Recent Results from the Airborne Tropical Tropopause EXperiment (ATTREX) Over the Western Tropical Pacific

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The tropopause over the western tropical Pacific Ocean is thought to be one of the primary entry points of air from the troposphere into the stratosphere. In this area, temperatures are low enough in the tropical tropopause layer (TTL) to dehydrate air to the low values observed in the stratosphere. The NASA ATTREX mission was designed to study the transport of water vapor and other trace gases in the TTL over the Pacific Ocean, in order to understand how dehydration occurs in this region and how trace gases involved in ozone depletion and climate reach the lower stratosphere. The field campaign phase of this mission recently concluded with flights of the Global Hawk aircraft over the western tropical Pacific from Guam in January-March 2014. The plane carried a suite of in situ and remote sensing instruments for gases, aerosols, radiation, and meteorology. Two deployments occurred previously from NASA/Dryden (now Armstrong) Flight Research Center, with flights to the eastern and central tropical Pacific.

Nearly 100 vertical profiles in the TTL from about 14 to 18 km were obtained over the western tropical Pacific, as well as a few long sections at nearly constant altitude. Results are shown here from the UAS Chromatograph for Atmospheric Trace Species (UCATS) instrument and other sensors. UCATS was configured to measure N_2O, SF_6, H_2, CH_4, CO, water vapor, and ozone. In contrast to previous deployments over the eastern and central Pacific, ozone values were extremely low over the western tropical Pacific. The long-lived tracers N_2O, methane, and SF_6 were at near-tropospheric values for long stretches of the flight tracks, indicating little or no in-mixing of older stratospheric air. CO was often at elevated levels (50-80 ppb) compared to what might be expected in the clean upper troposphere/lower stratosphere for this region. Water vapor showed large variations and condensed water (ice) was often observed, along with high concentrations of ice particles.

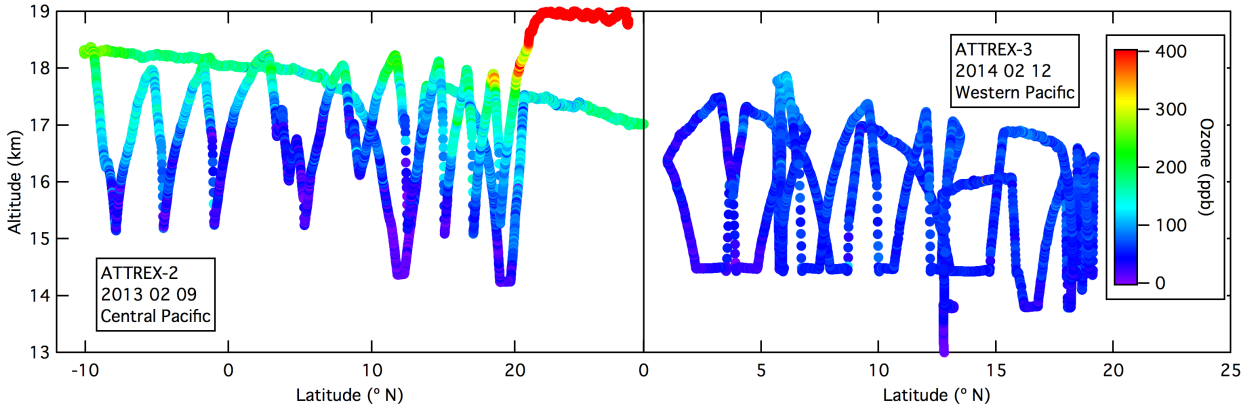

Figure 1. (Left) Flight track of the Global Hawk, February 9, 2013 over the central tropical Pacific, color-coded by UCATS ozone data. (Right) Flight track of the Global Hawk, February 12, 2014 over the western Pacific, color-coded by UCATS ozone data. Some of the difference in ozone mixing ratio is due to the lower altitudes sampled by the aircraft in 2014, but ozone was clearly lower on the flight from Guam even at the same altitude and latitude.