**NASA DEVELOP National Program**

**2018 Fall Project Proposal**

**Virginia – Langley**

**Intermountain West Health & Air Quality II**

*Adapting NASA Earth Observations to Help the National Park Service Monitor and Address Air Pollution in National Parks*

**Project Overview**

***Project Synopsis*:** Building on previous work with the National Park Service (NPS), this project targets air quality issues experienced by national parks in the Intermountain region as a result of aerosols and other air pollutants. Understanding air pollutants is critical for park visitor health, the ecological health of park flora and fauna, and the preservation of extensive vistas. This project will utilize Aura OMI, the Sentinel-5P’s TROPOMI, and CALIPSO in order to examine aerosol optical depth throughout the Intermountain West region, producing visibility maps and other visual aids to communicate this research to park staff and visitors. These data will also be compared to pre-existing trend maps of pollutants created by the Intermountain West Health & Air Quality I team to provide a more thorough understanding of the relationship between the vertical profile and spatial distribution of NO2 and other pollutants as they relate to visibility in national parks.

***Community Concern:*** Air quality is of particular importance to the NPS because clean air supports many natural resources like soils, visibility, water, and vegetation, which are all considered air quality related values (AQRVs). While monitoring programs exist to track air quality over time, not all parks have these programs, which makes creating management actions difficult. In order to protect AQRVs, it is important to understand where potential emissions source regions are located. Some types of emissions, particularly emissions from area sources such as oil and gas-related facilities, are not fully understood. Thus, adding satellite-derived data to intra-park monitoring efforts would greatly expand the scope of understanding in the region.

***Source of Project Idea:*** This project is based off previous DEVELOP work at the Virginia – Langley (LaRC) node. Further investigations of atmospheric pollutants and air quality issues affecting the Intermountain region have been deemed necessary.

***National Application Area Addressed:*** Health & Air Quality

***Study Location:*** Intermountain West Region, AZ, CO, NM, MT, OK, TX, UT, WY

***Study Period:*** January 2005 – August 2018

***Advisors:*** Dr. Kenton Ross (NASA Langley Research Center)

**Partner Overview**

***Partner Organization:***

|  |  |  |  |
| --- | --- | --- | --- |
| **Organization** | **POC (Name, Position/Title)** | **Partner Type** | **Boundary Org?** |
| **National Park Service, Intermountain Region** | Debbie Miller, Air Resource Specialist | End User | No |

***End User Overview***

***End User’s Current Decision-Making Process:***The NPS currently relies on station measurements from select parks in the Intermountain region to assess air quality across the whole region. These measurements are used to create management decisions about park resources, and to mitigate emissions from sources (both internal and external to parks) that are likely to impact park resources. Numerous studies have been conducted that evaluate emissions from outside of park lands, but there is a need for more in-depth studies on specific pollutants.

***End User’s Capacity to Use NASA Earth Observations:***

*National Park Service, Intermountain Region* – The end user is familiar with NASA data and other DEVELOP work related to this project. However, satellite-derived data are not currently part of the end user’s decision-making processes.

***Project Communication & Transition Overview***

***In-Term Communication Plan*:** Project updates and discussion will occur biweekly through telephone or video calls, and the end users will be updated weekly on progress made. The main POCs for the project will be the Project Lead and the LaRC Center Lead.

***Transition Plan*:** The project handoff will occur at the end of the Fall 2018 term. All maps, deliverables, and data will be handed off to the partners via Google Drive along with necessary documentation. Results will be communicated via teleconference.

**Earth Observations Overview**

***Earth Observations:***

|  |  |  |
| --- | --- | --- |
| **Platform & Sensor** | **Parameter(s)** | **Use** |
| **Aura OMI** | AOD | Aura OMI will be used to assess visibility and measure aerosol optical depth of pollutants. |
| **Sentinel-5P TROPOMI** | AOD | Sentinel-5P Tropomi will be used to assess visibility and measure aerosol optical depth of pollutants. |
| **CALIPSO CALIOP** | LIDAR Backscatter | CALIPSO CALIOP will be used to measure aerosol layer heights and aerosol extinction profiles. |

***Ancillary Datasets:***

National Park Service known locations of oil and gas facilities – information about potential sources of pollutant

NOAA NCEI Automated Surface Observing Systems (ASOS) – airport ground station data for satellite validation

***Software & Scripting:***

Esri ArcGIS – analyze data and produce visuals

Python – produce monthly and yearly averages of pollutant species

IDL – read access to CALIPSO data files

**Decision Support Tool & End Product Overview**

***End Products:***

|  |  |  |  |
| --- | --- | --- | --- |
| **End Products** | **Partner Use** | **Datasets & Analyses** | **Software Release Category** |
| **Multi-Dimensional Aerosol Visibility Maps** | Visibility maps for the Intermountain region will be derived from horizontal and vertical aerosol profiles. These maps will be used to prioritize areas with heavier concentrations of pollutants for mitigation activities. | Aura OMI, ESA Tropomi, and CALIPSO CALIOP will be processed to create aerosol optical depth maps. | I |

***End User Benefit*:** Adding NASA datasets to the Intermountain region’s workflow will enhance their understanding of known sourcesof pollutants, which will support development of mitigation strategies for adjacent parks and long-term management actions. In many cases, these NASA datasets are accessible sooner than *in situ* station data and can be used to develop a regional perspective of air quality. The visibility maps will provide the region with another tool to protect national park resources, and an increased understanding of the patterns of distribution in atmospheric pollutants. These results can help identify large or potentially significant sources that the NPS is currently missing, and provide additional insight on mixing, dilution, and transport. Park interpretation and education programs will use trend maps from term 1 and visibility maps from term 2 to inform visitors.

**Project Timeline & Previous Related Work**

***Project Timeline:*** 2 Terms: 2018 Summer to 2018 Fall

* **Term 1:** 2018 Summer (LaRC) – Intermountain Health & Air Quality
  + The first term of the project focused on mapping trends in NO2 and other atmospheric pollutants and created visual aids to help assess trends in atmospheric pollutants. These data were also compared to *in situ* air quality data for validation. Initial end products were provided to the partners for review, including the standard project deliverables, visual aids, and communication and outreach information to share with park managers and the public.
* **Term 2 (Proposed Term):** 2018 Fall (LaRC) – Intermountain Health & Air Quality II
  + The second term of the project will build on the previously created trend maps from the first term to focus on visibility as it is affected by aerosols. Further, the team will write up their methodology to create a tutorial that can be used to maintain the Intermountain region’s use of NASA Earth observations. Finally, all results from both projects will be packaged to communicate with park officials and the general public.

***Related DEVELOP Work:***

2017 Fall (LaRC) – Shenandoah Health & Air Quality II: Monitoring Air Quality in Shenandoah National Park to Address National Park Service Initiatives Using NASA Earth Observations

2017 Summer (LaRC) – Shenandoah Health & Air Quality: Monitoring Air Quality in Shenandoah National Park to Address National Park Service Initiatives Using NASA Earth Observations

2016 Summer (LaRC & VA) – Appalachian Trail Health & Air Quality: Monitoring Ozone and Atmospheric Pollutants in the Troposphere to Help Regulate Point Source Emissions and to Improve Ozone Advisory Messages by the National Park Service

**Notes & References:**

***References:***

42 U.S.C. §7475(d)(2)(B)).

Alston, E. J., Sokolik, I. N., & Doddridge, B. G. (2011). Investigation into the use of satellite data in aiding characterization of particulate air quality in the Atlanta, Georgia metropolitan area. *Journal of the Air & Waste Management Association,* *61*(2), 211-225.

Kessner, A.L., J. Wang, R.C. Levy, & P.R. Colarco. (2013). Remote sensing of surface visibility from space: A look at the United States East Coast. *Atmospheric Environment,* *81*, 136-147.

Murray, G. L. D., Kimball, K., Hill, L. B., Allen, G. A., Wolfson, J. M., Pszenny, … & Boris, A. (2009). A comparison of fine particle and aerosol strong acidity at the interface zone (1540 m) and within (452 m) the planetary boundary layer of the Great Gulf and Presidential-Dry River Class I Wildernesses on the Presidential Range, New Hampshire USA. *Atmospheric Environment,* *43*(22), 3605-3613.

National Park Service. (2015, April). Foundation Document. Shenandoah National Park. Luray, VA. Retrieved from <https://www.nps.gov/shen/getinvolved/upload/SHEN_FD_SP-Full-doc-final.pdf>.