6.150 Convective transport of short-lived hydrocarbons and bromocarbons from the surface to the upper troposphere and lower stratosphere.

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Abstract:

Deep convection is the primary mechanism that delivers important chemical trace gases into the upper troposphere and the lower stratosphere (UT/LS), where they exert significant impacts on atmospheric O_3 and OH. The Western Pacific has been viewed traditionally as the primary convective lofting region for air to enter the tropical tropopause layer (TTL), although deep convective injection over the continental U.S. has also been proposed as a potential pathway. We have analyzed aircraft measurements of CO_2, NMHCs (CO, ethyne, ethane, HCHO), and very-short-lived bromocarbons from multiple aircraft missions with trace gas simulations from the NASA GOES-5 chemistry climate model. The results from the NASA SEAC^{4}RS mission over the N. American continental sub-tropics are compared with those from the NASA ATTREX and NSF CONTRAST missions over the Western Pacific to examine the transport timescale and transport efficiency of these chemical compounds from the surface to the UT/LS and to investigate how convective transport differ in these two regions. We found that the Western Pacific is convectively efficient with rapid vertical transport from the surface to the 365K potential temperature level (~16 km) within 60 days. Convective transport over the continental N. America is less frequent and much slower (120 days from surface to 365K), but sporadic injection can be as high as the 400K potential temperature level (~18 km) during some occasions. We will extend the analysis to additional aircraft missions, including the NASA TC^4 mission in the deep tropical Central America and the early summer NSF DC^3 mission over the continental U.S, to achieve a better understanding of convective transport into the UT/LS and how it varies with season and region.