

## Trace Gas Measurements from the Unmanned Aerial System (UAS) Altair

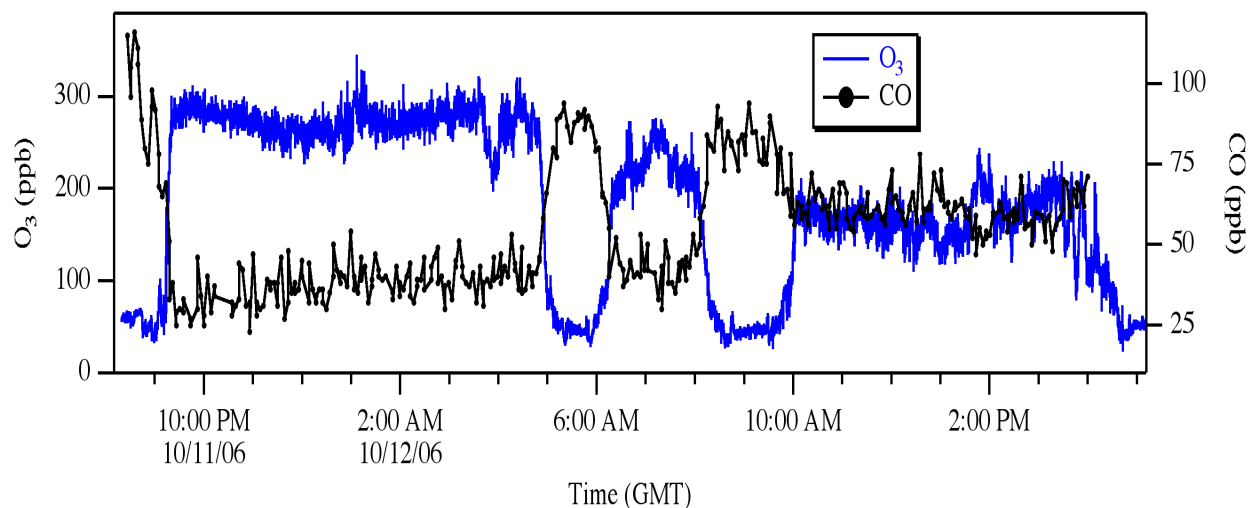
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Unmanned Aerial Systems (UASs) will soon be integral to the monitoring of atmospheric composition because they provide a unique combination of payload capacity, altitude range, and most importantly, endurance far beyond that of manned aircraft. During 2005-2006, ESRL contributed to two UAS-based science projects by operating the UAS Chromatograph for Atmospheric Trace Species (UCATS) aboard the high-altitude, long-endurance Altair UAS (General Atomics - Aeronautical Systems Inc). UCATS is a 2-channel gas chromatograph, dual-beam ozone photometer, and tunable diode laser water vapor hygrometer contained within a compact (46x41x25 cm), lightweight (27 kg) enclosure. To date UCATS has amassed >130 flight hours with Altair, including four flights of 18-23 hours duration.

UCATS obtained vertical profile measurements of trace gases and water vapor (H<sub>2</sub>O) between the mid-troposphere (~6 km) and lower stratosphere (~15 km) on several flights while Altair performed slow spiral ascent/descent maneuvers. Tropopause crossings are readily identifiable in the UCATS time series of ozone (O<sub>3</sub>) and carbon monoxide (CO) measurements as rapid, opposing changes in their mixing ratios (Figure 1). UCATS vertical profile data for O<sub>3</sub> and H<sub>2</sub>O will be compared to coordinated profiles obtained nearby from balloon-based ECC ozonesondes and cryogenic frostpoint hygrometers, and to retrievals from proximate soundings of the Microwave Limb Sounder aboard the NASA Aura satellite.



**Figure 1.** UCATS in situ measurements of ozone (blue) and carbon monoxide (black) reveal a total of 6 tropopause crossings during the 21-hour Altair UAS flight of October 11-12, 2006. Spiral descent/ascent maneuvers by Altair between 6 and 15 km lead to the 4 tropopause crossings in addition to those achieved during initial climb (to 13.4 km) and final descent (from 13.5 km).