**NASA DEVELOP National Program**

**2018 Summer Project Proposal**

**Virginia – Langley**

**Intermountain West Health & Air Quality**

*Monitoring Regional Air Quality to Address Air Pollution in National Parks through the Application of NASA Earth Observations*

**Project Overview**

***Project Synopsis*:** Building on previous work with the National Park Service (NPS), this project targets air quality and visibility issues experienced by national parks in the Intermountain region as a result of aerosols and other air pollutants. The NPS is mandated by law to protect the natural resources of national parks (i.e. air quality, ecosystem health, & visibility). Understanding air pollutants is critical for park visitor health, the ecological health of park flora and fauna, and the preservation of extensive vistas as mandated by Congress. This project will utilize Aura OMI, the ESA’s Sentinel-5’s TROPOMI, and MERRA-2 data in order to track visibility levels and atmospheric pollutants throughout the Intermountain region, producing trend maps and other visual aids to communicate this research to park staff and visitors. These data will be compared to existing monitoring data sets to better understand the relationship between satellite and ground-level data, and to synthesize the two workflows for the NPS.

***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 (like IMPROVE), 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 within-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 and further investigations of atmospheric pollutants and air quality issues affecting the Intermountain region are needed.

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

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

***Study Period:*** January 2005 – December 2017

***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 Summer 2018 term. All maps, deliverables, and data will be handed off to the partners via teleconference along with necessary documentation.

**Earth Observations Overview**

***Earth Observations:***

|  |  |  |
| --- | --- | --- |
| **Platform & Sensor** | **Parameter(s)** | **Use** |
| **Aura OMI** | NO2 | Aura OMI will be used to create trend maps and other assessments of pollutants. Additionally, TOR data derived from Aura OMI will be used to examine ozone levels in the region. |
| **Sentinel-5 TROPOMI** | NO2 | Sentinel-5 Tropomi will be used to create trend maps and other assessments of pollutants.  |

***Ancillary Datasets:***

EPA Clean Air Status and Trends Network (CASTNET) – ground station data for validation of NO2 retrievals

NASA Goddard Space Flight Center Modern-Era Retrospective Analysis for Research and Applications, Version 2 (MERRA-2) – additional source of satellite-derived atmospheric pollutant data

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

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

**Decision Support Tool & End Product Overview**

***End Products:***

|  |  |  |  |
| --- | --- | --- | --- |
| **End Products** | **Partner Use** | **Datasets & Analyses** | **Software Release Category** |
| **Annual, Seasonal, and Daily Trend Maps of NO2** | Annual, seasonal, and daily trend maps will be used to assess spatial and seasonal trends in pollutant species over the Intermountain region. | Aura OMI and Sentinel-5 data will be processed to create annual, seasonal, and daily trend maps, and will be compared to *in situ* station data for validation. | I |

***End User Benefit*:** Area sources, such as oil and gas facilities, are increasing in the Intermountain region and are often located near to the NPS lands. Even those industries that are not directly adjacent to a park are still potential sources of air pollution. While many of the largest sources are tracked, there are smaller groups that are not routinely monitored. Further, not all national parks in the region have air quality monitoring stations to provide visitors and park managers information about air quality conditions. Adding NASA datasets to the Intermountain region’s workflow could enhance their understanding of known sources regions, which will help with developing mitigation strategies for adjacent parks, and for creating long-term management actions. In many cases, these NASA datasets are accessible sooner than *in situ* station data to develop a regional perspective of air quality. The trend maps will provide the region another tool to protect national park resources, and provide an increased understanding of trends in visibility and atmospheric pollutants. Additionally, trend maps can be used by the park interpretation and education programs to inform visitors. These results can help identify large or potentially significant source regions that the NPS is currently missing, and provide additional insight on mixing, dilution, and transport.

**Project Timeline & Previous Related Work**

***Project Timeline:*** 2018 Summer

***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.