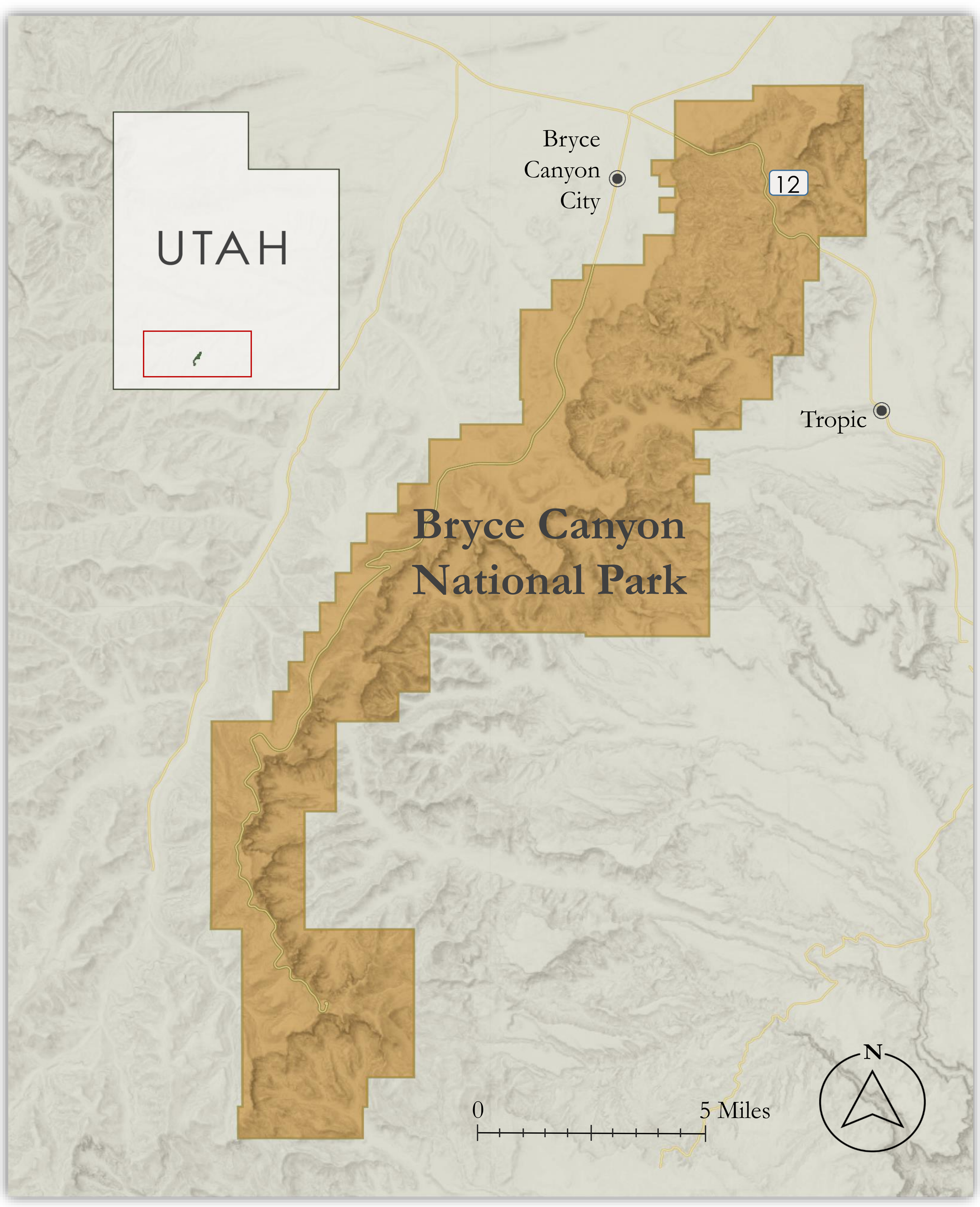
Monitoring Vegetation Health and Water Availability in Bryce Canyon National Park for Drought Stress Mitigation Planning

Abstract

Bryce Canyon National Park is home to groundwater-dependent ecosystems (GDEs) that are threatened by a multidecadal drought and increased groundwater extraction due to a spike in tourism. These ecosystems contain unique species that are only found in areas where near-surface groundwater is present, such as aspen groves and fens. These species contribute to the high biodiversity found in Bryce Canyon, which boosts an ecosystem's productivity and the services it provides to the park. Unfortunately, many of these GDEs are too small to identify with traditional Earth observation platforms and are difficult to physically reach for monitoring purposes. This project partnered with the National Park Service to identify springs and seeps as a proxy for GDEs within Bryce Canyon from 2013–2022. The team mapped groundwater discharge with high resolution National Agriculture Imagery Program (NAIP) and assessed park vegetation trends with Landsat 8 Operational Land Imager (OLI) and PlanetScope imagery. In-situ precipitation data and the Western Land Data Assimilation System (WLDAS) were used to produce time series of climatic variables. Seeps and spring locations were predicted using random forest classification and maximum entropy machine learning models.

Study Area

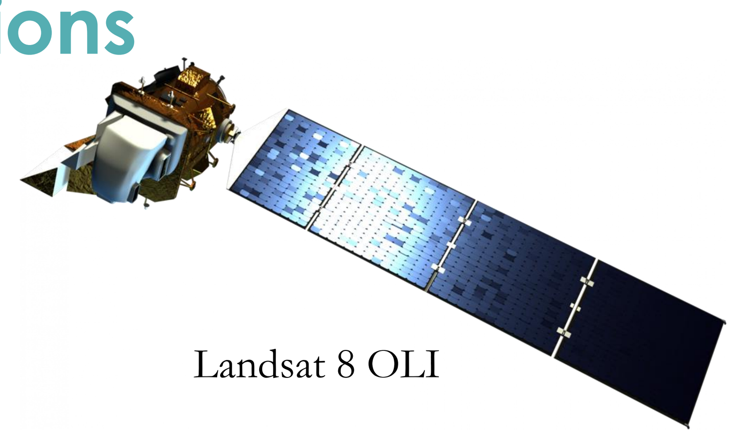


Objectives

- **Apply** sophisticated remote sensing techniques to:
  - **Detect** springs, seeps, and groundwater-dependent ecosystems
  - **Understand** changes in vegetation presence and health
  - **Visualize** changes in climate
- **Create** a framework for future applications

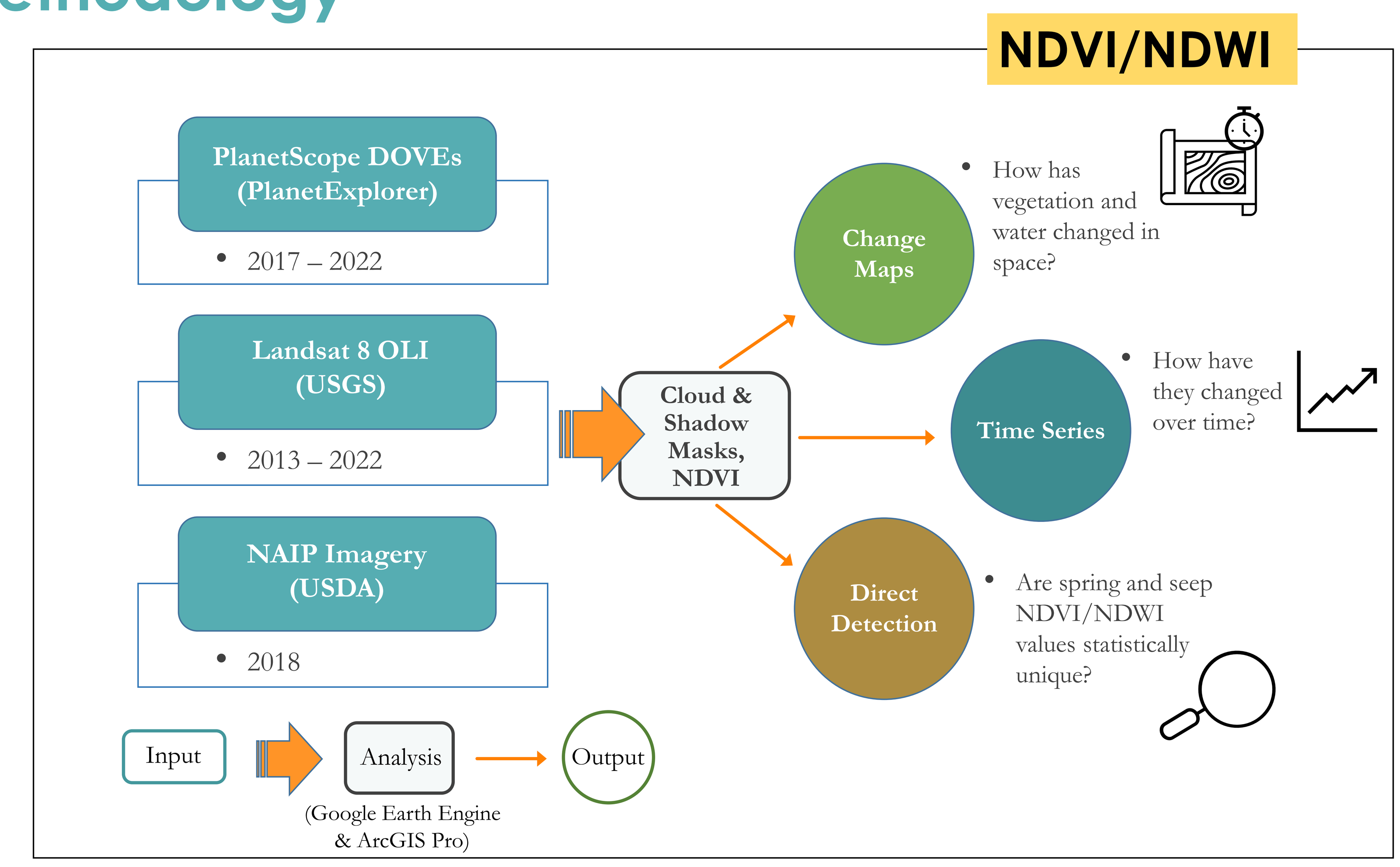
Earth Observations

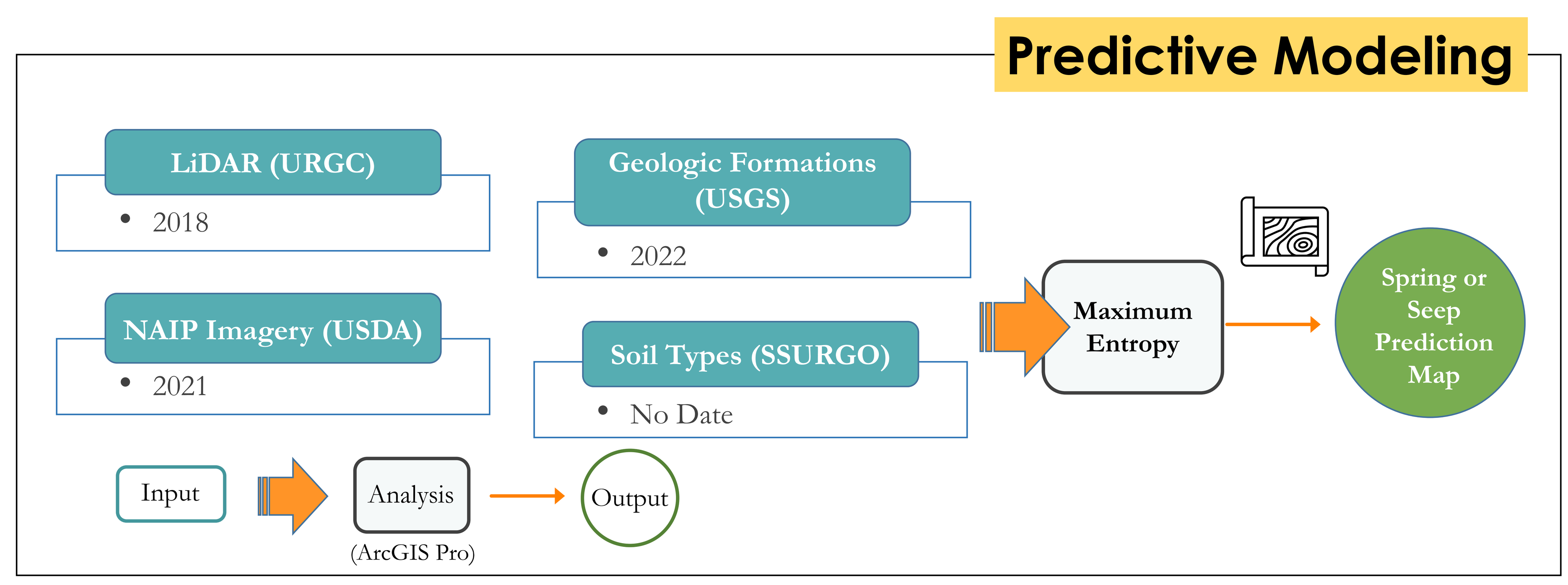
PlanetScope DOVEs



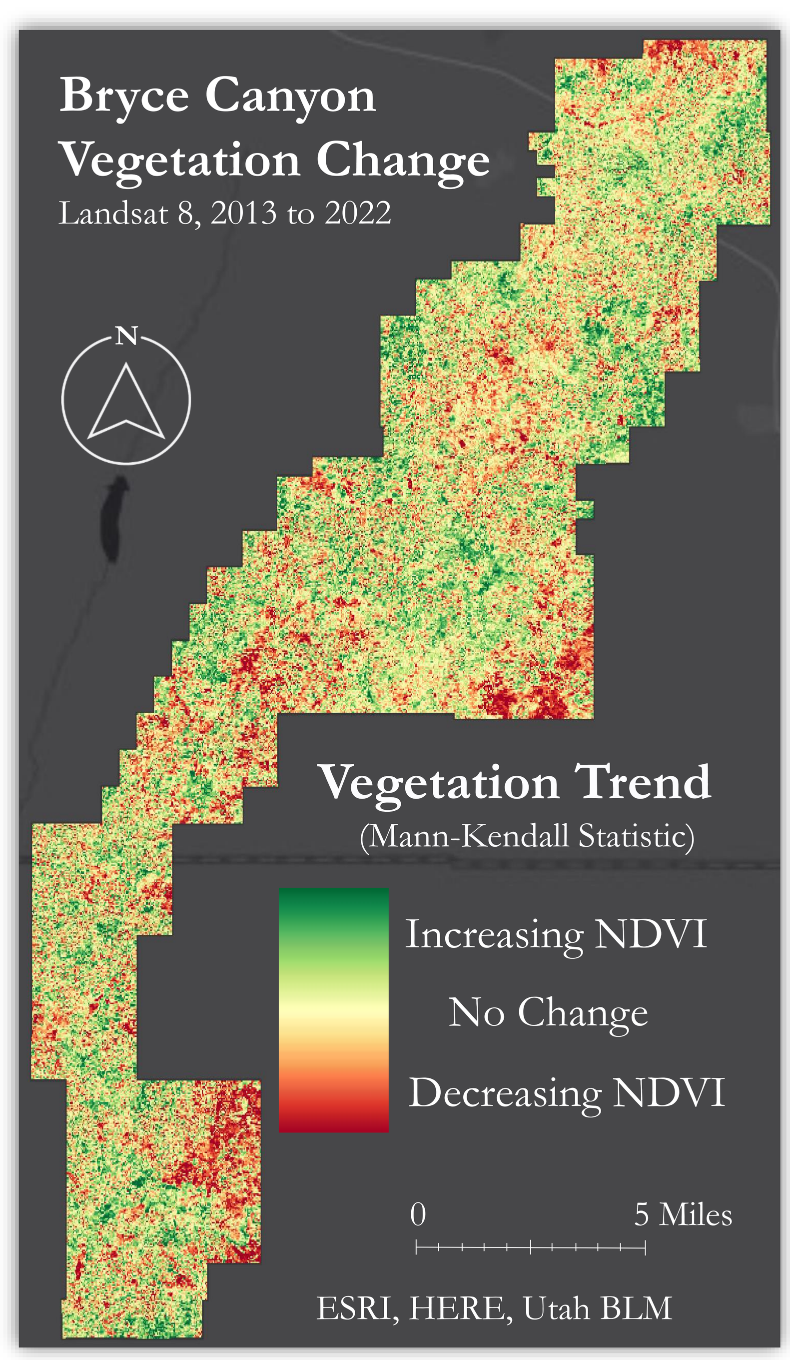
Landsat 8 OLI

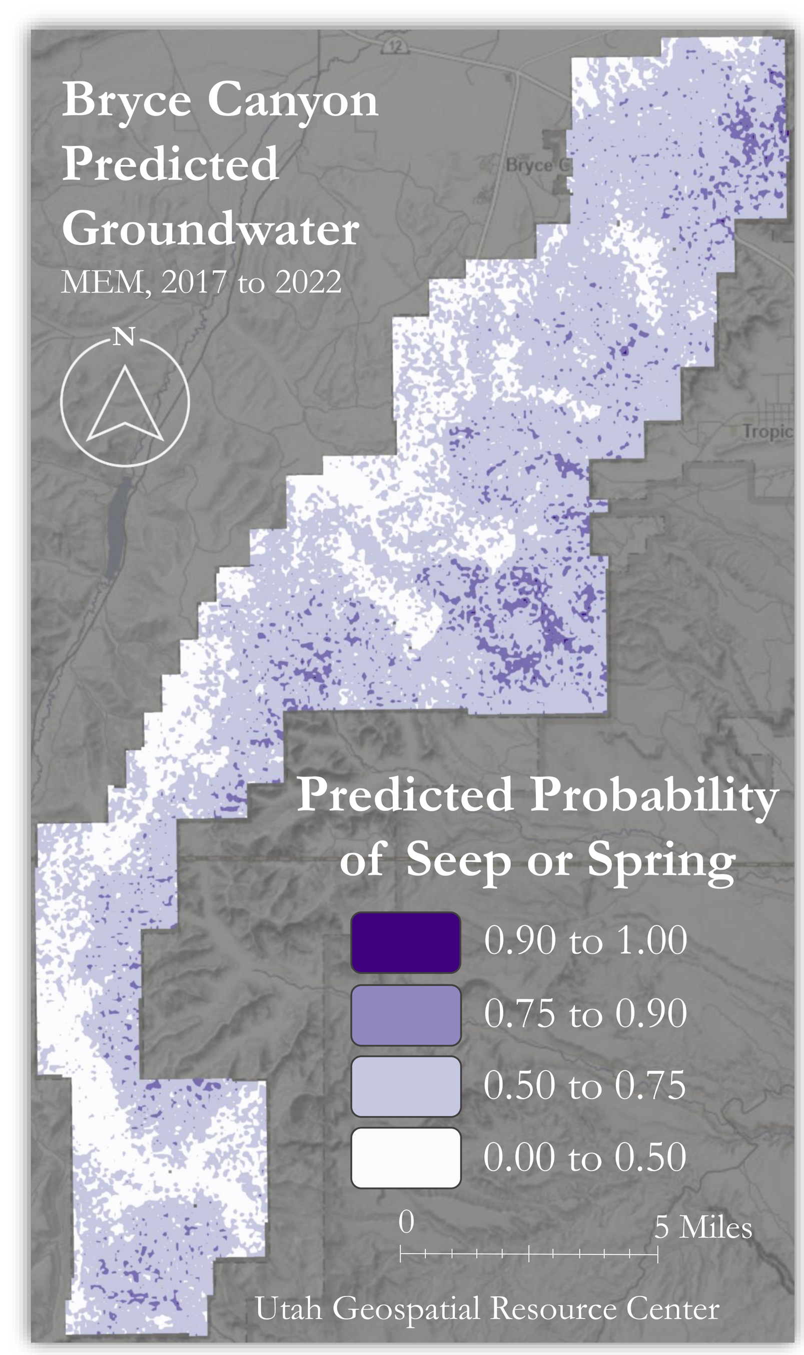
Methodology





Results





Conclusions

- NDVI and NDWI alone are not a reliable indicator of spring and seep presence
- Maximum Entropy models predicted the probability of where springs and seeps are located
- Snowfall and snow sublimation have decreased since 1979 while rainfall has remained consistent; pervasive drought conditions suggest that snow is an important contributor to vegetation health

Acknowledgements

- **Partners:** Tyra Olstad (Bryce Canyon National Park, National Park Service)
- **Advisors:** Sean McCartney (Science Systems & Applications, Inc., GSFC)
- **Fellows:** Carli Merrick (Science Systems & Applications, Inc., GSFC) and Nicole Ramberg-Pihl (Science Systems & Applications, Inc., GSFC)
- **Special thanks:** Dr. Jessica Erlingis (University of Maryland, GSFC)

This model contains modified LIDAR (2018) data from UGRC, NAIP (2021) and Soil Survey data collected by USDA, geological features maps (2022) from USGS and altered by NPS, and PlanetScope Data (2017-2022).

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Bryce Canyon Water Resources

Fall 2022 | Maryland - Goddard

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