**NASA DEVELOP National Program**

**2017 Spring Project Proposal**

**Wise County Clerk of Court’s Office**

**Wyoming Cross-Cutting**

*Utilizing NASA Earth Observations to Detect Changes in Nighttime Sky Brightness in Grand Teton National Park*

**Project Overview**

***Project Synopsis*:** Artificial light has increased with the expansion of the human population and the growth of industrialization. While life on Earth relies on a predictable cycle of day and night, the visible disruption given off by artificial light has a detrimental effect, hindering the reproductive, migratory, feeding, sleep, and predatory habits of wildlife. Additionally, light pollution degrades the quality in which humans view the night sky. NASA DEVELOP will assist Grand Teton National Park in Wyoming by monitoring changes in light pollution using the Suomi National Polar-orbiting Partnership (NPP) Visible Infrared Imaging Radiometer Suite (VIIRS) as well as Aqua and Terra Moderate Resolution Imaging Spectroradiometer (MODIS) Aerosol Optical Depth (AOD). The products and tools generated will help Grand Teton National Park identify areas where changes in lighting policy and practices have been effective in reducing light pollution as well as areas where further mitigation is needed.

***Community Concern:*** Anthropogenic lighting has detrimental effects to nighttime sky quality, wildlife, and humans alike. Grand Teton National Park and the surrounding area have historically had some of the clearest night skies in the country due to low humidity and the isolated area. As light from urban areas has increased and suburban areas have encroached on the park, this world class night-time visibility has decreased. In addition to decreased sky-gazing opportunities, increased artificial light has the potential to alter wildlife migratory patterns, breeding and feeding habits.

***Source of Project Idea:*** This project idea originated from conversations between Bob VanGundy, DEVELOP Science Advisor for the Wise County node and Michael Brooke, Center Lead of the Wise County node.

***National Application Areas Addressed:*** Cross-Cutting

***Study Location:*** Grand Teton National Park, WY

***Study Period:*** January 2012 to December 2016

***Advisors:*** Dr. Kenton Ross (NASA Langley Research Center), Dr. Dewayne Cecil (NOAA National Center for Environmental Information, Global Science and Technologies), Bob VanGundy (The University of Virginia’s College at Wise)

**Partner Overview**

***Partner Organizations:***

|  |  |  |  |
| --- | --- | --- | --- |
| **Organization** | **POC (Name, Position/Title)** | **Partner Type** | **Boundary Org?** |
| National Park Service, Intermountain Region | Randy Stanley, Acoustic Specialist | End-User | No |
| Grand Teton National Park | Dan Greenblatt, Colter Bay District Interpreter | End-User | No |
| International Dark-Sky Association | John Barentine, Program Manager | Collaborator | Yes |

***End-User Overview***

***End-User’s Current Decision-Making Process:***Grand Teton National Park monitors nighttime visibility at point locations using handheld or tripod mounted light meters. These readings are used to quantify the effect that modifications to the lighting of surrounding areas has on visibility within the park. By tracking these readings over time, the lighting practices within the park and lighting policies that cities near the park employ can be addressed to maximize night sky viewing and minimize impacts on wildlife.

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

*Grand Teton National Park* – Grand Teton National Park is familiar with NASA Earth Observations and uses Landsat and MODIS Vegetation indices in daily operations. However, they do not use Suomi NPP VIIRS to monitor changes in nighttime lighting. This project would introduce our partners to the capabilities that the VIIRS Day/Night band has for light pollution monitoring.

***Collaborator & Boundary Organization Overview***

***Collaborator Support:***

*International Dark Sky Association* – The International Dark Sky Association (IDA) “introduces initiatives to protect the night skies and fragile ecosystems in parks and protected areas worldwide.” The IDA also hosts the Artificial Light at Night (ALAN) Research Literature Database. Their wealth of knowledge on the subject of light pollution will contribute to the overall value and scope of the project.

***Dissemination by Boundary Organizations*:** The IDA will distribute the results of this project through their ALAN Literature Database and may highlight the project on their website, www.darksky.org as well. Based on the result of this project, the IDA may certify Grand Teton National Park as an International Dark Sky Park. This will bring more amateur astronomers and sky-gazers to the park.

***Project Communication & Transition Overview***

***In-Term Communication Plan*:** The team will communicate project issues and progress with Dan Greenblatt at Grand Teton National Park, Randy Stanley with the National Park Service Intermountain Region, and John Barentine with the International Dark-Sky Association via bi-weekly telecon. The main DEVELOP POC will be the team lead.

***Transition Plan*:** Hand off will be conducted either over teleconference with shared screen or Google Hangout. The tools produced by this project will be used by the partner to identify areas where mitigation of artificial light is needed. Software release is not anticipated.

**Earth Observations Overview**

***Earth Observations:***

|  |  |  |
| --- | --- | --- |
| **Platform & Sensor** | **Parameter(s)** | **Use** |
| **Suomi NPP VIIRS** | Day/Night Band (DNB) | Highlight areas of artificial lighting which may encroach upon Grand Teton National Park |
| **Aqua and Terra MODIS** | Aerosol Optical Depth | Assess the effects that aerosols may have on nighttime visibility |

***Ancillary Datasets:***

NPS, Grand Teton National Park – Sky brightness survey – Used to correlate VIIRS DNB data with ground truth.

***Software & Scripting:***

ERDAS IMAGINE – interpretation of raster imagery

Esri ArcGIS – Raster manipulation, statistical interpretation, map creation

**Decision Support Tool & End Product Overview**

***End Products:***

|  |  |  |  |
| --- | --- | --- | --- |
| **End Product(s)** | **Partner Use** | **Datasets & Analyses** | **Software Release Category** |
| Yearly Nighttime Radiance | Identification of areas that are affected by excessive artificial light | Suomi NPP VIIRS DNB will be used to assess changes in nighttime artificial light during the study period | N/A |
| Aerosol Transport | Identification of years and seasons during which aerosols impact visibility | MODIS AOD will be used to identify the periods during which aerosols cause atmospheric scattering of light | N/A |

***End-User Benefit*:** Grand Teton National Park will use the Yearly Nighttime Radiance product to assess recent changes made to nighttime lighting in nearby communities. Additionally this product will identify areas within the park and surrounding communities that need further mitigation of artificial light. The Aerosol Transport product will help identify the seasons that are most appropriate for promoting astro-tourism within the park. These products would augment existing ground-based sky brightness readings within the park and provide a comprehensive, park-wide approach to the measurements.

**Project Timeline & Previous Related Work**

***Project Timeline:*** 1 Term: 2017 Spring

***Related DEVELOP Work:***

2013 Spring – Continental United States Climate: Determining the Feasibility of Using VIIRS Global Combustion Source Detection Products to Estimate the Regional Contributions of Natural Gas Flaring to U.S. Greenhouse Gas Emissions

***References***

Cinzano, P., Falchi, F. and Elvidge, C.D. (2001), The first World Atlas of the artificial night sky brightness. Monthly Notices of the Royal Astronomical Society, 328: 689–707. doi:10.1046/j.1365-8711.2001.04882.x

Falchi, F., Cinzano, P., Kyba, C., & Portnov, B. A. (2015). The new World Atlas of Artificial Sky Brightness. IAU General Assembly, 22, 47038.

ISS Request

Grand Teton National Park is working to achieve International Dark-Sky Park status. This DEVELOP team is looking to assist them by using NASA EO to detect changes in night-sky brightness in Grand Teton National Park and the surrounding areas. This will allow Grand Teton National Park to focus on reducing light pollution in areas that will have the greatest impact.

The NPP VIIRS DNB can sense low levels of light which allows for insight into nighttime light sources. The VIIRS DNB is only sensitive to light with wavelengths between 0.5-0.9µm, this excludes light in the blue range. LED lights are more efficient, but put out light in the blue range. As a consequence the VIIRS DNB will see a reduction of light in cities that is really just a switch to a different light source. The astronauts on the ISS can help determine if the “blue blindiness” of the VIIRS DNB will affect our data by procuring images of the study area with full visible spectrum. These images could help validate the results of our study.