ENSO Impact on Interannual Variability in Springtime Carbon Monoxide over the North Atlantic Europe

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Abstract

In view of the importance of carbon monoxide (CO) to air quality and tropospheric chemistry, it is desirable to investigate CO variability at different scales, including interannual variation (IAV) and the associated controlling mechanisms. ENSO is known to influence IAV in meteorological variables but its influence on atmospheric CO is not well understood. Investigating ENSO-CO teleconnections is challenging because of multiple factors controlling both ENSO and CO. In addition, long-term datasets of CO are also required. Here we report an ENSO teleconnection to the IAV in tropospheric CO concentrations over the northern Atlantic European region (NAE) in spring, based on analysis of a trajectory-mapped airborne CO dataset. We find that ENSO in boreal winter (November to February) is positively correlated with tropospheric CO over the NAE in the following boreal spring (March to May). The correlation coefficient between an ENSO index and detrended CO concentrations in the NAE is 0.67 at 400 hPa and 0.63 near the surface. This teleconnection is further confirmed by surface observations, satellite data, and model simulations. This ENSO-induced CO variability is presented with a high level of vertical and horizontal details. With an 18-year dataset covering 2002-2019, our conclusions are fairly robust. We further show that ENSO regulate CO concentrations in the NAE through modulating fire emissions from distant source regions rather than from the NAE itself. The teleconnection results from a combined ENSO effect on both biomass burning and atmospheric transport. This study advances our understanding of ENSO regulation of CO IAV in mid-high latitudes, which can be beneficial to CO prediction when ENSO events occur.

Early Career Scientist

NO, I am not an early career scientist.

IGAC Activities

TOAR: Tropospheric Ozone Assessment Report, ACAM: Atmospheric Chemistry and the Asian Monsoon, BBURNED: Biomass Burning Uncertainty: ReactioNs, Emissions and Dynamics