**NASA DEVELOP National Program**

**2024 Summer Project Proposal**

**Virginia – Langley**

**Glacier & Denali Space Weather**

*Enhancing Aurora Watch Planning at Glacier and Denali National Parks with NASA Earth Observations*

**Project Overview**

***Project Synopsis*:** Every Spring and Fall, Glacier National Park in Montana and Denali National Park in Alaska attract aurora borealis watchers to enjoy the magnificent scenes. Prediction of if, where, and when aurora could be observed at these parks is crucial for park management to allocate resources to serve areas where high tourist traffic could be expected. This project will characterize what the aurora borealis would look like from both space and from the ground using historic aurora observations from NASA’s Polar Ultraviolet Imager (UVI) and Imager for Magnetopause-to-Aurora Global Exploration (IMAGE Far Ultraviolet Imager (FUV), and simulated aurora bands from the OVATION Prime model. It will further validate current aurora predictions using observations from the Visible Infrared Imaging Radiometer Suite (VIIRS) Day Night Band. Lastly, the project will explore enhancing the capability of predicting the aurora borealis using the polar or local disturbance index instead of the global disturbance index. With solar activity projected to reach its maximum in 2025, these findings and tools could help Glacier and Denali National Parks improve their aurora prediction capabilities to better serve aurora borealis enthusiasts and park visitors in general.

***Study Location:*** Glacier National Park, West Glacier, MT; Denali National Park, AK

***Study Period:*** December 2019 – May 2024 (Solar Cycle 25)

***Advisors:*** Xia Cai (NASA Langley Research Center), Yihua Zheng (NASA Community Coordinated Modeling Center), Jamie Favors (NASA Headquarters)

**Partner Overview**

***Partner Organizations:***

|  |  |  |  |
| --- | --- | --- | --- |
| **Organization** | **Contact (Name, Position/Title)** | **Partner Type** | **Sector** |
| **National Park Service, Glacier National Park** | Debby Smith, Hudson Bay District Interpreter, debby\_smith@nps.gov | End User | Federal Government |
| **National Park Service, Natural Sounds and Night Skies Division** | Sharolyn Anderson, Physical Scientist, sharolyn\_anderson@nps.gov | Collaborator  | Federal Government |

***End User Overview***

***End User’s Current Decision-Making Process & Capacity to use Earth Observations:***

Glacier and Denali National Park both currently depend on a 3-day aurora forecast hosted at the University of Alaska at Fairbanks. This prediction is based on forecasted global disturbance; then, the forecasted aurora is shown over all of Northern America. The district coordinator for Glacier National Park provides aurora predictions based on visual inspection of whether or not park locations are within the aurora oval over Northern America. If an aurora event is likely to occur within 3 days, an aurora alert is posted on social media. Additionally, park management broadcasts aurora events within the park to the public via live stream. To prepare for the aurora season around the solar maximum in 2025, the partner seeks to predict the aurora borealis at their park locations. They would also like to evaluate the accuracy of and identify improvements to their current aurora prediction practices using aurora observations.

**Satellite Observation Overview**

***Satellite Observations:***

|  |  |  |
| --- | --- | --- |
| **Platform & Sensor** | **Parameter(s)** | **Use** |
| **Polar UVI** | Ultraviolet aurora images | Images would be used to identify aurora oval |
| **IMAGE FUV** | Far ultraviolet aurora images | Images would be used to identify aurora oval |
| **ACE MAG & SWEPAM** | Solar magnetic field, solar wind proton density, solar wind speed | Upstream solar conditions at L1 Lagrange point  |
| **WIND MFI & SWE** | Solar magnetic field, solar wind proton density, solar wind speed | Upstream solar conditions around L1 Lagrange point |
| **SUOMI NPP VIIRS** | Day Night Band | Images would be used to identify auroras  |
| **NOAA-20 VIIRS** | Day Night Band | Images would be used to identify auroras |

***Ancillary Datasets:***

* [JHUAPL & SuperMAG](https://supermag.jhuapl.edu/info/) – identify magnetometers around Glacier and Denali National Parks to estimate local magnetic disturbance
* [University of Kyoto, Japan & Geomagnetic Auroral Electrojet index](https://wdc.kugi.kyoto-u.ac.jp/aedir/index.html) – magnetic disturbance at the polar regions

***Modeling:***

* [OVATION Prime model](https://ccmc.gsfc.nasa.gov/models/Ovation-Prime~2.3) (POC: Yihua Zheng, NASA GSFC CCMC) – provide statistical distribution of aurora oval
* [Tsyganenko Geomagnetic Field Model and GEOPACK libraries](https://ccmc.gsfc.nasa.gov/models/Tsyganenko%20Magnetic%20Field~TS05/) (POC: Masha Kuznetsova, NASA GSFC CCMC) – transform between the Geocentric Solar Magnetic and Geocentric Solar Ecliptic coordinate systems
* [3-Day Geomagnetic Forecasting](https://www.swpc.noaa.gov/products/3-day-geomagnetic-forecast) (POC: NOAA Space Weather Prediction Center) – provide 3-day Planetary K (Kp) index at a timestep of 3 hours

Forecast Kp Index - Space Weather (gfz-potsdam.de)

* 4-Day Auroral Electrojet Index Forecasting (POC: Professor Xinlin Li, University of Colorado at Boulder) – provide 4-day auroral electrojet index (AE or AL) at timestep of 10 minutes

**Decision Support Tool & End Product Overview**

***End Products:***

|  |  |  |
| --- | --- | --- |
| **End Product** | **Partner Use** | **Datasets & Analyses** |
| **Aurora observed at Glacier and Denali National Parks – viewing from space** | Help the partner understand characteristics of the aurora  | Polar UVI; IMAGE FUV; OVATION Prime model; show how aurora ovals change with solar conditions, viewing from space |
| **Aurora observed at Glacier and Denali National parks – viewing from ground** | Help the partner understand characteristics of the aurora | Polar UVI; IMAGE FUV; OVATION Prime model; show how aurora ovals change with solar conditions, viewing from ground |
| **Assessment of aurora prediction accuracy using Kp index** | Help the partner validate current aurora predictions  | SUOMI NPP VIIRS; NOAA-20 VIIRS; identify aurora from Day Night Band; compare predicted Kp and actual Kp |
| **Exploration of aurora prediction using aurora index** | Help the partner test an alternative aurora prediction method | SUOMI NPP VIIRS; NOAA-20 VIIRS; identify aurora from Day Night Band; compare predicted aurora index and actual aurora index |

**Project Timeline & Previous Related Work**

***Project Timeline:*** 1 Term: 2024 Summer

***Similar Past DEVELOP Projects***:

* 2019 Summer (LaRC) – [US Urban Development II](https://develop.larc.nasa.gov/2019/summer/USUrbanII.html): https://www.devpedia.developexchange.com/dp/index.php?title=US\_Urban\_Development\_II\_LaRC\_Summer\_2019
* 2018 Summer (LaRC) – [US Urban Development I](https://develop.larc.nasa.gov/2018/summer/USUrban.html): <https://www.devpedia.developexchange.com/dp/index.php?title=US_Urban_Development_LaRC_Summer_2018>
* 2017 Fall (LaRC) – [Colorado Plateau Urban Development](https://develop.larc.nasa.gov/2017/fall/ColoradoPlateauUD.html):

<https://www.devpedia.developexchange.com/dp/index.php?title=Colorado_Plateau_Urban_Development_VA_Fall_2017>

* 2017 Summer (VA) – [Wyoming Cross-Cutting II](https://develop.larc.nasa.gov/2017/summer/WyomingCrossII.html):

https://www.devpedia.developexchange.com/dp/index.php?title=Wyoming\_Cross-Cutting\_II\_WC\_Summer\_2017

* 2017 Spring (VA) – [Wyoming Cross-Cutting I](https://develop.larc.nasa.gov/2017/spring/WyomingCC.html):

<https://www.devpedia.developexchange.com/dp/index>

.php?title=Wyoming\_Cross-Cutting\_WC\_Spring\_2017

**Notes & References:**

***Notes*:** If the proposed work seems challenging, the team might consider focusing on the aurora season in Spring 2024 to demonstrate the feasibility.

***References:***

University of Alaska Fairbanks. (n.d.). *Aurora Forecast*. Geophysical Institute. <https://www.gi.alaska.edu/monitors/aurora-forecast>