Putting Next Generation Sensors in practice to reduce wood smoke in a highly impacted, multi-cultural rural setting (NextGenSS)

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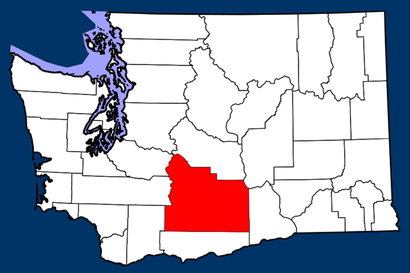
ABSTRACT

The Yakima Valley of Washington State is a rural region that is highly impacted by episodic poor air quality with two major underrepresented populations in environmental health research, Native Americans and immigrant Latino farm worker families. As part of the EPA Air Pollution Monitoring for Community program, the University of Washington (UW) air pollution researchers partnered with the community's Heritage University faculty. The team has deployed a combination of next generation (NextGenSS) low-cost sensors and research-grade particle instruments in student-directed studies addressing key scientific questions pertaining to heavy wood smoke impacts in their rural community.



ACKNOWLEDGEMENT

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DISCLAIMER

This poster was developed under Assistance Agreement #RD83618501 awarded by the U.S. Environmental Protection Agency to Dr. Catherine Karr. It has not been formally reviewed by EPA. The views expressed in this document are solely those of [name of recipient or names of authors] and do not necessarily reflect those of the Agency. EPA does not endorse any products or commercial services mentioned in this publication.

INTRODUCTION

The primary objective of this project is to deploy next generation (NextGenSS) low-cost particle sensors in student-directed studies pertaining to heavy woodsmoke impact in a rural community of Yakima County, WA.

The main project activities are to:

- Develop an adaptable web based air pollution curriculum intended for our community mentors (HU) and high school students.
- Equip students to generate, use, and apply data from air pollution monitoring equipment.
- Evaluate sensor effectiveness in community studies.
- Understand local wood smoke/air quality concerns.
- Devise solutions in a culturally competent framework that may benefit this region and be an example to share with others

METHODS

Needs Assessment and Environmental Literacy
Designed to asses air pollution Knowledge, Attitude and Need of community members' and stakeholders'.

Educational Curriculum
Developed an adaptable web based air pollution curriculum leading to successful deployment and interpretation of data from NextGenSS sensors.

Exposure Assessment
YEAR 1 (2016-2017): Low-cost monitors (Dylos) were provided to students and their mentors. In addition, a central site location included a TSI 3300 Optical Particle Sizer to measure fine particulate matter ($PM_{2.5}$) and size distribution and a dual-channel microAeth® AE52 (AethLabs) to identify black carbon (BC) associated with wood smoke.

YEAR 2 (2017-2018): Low-cost community air monitors (Seto Lab) were provided to students and their mentors. Each monitor collects time-resolved particle size distribution and NO, NO_2, Ozone and CO. In addition, a central site location will include a multi-channel microAeth® (AethLabs) to identify black carbon (BC) associated with wood smoke.

YEAR 3 (2018-2019): Continued deployment of NextgenSS instruments and result dissemination to community partners.

RESULTS

The first year of this project yielded quality central site data collected during the wood burning season (January-March). The NextGenSS data collected in this initial year was analyzed by high school students to generate scientific posters presented at an EnvironMentors national meeting in Washington, DC but did not have enough temporal or spatial resolution to answer the woodsmoke hypothesis questions of this project.

The needs assessment participants (n=20) included advisory community members, EnvironMentors and High School Students. The survey demonstrated moderate air pollution knowledge (60% correct) and considerable concern about the environment with some group specific differences. Some main environmental concerns included sustainable hunting and fishing as well as global warming.

Figure 1. Central Site Location

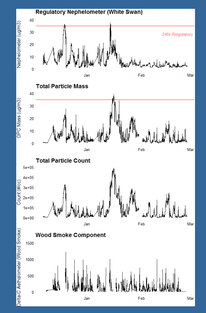

Figure 2. Central Site Monitoring Data

Figure 3. Students preparing research posters based on data collected using the Dylos air monitors. Posters presented in Washington, DC at the EnvironMentors National Fair - July 2017

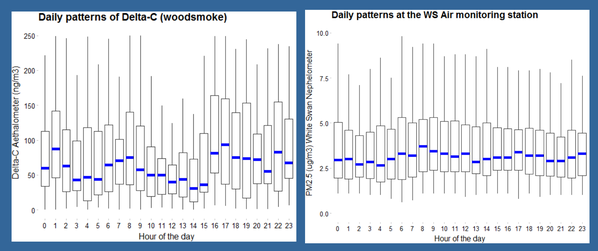

Figure 4. Central Site data showing diurnal patterns in the Delta-C component of the Black Carbon measurement as compared to total $PM_{2.5}$ measured at the Yakama Nation Air Monitoring Site.

DISCUSSION

The first year of this project has yielded important foundational work despite the delayed start in classroom based activities. One of the more exciting aspects of this project is the excellent support from the school community. School staff and students successfully operated a MicroAeth instrument, changing filter strips every three days and transmitting data to University partners.

The current year will use new Community Air Monitors which will allow for indoor/outdoor sampling of particles and gases. These deployments will increase the spatial temporal data and begin the process of assessing the wood smoke impact.

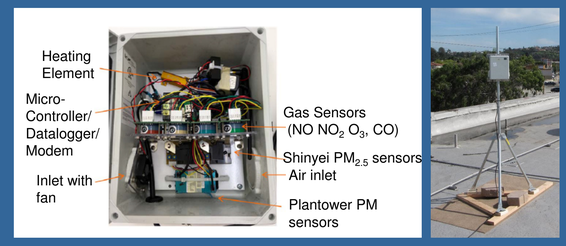

Figure 4. a) Community monitor schematic b) Outdoor Deployment

CONCLUSIONS

An adaptable web based air pollution curriculum was developed and implemented. This curriculum culminates in deployment of NextGenSS sensors based on hypotheses generated by the student participants. Students successfully operated research-grade instruments at a school based fixed site for the 2016-17 winter season and the data collected showed good agreement between optical methods and the tribal air quality site operated on the same property.

Diurnal patterns in wood smoke, as measured through a dual-channel aethalometer suggest that in the second year of monitoring, additional focus be placed on early morning and evening hours. In the next 2 years of the project, we anticipate introducing other NextGenSS monitors that can be deployed at outdoor locations in order to better grasp spatial distribution within the community. We also anticipate broader community engagement in developing and designing the student led deployments.