Mapping Biomass to Inform Conservation Planning of a Future State Park in Southern Colorado

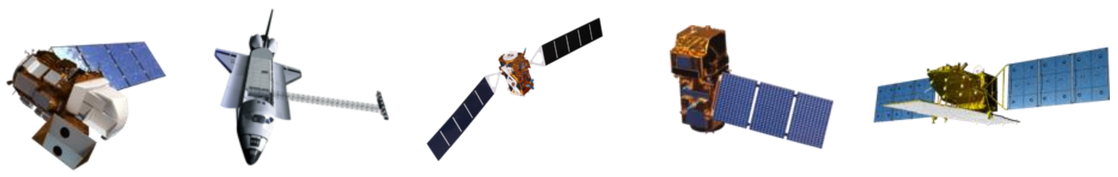
Abstract

Fisher's Peak will be a 77.5 km^2 property southeast of Trinidad, Colorado. The area experienced limited anthropogenic disturbance and is home to an abundance of unique habitats and species. A rapid, 3,000-foot change in elevation over the extent of the area nurtures a variety of plants and animals, including the endangered New Mexico meadow jumping mouse. In 2019, the State of Colorado obtained Fisher's Peak with plans to make it Colorado's second largest state park. A diverse group of collaborators, including the Colorado State Forest Service and The Nature Conservancy, worked closely to design the state park to maximize recreation opportunity while conserving the property's rich habitats and biodiversity. The Fisher's Peak Ecological Forecasting Team utilized Light Detection and Ranging surveys, *in situ* forest inventory data, as well as Earth observations from Landsat 8 Operational Land Imager, Sentinel-1 and Sentinel-2, ALOS-2 PALSAR. and the Shuttle Radar Topography Mission to quantify and map biomass over the extent of the study area. The results from modeling biomass had an out-of-bag root mean square error of 54.98 and an R^2 of 11.66. The resulting map indicates areas where carbon storage on the property is high, informing decision-making processes for future park development. While more *in situ* training data may improve modeling capacity for biomass in the Fisher's Peak area, this work represents a feasible attempt to better understand biomass distribution using Earth observations.

Objectives

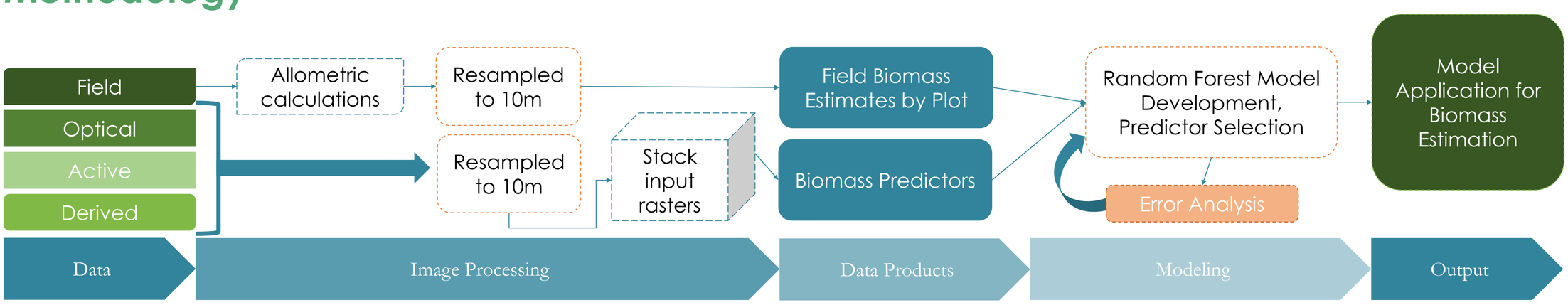
- **Map** biomass for the Fisher's Peak property to inform park development as it concerns existing forest inventory in the form of biomass and carbon stocks
- **Identify** areas of high carbon storage and fuel loads and the priority for preservation
- **Forecast** high priority preservation areas by highlighting areas of old growth forest and high carbon storage

Earth Observations

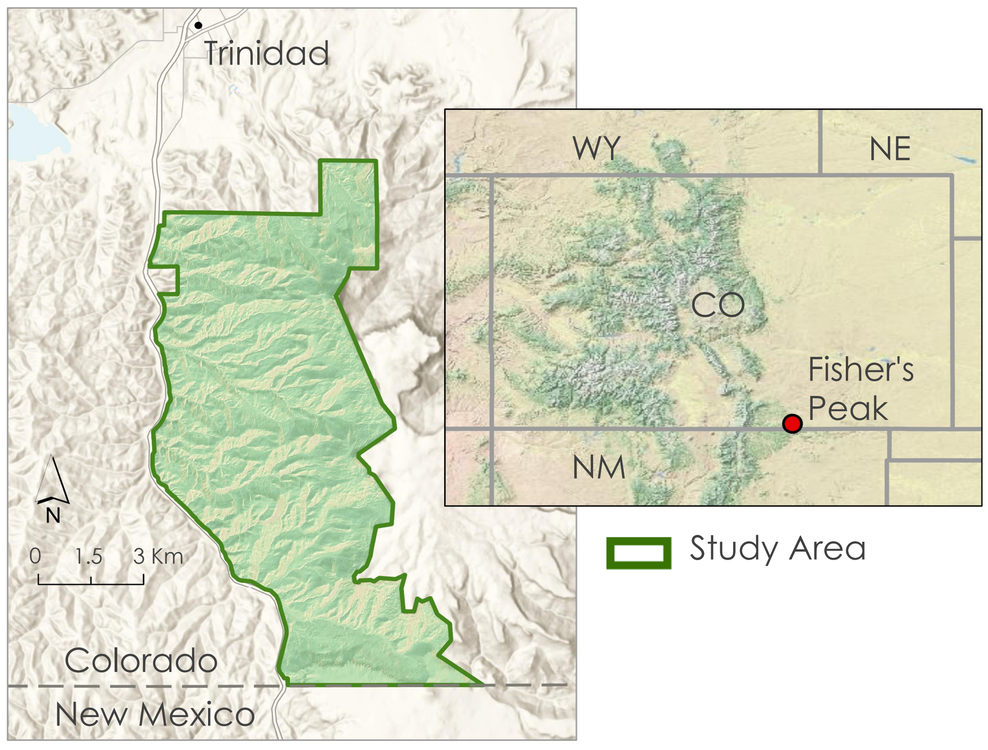


Landsat 8 | SRTM | Sentinel-1 | Sentinel-2 | ALOS-2

Methodology

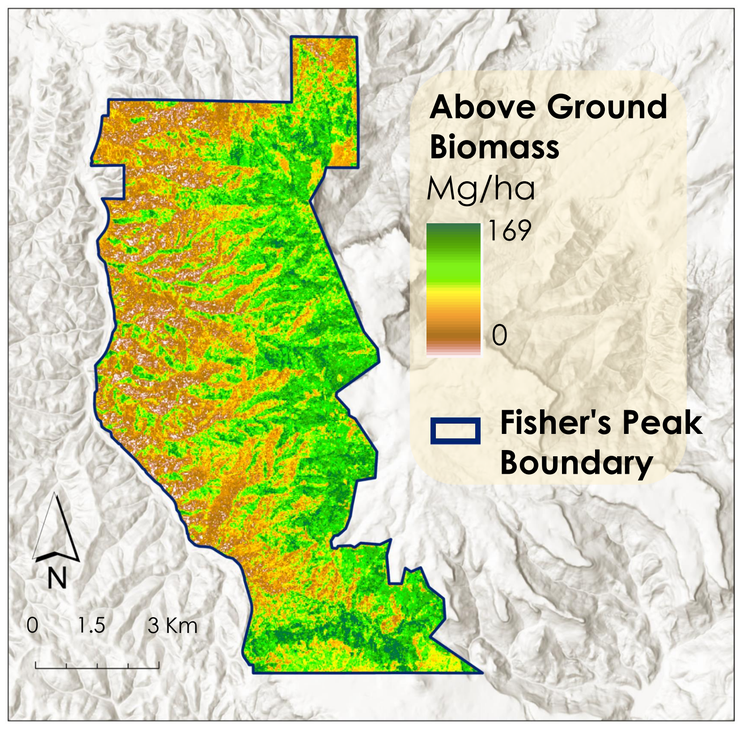


Study Area



Results

The optimal combination of predictor variables was a mix of Landsat 8 tasseled cap variables, SRTM topographic variables, and Sentinel and ALOS PALSAR C and L band variables. This model gave us an RMSE of 54.98 Mg/ha and an out-of-bag R^2 value of 11.66.



Conclusions

- The team found that the creation of a predictive biomass map using forest inventory and remotely sensed data is possible.
- This model would benefit from a higher number of plots that are sampled on a fixed radius.
- Model importance determined that radar data from ALOS-2 PALSAR and Sentinel-1 C-band predicted biomass better than LiDAR derived canopy height.
- Fisher's Peak has 3,277 carbon offsets for entering the carbon market.

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