Using NASA Earth Observations and Synthetic Aperture Radar to Enhance Crop Classification Accuracy from Ground Surveys to Larger Scales in the Long Term Agroecosystem Research Network

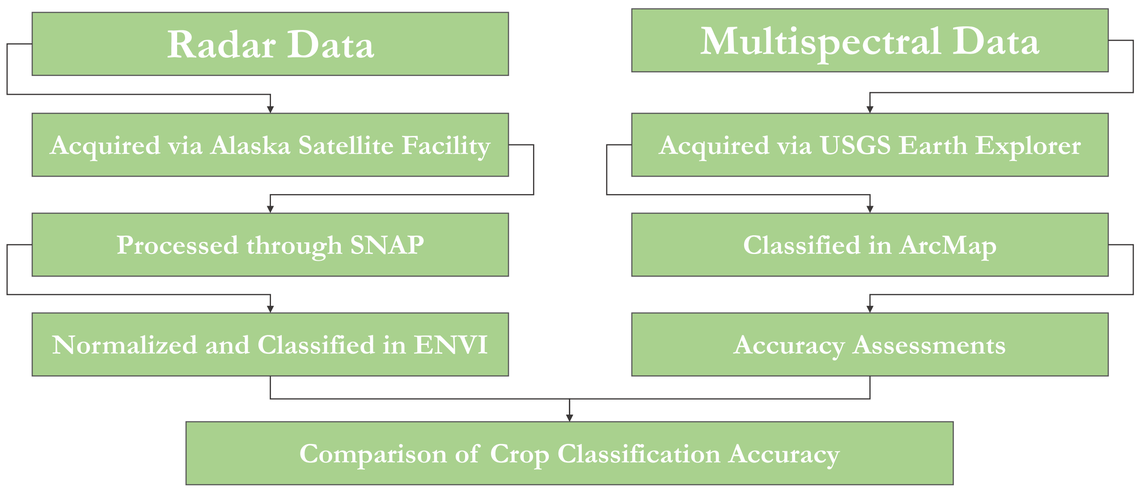
Abstract

Each year, the United States Department of Agriculture (USDA) releases a Cropland Data Layer (CDL) that serves as a nationwide classification system and statistical service for the United States agriculture industry. The CDL is compiled using Landsat 8 Optical Land Imager (OLI) and Sentinel-2 Multispectral Imager (MSI) data, among other sources. This optical satellite imagery is susceptible to temporal restrictions and inclement weather, which limits the number of scenes available each year and impedes analysis. As a combined effort between the USDA's Agricultural Research Service (ARS), National Agricultural Statistics Service (NASS), and NASA DEVELOP, this project explored the effectiveness of using Synthetic Aperture Radar (SAR) to accurately classify crops. SAR has both day and night time capabilities as well as the ability to pierce cloud cover, which will increase data availability when compiling the CDL. For the 2016 and 2017 growing seasons, multispectral and SAR imagery were compared for test sites near Tifton, GA. A time series of SAR imagery was created to show that different crop types exhibit distinct backscatter signatures, allowing for more refined crop classification.

Objectives

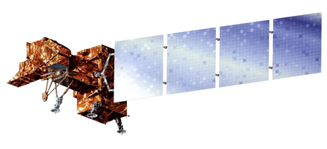
- **Compare** crop classification accuracy of Sentinel-1 C-SAR data with multispectral imagery from Landsat-8 Optical Land Imager (OLI) and Sentinel-2 Multispectral Imager (MSI)
- **Determine** the ability of SAR to accurately classify crops such as peanuts, cotton, corn, etc. by comparing backscatter values in Tifton, GA
- **Establish** groundwork for the Southeast Watershed Research Laboratory (SEWRL) and the Northern Great Plains Research Laboratory (NGPRL) to use SAR data for a regional approach

Methodology

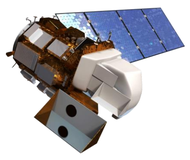


Earth Observations

Landsat 7 TM

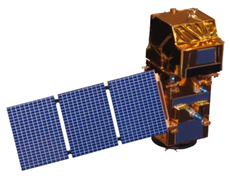


Landsat 8 OLI



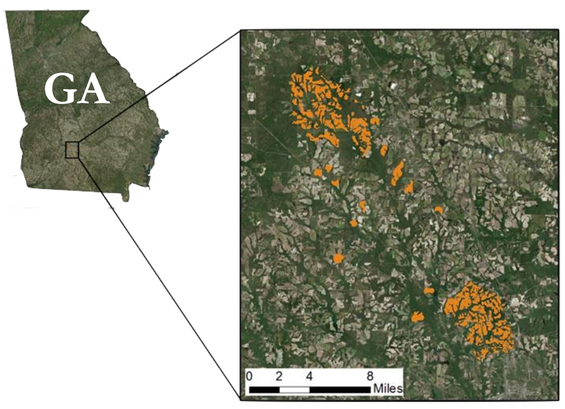
Sentinel-1 C-SAR

Sentinel-2 MSI

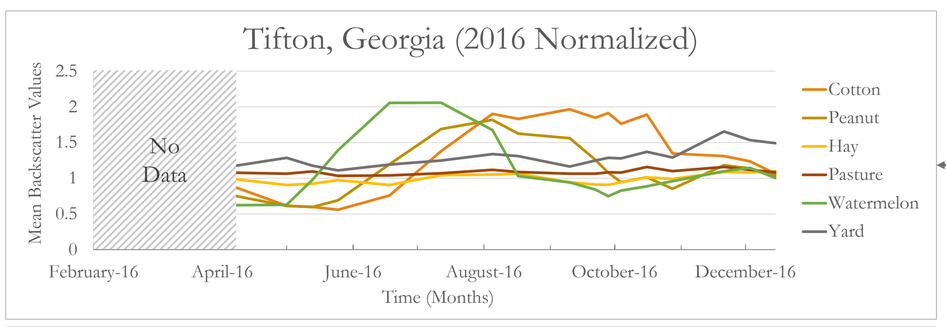


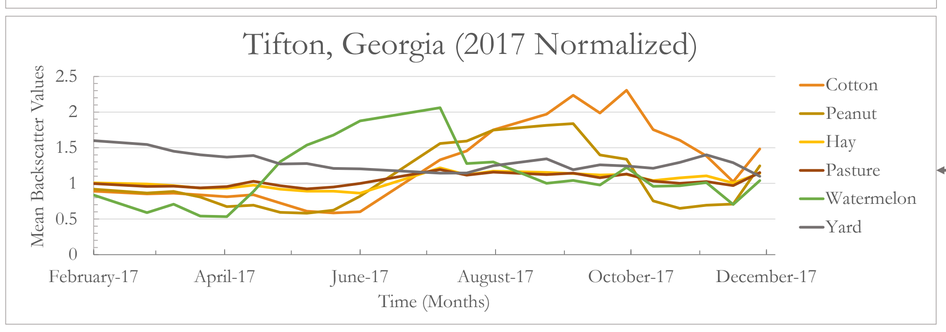
Study Area

Study area map and inset depicting the fields of interest near the Southeast Watershed Research Laboratory LTAR location in Tifton, Georgia. A previous project focused on an alternate location in Mandan, North Dakota comprising a smaller number of ground truth sites for classification and analysis.

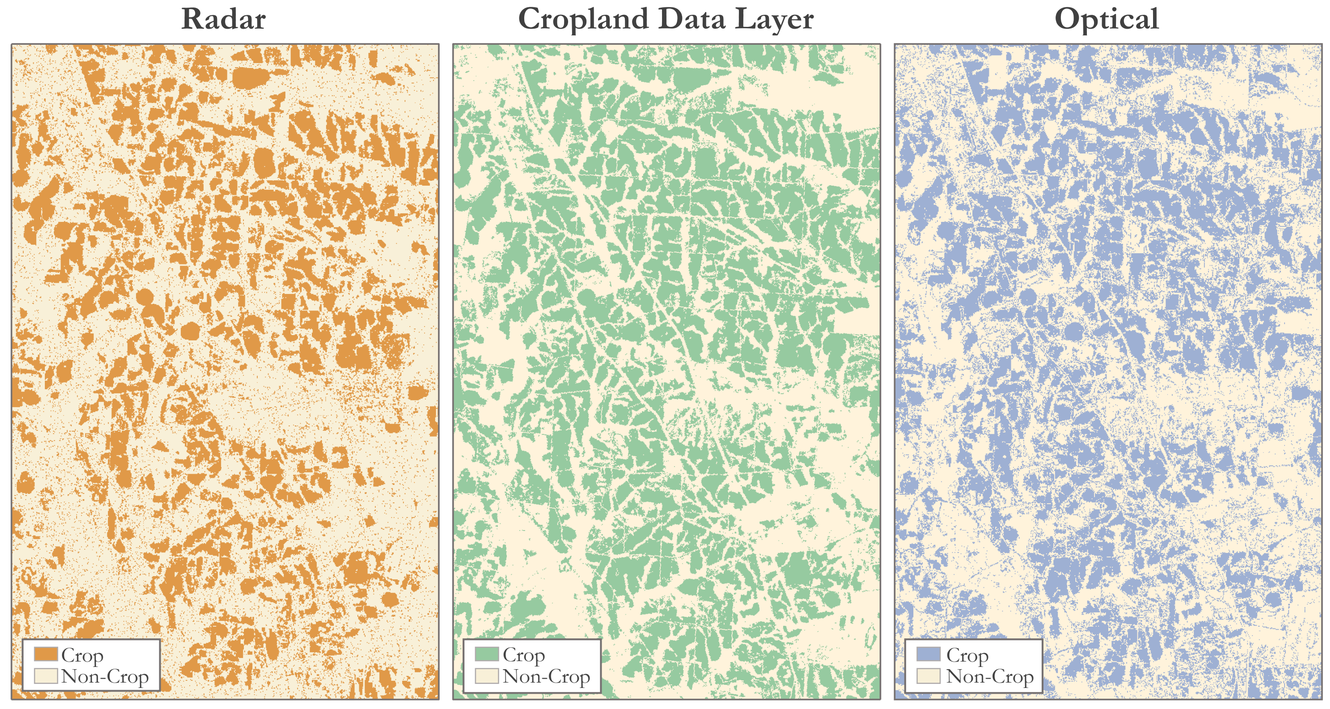


Results





Time series over the 2016 (top) and 2017 (bottom) growing seasons of select crop and non-crop fields showing normalized backscatter values from Sentinel-1.



Binary classifications of identical scenes comparing the effectiveness of radar, the CDL, and optical imagery.

Project Partners

- **USDA Agricultural Research Service**
  - Southeast Watershed Research Laboratory
  - Northern Great Plains Research Laboratory
- **USDA National Agriculture Statistics Service**
  - Spatial Analysis Research Section

Conclusions

- SAR imagery is able to fill critical data gaps in crop classifications given its all-weather capabilities and shorter orbit time.
- Crop and non-crop areas in Tifton, GA can be distinguished by isolating their individual backscatter values.
- Incorporating VH polarized bands into optical classification can improve overall accuracy during early stages of plant growth.

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Team Members

Connor Holzmann
Project Lead

Hannah Mosiniak

Jared Belvin

Project Website

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