**NASA DEVELOP National Program**

**2017 Fall Project Proposal**

**Virginia - Wise**

**Colorado Plateau Urban Development**

*Utilizing NASA Earth Observations to Detect Changes in Nighttime Sky Brightness in the Colorado Plateau*

**Project Overview**

***Project Synopsis*:** Artificial light has increased with the expansion of the human population and the growth of industrialization. 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 the Intermountain Region of the National Park service in Arizona, Colorado, New Mexico, and Utah by monitoring changes in light pollution using the Suomi National Polar-orbiting Partnership (NPP) Visible Infrared Imaging Radiometer Suite (VIIRS). The products and tools generated will help parks in the Colorado Plateau 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. National Parks within the Colorado Plateau 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, 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 Randy Stanley and Kurt Fristrup with the National Park Service Intermountain Region and conversations between Bob VanGundy, DEVELOP Science Advisor for the Wise County node and Michael Brooke, former Center Lead of the Wise County node.

***National Application Area Addressed:*** Urban Development

***Study Location:*** Colorado Plateau; AZ, CO, NM, UT

***Study Period:*** January 2012 – August 2017

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

**Partner Overview**

***Partner Organization(s):***

|  |  |  |  |
| --- | --- | --- | --- |
| **Organization** | **POC (Name, Position/Title)** | **Partner Type** | **Boundary Org?** |
| National Park Service, Intermountain Region | Randy Stanley, Director, Natural Sounds and Night Skies Division | End User | No |
| National Park Service, Natural Sounds and Night Skies Division | Sharolyn Anderson, Research Scientist  Li Wei Hung, Research Scientist | End User | No |

***End-User Overview***

***End User’s Current Decision-Making Process:***National Parks within the Colorado Plateau study 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:***

*National Park* *Service, Intermountain Region* – The National Park Service is familiar with NASA Earth observations and uses Landsat and MODIS vegetation indices in daily operations. Partners on this project are also key authors on several papers concerning using NASA Earth observations to monitor nighttime emissivity using Suomi NPP VIIRS Day/Night Band (DNB).

*National Park Service, Natural Sounds and Night Skies Division –* The National Park Service is familiar with NASA Earth observations. This project would introduce our partners to the capabilities that NASA has for more quickly updating and analyzing products from the VIIRS DNB for light pollution monitoring.

***Project Communication & Transition Overview***

***In-Term Communication Plan*:** The team will communicate project issues and progress with 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 products created by this project will be used by the partner to identify areas where mitigation of artificial light is needed. Software release is anticipated.

**Earth Observations Overview**

***Earth Observations:***

|  |  |  |
| --- | --- | --- |
| **Platform & Sensor** | **Parameter** | **Use** |
| **Suomi NPP VIIRS** | Day/Night Band (DNB) | The DNB will be used to highlight areas of artificial lighting which may diminish nighttime visibility in the Colorado Plateau. |

***Ancillary Datasets:***

National Park Service, Colorado Plateau – 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

Bit Bucket – version control, code repository

Skygow Estimation Toolbox (SET) - Python script modelling light propagation using VIIRS imagery

GitBash – access to online repository

Anaconda – program to run Skyglow Estimation Toolbox (SET)

**Decision Support Tool & End Product Overview**

***End Products:***

|  |  |  |  |
| --- | --- | --- | --- |
| **End Product** | **Partner Use** | **Datasets & Analyses** | **Software Release Category** |
| Yearly Nighttime Artificial Skyglow Maps | Skyglow maps will be used by the partners to identify areas that are affected by excessive artificial light in order to assess light pollution in the study area and assist partners in mitigating current lighting practices | Suomi NPP VIIRS DNB will be used to assess changes in nighttime artificial light during the study period by providing skyglow estimations in the Colorado Plateau. | IV |

***End-User Benefit*:** The Intermountain Region and Natural Sounds and Night Skies Division of the National Park Service will use the Yearly Nighttime Artificial Skyglow Maps to assess recent changes made to nighttime lighting in nearby communities. Additionally, this product will identify areas within parks and surrounding communities that need further mitigation of artificial light. These products will augment existing ground-based sky brightness readings within Intermountain Region National Parks and provide a comprehensive, regional approach to the measurements.

**Project Timeline & Previous Related Work**

***Project Timeline:*** 1 Term: 2017 Fall

***Related DEVELOP Work:***

2017 Spring (VA) – Wyoming Cross-Cutting I: Utilizing NASA Earth Observations to Detect Changes in Nighttime Sky Brightness in Grand Teton National Park

2017 Summer (VA) – Wyoming Cross-Cutting II: Utilizing NASA Earth Observations to Detect Changes in Nighttime Sky Brightness in Grand Teton National Park

**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.