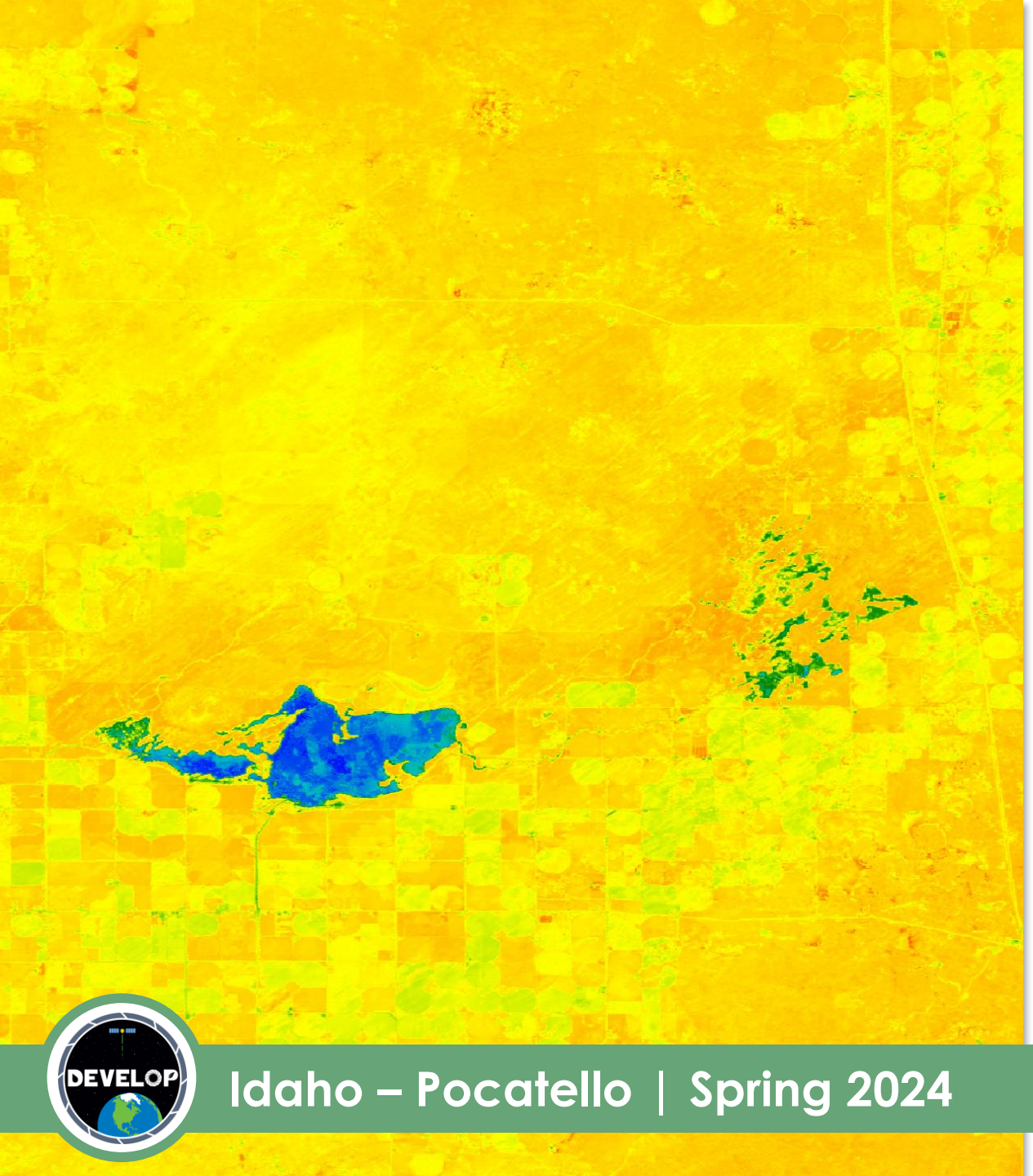


National Aeronautics and Space Administration

JEFFERSON COUNTY ECOLOGICAL CONSERVATION

Quantifying the Effects of Hydrologic Restoration in the Camas National Wildlife Refuge and Mud Lake Wildlife Management Area

Cassidy Bromka

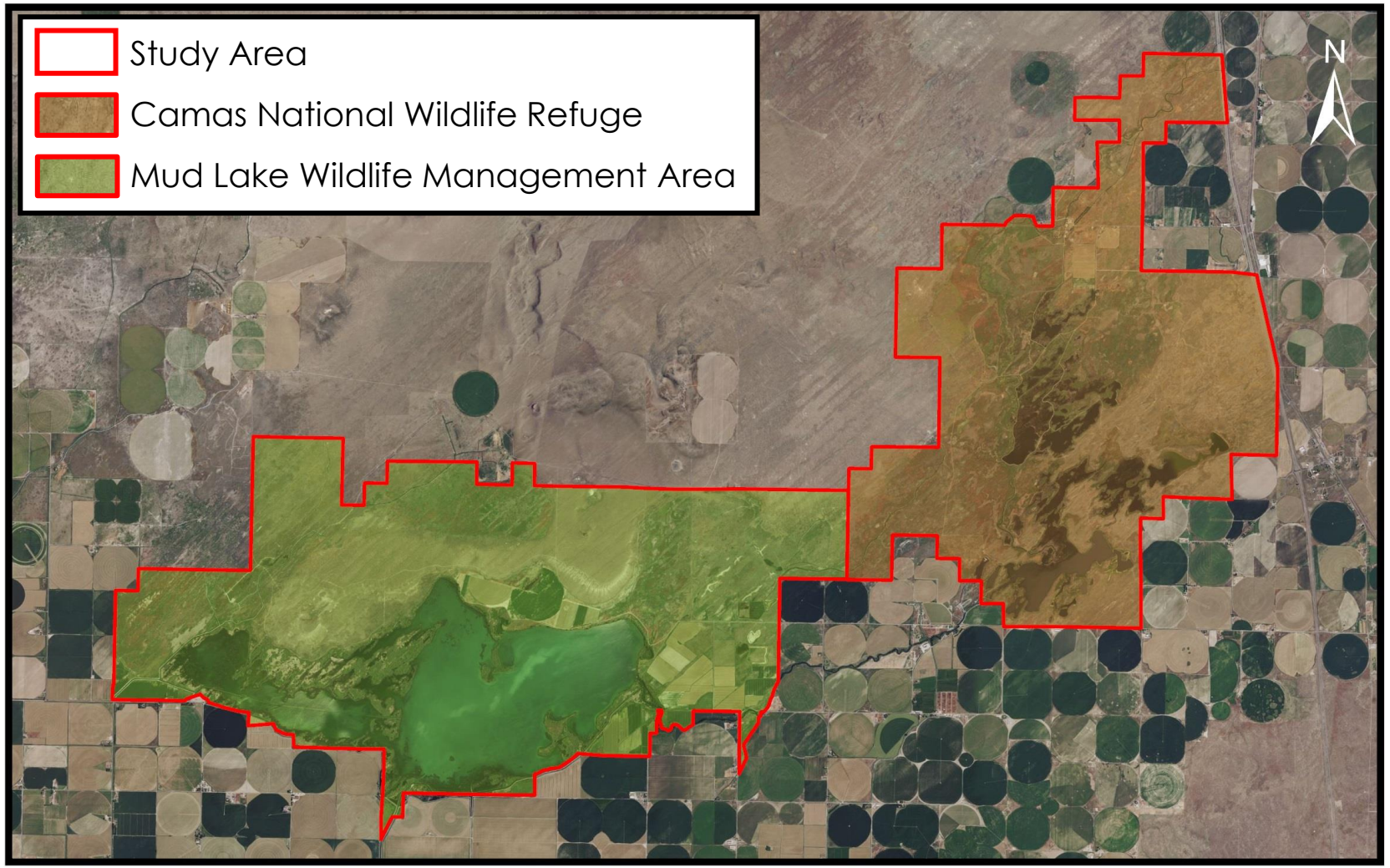
Rosemary D'Andrea

Matthew Stewart

Kevin Jo

Idaho – Pocatello | Spring 2024

Jefferson County, Idaho
2011 – 2023, Forecasting to 2060



Basemaps: 2017 NAIP, ESRI World Terrain

Partners

U.S. Fish and Wildlife Service (USFWS)

Idaho Department of Fish and Game (IDFG)

Image Credit: US Fish and Wildlife Service

Community Concerns

- Surface water decline since 1980's
- Lowered aquifer level

Riparian habitat degradation

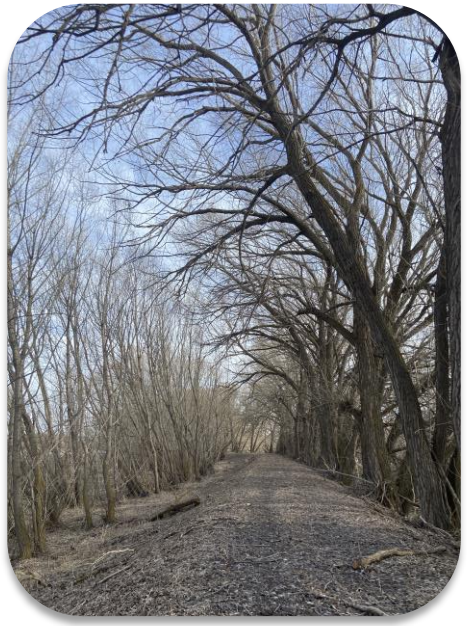


Image Credits: Rosemary D'Andrea

Project Objectives

Quantify wetland extent and change

Provide methods to guide
future monitoring and decision-making

LANDCOVER CLASSIFICATION

WETLAND CHANGE ANALYSIS

MODEL FUTURE WETLAND EXTENT

TUTORIAL

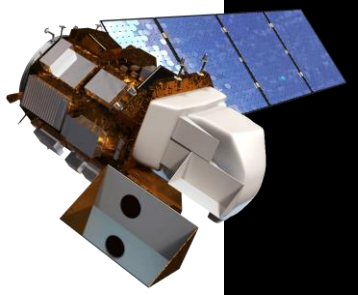
Earth Observation Sensors

Landsat 5 TM

2011

Landsat 8 OLI

2016 – 2020



Sentinel 2 MSI

2016 – 2023

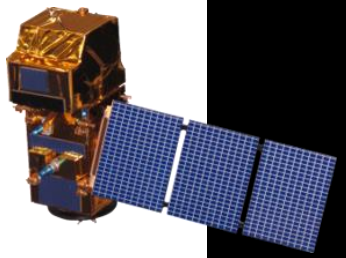
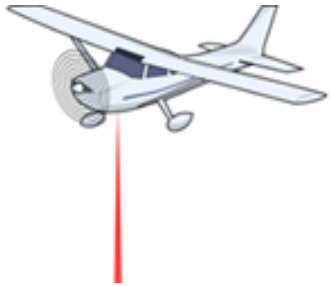
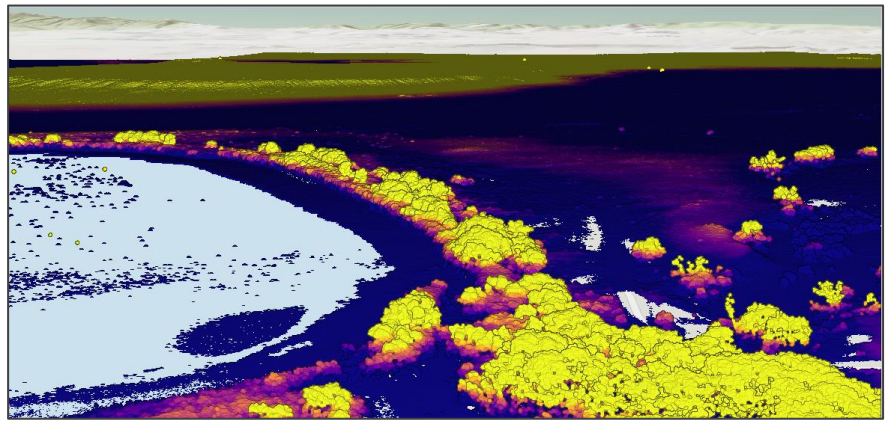


Image Credit: NASA, Rama

Additional Data

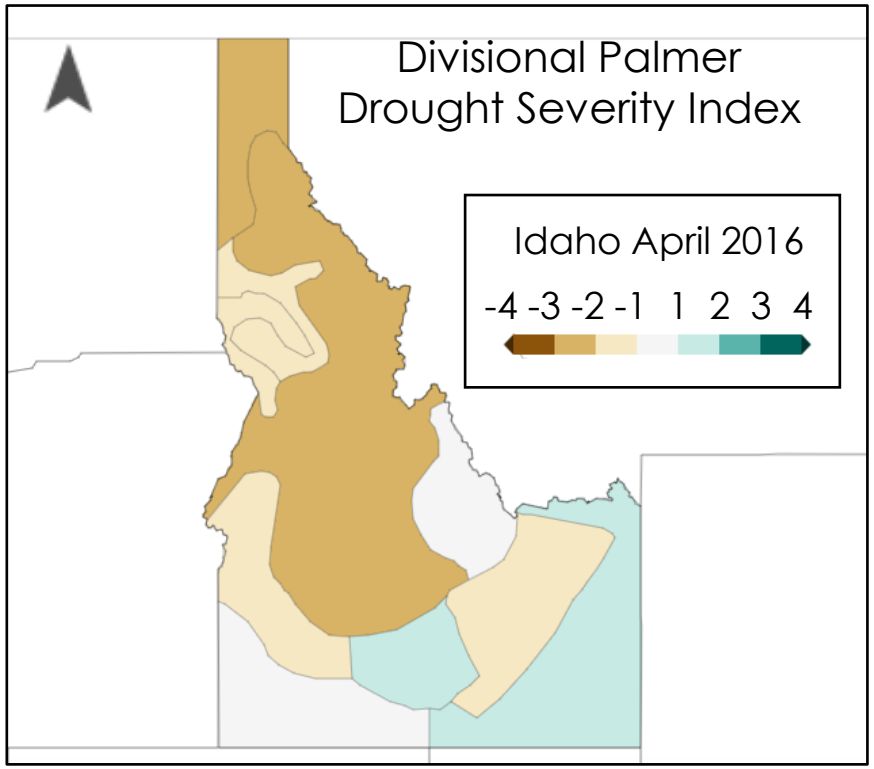
Light Detection and Ranging (lidar)





Use: topographic variables and vegetation change analysis

Historical Palmer Drought Severity Index (PDSI)

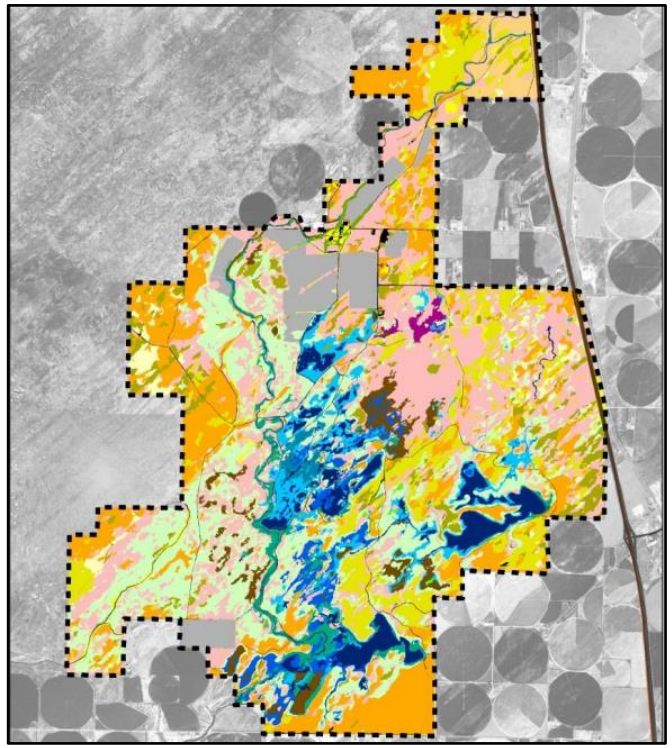


Use: determine years with similar drought levels

Image Credits: Matthew Stewart, Wikimedia Commons, NOAA

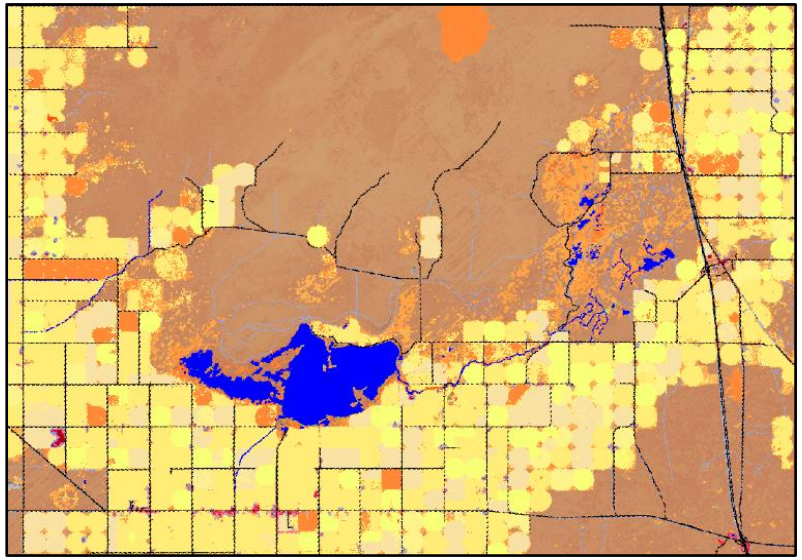
Additional Data

Camas Vegetation Dataset



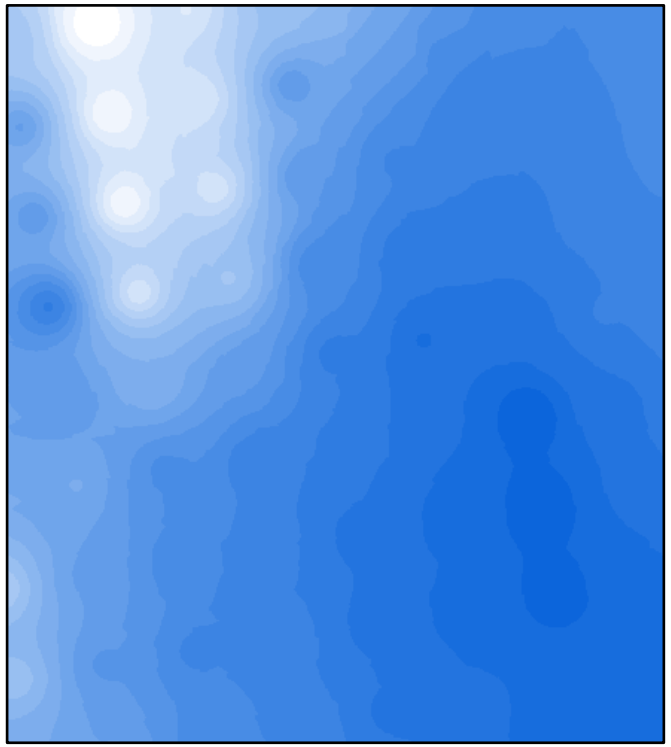
Use: Reference for creating training and validation sites

LandFire Existing Vegetation Cover (EVC), Existing Vegetation Type (EVT)



Use: Reference for creating training sites and validation sites

Precipitation Dataset



Use: Land Change Modeler predictor variable

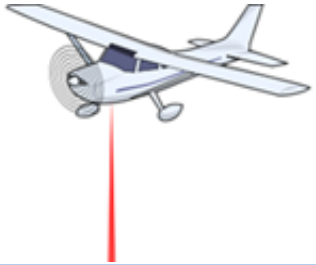
Image Credit: LandFire, USFWS

Methods: Lidar Analysis

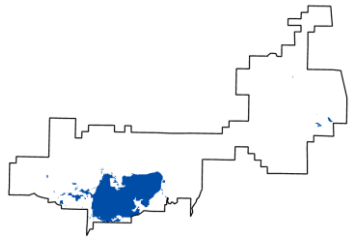
ArcGIS Pro

Data collection and selection

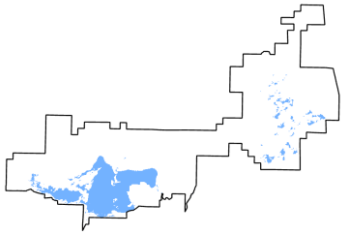
lidar derived DEMS



Processing using QA band water



2019

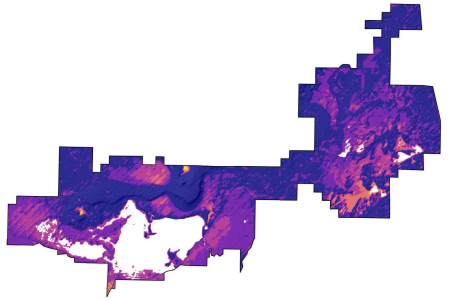


2011

Calculate elevation changes

2019 – 2011

Elevation Change Map



Calculate water level changes

2019 – 2011

Water Level Change Map

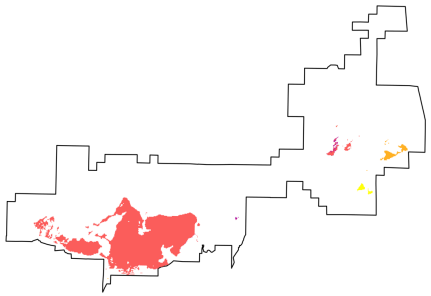


Image Credit: Wikimedia Commons

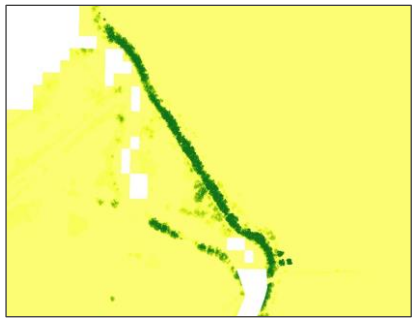
Methods: Lidar Vegetation Analysis

ArcGIS Pro

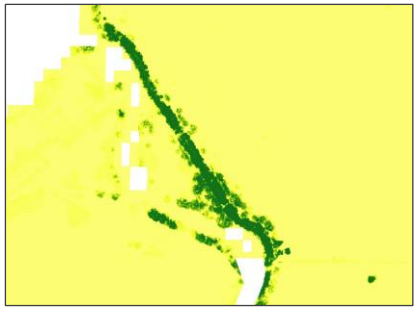
Data collection and selection

2011 DHM
& 2019 DHM

DHMs



2011

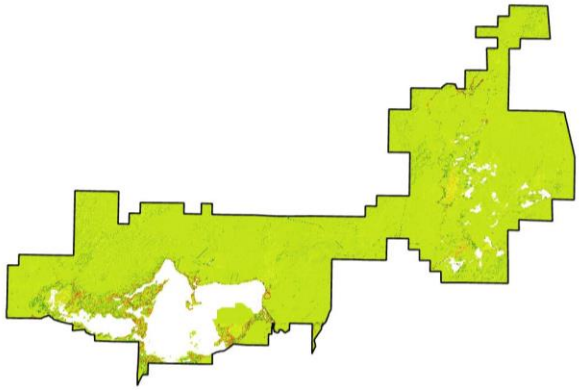


2019

Calculate change

2019 – 2011

Vegetation Height Change Map

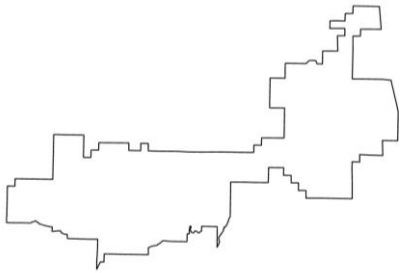


Methods: NDVI Vegetation Health

Google Earth Engine

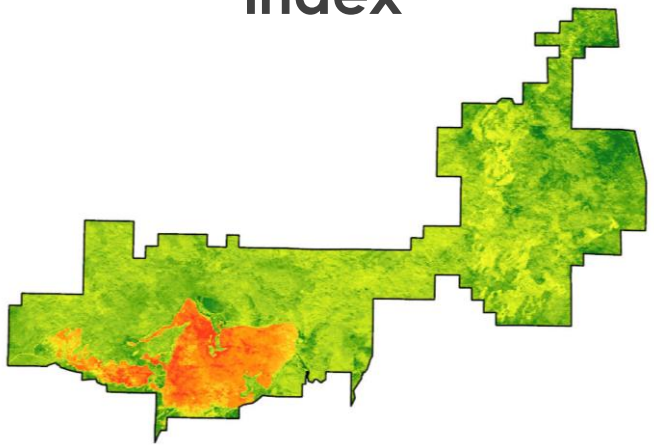
Data collection and filtering

Sentinel 2



Study Area

Calculate vegetation index



NDVI

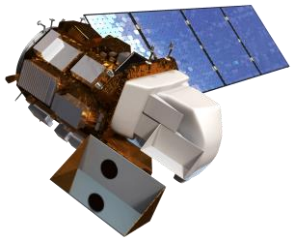
Annual median for April – May

Image Credit: Rama

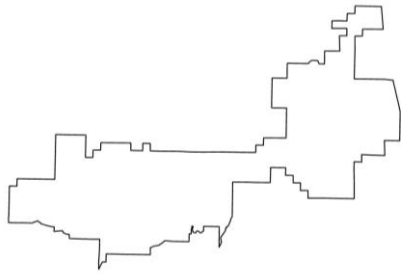
Methods: Classification

Google Earth Engine

Data collection and filtering

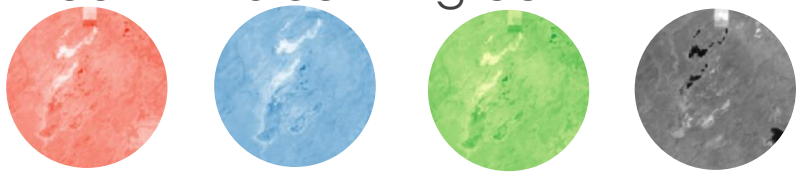


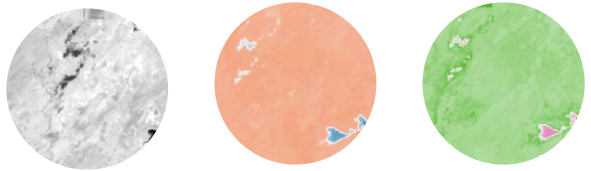
Landsat 8



Study Area

Calculate indices and generate individual bands





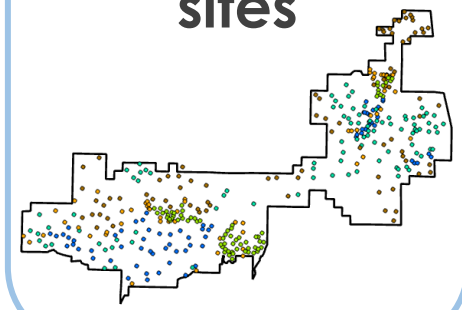
Annual median for each season 2016 and 2020

Image Credit: NASA

Methods: Classification

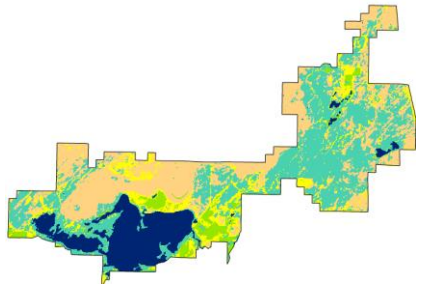
ArcGIS Pro

Create training and validation sites

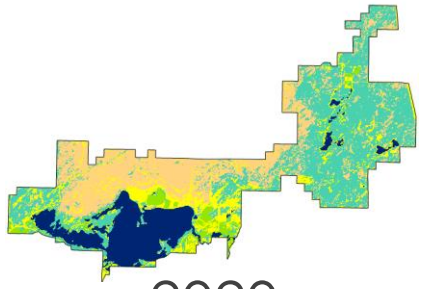


Forest-based Boosted Classification

Classification Maps



2016



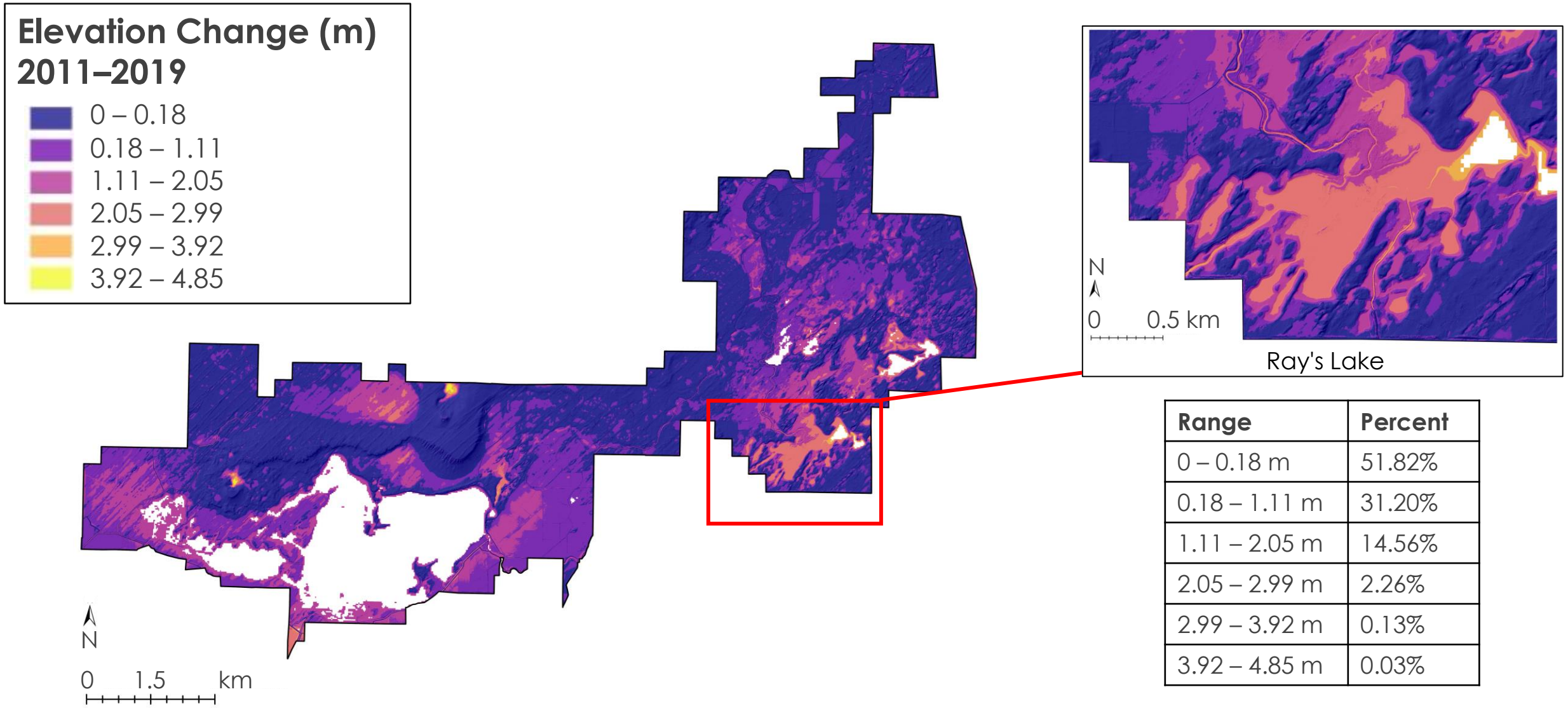
2020

Precipitation data

TerrSet

Generate Land Change Modeler 2060 prediction map

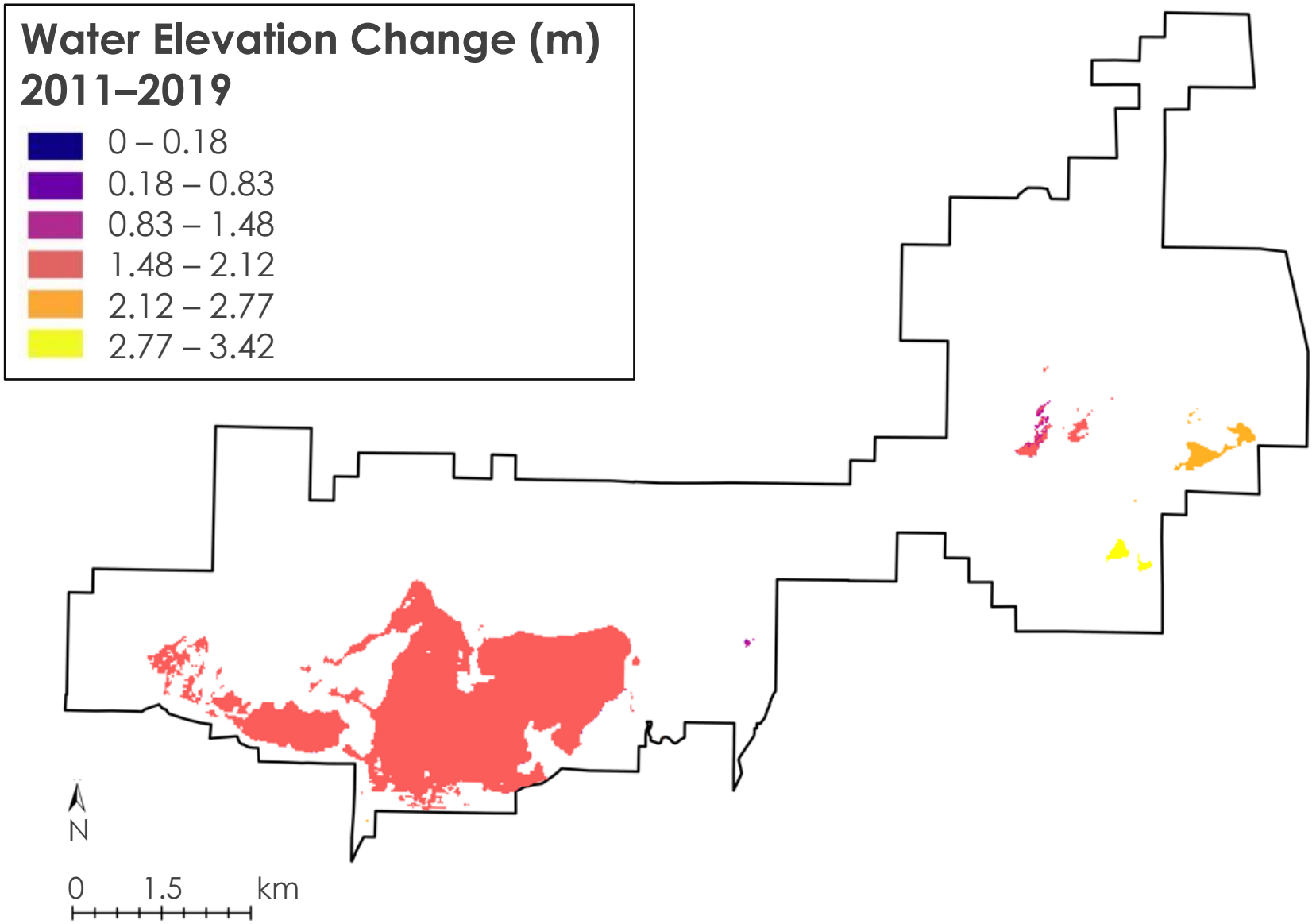
Results: Lidar Elevation Change



Range	Percent
0 – 0.18 m	51.82%
0.18 – 1.11 m	31.20%
1.11 – 2.05 m	14.56%
2.05 – 2.99 m	2.26%
2.99 – 3.92 m	0.13%
3.92 – 4.85 m	0.03%

1 m Resolution with Error: ± 0.18 m

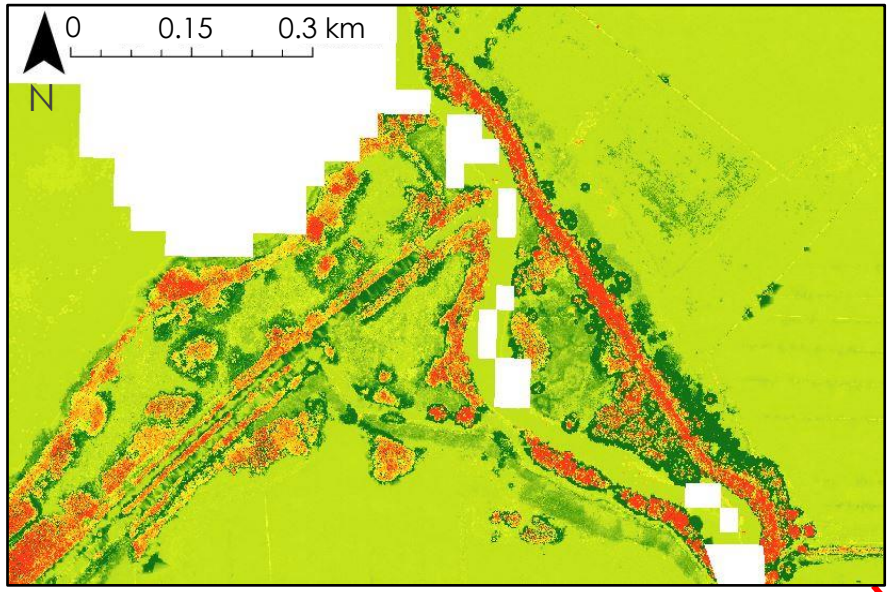
Results: Lidar Water Elevation Change



Range	Percent
0 – 0.18 m	0.00%
0.18 – 0.83 m	0.04%
0.83 – 1.48 m	0.63%
1.48 – 2.12 m	96.01%
2.12 – 2.77 m	2.43%
2.77 – 3.42 m	0.89%

1 m Resolution with Error: ± 0.18 m

Results: Lidar Vegetation Height Change



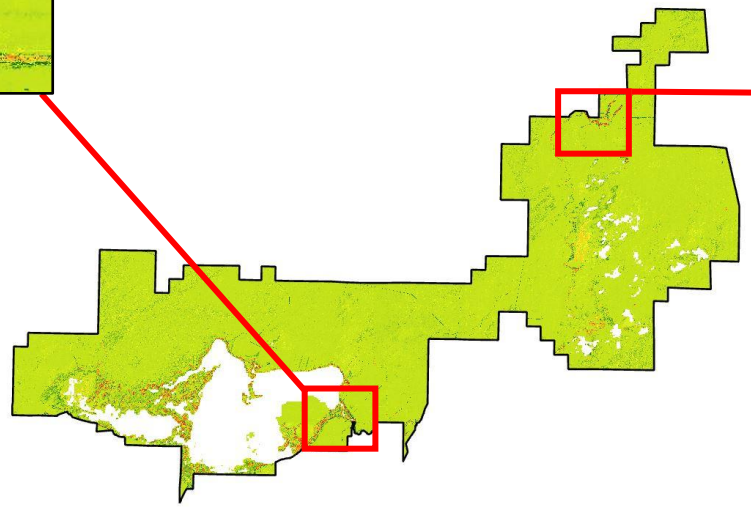
Vegetation change in SE corner of Mud Lake, around the Camas Creek delta.

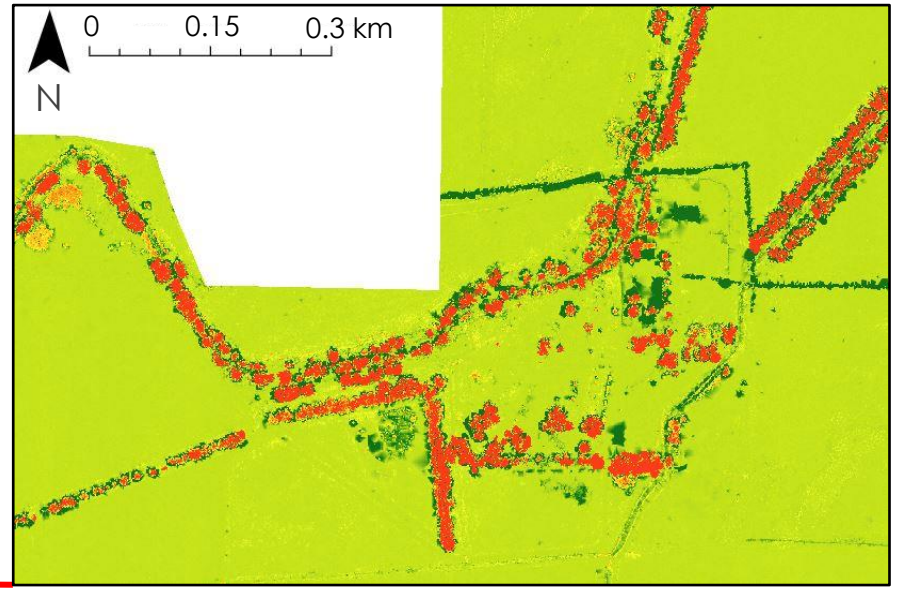
Vegetation Height (m) 2011–2019

29.77

-29.46

Mean height change: +0.016 m



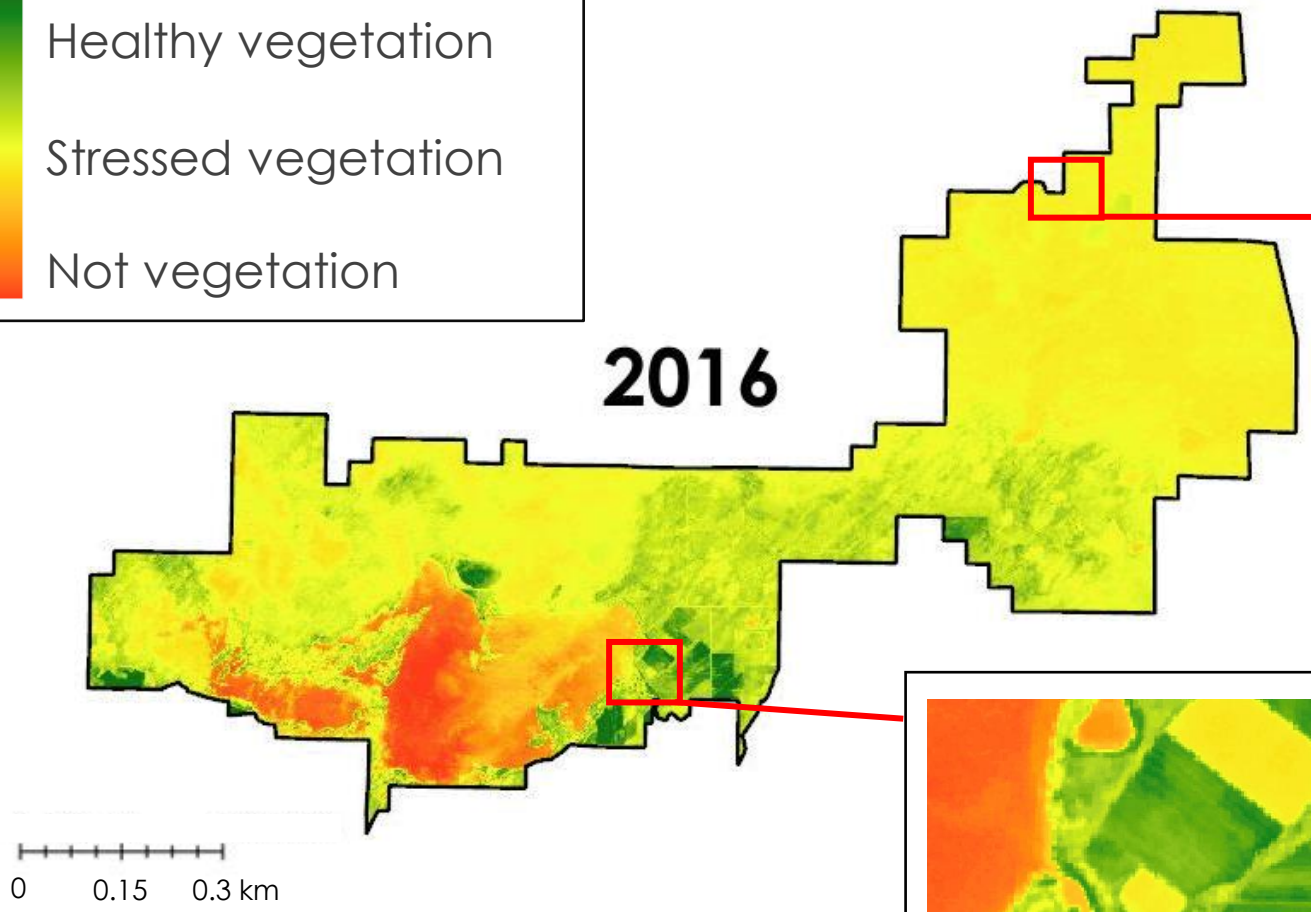


Vegetation change in the northern region on Camas NWR. This cohort of cottonwood trees is about 70 years old.

Results: NDVI Vegetation Health

NDVI Values

- Healthy vegetation
- Stressed vegetation
- Not vegetation

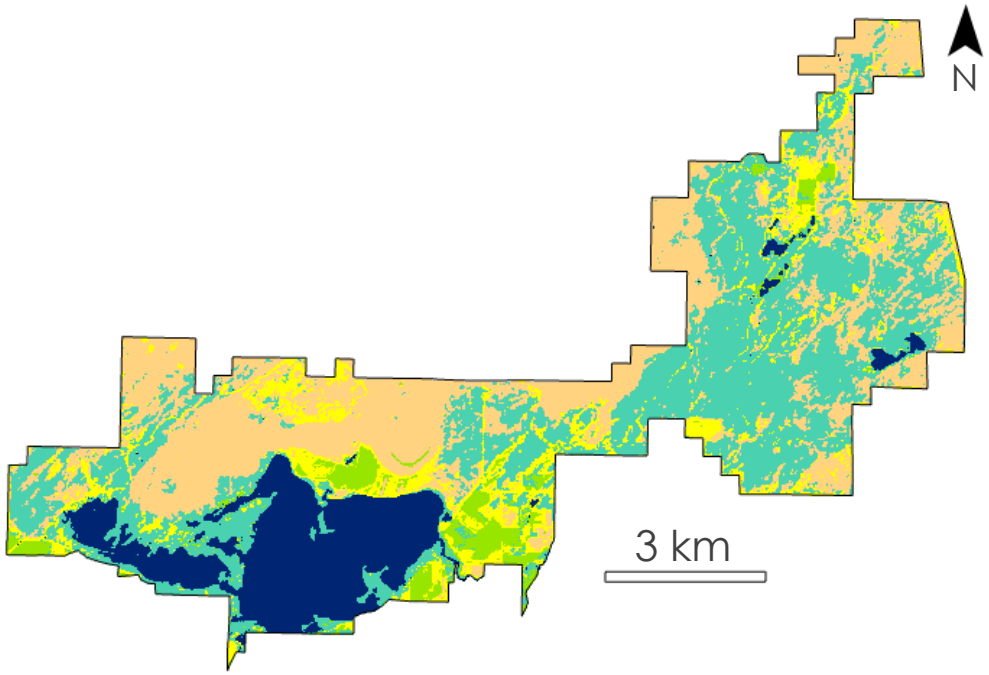


NDVI change in the northern region on Camas NWR.

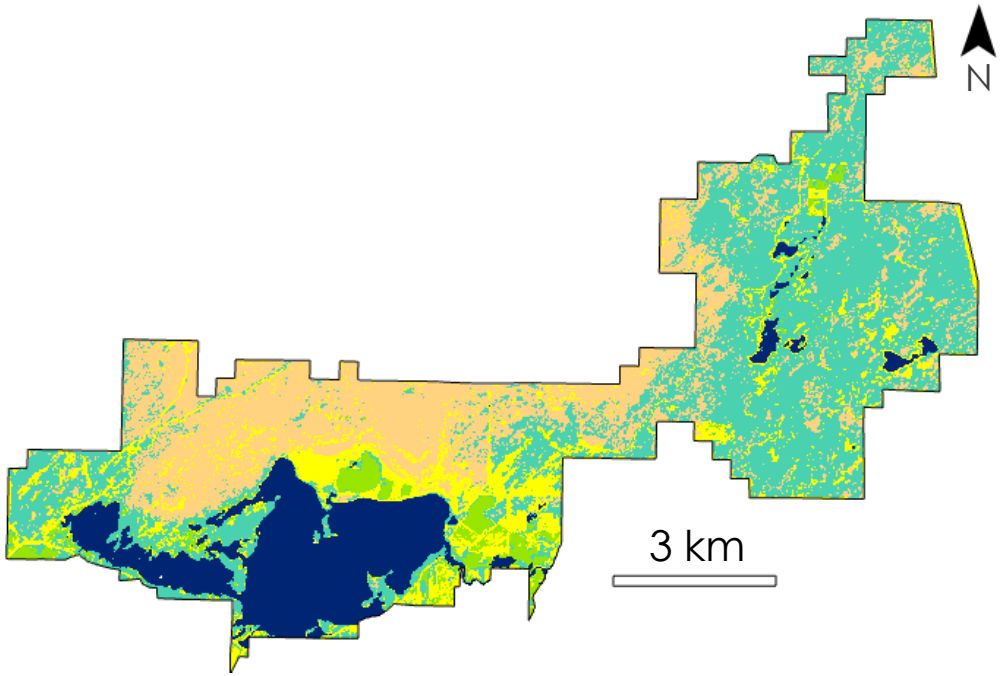
NDVI change in SE corner of Mud Lake, around the Camas Creek delta.

Results: Forest-based Boosted Classification

2016



2020



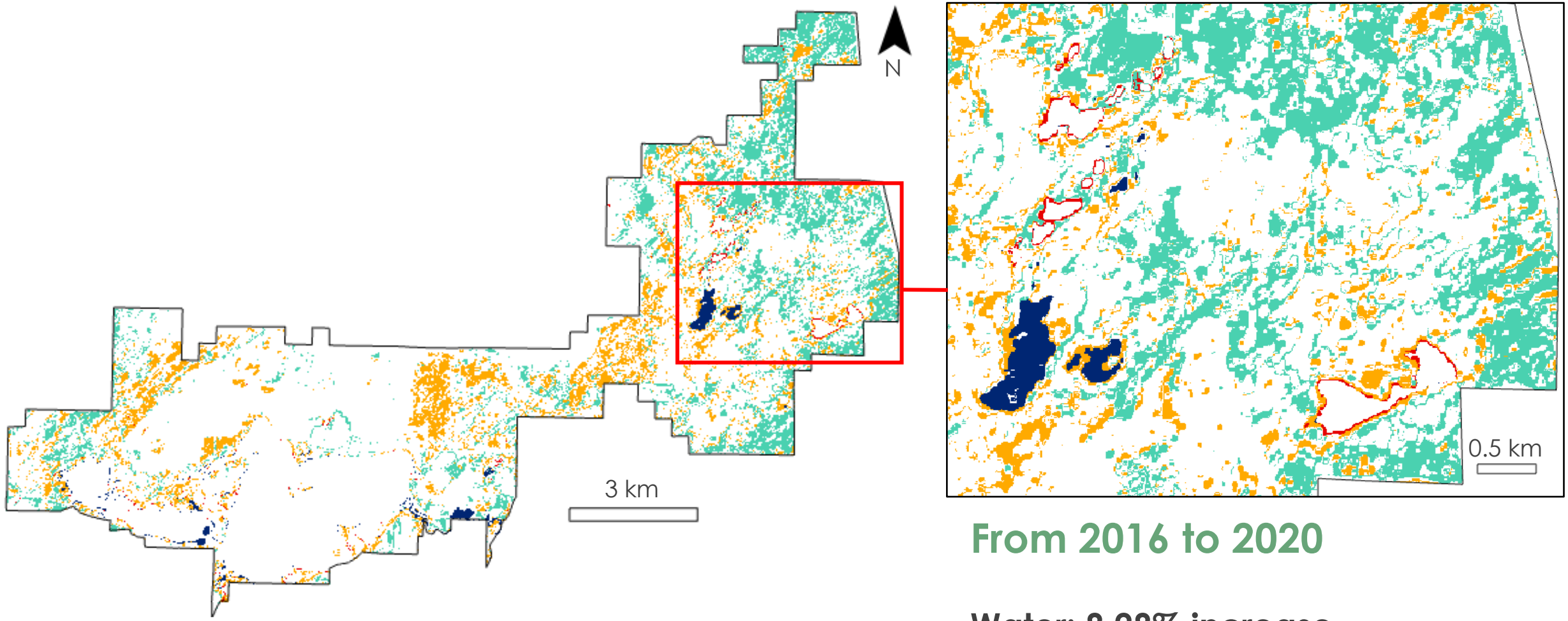
Landcover Classes

Water | Wetlands | Developed | Sagebrush | Crops

- **86.52%** overall accuracy
- **Kappa: 0.83**

- **84.27%** overall accuracy
- **Kappa: 0.80**

Results: Land Cover Change 2016–2020

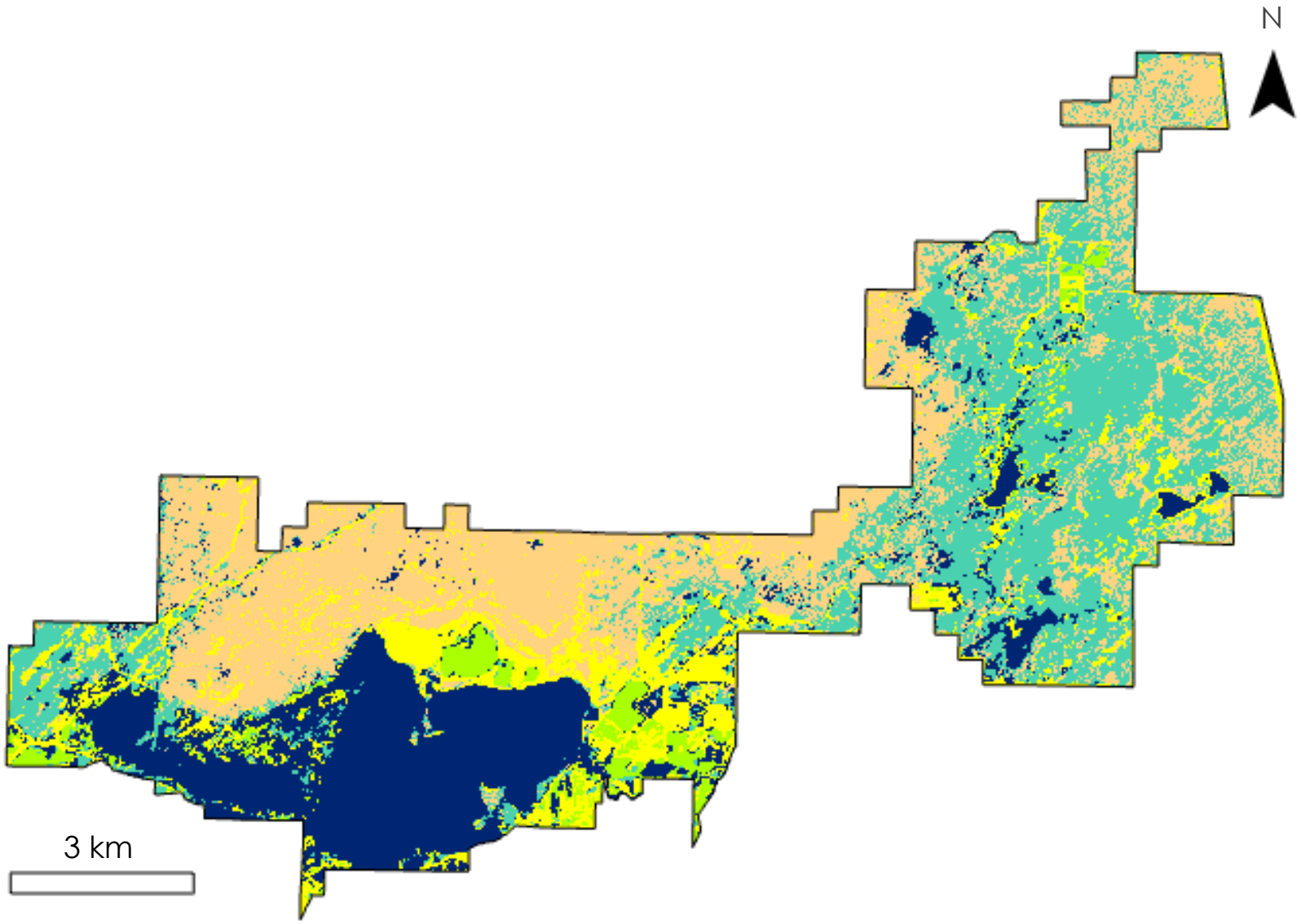


From 2016 to 2020

Water: 8.28% increase

Wetlands: 4.37% increase

Results: Forecasted Model to 2060



Landcover Classes

- Water
- Wetlands
- Developed
- Sagebrush
- Crops

From 2020 to 2060

Wetlands: 38.96% decrease

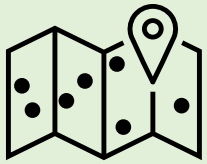
Water: 27.98% increase

Conclusions

- **Detected** elevation, water level, and vegetation height changes using **lidar**
- **Forest-based Classification** using remotely collected training data can identify wetlands with **greater than 84% validation accuracy**.
- **Change analysis** showed that wetlands extent **increased by over 8% between 2016 and 2020**
- **Land Change Modeler** predicted wetlands to **decrease by 38.96% by 2060**
- **Created repeatable monitoring workflow** through **tutorial** for partners

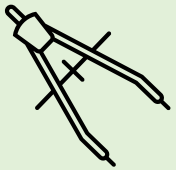
Image Credit: Nick Athanas

Limitations & Errors



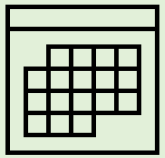
Lack of in-situ training sites for classification

Discrepancies between partner knowledge of wetland extent and classification results



Coarse and inconsistent spatial resolution

2060 Landcover only a **prediction**



Future Work

- **Collect** ground truth sites to improve classification
- **Include** high resolution imagery to increase spatial precision
- **Utilize** multispectral imagery to distinguish vegetation type and health
- **Expand** study to more years
- **Explore** QA band water accuracy

Image Credit: Brett Lawrence

Acknowledgments

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Fellows

- Jane Zugarek
- Michael Pazmino

Others

- Ryan Healey, Intermountain Bird Observatory
- ISU GIS Training and Research Center

Partners

- **US Fish and Wildlife Service:** Andrea Kristof, Brian Wehausen, Michelle Chappell, Jeremy Timpey
- **Idaho Fish and Game:** Brett Panting, Ailvie Freestorm

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