Estimating CO2 and CH4 Emissions from Washington DC Using Low Cost Sensors and Small Drone Technology

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Anthropogenic emissions of methane (CH4) and carbon dioxide (CO2) especially from large cities have resulted in the build-up of greenhouse gas concentrations responsible for climate change. Existing greenhouse gas sensor technology is both too heavy and expensive for large-scale use in urban areas, and current platforms for measurement are limited in height and stability. In this project, I present the construction and calibration of an inexpensive methane and carbon dioxide sensor. A small low-powered drone was designed and built to serve as a stable platform for accurate measurements. An atmospheric transport/inversion model to estimate emission inventories for large cities using data collected by drones and tower networks was developed. Low-cost sensor data compared favorably with state-of-the-art instruments (correlation factor = 0.99), and exhibited expected diurnal cycles and traffic patterns. Successful flight demonstrates the potential for sensor-mounted drones to make continuous atmospheric measurements. The predicted CO2 emission inventory for Washington DC showed a large contribution from the transportation sector. Overall, I demonstrate a methodology to measure and monitor city-wide CO2 and CH4 emissions by combining low-cost lightweight sensors, small drone technology and mathematical models, and taking the first step to targeting specific greenhouse gas sources and reducing overall emissions.

Awards Won:

Second Award of $2,000

American Meteorological Society: First Award of $2,000