate daily fluctuations, and looked at the impact of individual convective events using statistical methods like linear regression and correlation coefficents. We found that CO transport from the two regions is driven by different convective centers (aligned with the South Asian and East Asian monsoon subcomponents). South Asian CO is also most efficiently transported higher into the atmosphere than East Asian CO, although there is a lot of interannual variability. Additionally, emissions from South Asia are more confined in the Asian monsoon anticyclone whereas East Asian emissions distribute throughout the entire region more freely. Our results showed that South Asian emissions to upper levels have a longer transport timescale (reaching transport peak of 100hPa after 4 days) and transport may be more driven by large-scale vertical ascent compared to East Asia where the transport is quicker (reaching transport peak of 150hPa after 2 days) and convection dominates.