**NASA DEVELOP National Program**

**North Carolina – NCEI**

*Project Summary – Spring 2018*

**Alaska Disasters**

*Development of a Snowmelt Monitoring Tool Using NASA MODIS and NOAA Climate Data Records to Aid Wildfire Managers in Alaska*

**VPS Title:** A Project of Ice and Fire: Monitoring Snowmelt in Alaska

**Project Team**

***Project Team*:**

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***Advisors & Mentors*:**

Jake Crouch (NOAA NCEI)

**Project Overview**

***Project Synopsis*:**

This project worked with the Alaska Interagency Coordination Center (AICC) and the National Weather Service Alaska Region to aid fire risk and monitoring efforts. The output of this project is a snow cover melt tool developed using Normalized Difference Snow Index from NASA’s Aqua Moderate Resolution Imaging Spectroradiometer (MODIS) data. The final version of this tool was updated to incorporate near real-time Snow Cover from NASA’s Suomi National Polar-orbiting Partnership (NPP) Visible Infrared Imaging Radiometer Suite (VIIRS) data for the project partners. The team also studied climatological trends in seasonal snow cover melt using NOAA’s Snow Cover Extent - Climate Data Record (SCE-CDR) to provide end users with a better understanding of historic and expected changes in snowmelt, which can be correlated to wildfire probability.

***Abstract*:**

Alaska is warming twice as fast as the rest of the nation due to changes in the climate, causing shorter winters, thawing permafrost, and rapidly receding glaciers. All of these weather changes are lengthening wildfire seasons and increasing the number of wildfires experienced by the state. Due to a current lack of actionable-data, the Alaska Interagency Coordination Center (AICC) and fire risk managers have difficulty determining when various areas within Alaska become snow-free and necessitate fire risk assessment. This project used NASA and NOAA satellite data to inform and improve the current snow monitoring processes of the AICC. The DEVELOP team used MODIS Normalized Difference Snow Index data to map snow cover extent and create a near real-time tool to monitor snowmelt and aid wildfire managers in determining locality for future fire risks. The team also utilized Snow Cover Extent - Climate Data Record (SCE-CDR) to study climatological trends in historic seasonal snow cover melt to provide analysis of historic changes and trends in snowmelt. The results of this study give users the capacity to visualize maps of snow cover melt at a higher spatial resolution than previously utilized. These results will be distributed to and used by the AICC and the National Weather Service Alaska Region to mitigate wildfire risk.

**Keywords:**

MODIS, Suomi NPP VIIRS, remote sensing, Snow Cover Extent – Climate Data Record (SCE-CDR), Normalized Difference Snow Index (NDSI), Alaska, wildfire, snowmelt

***National Application Area Addressed:*** Disasters

***Study Location:*** AK

***Study Period:*** 1967 – 2017 (January – July)

***Community Concerns:***

* Climate and environmental changes are increasing the number of wildfires experienced by the state of Alaska, include shorter winters, lengthening of wildfire season, thawing permafrost, and rapidly receding glaciers
* An increase in wildfires could cause an increase in flooding and erosion, an increase in biogeochemical changes with carbon storage, a decrease in wildlife habitat, a decrease in timber production, a decrease in water production and accessibility, and fluctuation in soil composition
* There are limited data available to inform the AICC of when snow cover melts throughout the state, leaving unmonitored areas at risk to wildfire before mitigation planning and efforts can be provided
* A large portion of the Alaskan economy is based on the extraction and use of natural resources, which will be negatively impacted by the changes to the environment that are occurring, including an increase in wildfires (fishing, tourism, forestry, oil, etc.)

***Project Objectives:***

* Utilize both NASA Earth observations and NOAA climate data to fill the gaps in current data used by project partners
* Create a snow cover monitoring tool to calculate the changes in near real-time using the MODIS Normalized Difference Snow Index data
* Distribute raw gridded snowmelt data to project partners for use within existing mapping services
* Revise tool to produce using VIIRS near real-time Snow Cover data outputs for project partners
* Study and document climatological trends in seasonal snow cover melt to provide insight on historic and expected changes in snowmelt

**Partner Overview**

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

|  |  |  |  |
| --- | --- | --- | --- |
| **Organization** | **POC (Name, Position/Title)** | **Partner Type** | **Boundary Org?** |
| **Alaska Interagency Coordination Center** | Heidi Strader, Meteorologist | End User | No |
| **National Weather Service, Alaska Region** | Rick Thoman, Climate Science and Services Manager | Collaborator | No |

***Decision Making Practices & Policies***:

The AICC developed the Alaska Fire and Fuels (AKFF) Website, an online fire monitoring and risk tool to distribute information about current wildfires and wildfire risk across the state with various maps, graphics, and tabular displays. A number of data sources are used to create these figures including weather station data, NOAA’s Real-Time Mesoscale Analysis, Quantitative Precipitation Estimates (QPE) from weather models, and National Digital Forecast Database (NDFD) data. Satellite data from MODIS and VIIRS are only used to analyze fire movement and spread in remote areas. The AICC has had several issues determining when various areas within Alaska become snow-free in the spring. This data gap creates uncertainty for when wildfire assessment managers should begin calculating wildfire related indices to identify areas at risk.

***Project Benefit to End User***:

These end products will be incorporated into current wildfire risk monitoring in Alaska and provide end-users with a better estimate of when and where snowmelt occurs throughout the state, especially in remote areas. As a result, the AICC will have access to a more reliable method of monitoring snow cover melt to calculate wildfire risk as soon as wildfires can be considered. End users will also have the ability to use the snow cover melt trends and patterns analysis to inform future preparation planning and better understand the start of the local wildfire season. The products created from this project will both inform and assist the end-users by equipping the organization with up-to-date and comprehensive data that is readily available and providing an outlook into the past to better prepare for future wildfire seasons.

**Earth Observations & End Products Overview**

***Earth Observations:***

|  |  |  |
| --- | --- | --- |
| **Platform & Sensor** | **Parameter(s)** | **Use** |
| **Aqua MODIS** | Normalized Difference Snow Index (NDSI) | Near real-time NDSI data was used to measure recent snow cover melt throughout Alaska. |
| **SCE-CDR** | Snow Cover Extent | The long-term record of snow cover extent data available from the SCE-CDR was used to determine climatological trends and patterns in Alaskan snow cover melt. |
| **Suomi NPP VIIRS** | Land Surface Snow Cover | The Visible Infrared Imaging Radiometer Suite was used to measure land surface snow cover to aid in mapping snow cover extent. |

***Ancillary Datasets:***

USDA Natural Resources Conservation Service (NRCS) Snow Telemetry (SNOTEL) snowpack characteristics *in situ* data - used as validation of snow cover satellite data

***Software & Scripting:***

Esri ArcMap – Mapping and data processing

Python – Data acquisition, processing, and validation

***End Products:***

|  |  |  |  |
| --- | --- | --- | --- |
| **End Product(s)** | **Earth Observations Used** | **Partner Benefit & Use** | **Software Release Category** |
| **Near Real-Time Snow Cover Monitoring Tool** | Terra MODIS, Aqua MODIS, and Suomi NPP VIIRS | This tool will be used by the AICC to identify areas in Alaska where they need to start calculating various fire indices to inform regional managers of developing wildfire risk. A near real-time tool will replace the currently used modeled snow free analysis data. | III |
| **Tutorial of Snow Cover Monitoring Tool** | N/A | This tutorial demonstrates the use and application of the snow cover tool for AICC use. | N/A |

**Project Handoff Package**

**Transition Plan:**

The project team will handoff project results at the end of the term via a video conference with the end user and collaborators. The team will also give a brief presentation of their project results and demonstrate the snow cover monitoring tool to partners during the hand-off event. A software release and a tutorial will be required before the snow cover monitoring tool can transfer to the end user.

*Software Release Plan*:

The Near Real-Time Snow Cover Monitoring Tool falls under software release category III. The DEVELOP team has verified that the software used for the tool is compatible with the end user’s current operations. The end user, the AICC, has been notified of the software release process and its time restraints. Through the duration of the Software Release Process, specifically during the onset of spring and snowmelt in Alaska (March-May), the tool will be run by the NCEI node leadership and the results will be sent to the AICC.

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**Handoff Package:**

* All project Deliverables
* Tutorial of Snow Cover Monitoring Tool
* Statistical and spatial analysis of climatological trends in seasonal snow cover melt
* Raw gridded snowmelt data

**References:**

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