Evaluating Satellite Based Fire Detection in GA

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Project Investigators

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Introduction

- Biomass burning is an important source of fine particles in southeastern US – 250K tons/yr primary emissions.
- Prescribed burns and wildfires in the SE are often very small and burn below the canopy. They are severely under-reported by MODIS and GOES based fire emission inventories.
- GA EPD is interested in improving their CMAQ fire emission inventory for regional simulations.

Fires in Georgia

- Wildfires
  - Often large, uncommon and vary greatly from year to year
  - High intensity
  - 9K fires burnt ~500K acres in 2007 (Harper et al. 2009)
- Prescribed fires
  - Small, very frequent and vary gradually from year to year
  - Low intensity
  - > 1 Million acres annually (Lee et al. 2005)

Research Objectives

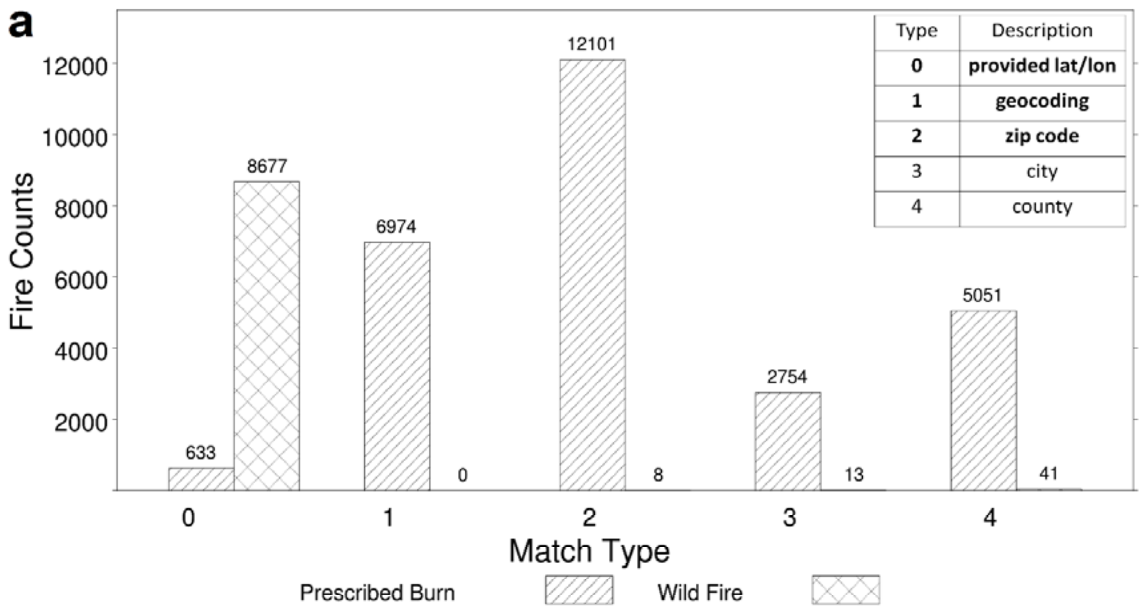
- Evaluate the performance of NOAA's Hazard Mapping System (HMS) active fire products with ground measurements.

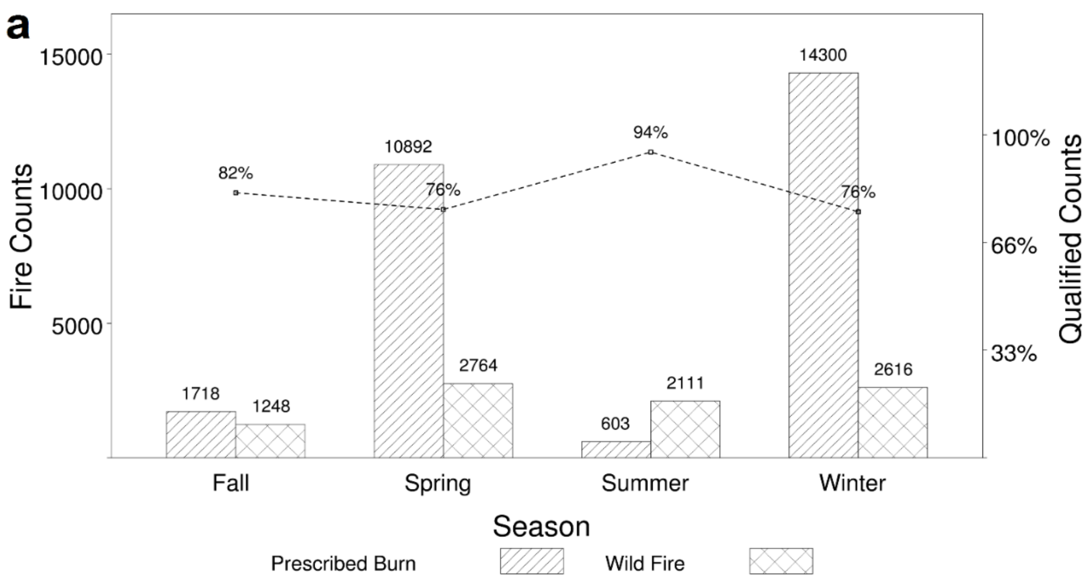
- Note: The detection rate of HMS was evaluated as a whole instead of individual satellite instruments in it

Data and Methods

- Study year: 2011
- HMS Active Fire Detections
  - From 2x GOES satellites, 2x MODIS, and 7xAVHRR
  - Nominal spatial resolution: 1x1 to 4x4 km^2
- GA EPD fire emissions inventory
  - Observed wild fires
  - Permit data for prescribed burns
  - Include location (5 levels of accuracy), area, date
  - Location types of “city” and “county” excluded

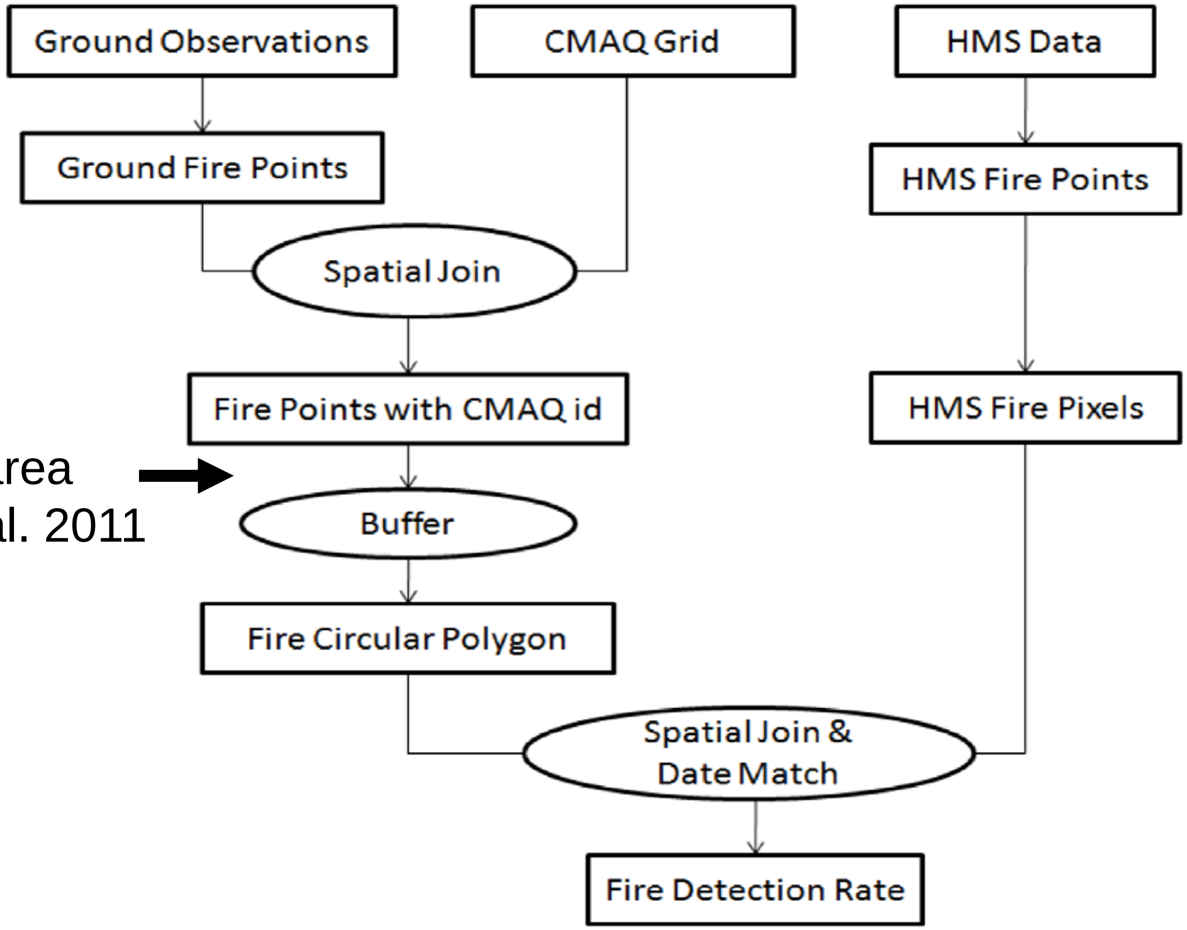
Summary of Ground Data





1. Most wild fires have detailed location information.
2. Most prescribed burns occurred in spring and winter while wildfires are more evenly distributed in time.
3. On average, 22% of the prescribed burns don't have accurate location information.

Spatial Matching and Detection Rate Calculation



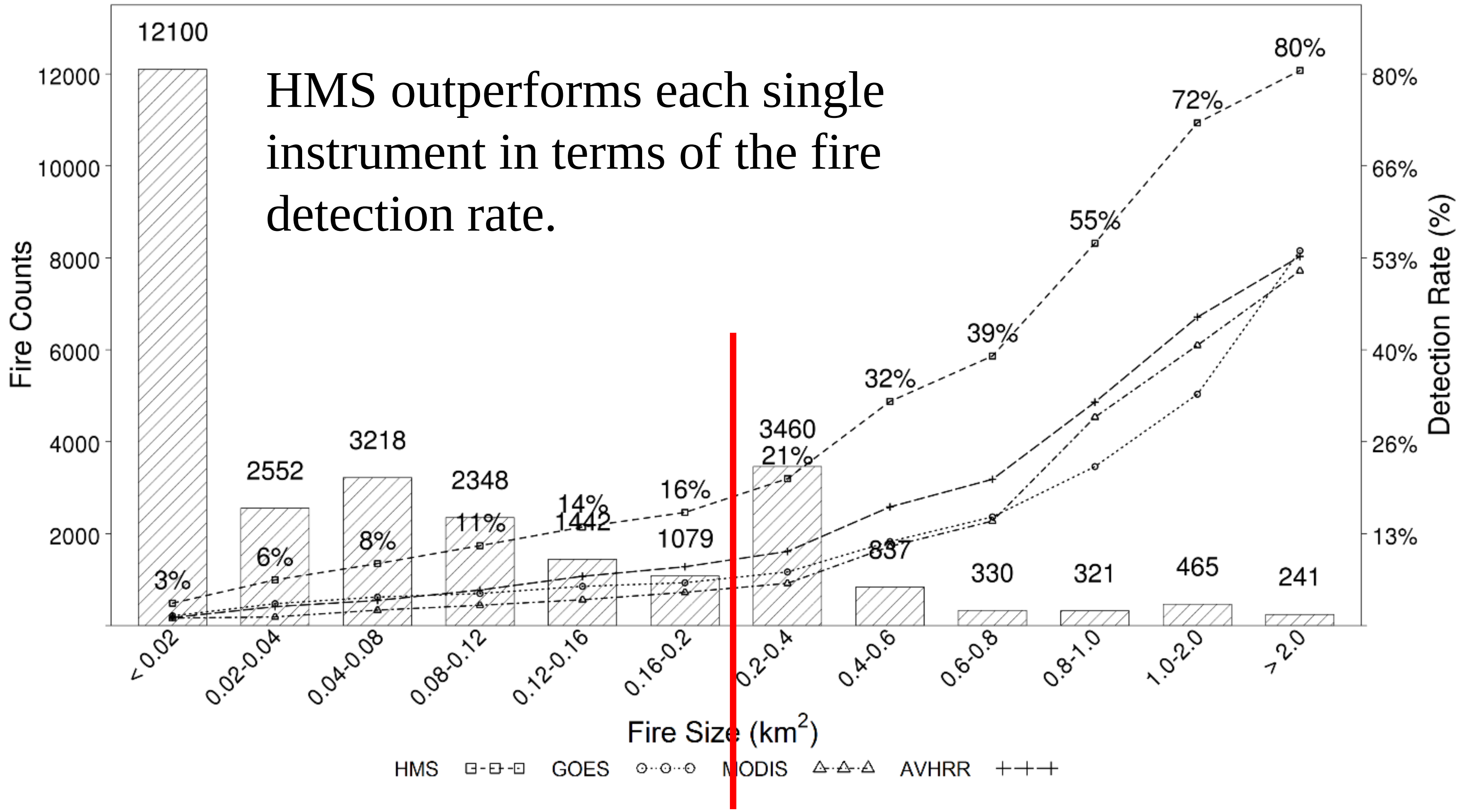
Equal to sensor pixel size

10x burn area
Zhang et al. 2011

$$Detection\ Rate = \frac{the\ Number\ of\ \ Fire\ Observations\ Detected\ by\ HMS}{the\ Number\ of\ \ Total\ \ Fire\ Observations} \times 100\%$$

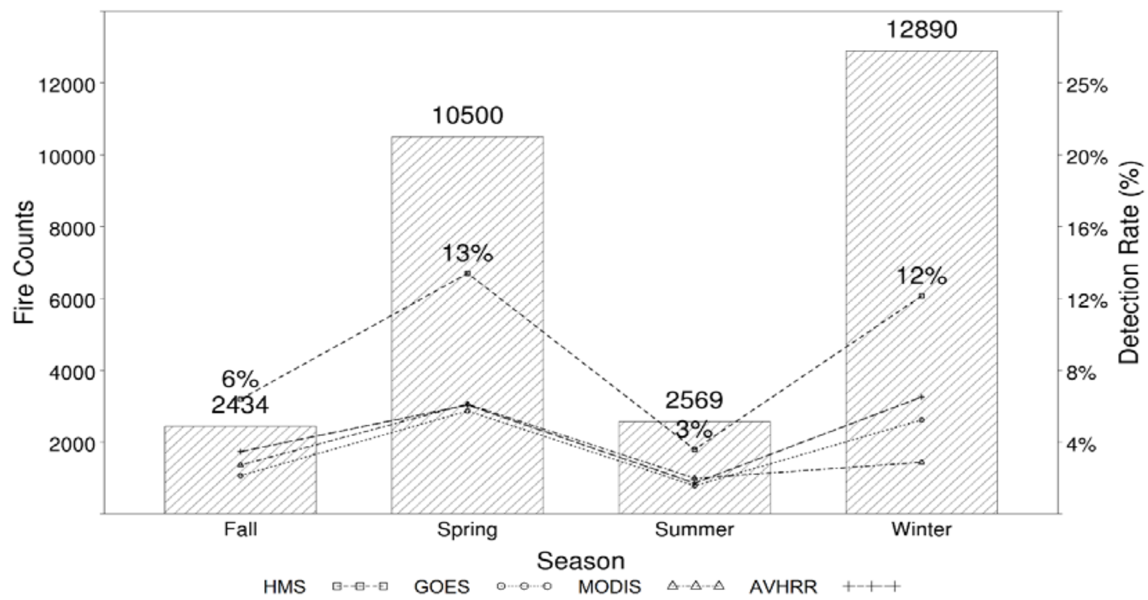
Results: HMS Detection Rate by Fire Size

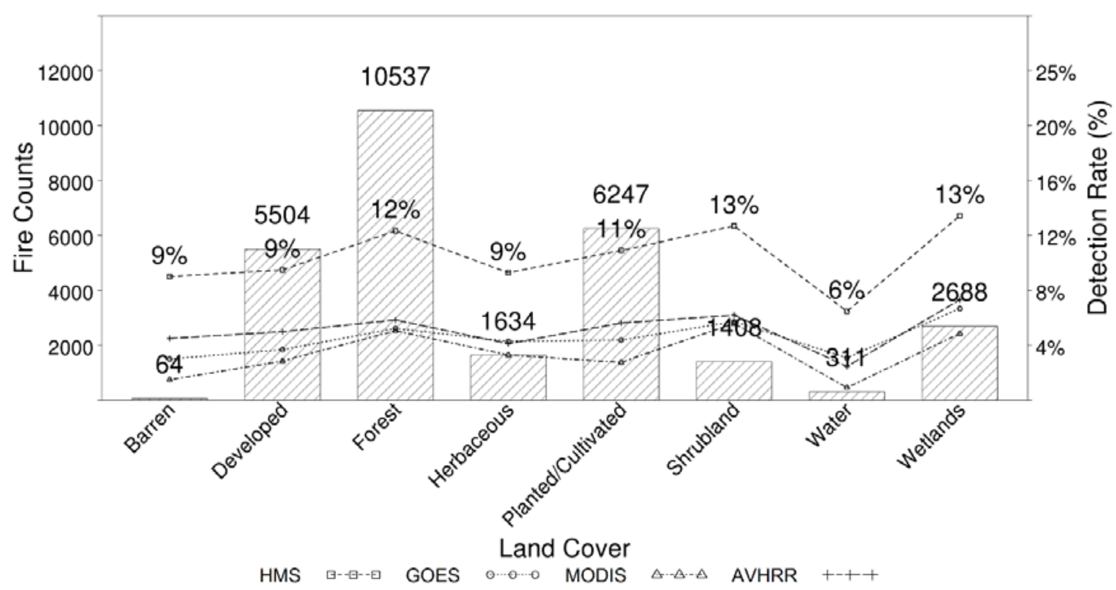
HMS outperforms each single instrument in terms of the fire detection rate.



80% of GA fires are smaller than 0.2 km^2 in size.

Results: HMS Detection Rates

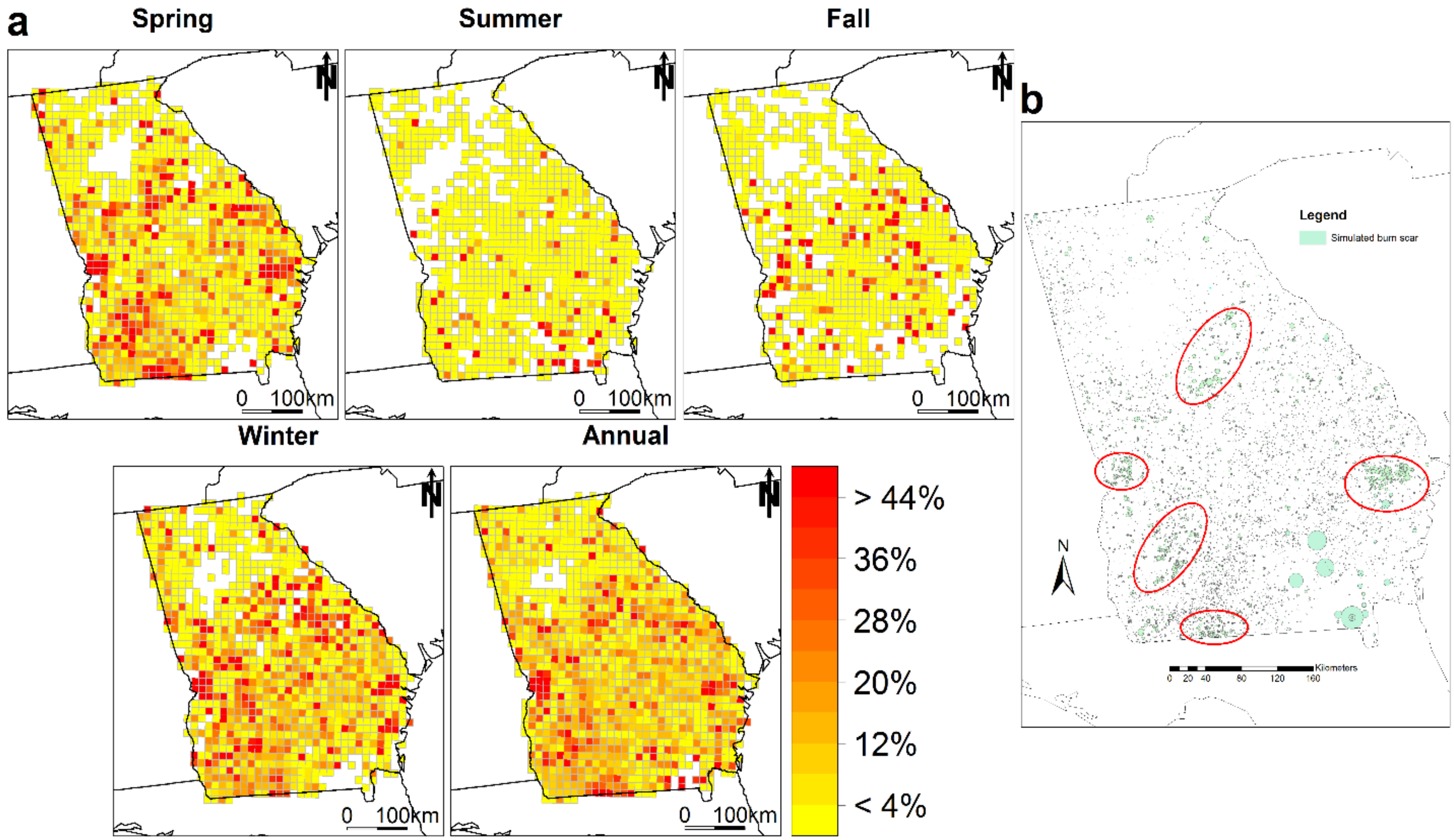




Detection rate is higher in spring and winter when more larger fires occurred.

Higher detection rates (>10%) are obtained in forest, cultivated land, shrub land, and wetlands, which are land covers prone to large fires.

Results: HMS Detection Rate on CMAQ Grid



Grid cells with high detection rates are where large fires occurred, not where more frequent burns occurred.

Discussion

- Ground data were treated as gold standard, but there is uncertainty with zip code level location information.
- We did not evaluate the rate of false detections because of the uncertainties in fire location, shape, and data exclusion in the ground data

Summary

- HMS fire detection rate in GA is ~12%
- Fire size has the strongest influence on HMS fire detection rate
- HMS is good at locating the fires that it can detect – should be useful for GA and other states to improve the location information of their fires in the emissions inventory

Going Forward

- Evaluating HMS location errors with high-res ground fire data from Tall Timbers and 3 GA military bases
- Evaluating VIIRS 375 – 750 m resolution fire products