Design and Implementation of an Airborne Particulate-Matter Sensor

Leonard Hochmuth, Todd McKinney, Dr. Mike Newchurch, Atmospheric and Earth Science

Overview

- Measuring particular matter (PM) in the atmosphere is a fundamental method of determining air quality.
- We develop and implement a sensor capable of distinguishing volume concentrations of particle sizes with diameters of 1.0, 2.5, or 10.0 microns and mass concentrations in μg/m³ at ±10% accuracy.

Key Findings

Figure 1: Aircraft PM2.5 data at 400m above ground level near Dauphin Island, Alabama. The data demonstrates differences between polluted air and clean air. Flaring from a natural-gas transfer station is the main cause of the localized polluted air over the land.

Conceptual Design

Figure 2: Design of the particulate matter sensor. Left panel shows the components of the sensor, which includes a GPS unit that records location and time, a sensor to record atmospheric data, and a data logger that writes to an SD card using a Teensy Controller. Right panel shows the inside of the PM sensor via a conceptual block diagram. Using backscatter from an emitted laser pulse, a filter amplifier and microprocessor can determine particular matter sizes and their associated concentrations.

Impact and Conclusions

A test flight of the particular matter sensor demonstrates our capability to measure air quality from both clean air and anthropogenic sources on fine spatial scales. In future air-quality campaigns, these sensors will be used to validate satellite measurements and to assess health impacts from lower air-quality regions.

Acknowledgements

This work would not have been possible without support from the UAH Department of Atmospheric and Earth Science and NASA’s Tropospheric Ozone Lidar Network (TOLNet). The RCEU program is sponsored in part by the UAH Office of the President, Office of the Provost, Office of the Vice President for Research and Economic Development, The Dean of the College of Science, the Dean of the College of Engineering, and the Alabama Space Grant Consortium.