**Measuring wildfire smoke with a miniature spectrometer**

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A major component missing from most small atmospheric research teams is the use of spectroscopy for discerning information about air quality. Expense and portability of spectrometer units are significant field-application barriers. Many molecules of interest have absorption bands in the mid-UV or mid-IR which is a challenging region for even moderately expensive portable spectrometers. Wood smoke from controlled burns and wildfires has a distinctive brownish hue that is conveniently in the visible region of the spectrum. We did a comparison of total column measurements of the solar spectrum under clear conditions, through smoke from a controlled burn, and for smoke transported from wildfires in California. To provide comparable intensity spectra in each case, measurements were also made using blue sky as the background source, a few degrees offset from the Sun. We found a distinct spectral extinction signature (from absorption and scattering) from wood smoke, as expected.

The primary spectrometer used in this project, an Ocean Optics HR4000CG-UV-NIR, has a spectral response of 200 - 1100 nm and spectral resolution < 1.0 nm. This instrument defined our baseline data. To address portability and affordability issues, we designed a miniature spectrometer system utilizing the Hamamatsu C12880MA micro-series spectrometer. This fingertip-sized spectrometer has a spectral response of 340 – 850 nm and spectral resolution (FWHM) of 15 nm. This spectrometer technology is ultra-compact, with high light sensitivity. A weather resistant housing was developed for this project that doubles as a pinhole collimator. The first prototype utilizes an Arduino Leonardo board but will be ported over to a dedicated microcontroller system in the future. Code to control the system was obtained in Arduino C and then a LabVIEW program was written to collect, calibrate, and display the spectra.

The goal is to replicate the results obtained from the high-resolution laboratory spectrometer ($6500) using the inexpensive (<$500) micro spectrometer. The initial tests indicate that this approach will be successful.