



ETHIOPIA WATER RESOURCES

*Application of Landsat 8 Imagery and Statistical Models
for Mapping Critical Headwater Wetlands of Ethiopia*

-
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 - ▶ Ryan Anderson (Colorado State University)
 - ▶ Tewodros Wakie (Colorado State University)

Bale Mountains, Ethiopia



- ▶ Largest afro-alpine area in Africa
- ▶ World-renowned Biodiversity Hotspot
- ▶ UNESCO World Heritage Site nominee
- ▶ Bale Mountains National Park



“Water Tower” for the Horn of Africa



- ▶ Headwaters for five major rivers
- ▶ Only perennial source of water for 12 million downstream users
- ▶ Sustains agriculture, livestock, and industry
- ▶ Regulates discharge, erosion, recharge



Source: http://en.wikipedia.org/wiki/Shebelle_River#mediaviewer/File:Jubbarivermap.png

Community Concerns



- ▶ Increasing population and grazing pressures may have significant effects on delicate ecohydrological systems
- ▶ Paucity of data hinders research on potential upstream-downstream hydrological changes
- ▶ Limited tools and resources available for continuous, regional-scale monitoring

Alpine lakes and wetlands

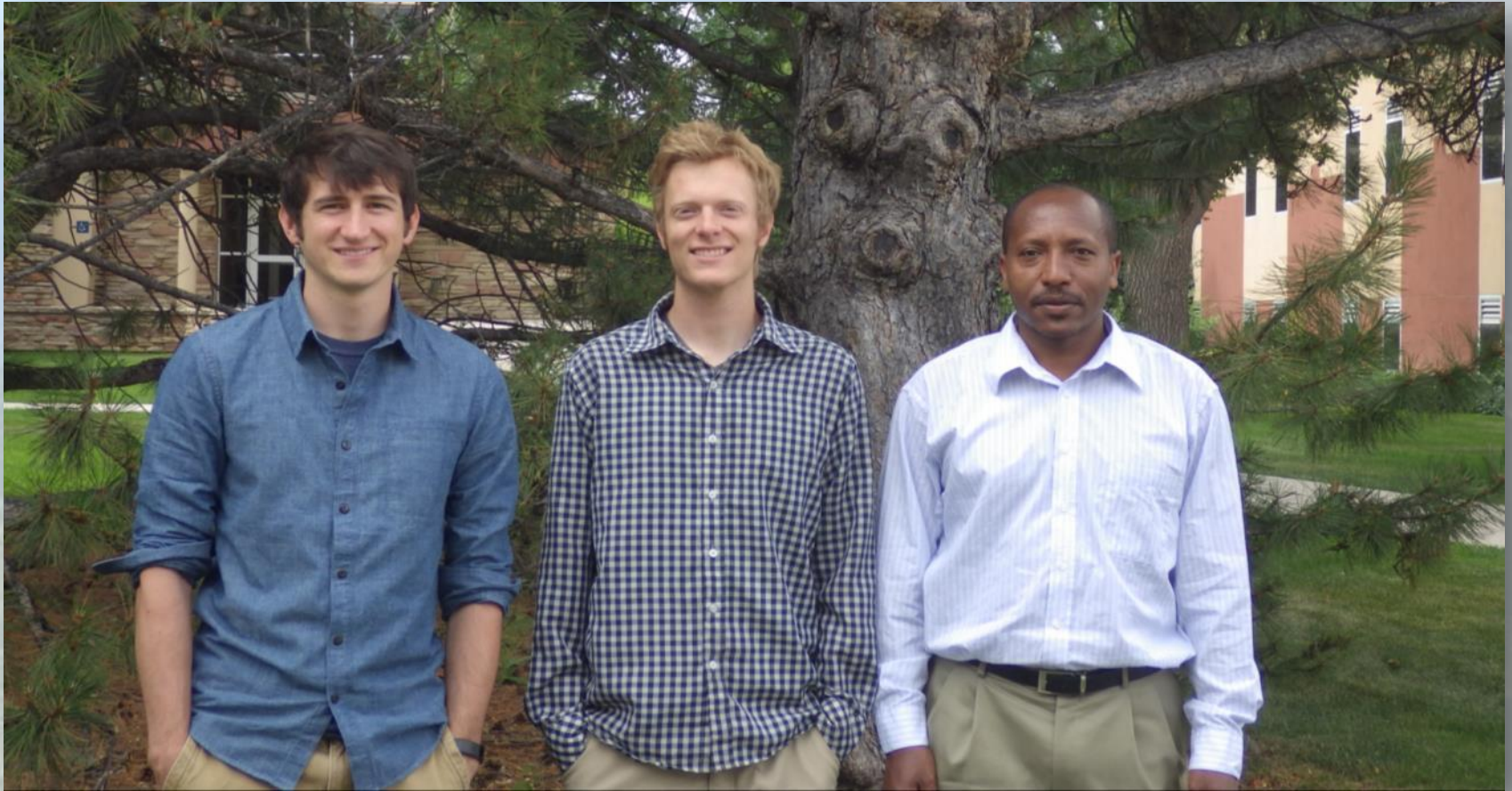


- ▶ Control discharge timing and erosion
- ▶ Facilitate groundwater recharge
- ▶ Nutrient cycling
- ▶ Provide Habitat for flora and fauna



Source: Left: Photo by Stephen Chignell, Right: Photo by Delphin Ruche (http://s3.amazonaws.com/mongabay-images/12/EthiopianWolf_DelphinRuche.bale.360.jpg)

Team Members



L to R: Ryan Anderson, Stephen Chignell, Tewodros Wakie

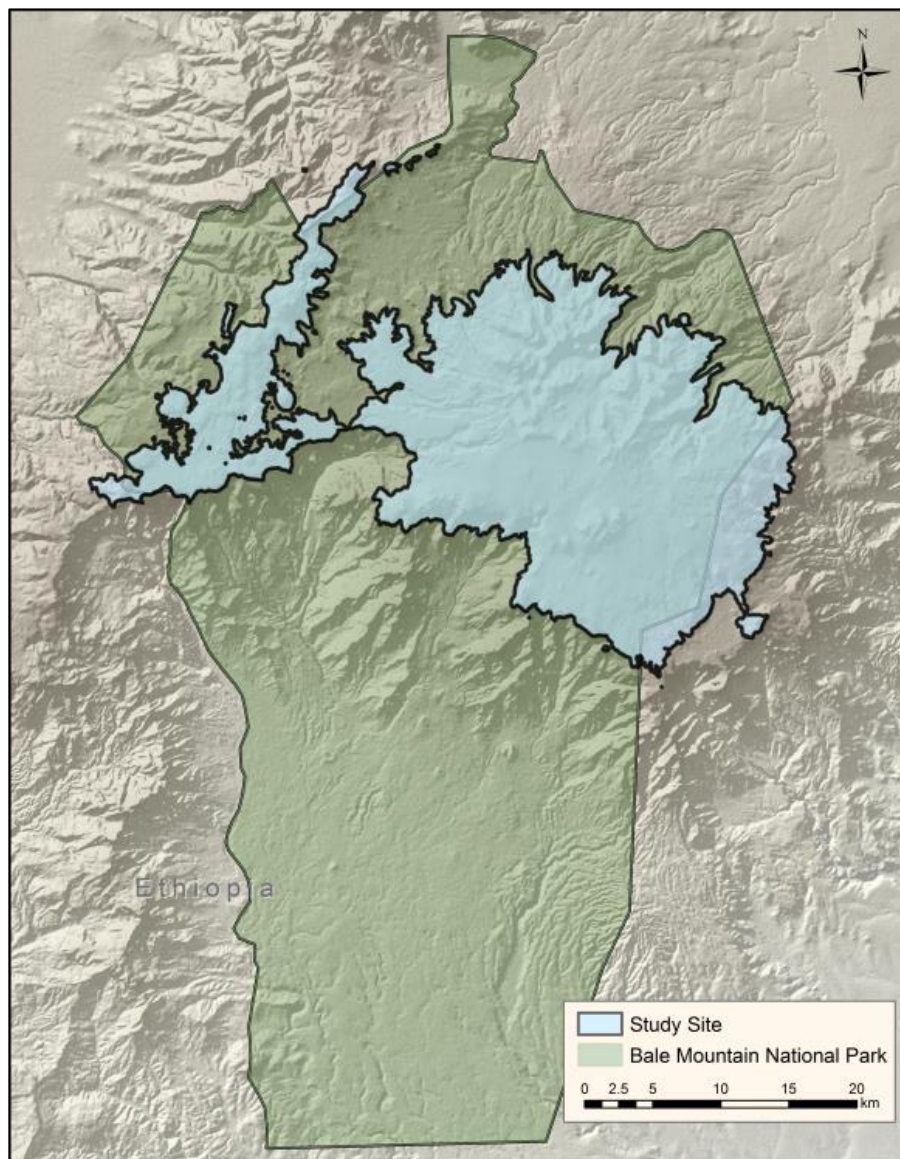
Project Partners & Objectives



- ▶ The Murulle Foundation
- ▶ Geospatial Centroid at CSU
- ▶ USGS Fort Collins Science Center



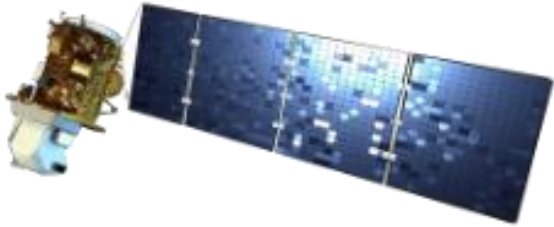
Study Site – Senetti Plateau



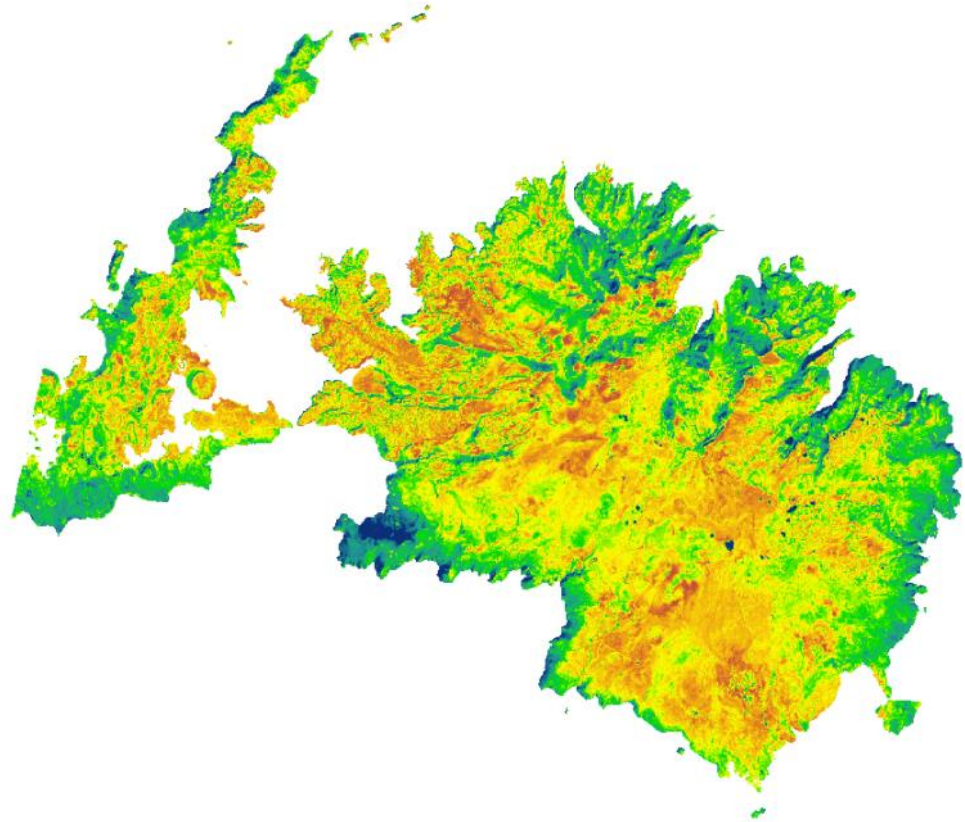
Methodology - Data Acquisition & Processing



Landsat 8



SRTM





Methodology – Occurrence Points

Google Earth

High Resolution

Dry Season:

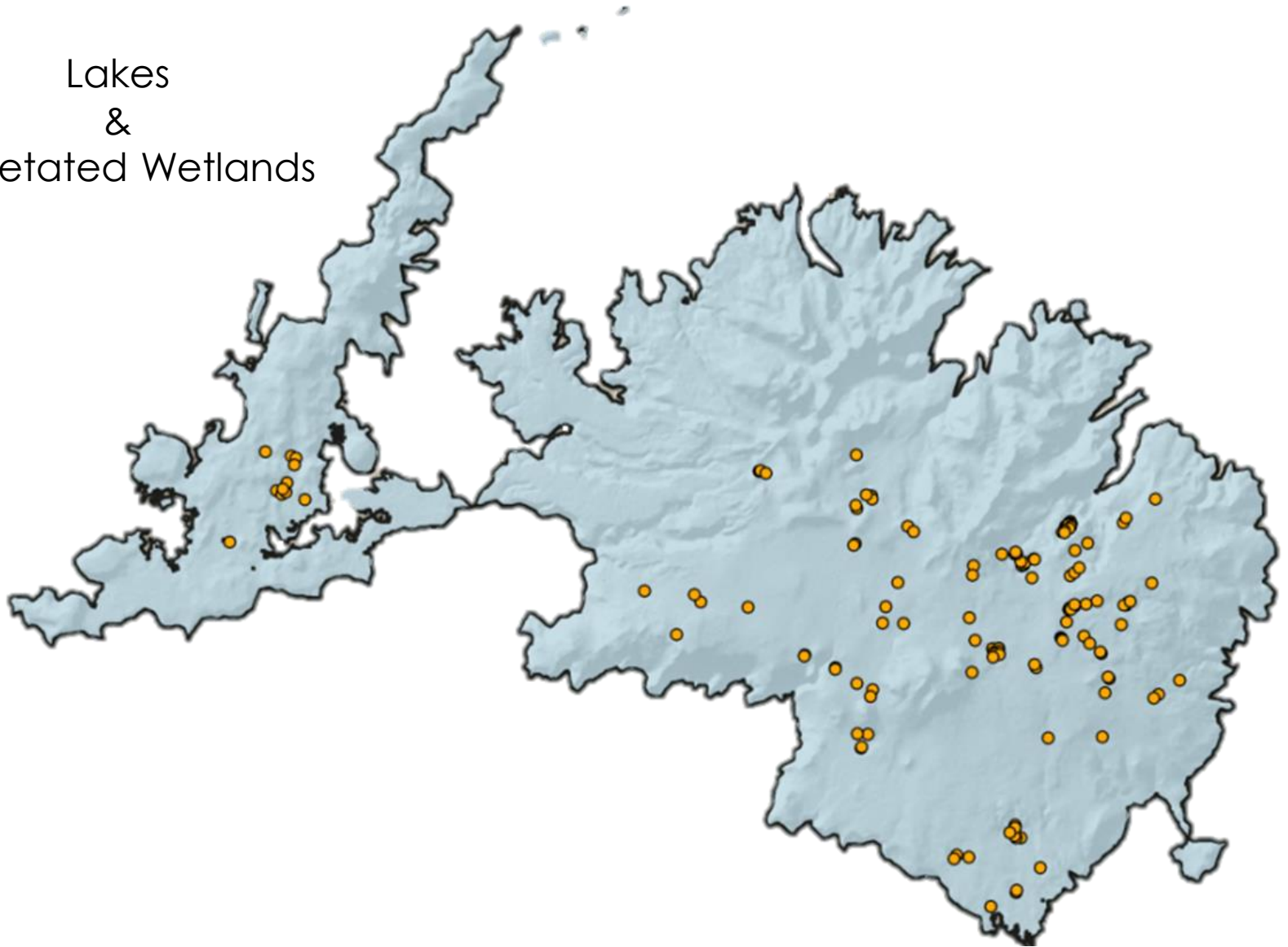
- Dec. 2013
- Jan. 2014



Methodology – Occurrence Points



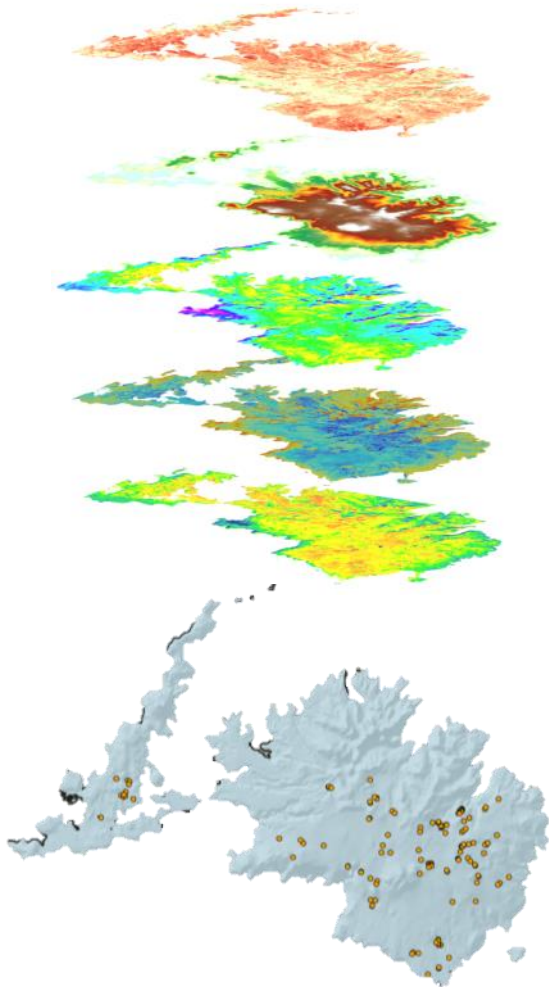
Lakes
&
Vegetated Wetlands



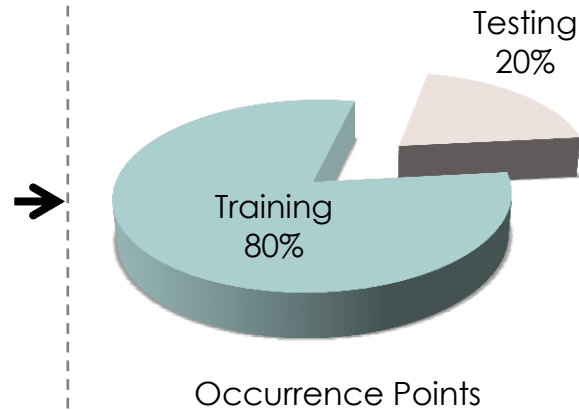
Methodology – Maxent Modeling



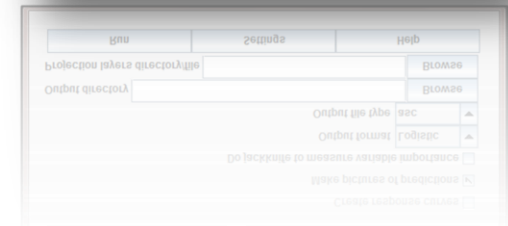
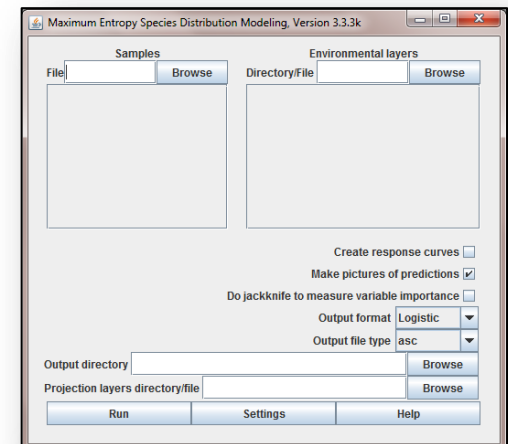
Extract Values to Points



Training/Testing Split



Maxent Modeling



Results - Lakes



100 %
Correctly Classified



Results – Vegetated Wetlands



97 %

Correctly Classified

0.99

AUC

0.96

Kappa

0.96

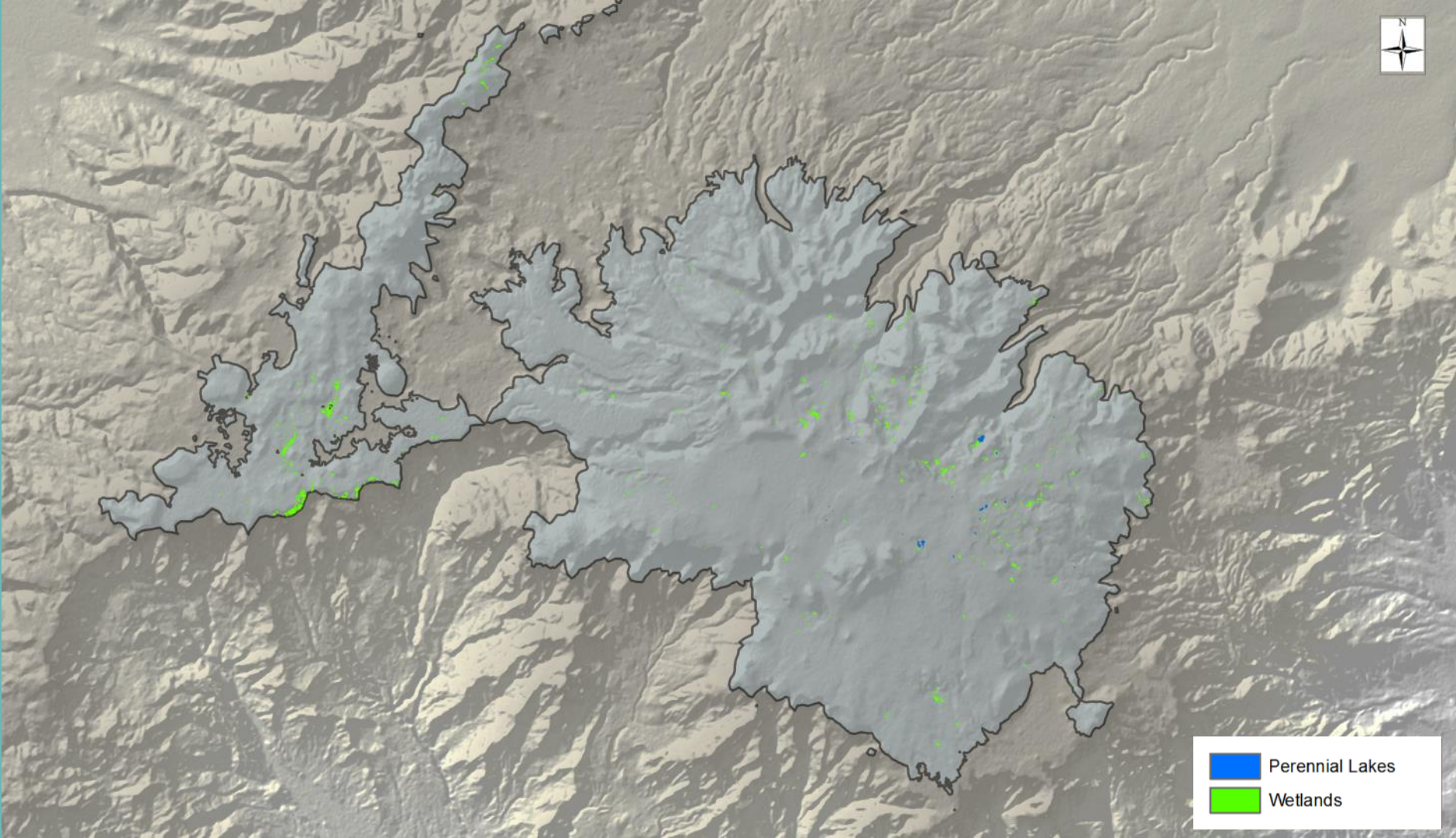
Sensitivity

0.96

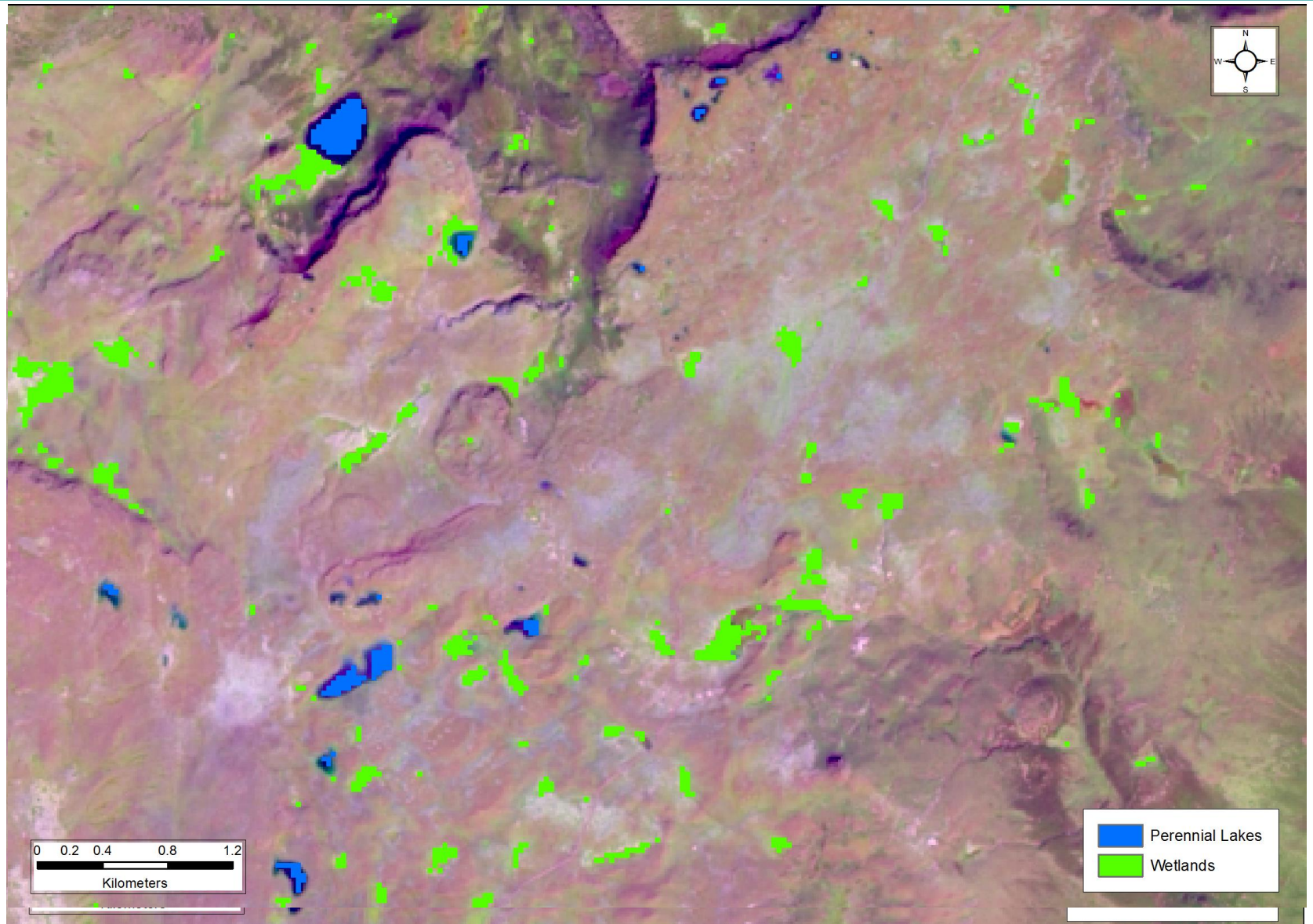
Specificity



Results



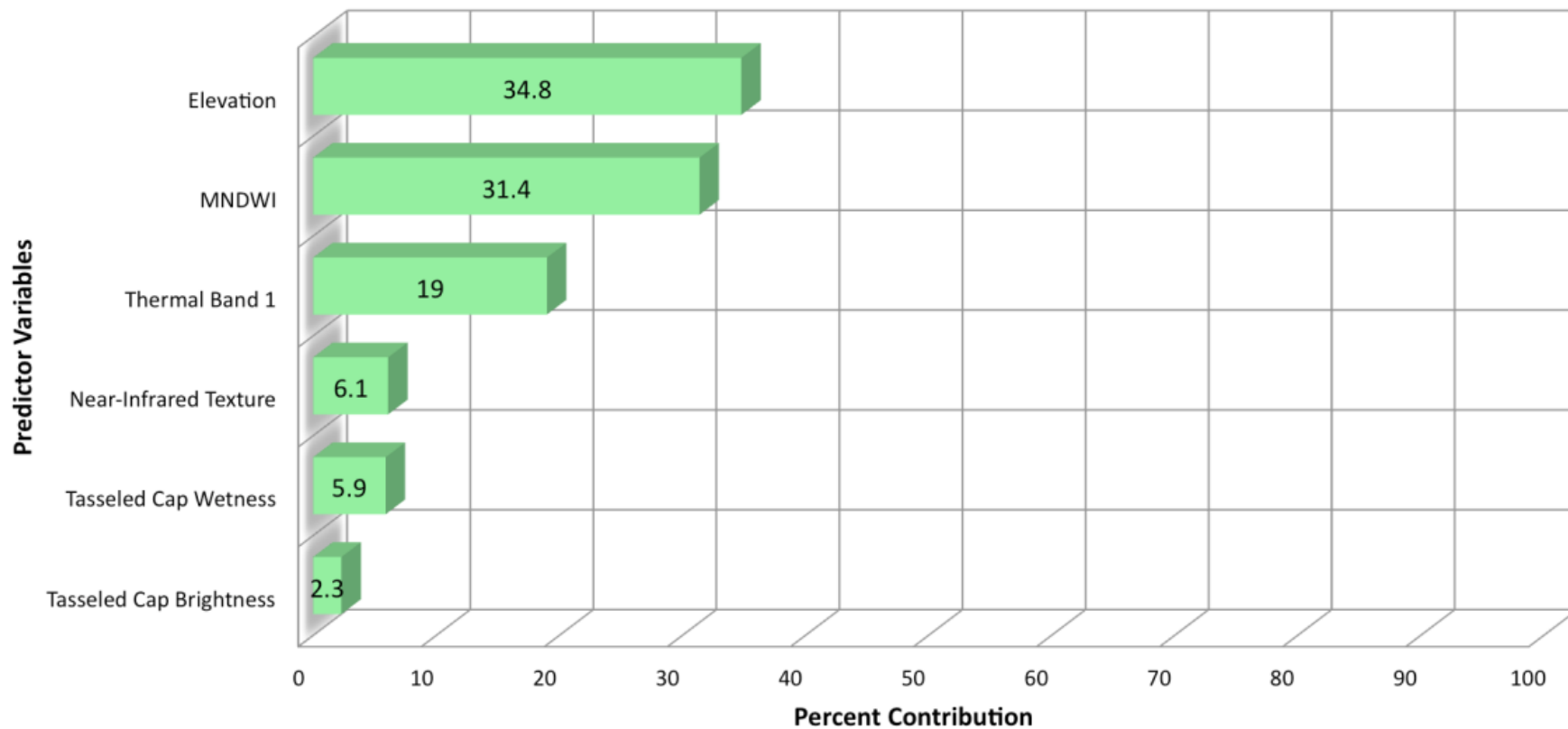
Results



Results



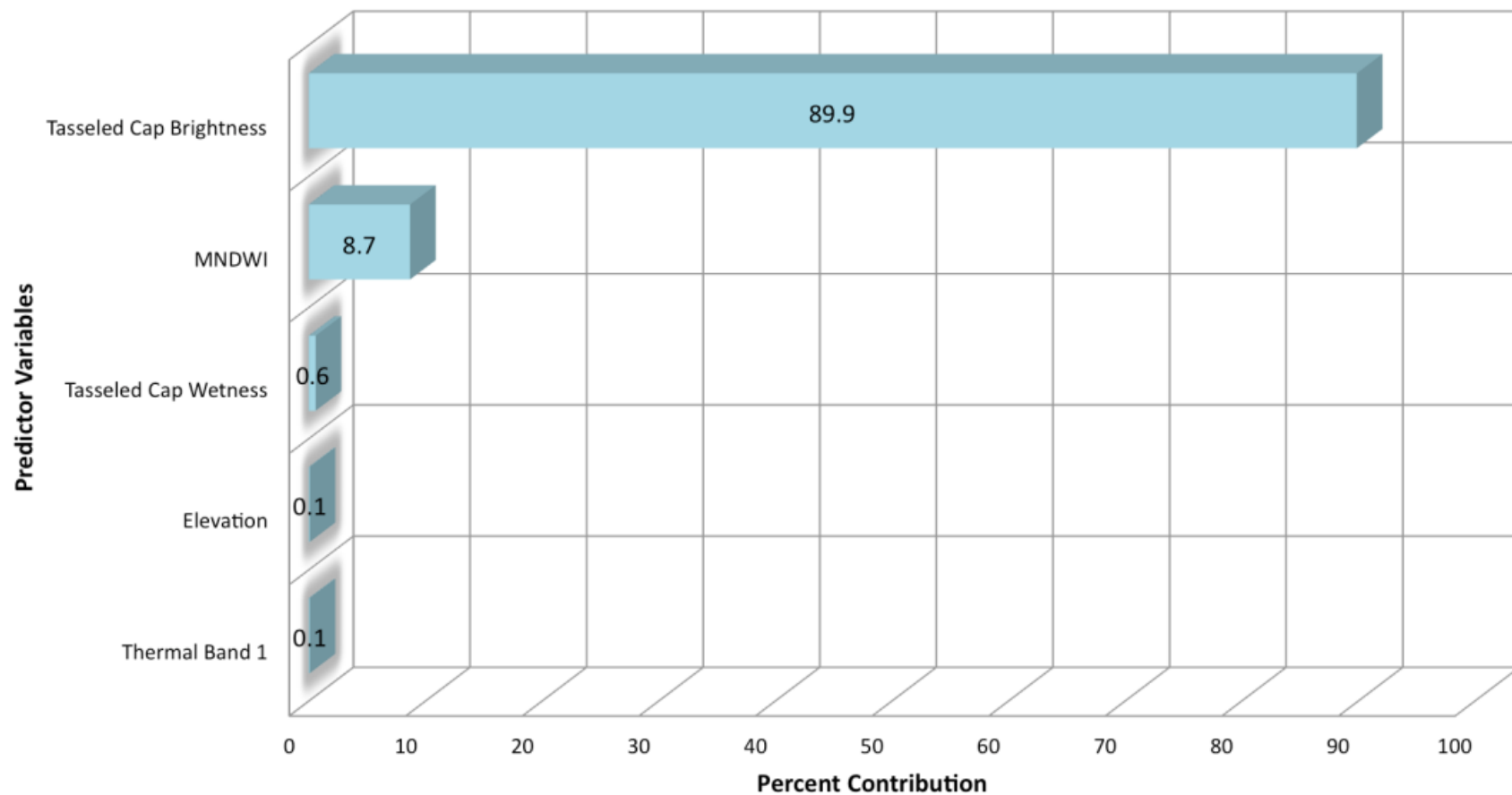
Predictor Importance - Wetland Model



Results - Lakes



Predictor Importance - Lakes Model



Conclusions



- ▶ Landsat 8 and Maximum Entropy modeling is a powerful combination for mapping headwater wetlands.
- ▶ Can successfully distinguish between water and shadow
- ▶ Facilitate targeting of conservation efforts by National Park and regional managers
- ▶ Straightforward methodology and database for future monitoring and research

Acknowledgements



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