Ozone and Other Trace Gases in the Tropical Tropopause Layer over the Pacific Ocean

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The distribution of ozone in the tropics is influenced by both chemistry and transport, and in turn affects the oxidation rate of a large number of organic species, including shorter-lived ozone depleting substances (ODS) such as organic bromine compounds. The NASA Airborne Tropical Tropopause Experiment (ATTREX) mission was designed to study trace gases, clouds, dehydration, and transport in the tropical tropopause layer (TTL; ~14-18.5 km) over the Pacific Ocean, one of the primary entry points of air from the troposphere into the stratosphere, in order to better understand how water vapor and ozone-depleting gases reach the lower stratosphere or are removed in the TTL. Field campaigns were carried out on the NASA Global Hawk aircraft, with about 200 vertical profiles in the TTL over the central and eastern tropical Pacific (ATTREX-1 and 2; 2011 and 2013) and the western Pacific in January-March 2014 (ATTREX-3). The National Science Foundation/National Center for Atmospheric Research (NSF/NCAR) GV and British BAe-146 aircraft also participated in flights from Guam during ATTREX-3, along with ozone and water vapor sondes, providing coverage of the atmosphere from the boundary layer to 19 km. Ozone was consistently low (10-40 ppb) in the lower TTL over the western Pacific, with low values extending up to the cold point tropopause, particularly in March 2014. Ozone over the central and eastern Pacific in February-March 2013 often averaged 40-50 ppb, and typically increased slowly with height from about 14 km to the tropopause. The results are consistent with frequent but not uniform deep convection, bringing low-ozone air from the marine boundary layer directly to the upper troposphere over the western tropical Pacific. During the winter 1987 STEP mission, the NASA ER-2 aircraft made several profiles at Guam during transit flights, which included very low values of ozone, lower than observed at their principal study site in Australia. ATTREX-3 results also showed gradients in ozone and other trace gases between northern and southern hemispheres, but with lower values of ozone in the southern hemisphere. Results will be presented on ozone distributions, other trace gases, and northern hemisphere/southern hemisphere differences.

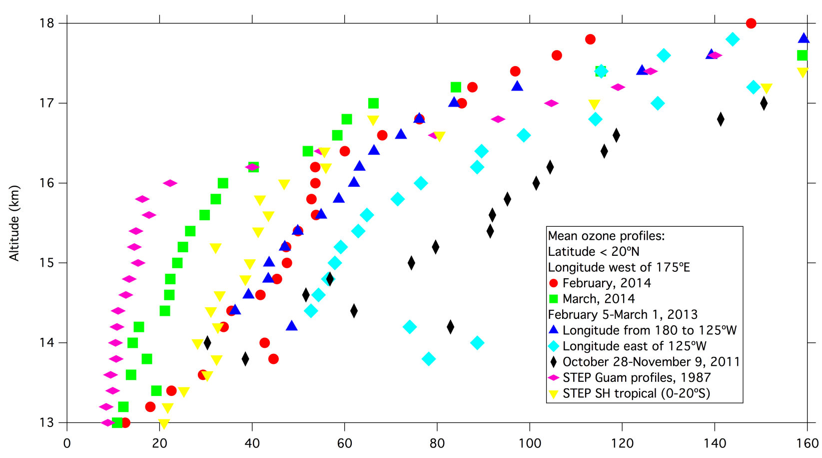

Figure 1. Average ozone profiles in the tropics for STEP and ATTREX flights over the Pacific.