Geophysical Research Abstracts
Vol. 19, EGU2017-11068, 2017
EGU General Assembly 2017

Aerial sampling using drones for measuring trace gases

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Aerial and ground-level samples were simultaneously collected at the northern tip of Taiwan, Cape Fuguei, which is commonly served as a receptor site to receive air parcels from East Asia, Asian continent, the northwest Pacific Ocean and the island of Taiwan itself. Both aerial and surface samples were analyzed for 106 volatile organic compounds (VOCs) and divided into three categories as follows: 1. the total concentrations of 106 VOC (T-VOC) at 300-m height that are lower than the T-VOC level at the surface (Category A), 2. T-VOC concentrations at 300-m that are higher than those at the surface (Category B), and 3. comparable concentrations (Category C). Ten VOCs were exploited as tracers for a variety of emission sources linking to possible sources and transport routes of airborne pollutants. The first two categories A and B showed significant differences in the observed composition and concentrations of tracers between aerial and ground-level samples, implying that the pollutants at different heights may have resulted from different sources and poor air mixing, despite only a 300-m difference in vertical height. In contrast, Category C showed good vertical mixing, as indicated by the comparable concentrations between the aerial and surface measurements. Since the three categories occurred in specific meteorological conditions (between, prior to, and after cold fronts), respectively, it suggests that varied prevailing meteorology controlled the distribution and transport of airborne pollutants. Unlike sampling commonly performed at the surface, this study uses aerial sampling to demonstrate that layered structures under different meteorological conditions. Sampling aloft in lower boundary layer avoids samples being over-influenced by the close-by surface sources such as traffic to reveal signatures of a broader region.