**NASA DEVELOP National Program**

****Mobile County Health Department

*Spring 2017*

**Short Title: Southeastern Arizona Water Resources II**

**Subtitle:** Using NASA Earth Observations to Assist the National Park Service in Assessing Snow Cover Distribution and Persistence Changes in the Sky Islands

**VPS Title:** How’s it Snowing?

**Project Team & Partners**

**Project Team:**

Tyler Lynn (Project Lead), tclynn11@gmail.com

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**Advisors & Mentors:**

Bernard Eichold, M.D., Dr. PH (Mobile County Health Department)

Joseph Spruce (NASA Langley Research Center)

**Past or Other Contributors:**

Farnaz Bayat

Katie Harville

**Partner Organizations:**

|  |  |  |  |
| --- | --- | --- | --- |
| **Organization** | **POC (Name, Position/Title)** | **Partner Type** | **Boundary Org?** |
| National Park Service, Intermountain Region | Colleen Filippone, Intermountain Region Hydrologist | End-User | No |
| National Park Service, Saguaro National Park | Don Swann, Biologist | End-User | No |

**Project Details**

**Applied Sciences National Applications Addressed:** Water Resources, Climate

**Study Area:** Southeastern Arizona, AZ

**Study Period:** January 1984 – March 2017

**Earth Observations & Parameters:**

Aqua Moderate Resolution Imaging Spectroradiometer (MODIS) – standard and value added snow cover products

Terra MODIS – standard and value added snow cover products

Landsat 5 Thematic Mapper (TM) – snow cover

Landsat 7 Enhanced Thematic Mapper Plus (ETM+) – snow cover

Landsat 8 Operational Land Imager (OLI) – snow cover

Sentinel-2 Multi Spectral Imager (MSI) – snow cover

**Ancillary Datasets Utilized:**

* USGS stream gauge data – stream flow
* Partner *in-situ* data – stream surface water presence and wetted length

**Software Utilized:**

* ESRI ArcGIS – raster manipulation and map production
* ERDAS Imagine – image data analysis
* Google Earth Engine API – processing of MODIS, Landsat, and Sentinel-2 time series data

**Project Overview**

**80-100 Word Objectives Overview:**

Arizona’s Sky Island mountain ranges are among the most diverse ecosystems in the world and snow is a fundamental resource supporting the biodiversity of these ecosystems. Previously, this project provided preliminary analysis of snow cover within the Rincon Mountains and will continue analyses of the Rincon Mountains while expanding to include the neighboring Santa Catalina Mountains in order to produce a detailed account of snowpack change using NASA Earth observation data products (Landsat and MODIS). This project will provide vital information that the National Park Service is currently missing when making park management decisions.

**Abstract:**

Southeastern Arizona is home to unique mountain ranges known as the Sky Islands. Sky islands are biodiversity hotspots and host various ecosystems, ranging from arid deserts to temperate forests. These mountain ecosystems rely on slow-melting snowpack to sustain themselves during dry periods. However, the changing climate and its contribution to decreasing snow cover is of growing concern. Currently, the National Park Service (NPS) monitors water presence, but a synoptic record of snow presence does not exist due to the remote and rugged topography of the region. As a result, it is difficult to study how the changing climate has affected water resources in the Sky Islands and what effect this has on wildlife and vegetation. This project used NASA Earth observations such as Landsat and MODIS data to aid the NPS in understanding the role of snow cover in the Arizona Sky Islands. Historical snow cover maps were created to address the current gap in information regarding snow presence. With a more complete understanding of the impact of snow cover, the NPS will be able to analyze past snow cover changes to improve future land management decisions.

**Keywords:**

Biodiversity Hotspot, climate, hydrology, remote sensing, Saguaro National Park, watershed

**Community Concerns:**

* The Southwestern United States is experiencing significant increases in temperature across the region due to the changing climate.
* Effects associated with warming climate include shifts in the hydrological cycle, decreased winter precipitation, shifting precipitation patterns towards rain rather than snow, and earlier yearly snowmelt in the Sky Island region.
* Shifts in precipitation patterns toward more rainfall are leading to rising concern that snow cover will decrease to levels that cannot sustain aquatic ecosystems through dry seasons.
* Decreasing water resources pose a threat to the aquatic habitats, which are home to unique species as well as to the back country visitors to the park who rely on streams and pools as their main source of hydration.

**Current Management Practices & Policies**:

The NPS currently does not use remote sensing to assess snow cover in Saguaro National Park and the surrounding Sky Islands. Snow cover assessments are currently done using empirical field data collected manually or electronically from remote stations located throughout the Arizona portion of the Sky Islands. In particular, park managers currently use weather data, stream gauge data and annual to semi-annual observations of water presence in tinajas, depressions eroded into the earth’s surface, to manage water resources. This resulting information is then used to manage resources for aquatic wildlife species (such as Leopard frogs), backpackers and hikers, and water rights cases. At the federal level, NPS resource management is guided by Director’s order #12 of the National Environmental Policy Act, and Arizona Title 49 at the state level. Research and management cooperatives, such as the Desert Landscape Conservation Co-op and the Sky Island Alliance, also play a role in resource conservation throughout the study area.

**Decision Support Tools & Benefits:**

|  |  |  |  |
| --- | --- | --- | --- |
| **End-Product** | **Earth Observations Used** | **Benefit & Impact** | **Software** **Release** |
| Historical Snow Cover Maps | Aqua and Terra MODIS, Landsat 5 TM, Landsat 7 ETM+, and Landsat 8 OLI | Establish a methodology in assessing snow cover distribution and persistence changes | N/A |
| Graph comparing snow cover and water presence | Aqua and Terra MODIS, Landsat 5 TM, Landsat 7 ETM+, and Landsat 8 OLI | Comparisons of snow cover and water presence. | N/A |
| Snow Cover Assessment Tool/Script | Aqua and Terra MODIS, Landsat 5 TM, Landsat 7 ETM+, and Landsat 8 OLI Sentinel-2, Multispectral Imager (MSI) | This tool will help assess snow cover distribution and its effect on water resources in the Sky Islands. | III |