Water Availability Assessment from Annual Snow Cover in the Fremont River Basin Based on NASA Earth Observations and In Situ Data

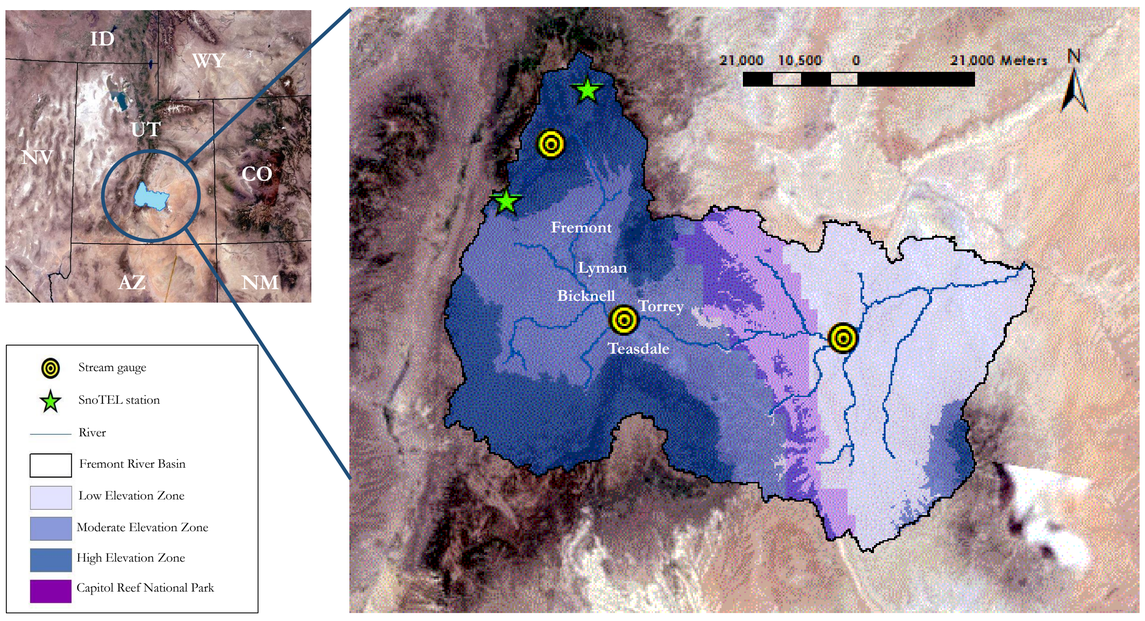
Abstract

As a largely snowmelt-fed watershed, Utah's Fremont River Basin provides year-round irrigation for approximately 16,000 acres of agricultural areas, including historic orchards and pastures maintained by Capitol Reef National Park (CARE). However, forecasts for seasonal water availability within the basin based on *in situ* snowpack data have been unreliable compared to water use allocations in the past. For this reason, a more robust method was required to provide accurate water availability assessments that help CARE plan future water allocations more effectively. Multiple NASA Earth observations and *in situ* data were employed to derive key trends and data insights for snowmelt and relevant climate variables across the watershed. Furthermore, a forecasting tool that predicts seasonal streamflow in the Fremont River Basin was created using machine learning models. The results of the snowmelt and climate analyses along with the forecasting tool will inform water resource management and enhance future irrigation allocation plans at CARE.

Objectives

- **Devise** the most suitable model to forecast streamflow in the Fremont River Basin
- **Conduct** an Exploratory Data Analysis report revealing key snowmelt and climate trends over time
- **Visualize** time series of snow cover changes in the Fremont River Basin

Study Area



Earth Observations

Terra MODIS

Landsat 5 TM

Team Members

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Project Partners

- **Capitol Reef National Park**
- **National Park Service**, Northern Colorado Plateau Network

Conclusions

- *In situ* and remotely sensed Terra MODIS data are effective inputs for training machine learning algorithms to forecast streamflow.
- SPAM exhibited greater accuracy (MAE, RMSE) in modeling streamflow over SNOW-M.
- The Streamflow variable was most correlated with Precipitation and Snow Cover Area.
- Mean Snow Cover Area data greatly fluctuated year to year from 2000 to 2017, with 203.15 sq. km in 2001 (min. year) and 399.44 sq. km in 2009 (max. year)

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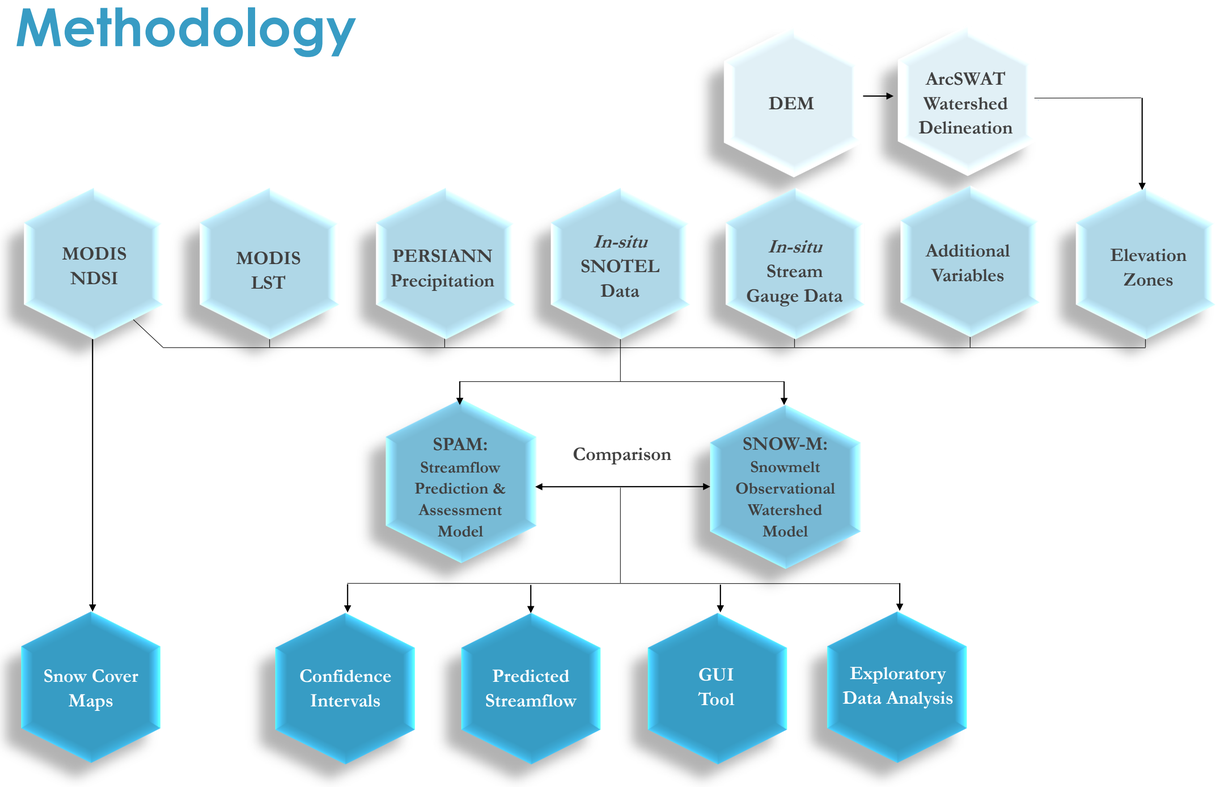
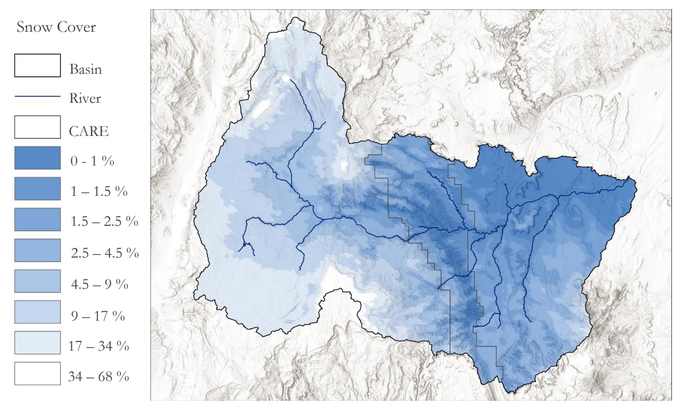
Margaret Mulhern, **Manda Au**, **Nolan Barrette**, & **Austin Counts**, NASA DEVELOP VA – Wise County

Methodology

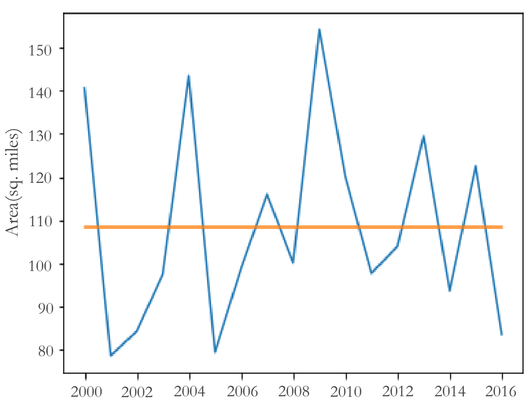


Results

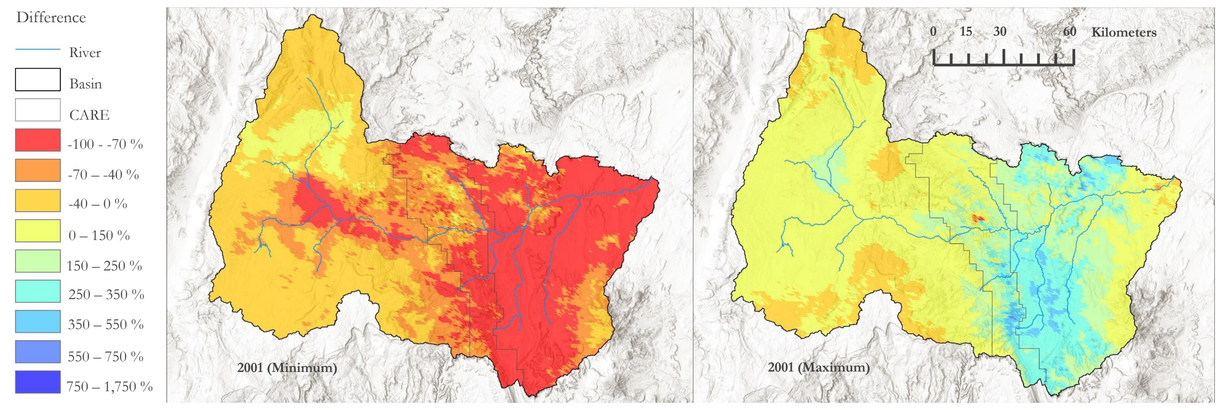
Mean Snow Cover Area (2000-2016)



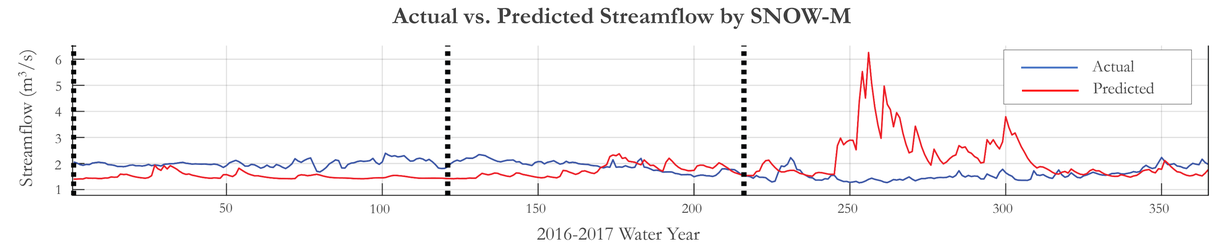
Annual Snow Cover Area in 2000-2016



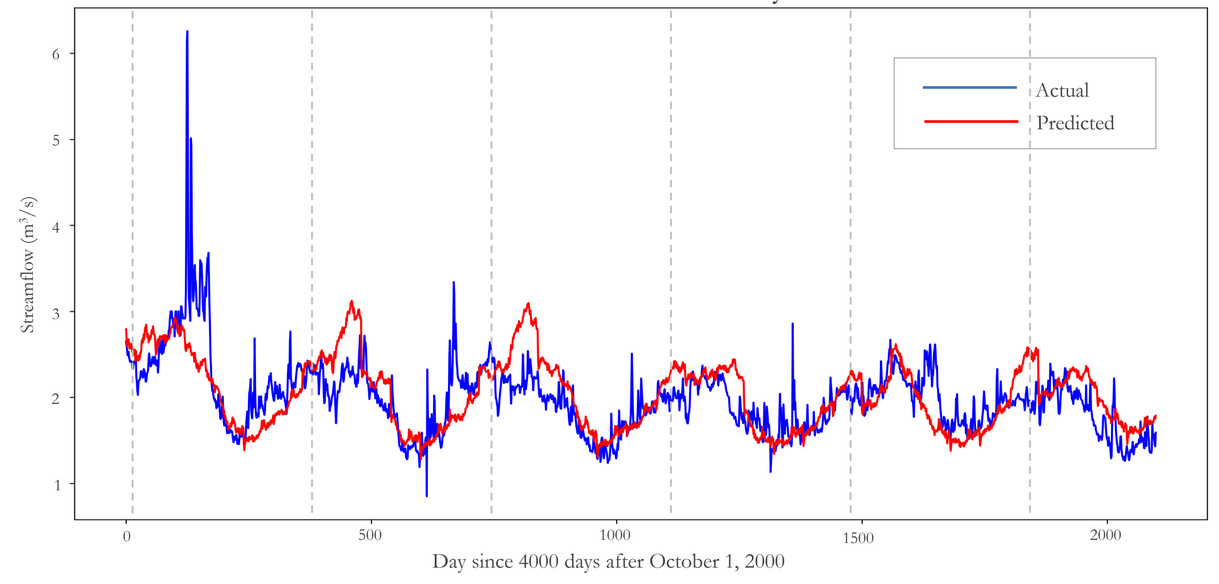
Snow Cover Area for Minimum and Maximum Years vs. Mean Snow Cover Area



Actual vs. Predicted Streamflow by SNOW-M



Actual vs. Predicted Streamflow by SPAM



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