Atmospheric Attenuation and Particulates Study

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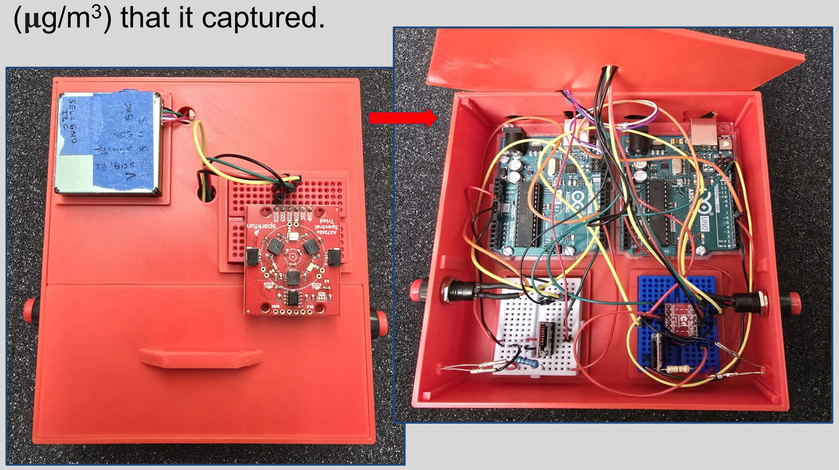
Introduction

The purpose of this work was to investigate ways to study air quality in the arctic circle. To do this, 2 methods were used - atmospheric extinction of sunlight, and particulate measurements.

Figure 1

Equipment & Methods

A system was designed and built that housed 2 sensors. The detector is based on a 3D printed box housing 2 Arduinos. These Arduinos run the AS-7265 spectral sensor and SPS-30 particulates sensor. The AS-7265 detects 18 different wavelengths of light and reads out their respective intensities in nW/cm^2. The SPS-30 measures the concentration of particulates that are 1, 2.5, 4, and 10 micron, and the mass density of such particles (μg/m^3) that it captured.

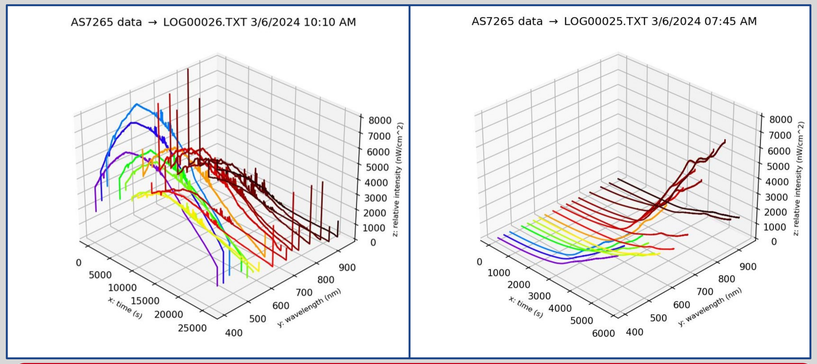


Arctic Solar Ray Attenuation

This sensor was placed outside in Utqiagvik, Alaska (Fig. 1) where winds bring particulates from other parts of the globe, but esp. eastern Asia. This sensor was set out multiple times including before sunrise in the morning, and through local noon. The light intensity data yields the extinction coefficient of the atmosphere through the slope of the graph (Figs. 4,5) of ln(I_f/I_0):

$$I_f = I_0 e^{-kd} \rightarrow \ln\left(\frac{I_f}{I_0}\right) = -kd$$

We note the change in the slopes of the longer wavelengths of the spectral lines (>750nm) during one of the observation periods that started before sunrise and continued into the early afternoon.



SPS Sensor

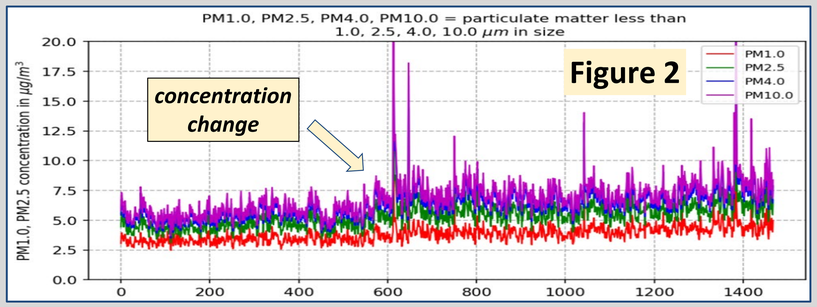


Figure 2

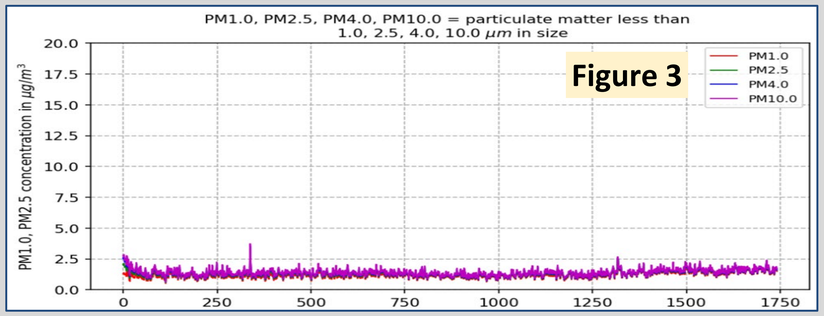


Figure 3

Results

Wavelength	Extinction Coefficient 100-200 km	Extinction Coefficient 200-275 km
680 nm	0.000594	0.000832
705 nm	0.000976	0.00162
730nm	0.000766	0.000937
760nm	0.001469	0.000885
810nm	0.000781	0.000833
860nm	0.00117	0.000312
900nm	0.000421	0.000989
960nm	0.00057	0.000753

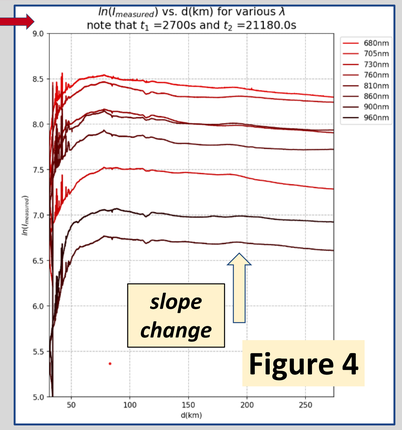


Figure 4

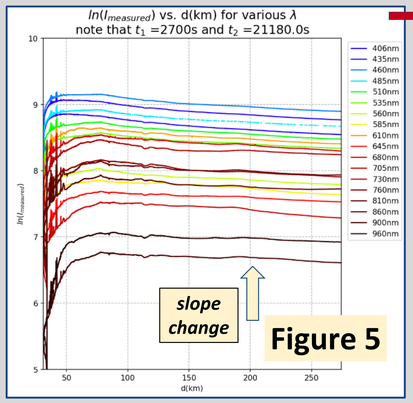


Figure 5

Wavelength	Extinction Coefficient 100-275 km
410 nm	0.00127
435 nm	0.000964
460 nm	0.000978
485 nm	0.000982
510 nm	0.000949
535 nm	0.000959
560 nm	0.000893
585 nm	0.000982
610 nm	0.000938
645 nm	0.000626

Results/Conclusions

We noted from Figs. 2 & 3 the particulates counts increased at the same time at the changes in the slopes in Fig. 4 & 5 occurred. Since the slopes changed only for the longer wavelengths, which are of the approx. same size as the smaller particulates detected, we posit that both of these detected what might be a cloud with particulates blowing in from perhaps eastern Asia. The skies were clear and unchanging to our eyes, but these data suggest the utility of these sensors for detecting particulates that we can't see.

Acknowledgments

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