



3-Dimensional sampling and observation platforms for probing near-ground atmosphere

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Aerial observation with spatial resolution becomes necessary for studying the accumulation, dispersion, transport and chemical/physical changes of pollutants in the atmosphere, especially in the boundary layer where emissions and atmospheric processes of pollutants occur most vigorously. AS-RCEC-TGAL group has been developing a variety of Aerial Sampling and Observation Platforms (ASOPs), aimed to have high maneuverability and can be readily deployed to obtain highly resolved vertical data of chemical species and meteorological variables from surface up to 1000-m height. The platform is composed of an octo-rotor multicopter drone, various light-weight remote-controlled aerial sampling devices, an array of optimized sensors and miniature detectors with wireless data transmission capabilities. Rapid launches for sampling followed by subsequent in-laboratory analysis provided mixing ratios for a variety of trace-level gaseous constituents, e.g., 106 VOCs, CO, CO₂, CH₄, N₂O, PFC tracers, or the data of CO₂ isotopologues. In addition, real-time measurements reported meteorological variables (high-precision temperature, humidity, pressure, different-wavelength radiation, and high spatial-resolution wind direction and speed) and total particle mass, particle sizes, black carbon, TVOCs, O₃, real-time visual or thermal images, depending on mission needs. The comprehensive spatial-resolution information of gaseous pollutants, particulate matters, meteorological parameters, and images provided by ASOPs with superior performance (e.g., low detection limit, high stability and tolerance to relatively harsh environments, simultaneous observation, and wireless data return) would help understand the causes, processing, and impacts of local climate variability and various types of environmental issues (e.g., PM_{2.5}, O₃, toxic substances, waste, etc.). Furthermore, the information can also assist modeling to validate and improve simulation and early warning for air pollution.