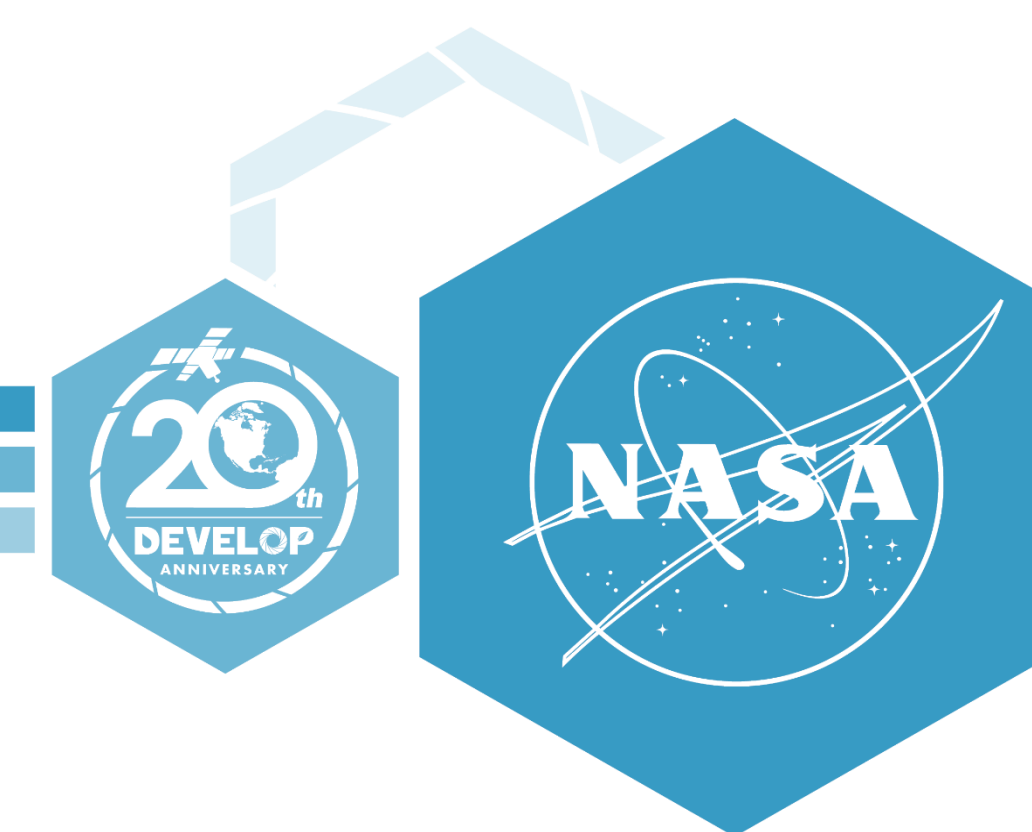


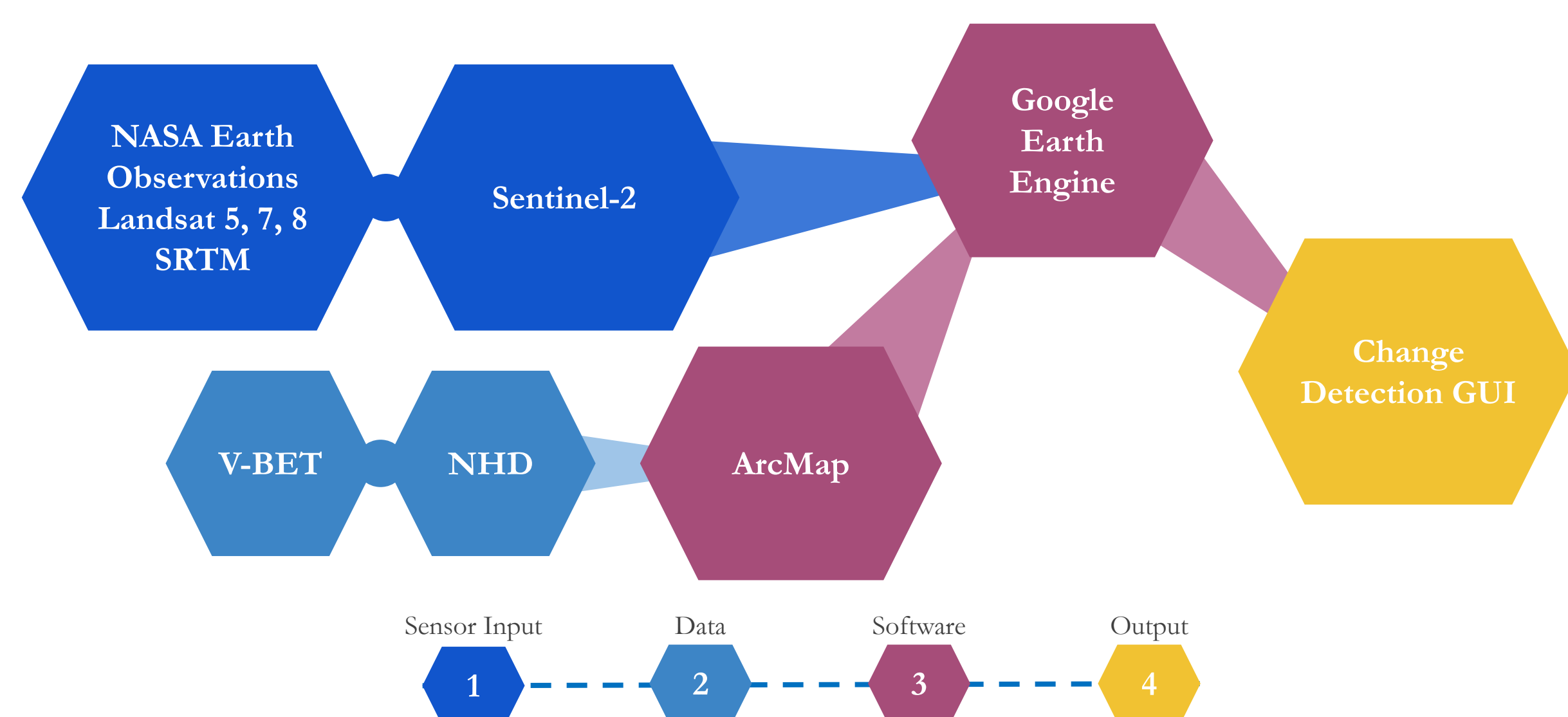
Designing a Modeling User Interface Incorporating Landsat to Monitor Changes in Riparian Vegetation and Endangered Fish Habitat



Abstract

Since the completion of the Flaming Gorge Dam in 1964, artificial flow releases along the Green River have promoted channel narrowing and encouraged non-native vegetation encroachment into the active stream channel. These changes in the Green River's flow regime have reduced the backwater habitat of four native endangered fish species: the Colorado Pikeminnow (*Ptychocheilus lucius*), Razorback Sucker (*Xyrauchen texanus*), Humpback Chub (*Gila cypha*), and Bonytail (*Gila elegans*). To promote population recovery, this project developed the River Morphology Evaluation Toolbox (RMET), a Google Earth Engine (GEE) tool, to more efficiently and cost-effectively monitor changes in vegetation and hydrology across large spatial and temporal scales. Using imagery collected from Landsat 5 Thematic Mapper (TM), Landsat 7 Enhanced Thematic Mapper Plus (ETM+), Landsat 8 Operational Land Imager (OLI) and Thermal Infrared Sensor (TIRS), Shuttle Radar Topography Mission (SRTM), and Sentinel-2 Multispectral Instrument (MSI) satellites, the team used the normalized difference vegetation index (NDVI), soil adjusted vegetation index (SAVI), modified normalized difference water index (MNDWI), and normalized difference water index (NDWI) to detect landcover changes. Trends in spectral index changes over user-selected focal years and the magnitudes of those changes were isolated and visualized through RMET. The project partners at the National Park Service and the Upper Colorado River Endangered Fish Recovery Program will use RMET to identify potential sites where changes in riparian vegetation and the active stream channel may have reduced fish habitat to make more informed recommendations for flow releases from the Flaming Gorge Dam.

Methodology



Objectives

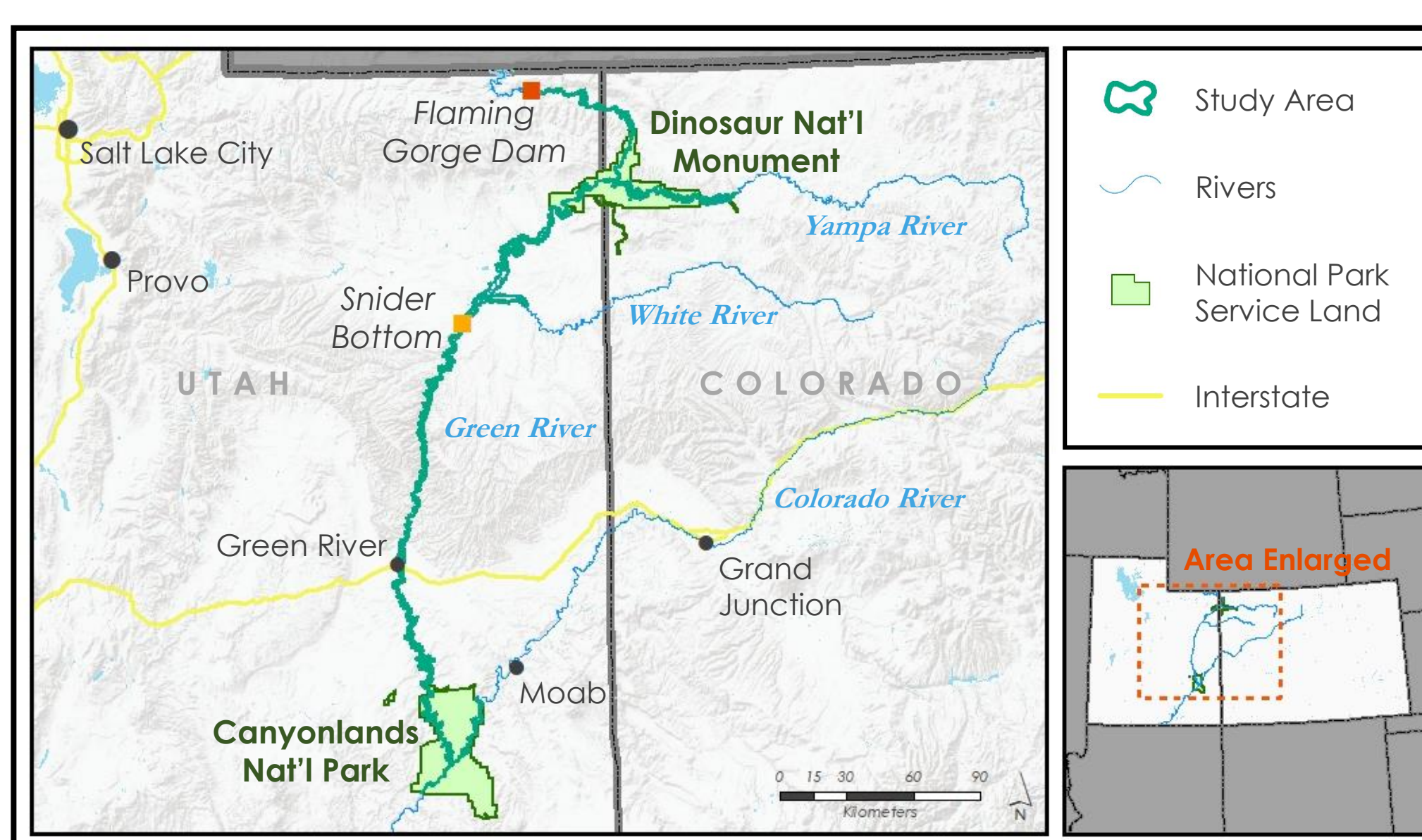
- ▶ **Test** the feasibility of detecting river geomorphology change and vegetation encroachment using NASA Earth observations
- ▶ **Create** a model which uses vegetation and water spectral indices to create binary presence/absence maps
- ▶ **Develop** an interactive Google Earth Engine (GEE) tool and accompanying tutorial to monitor changes in vegetation and hydrology

Project Partners

- ▶ **National Park Service**, Water Resources Division
- ▶ **National Park Service**, Inventory & Monitoring Division, Northern Colorado Plateau Network
- ▶ **Upper Colorado River Endangered Fish Recovery Program**



Study Area



Study Area Map

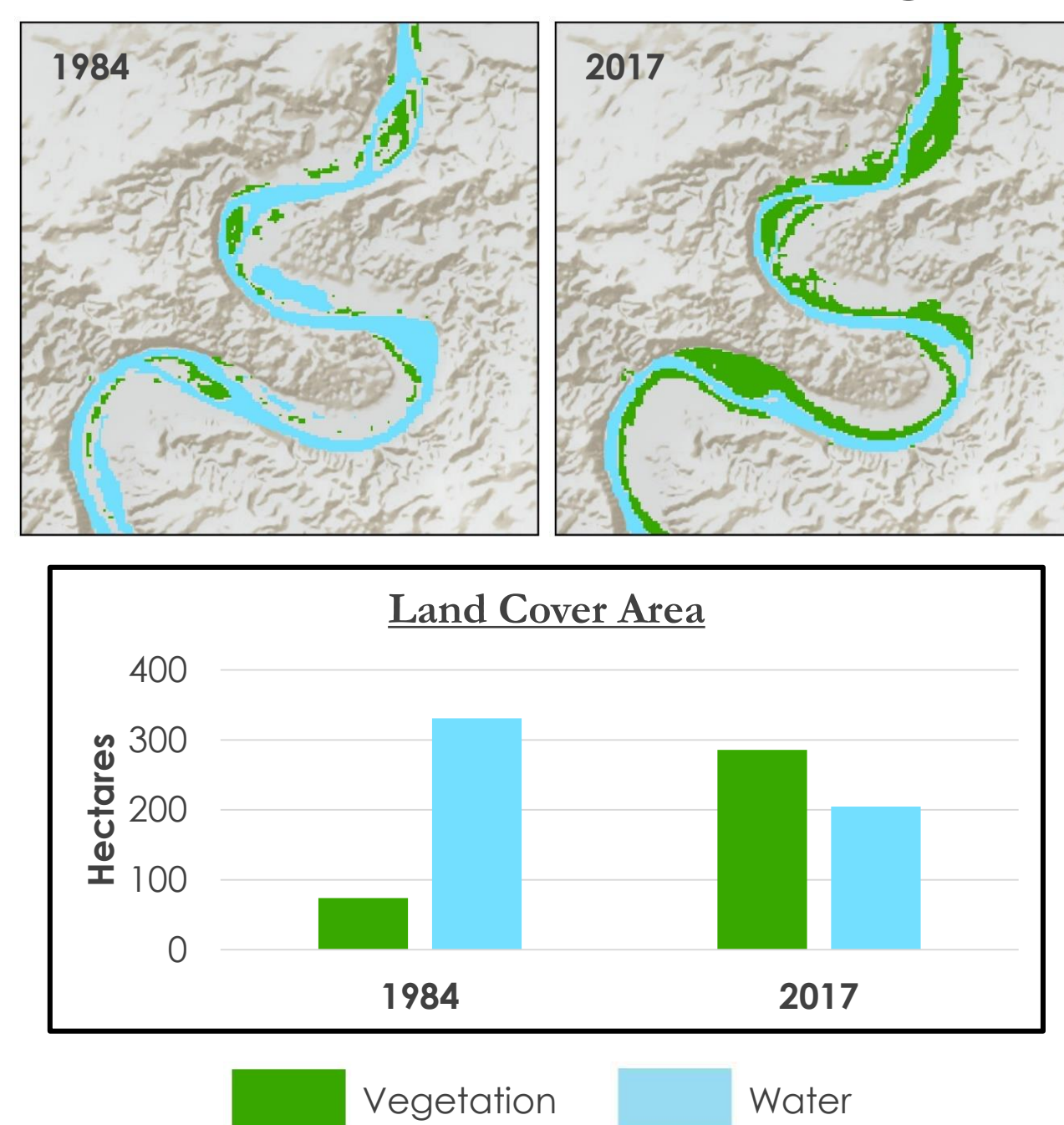
Our study area covers about 872 kilometers of riparian corridors in the Upper Colorado River Basin.

The time frame for our study was from 1984 to 2017.

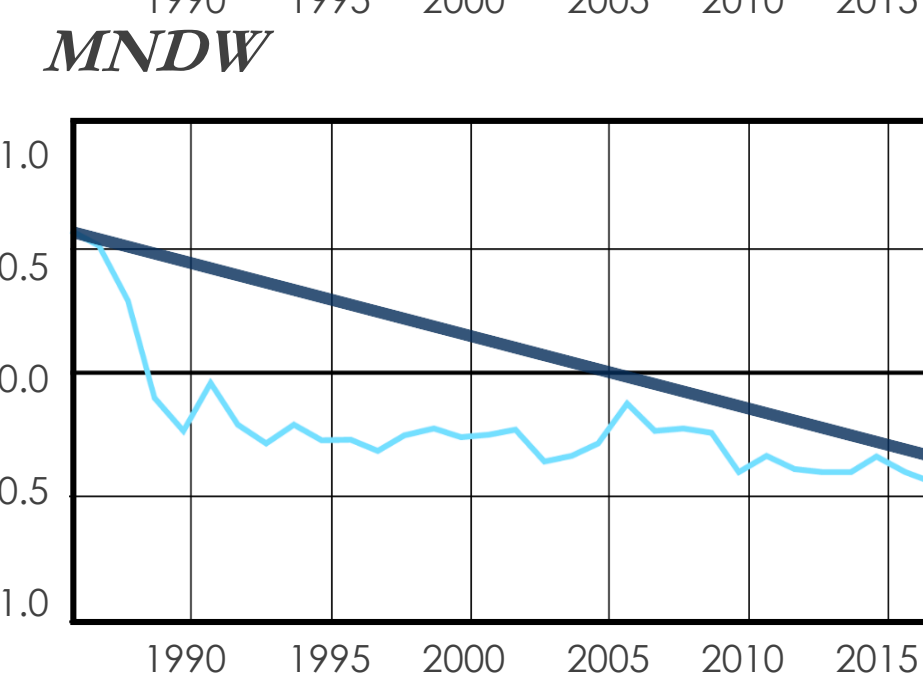
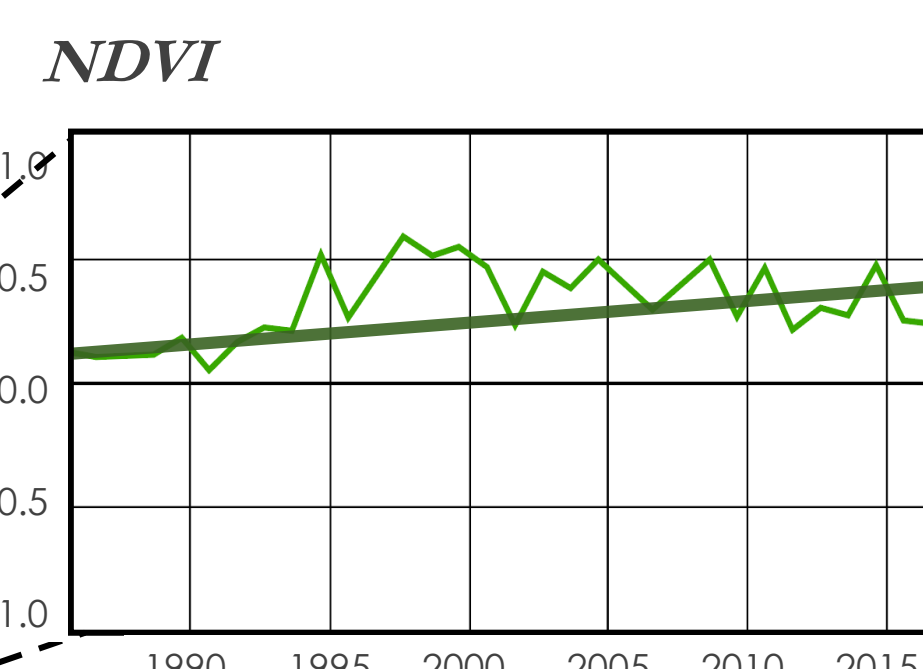
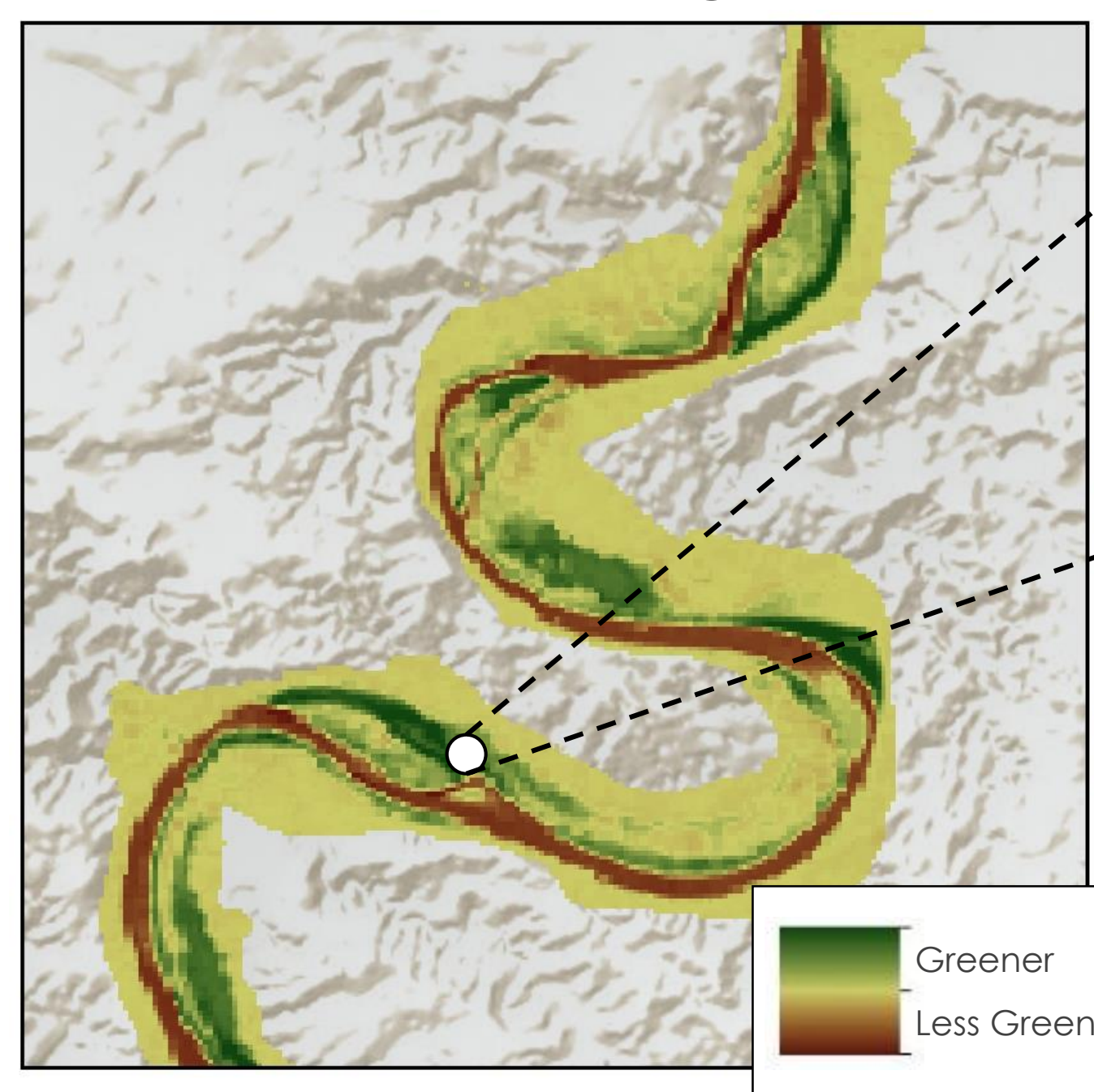
To better illustrate our findings, we focused on Snider Bottom because it appears vegetation has encroached into the active stream channel, the channel has narrowed, and endangered species habitat has potentially been reduced in this area.

Results

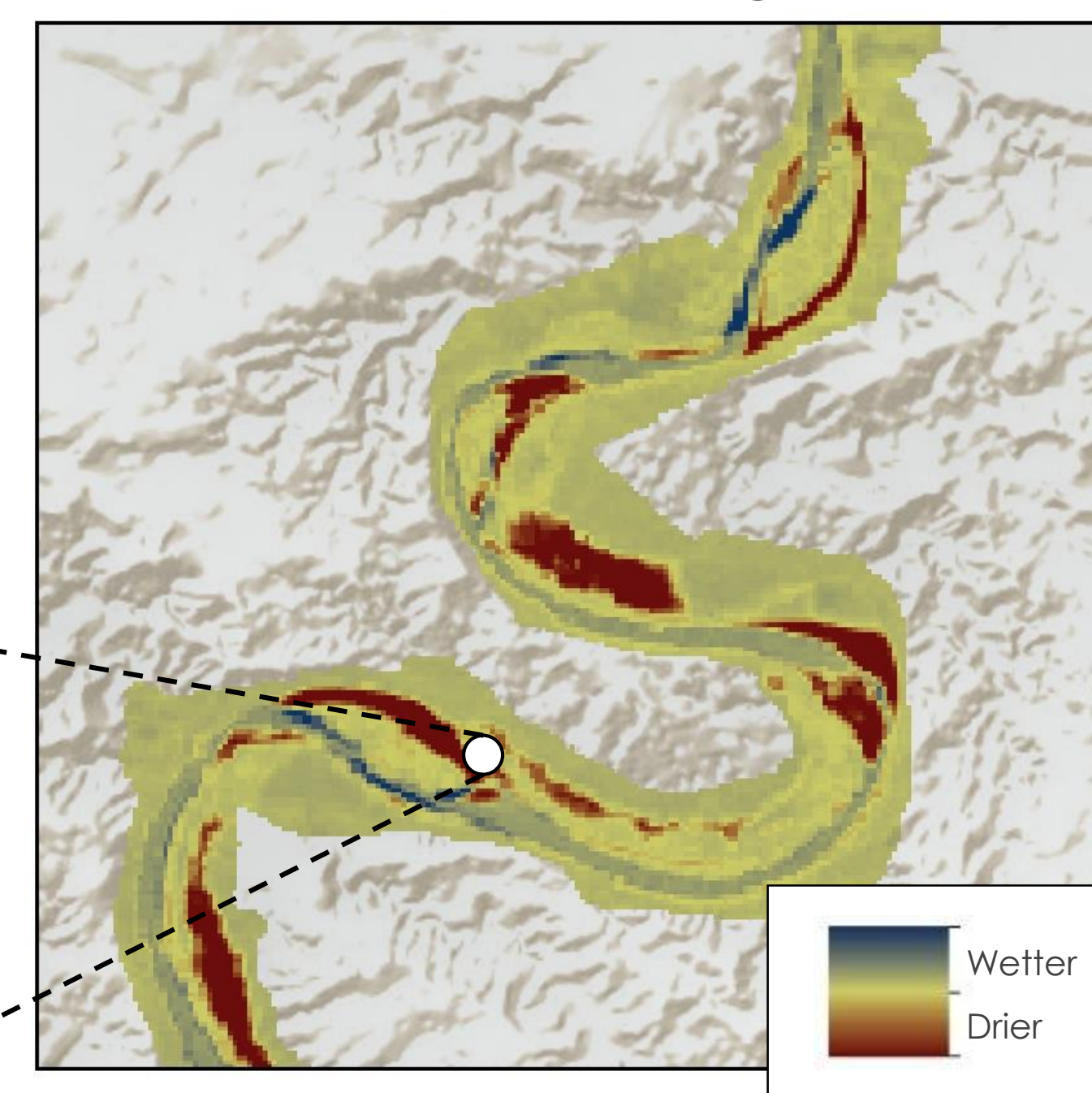
Snider Bottom Land Cover Change



Snider Bottom NDVI Change: 1984 - 2017



Snider Bottom MNDWI Change: 1984 - 2017



Earth Observations



Landsat 5 TM

Landsat 7 ETM+

Landsat 8 OLI

Sentinel-2 MSI

SRTM

Team Members



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Project Lead



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Nathaniel Penrod

Conclusions

- ▶ RMET via Google Earth Engine enables rapid detection of changes which have occurred in riparian vegetation distribution and hydrology features along the Green, Yampa, White, and Colorado Rivers since 1984. This enhances our project partners' ability to identify areas of potential endangered fish habitat loss and determine locations for more intensive field studies.
- ▶ Spectral index change maps support the well-documented phenomenon of stream channel narrowing and vegetation encroachment into the active stream channel.

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