2019

Applying Cloud-Based Computing and Emerging Remote Sensing Technologies to Inform Land Management Decisions

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Publication Information

Vermillion, Monica; Enterkine, Josh; Spaete, Lucas; and Glenn, Nancy. (2019). "Applying Cloud-Based Computing and Emerging Remote Sensing Technologies to Inform Land Management Decisions". *ASPRS Annual Conference and International Lidar Mapping Forum 2019*, .

This document was originally published in *ASPRS Annual Conference and International Lidar Mapping Forum 2019* by American Society for Photogrammetry and Remote Sensing.

Applying Cloud-Based Computing and Emerging Remote Sensing Technologies to Inform Land Management Decisions

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Introduction

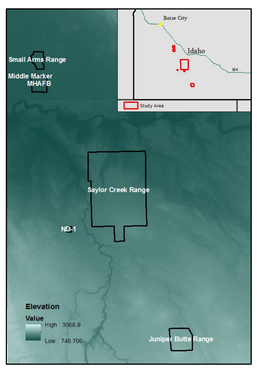
Who: Boise State University and Mountain Home Air Force Base
What: Creating a species level classification map through the use of Google Earth Engine (GEE), a cloud-based computing platform, to map invasive species
When: In-situ data collected in Summer 2018, a continuation of data collected in Summer 2016. Classification was created in Fall 2018. Unmanned aerial vehicles (UAV) flights in August 2018.
Where: Mountain Home Air Force Base (MHAFB) in southwest Idaho, ecosystem is in the Great Basin Range (GBR)
Why: The introduction of exotic species like cheatgrass (*Bromus tectorum*) has drastically altered the fire cycle of the Northern Great Basin (NGB) from 50 – 100 year burn intervals to 10 year intervals (1). Factors such as soil, elevation, temperature, and precipitation can affect the resilience of a sagebrush steppe ecosystem to invasive species. Remote sensing techniques allow large scale analysis of invasive encroachment and assessment of conservation efforts and land management.

Native Bunchgrass

Healthy Sage Plot with Biocrust

Tumble Mustard and Cheatgrass Plot

Study Area



Mountain Home Air Force Base (MHAFB) manages 54 hundred hectares of land in the GBR which they are responsible for maintaining. A large portion of this land has cheatgrass and other exotics starting to compete out the sagebrush steppe. To maintain the installations MHAFB needs high resolution maps of dominant vegetation in order to better make land management decisions. Remote sensing and the use of satellite data combined with field data collection is the most efficient method for mapping a large area of vegetation at a small (10m) spatial scale.

Objectives

Determine areas of cheatgrass and Tumble Mustard (*Sisymbrium altissimum)* encroachment and assesses best course of action for restoration and land management.

Look at impacts of this year's fire and previous fires at MHAFB, looking at specific changes in areas where cheatgrass has taken over and what vegetation was there before. What areas are most at risk?

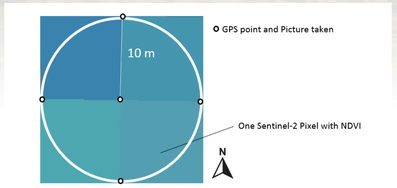
Can UAV's eventually be used to replace field surveying data?

Methods

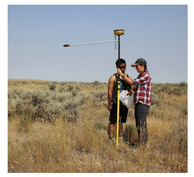
Field Data Collection

250 plots on 140,000 acres

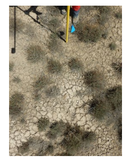
- Representing 25 different vegetation species
- Real-time Kinematic GPS Point Collection
- RGB Camera NADIR Imagery
- Sample Point classification
- Percentage Area cover to decide training data



Schematic of a Field Plot



RTK GPS Collection



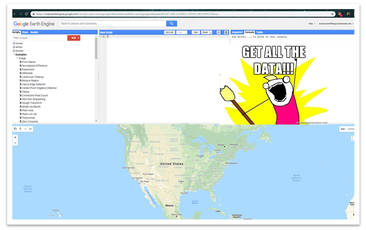
Nikon Camera Image from Boom

UAV Data Collection

- Micasense Rededge Camera
  - 5 Bands: RGB, RedEdge, NIR
- Aerial Visions Switchblade UAV
- Flights at 40, 80, 120 m height
- 150 Ground Control Points taken with RTK GPS

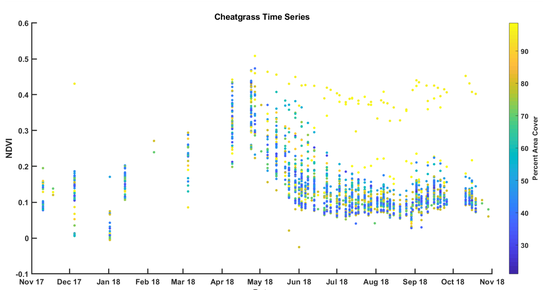
Satellite Data and Google Earth Engine (GEE)

- Sentinel-2 Satellite Data Compiled for 2018
- Processed in Google Earth Engine
  - 8 Computed Spectral indices
  - Plot spectral values
  - Reduce Regions function for plot training data
  - Random Forest Regression
    - Species level classification
    - Accuracy Assessment

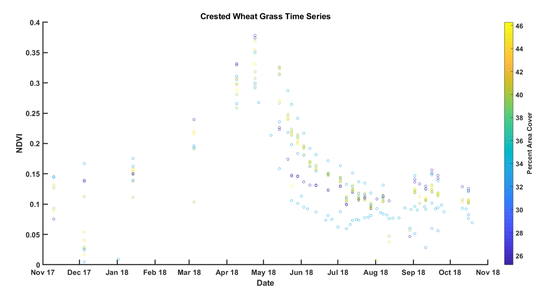


176 Predictor Elements for Each Image Using GEE

Plant Phenology



Phenology of Cheatgrass based on Sentinel-2 Imagery



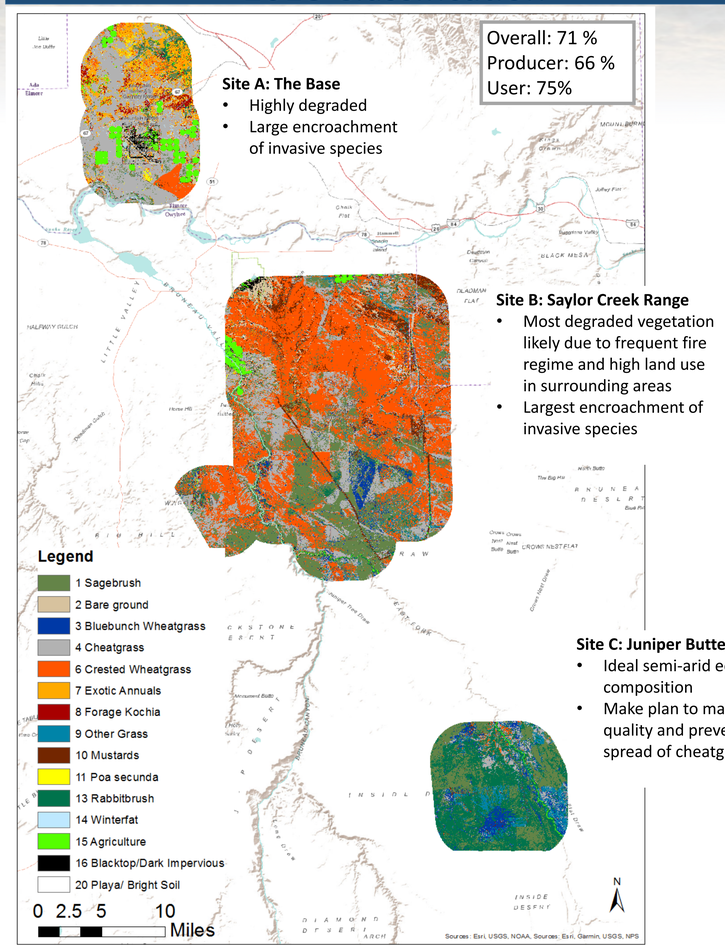
Phenology of Crested Wheat based on Sentinel-2 Imagery

NDVI was extracted from each plot for each Sentinel-2 Image over 2018 to show the phonology response of different plant species. The time of greening and senescence of cheatgrass and crested wheatgrass is similar, making classification between the two difficult.

How does percent area cover factor into phenology?

$$NDVI = \frac{(NIR - Red)}{(NIR + Red)}$$

2018 Classification



Future Work

Preliminary UAV flights at Saylor Creek Range

1. Object based classification of UAV imagery over MHAFB
2. Comparison of object based classification and the classifications from Sentinel-2 Imagery
3. Comparison of pixel to pixel classification of UAV imagery and object based classification.
4. Does the high resolution of UAV imagery provide a better classification map without the temporal component?

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This material is based upon work supported by Mountain Home Air Force Base under contract NOW-CSU-17-25