Monitoring Air Quality in Shenandoah National Park to Address National Park Service Initiatives

Abstract

Gases such as ozone (O_3), nitrogen dioxide (NO_2), and sulfur dioxide (SO_2) 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.

Objectives

- **Assess** spatial and temporal trends in atmospheric pollutant species over Shenandoah National Park
- **Analyze** trends based on monthly, seasonal, and annual time steps
- **Create** a methodology to visual air quality parameters over time

Earth Observations

Aura OMI

Project Partners

Methodology

Data Acquisition

Aura OMI – Ozone, NO_2, SO_2	Big Meadows (*in situ*) – CASTNET

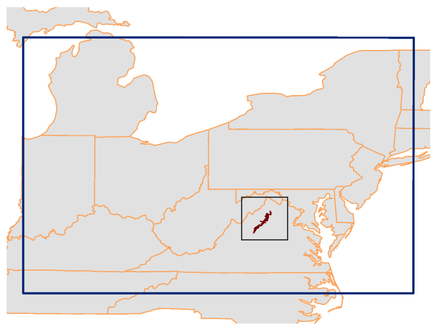
Data Processing

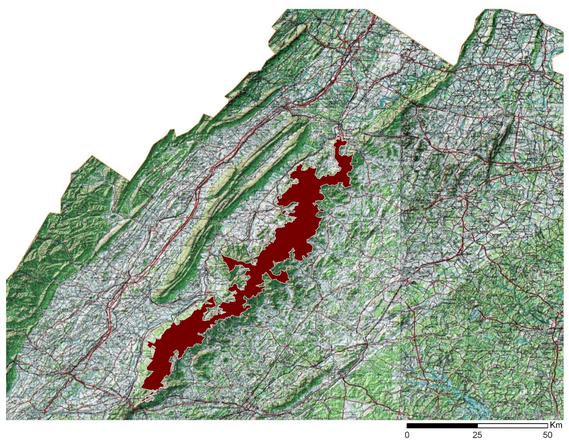
Monthly & Annual Averages	Time Series

Data Analysis

Correlation Analysis	Trend Maps

Study Area



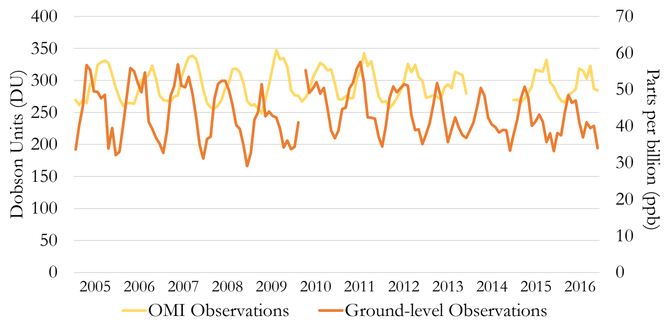


Shenandoah National Park, Virginia

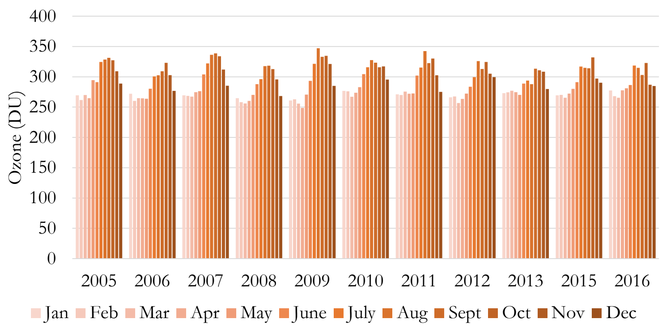
Results

Ozone

Annual O_3 Averages

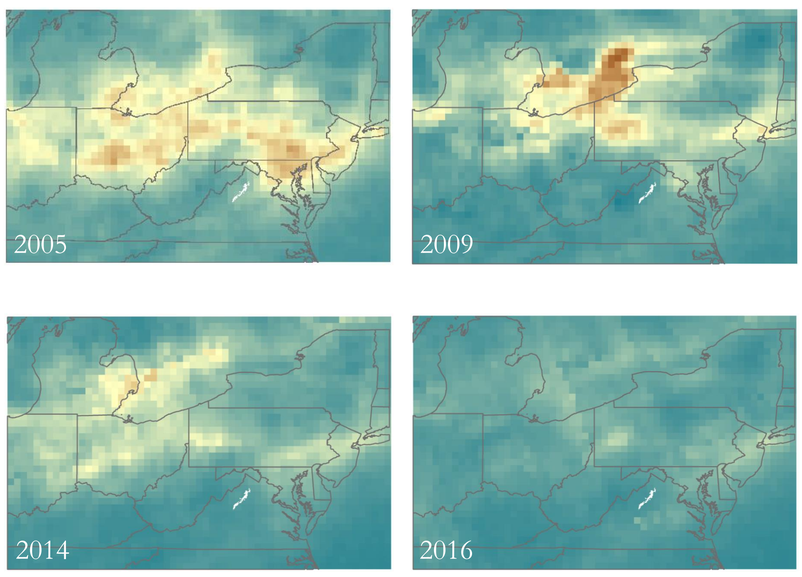


OMI Monthly O_3 Average over Shenandoah

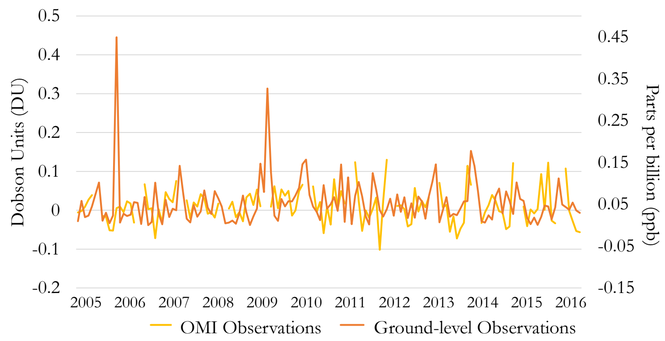


Nitrogen and Sulfur Dioxides

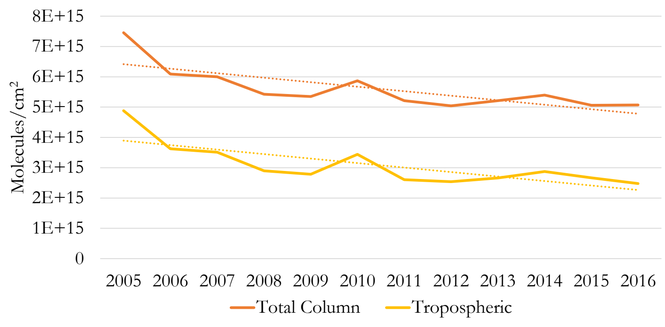
January NO_2 Concentrations



Annual SO_2 Averages



Annual NO_2 Averages



Conclusions

- Remotely sensed NO_2 exhibited a decrease over time, but ozone and SO_2 remained relatively constant.
- Ozone and SO_2 data were not statistically correlated with *in situ* observations.
- Tropospheric NO_2 and total column NO_2 were highly correlated.
- Remote sensing can provide the park with big-picture, long-term data to foresee trends in air pollutants that affect the park.

Team Members

Ellen Bubak (Project Lead) | Amanda Clayton | Doug Gardiner | Nicholas Lenfant | Julie Terhune

Acknowledgements

Jalyn Cummings, National Park Service, Shenandoah National Park

Dr. Barkley Sive, National Park Service, Air Resources Division

Dr. Bruce Doddridge, NASA Langley Research Center

Dr. Kenton Ross, NASA Langley Research Center

Shenandoah Health & Air Quality

NASA Langley Research Center – Summer 2017

This material is based upon work supported by NASA through contract NNL16AA05C and cooperative agreement NNX14AB60A. Any mention of a commercial product, service, or activity in this material does not constitute NASA endorsement. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Aeronautics and Space Administration and partner organizations.