**NASA DEVELOP National Program**

NASA Langley Research Center

*Summer 2017*

**Short Title: Shenandoah Health & Air Quality**

**Subtitle:** Monitoring Air Quality in Shenandoah National Park to Address National Park Service Initiatives Using NASA Earth Observations

**VPS Title:** The Sky to Behold: Clearing up the Shenandoah Skyline

**Project Team**

**Project Team:**

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**Project Overview**

**Objectives Overview:**

Understanding how air pollutants are distributed in Shenandoah National Park (SHEN) is critical for visitor and ecological health and the preservation of the park’s vistas. The park only has one air quality station to inform its entire 105-mile length with varying topography. Using NASA Earth observations, the Shenandoah Health & Air Quality team created trend maps of pollutants and provided the National Park Service with a replicable methodology to incorporate remote sensing data into their management decisions. This project will allow officials to effectively keep the park healthy and inform visitors of visibility and air quality concerns.

**Abstract:**

Gases such as ozone (O3), nitrogen dioxide (NO2), and sulfur dioxide (SO2) have impeded visibility and impacted air health in Shenandoah National Park, one of the primary attractions of Virginia. Air quality is considered one of the park’s fundamental resources and is essential to maintaining its significance as a premier park with world-class views. This project utilized NASA Earth observations, including Aura's Ozone Monitoring Instrument (OMI), to monitor ozone and nitrogen dioxide that threaten visibility and plant, animal, water, and human health in the park. Trend maps were created to assess spatial and temporal trends in pollutant species over Shenandoah National Park and the surrounding airshed. A methodology was created to help the National Park Service incorporate remote sensing data into their management decisions related to park health and air quality concerns. *In situ* station data from Big Meadows monitoring station were used to validate the NASA Earth observations. This information will aid in future decisions related to visitor education and ecological management in accordance with mandates from the Clean Air Act, the National Park Service Organic Act of 1916, and the Wilderness Act.

**Keywords:**

Aerosol pollutants, air pollution, atmospheric gases, Health & Air Quality, Shenandoah National Park, remote sensing

**Partner Organizations:**

|  |  |  |  |
| --- | --- | --- | --- |
| **Organization** | **POC (Name, Position/Title)** | **Partner Type** | **Boundary Org?** |
| National Park Service, Shenandoah National Park | Jalyn Cummings, Physical Scientist, Air & Water Resources Program Manager | End-User | No |
| National Park Service, Air Resources Division, Research & Monitoring Branch | Barkley Sive, Chemist | Collaborator | No |

**Community Concerns:**

* Damage to plants caused by surface level ozone creates less vibrant vistas, decreasing attendance at the parks.
* Acidification of many streams from high levels of SO2 and NO2 have harmful effects on pH-sensitive fish and other life.
* Lack of visibility of scenic views because of atmospheric pollutants adversely affects the park’s attendance.
* Health concerns caused by atmospheric pollutants, such as asthma attacks brought on by high levels of Particulate Matter (PM10 and PM2.5), create dangerous conditions for susceptible park patrons.

**Current Decision-Making Practices & Policies**:

The National Park Service relies on one air quality monitoring station in Big Meadows to assess air quality in Shenandoah National Park. As a Class 1 park under the Clean Air Act, SHEN has the responsibility to protect the air quality of their lands. As this includes visibility, park managers use the best possible science to evaluate how new and old sources of pollution could impact the park. Currently, SHEN managers utilize the Big Meadows air quality station and directives defined under the Clean Air Act, the National Park Service Organic Act of 1916, and the Wilderness Act to accomplish their mandates.

**Decision Support Tools & Benefits:**

|  |  |  |  |
| --- | --- | --- | --- |
| **End Product** | **Earth Observations Used** | **Partner Benefit & Use** | **Software****Release** |
| Seasonal and Annual Trend Maps of Pollutant Species | Aura OMI | Seasonal and annual trend maps will be used to assess spatial and temporal trends in pollutant species over SHEN and the surrounding park region providing the partner with data not currently used in SHEN.  | I |
| Project description fact sheet | Aura OMI  | Fact sheet will be given to the project partners to discuss the project with visitors | I |
| Flipbook for the past 3-5 years of available data on air pollutants, with an emphasis on annual and seasonal variation | Aura OMI  | The flipbook will be used to illustrate air pollutants in the park and surrounding airshed in an accessible format | I |

**Project Benefit to End User**:

This project provided the National Park Service with additional tools to monitor atmospheric pollutants in Shenandoah National Park. The project created methodologies to enable park managers to notify guests of atmospheric pollution that may impact their views or health. It also provided information to protect park resources and understand trends in environmental hazards. Furthermore, the results look for previously unconsidered sources of air pollutants and provide insight on transport of these products along with their potential impacts.

**Project Details**

**Applied Sciences National Application Addressed:** Health & Air Quality

**Study Area:** Shenandoah National Park, VA

**Study Period:** January 2005 to December 2016

**Earth Observations & Parameters:**

|  |  |  |
| --- | --- | --- |
| **Platform & Sensor** | **Parameter(s)** | **Use** |
| Aura OMI | Tropospheric NO2, Total Column SO2, Total Column Ozone | Aura data will be used to create trend maps and other assessments of pollutant species. Additionally, total column ozone will be used to supplement our understanding of atmospheric pollutants in the region. |

**Ancillary Datasets Utilized:**

* Environmental Protection Agency Clean Air Status and Trends Network (CASTNET) *in situ* data – Tropospheric NO2, Total Column Ozone

**Software Utilized:**

* Esri ArcGIS – analyze data and produce visuals

**Project Handoff Package**

**Transition Plan:**

There will be a presentation and deliverables hand-off from the first term of this project on July 31, 2017 on-site at Shenandoah National Park. Preliminary annual and seasonal trend maps will be provided regarding NO2 and O3, and trace gases with an emphasis on the most recent three to five years. These products will be given to the partners to gain insight on usage and for any potential updates to products.

*Project Continuation:* A final project handoff will occur at the end of the second term of the project (Fall 2017). Products from the first term will be used to give ideas for updates for the second term deliverables. These second term deliverables will include a tutorial to continue the park’s use of NASA Earth observations.

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**Handoff Package:**

* Technical paper
* Project poster
* Project video
* Seasonal and Annual Trend Maps of Pollutant Species
* One-page fact sheet on atmospheric pollutants and their relation to Shenandoah National Park
* Flipbook for the past several (3-5) years of available data on air pollutants, with an emphasis on annual and seasonal variation