**NASA DEVELOP National Program**

**Summer 2016 Project Proposal**

**NASA Langley Research Center**

**Appalachian Trail Health & Air Quality**

Utilizing NASA Earth Observations to Monitor Tropospheric Ozone in National Parks along the Appalachian Trail for Enhanced Forest Management

**Project Overview**

***Objective:*** To utilize NASA Earth observations to enhance tropospheric ozone measurement capabilities in the forested regions along the Appalachian Trail.

***Community Concern:*** Ozone in the stratosphere is essential for protecting the Earth from ultraviolet radiation however, ground-level - or tropospheric - ozone is a pollutant that poses significant health risks to plants and humans, According to the California Air Resources Board, exposure to high ozone levels irritates the respiratory system, can worsen asthma symptoms and may cause permanent lung damage. Ground level ozone has been increasing as fossil fuel combustion has increased. The United Stated Department of Agriculture states that tropospheric ozone causes more damage to plant life than all other atmospheric pollutants combined. Tropospheric ozone damages forests in many ways--including foliar damage, which decreases photosynthesis and increases leaf senescence. These effects increase the vegetation’s susceptibility to drought, invasive species infestation, and wildfire.

***National Application Areas Addressed:*** Health & Air Quality, Climate

***Study Location:*** Appalachian Trail National Parks – Appalachian National Scenic Trail, Delaware Water Gap National Recreation Area, Harpers Ferry National Historic Park, C&O Canal National Historic Park, Shenandoah National Park, Blue Ridge Parkway National Park, and Great Smoky Mountains National Park – CT, GA, MA, MD, ME, NC, NH, NJ, PA, TN, VA, WV, NY, VT.

***Study Period:*** May 2015 through September 2015

***Advisors:*** Travis Knepp (SSAI), Dr. Kenton Ross (NASA DEVELOP National Program)

***Source of Project Idea:*** This project idea came about through discussions with the NASA DEVELOP National Program science advisor, Dr. Kenton Ross, and NASA Science Directorate researchers, including Bruce Doddridge, at NASA Langley Research Center. After the initial project discussions, individuals from the National Parks along the Appalachian Trail were contacted. These discussions confirmed the need for this type of product to inform park management.

**Partner Overview**

***Partner Organizations:***

|  |  |  |  |
| --- | --- | --- | --- |
| **Organization** | **POC (Name, Position/Title)** | **Partner Type** | **Boundary Org?** |
| Shenandoah National Park | Jayln Cummings | End-User | No |
| Harpers Ferry National Historical Park | Andrew Lee | End-User | No |
| Appalachian Trail Conservancy | Tenny Webster and Laura Belleville | End-User | No |
| Northeast Temperate Network | Fred Dieffenbach | End-User | No |
| NASA Langley Research Center - SSAI | Travis Knepp | Collaborator | No |

***End-User Overview***

***End-User’s Current Decision Making Process:***

Currently, the National Park Service relies on sparsely distributed ground station measurements to measure tropospheric ozone. These measurements are of interest to the NPS because they relate to physiological, morphological, or historical injury to park biological resources, and to global climate change.

***End-User’s NASA Earth Observations Capacity:***

National Parks Service – The National Parks Service does not currently use Aura or Aqua atmospheric products to make decisions regarding tropospheric ozone. Utilizing NASA derived ozone products would save time and money spent managing the ground based stations as well as more accurately filling in gaps between stations. A more complete understanding of tropospheric ozone levels in the National Parks along the Appalachian Trail will allow the National Park Service to improve their management plans regarding Ozone Advisory Procedures, damage assessments and work plans.

***Collaborator Overview***

***Collaborator Support:***

NASA Langley Research Center – atmospheric data scientists will serve as advisors, aiding in the development of the methodology as well as the collection and interpretation of the data.

***Project Communication & Transition Overview***

***In-Term Communication Plan:***

The team lead will serve as the main point of contact for communication with the partners. They will communicate with the partners bi-weekly teleconferences and email updates as necessary.

***Transition Approach:***

The end products will be delivered to the partners during week 10 through a teleconference with a screen share to discuss results and answer any questions.

**Earth Observations Overview**

***Earth Observations:***

|  |  |  |
| --- | --- | --- |
| **Platform & Sensor** | **Parameter(s)** | **Use** |
| **Aura, Ozone Monitoring Instrument (OMI)** | Total Column Ozone | Used along with MLS to estimate tropospheric ozone levels\* |
| **Aura, Microwave Limb Sounder (MLS)** | Stratospheric Ozone | Used along with OMI to estimate tropospheric ozone levels\* |
| **Aura, Tropospheric Emission Spectrometer (TES)** | Tropospheric ozone | Used from 2005 to 2010 to estimate vertical profiles of tropospheric ozone along satellite path |
| **Aqua Atmospheric Infared Sounder (AIRS)** | Atmospheric Ozone | Gridded vertical profiles of tropospheric ozone |

***Ancillary Datasets:***

EPA – Clean Air Status and Trends Network (CASTNET) – Ozone Data

State GIS Data Exchanges – LiDAR, ASTER and SRTM Digital Elevation Models – Topography

**Decision Support Tool & End-Product Overview**

***End Products:***

|  |  |  |  |
| --- | --- | --- | --- |
| **End Products** | **Partner Use** | **Datasets & Analyses** | **Software Release Category** |
| Tropospheric Ozone Hotspot Maps of the Appalachian Trail and Associated National Parks | These maps will aid the partners in identifying areas of the parks where tropospheric ozone levels are highest | The sensors on board the Aura satellite and Aqua AIRS will be used to calculate tropospheric ozone levels | N/A |

***End-User Benefit:***

These maps will identify the locations of highest tropospheric ozone along the Appalachian Trail for increased mitigation by the National Park Service. These maps will also serve to provide a more continuous spatial, in-depth, coverage of the Appalachian Trail, where ground measurements are not available. As ground measurements can be costly, the ability to accurately determine tropospheric ozone using NASA Earth observations would save valuable time and money.

**Project Timeline & Previous Related Work**

***Project Timeline:*** 1 Term: 2016 Summer

***Related DEVELOP Work:***

2013 Spring (Stennis Space Center) – Appalachian Mountains Health and Air Quality: Comparison of NASA OMI and MLS Ozone Products with USDA Forest Service Ground-based Ozone Monitoring Data for USDA Forest Service Air Quality/Forest Management Support

**Project Needs/Requests**

***Participants Requested:*** 4

***Software & Scripting:***

ArcGIS- data visualization, analysis, creation of end products

**References:**

Appalachian National Scenic Trail Ozone Summary: <http://science.nature.nps.gov/im/units/NETN/reports/ResourceBriefs/APPA_Ozone.cfm>

Ziemke, J. R., S. Chandra, B. N. Duncan, L. Froidevaux, P. K. Bhartia, P. F. Levelt, and J. W. Waters, "Tropospheric ozone determined from Aura OMI and MLS: Evaluation of measurements and comparison with the Global Modeling Initiative's Chemical Transport Model", J. Geophys. Res., 111, D19303, doi:10.1029/2006JD007089, 2006.