1. Title Slide

Title: Geostationary Fire Detection and Characterization with GOES-R ABI

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Topics: Non-Convective Forecast Applications

Program: AWG

2. Introduction

- The GOES Wildfire Automated Biomass Burning Algorithm (WF_ABBA) has been an Operational product since 2002 providing fire locations and when possible instantaneous fire size, temperature, and radiative power
- The data are used by air quality modelers at various agencies (including NOAA and the Navy), by international partners to monitor biomass burning, agencies such as the USFS and local emergency managers, and private corporations who use the data directly and/or indirectly as part of other products to monitor fires that may impact their assets
- The goal of the ABI version of this algorithm is to provide continuity with the current operational algorithm as well as improved temporal and spatial resolution afforded by the instrument

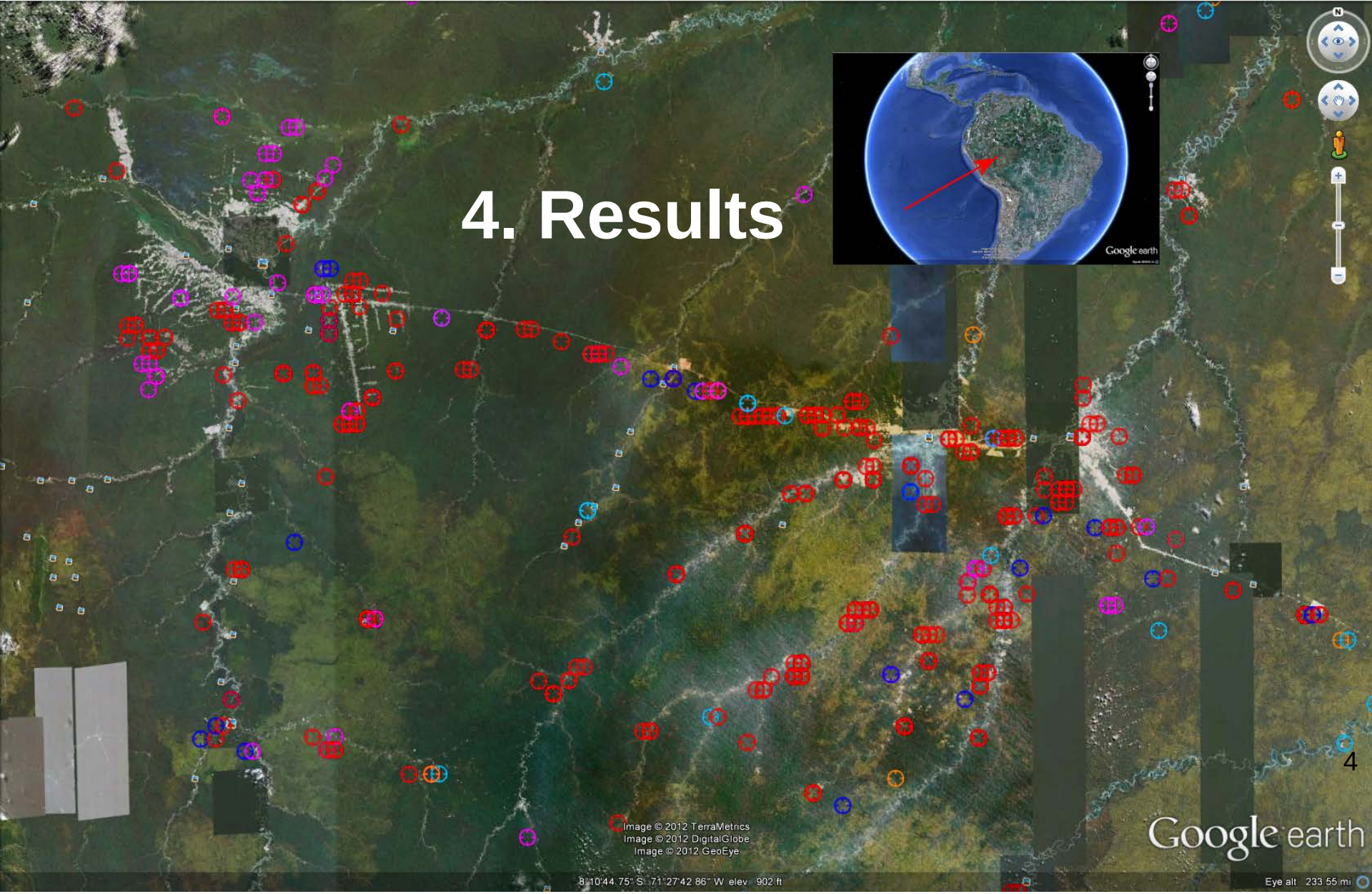
3. Methodology/Expected Outcomes

- The ABI Fire Detection and Characterization Algorithm (FDCA) is a dynamic, multi-spectral, thresholding contextual algorithm that uses the visible (when available) and the 3.9 and 11.2 µm bands to locate fires and characterize sub-pixel fire characteristics. The 12 µm band is used along with the other bands to help identify opaque clouds.
- 5 minute CONUS, 15 minute full disk refresh; 2 km resolution
- 24/7 monitoring of a hemisphere allows for tracking trends and detecting fires earlier than allowed by polar platforms
- The fire's radiative power (FRP), size, and temperature can be used to estimate emissions and intensity
  - FRP is related to the mass consumed
  - FRP is proportional to temperature to the fourth power times size

Product outputs:

- Fire location
- Fire instantaneous size, temperature, and radiative power
- Metadata mask including information about opaque clouds, solar reflection block-out zones, unusable ecosystem types.

4. Results



Current WFABBA example: GOES-12 composite for 8 September 2010 showing burning in western Brazil. The icons roughly approximate the satellite footprint and not the size of the fire. Red indicates high confidence fires with associated size, temperature, and power. Other colors represent cloud covered fires (purple), saturate pixels (yellow), and other confidence levels. The fires line up along previous clearings and roads, a common pattern for fires in the South American forest.

4. Results

The detection threshold in ABI simulated data

The charts depict the GOES-R Fire Detection Algorithm fire detection and classification as a function of the model simulated ABI fire size and fire temperature. Fire detection case studies of simulated ABI data (developed at CIRA). The WFABBA is quite successful detecting fires with FRP > 75 MW (purple curved line, gray curved lines are on a log scale of MW).

Not Detected

Not Detected, Block-out zone

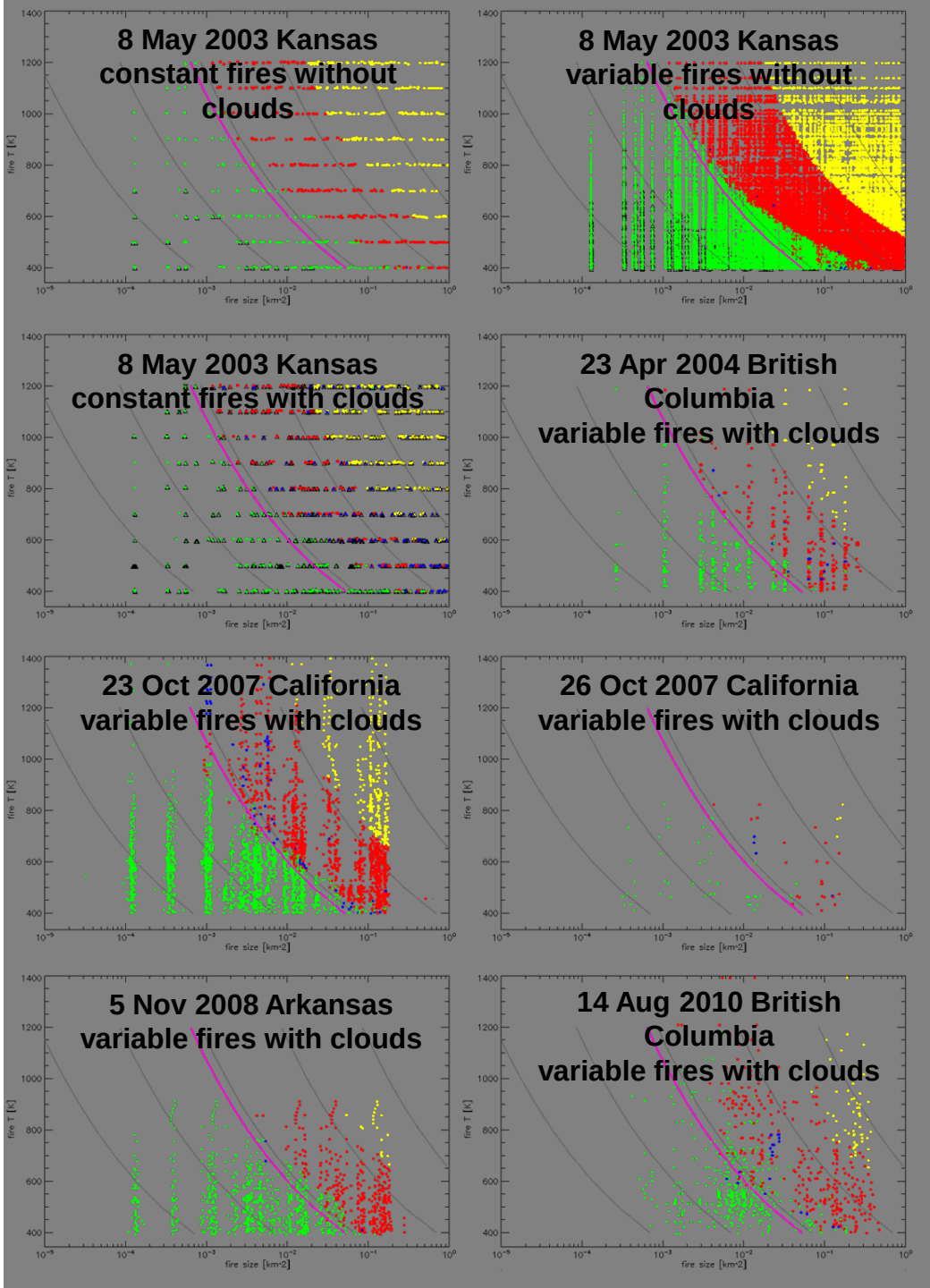
Processed Fire Pixel

Saturated Fire Pixel

Cloudy Fire Pixel

High Probability Fire Pixel

Medium Probability Fire Pixel



4. Results

The deep-dive fire detection and characterization validation tool builds on methods originally developed for MODIS and GOES Imager

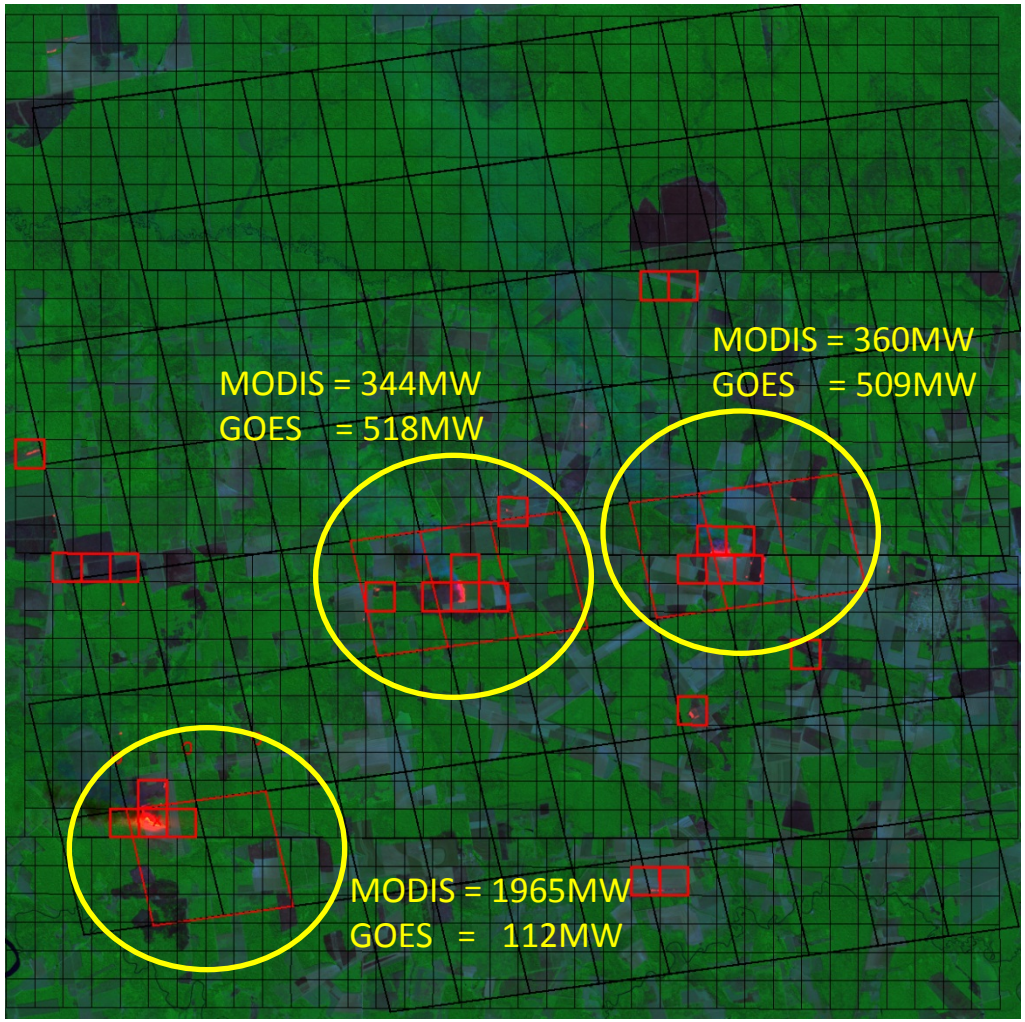
- Use of near-coincident (<15min) Landsat-class and airborne data to generate sub-pixel summary statistics of fire activity
- Landsat-class data are used to assess fire detection performance
  - History of successful applications using ASTER, Landsat TM and ETM+ to estimate MODIS and GOES fire detection probabilities and commission error rates (false alarms). Methods published in seven peer reviewed journal articles
  - Limited fire characterization assessment (approximate fire size only). Frequent pixel saturation and lack of middle infrared band prevent assessment of ABI's fire characterization parameters
- Airborne sensors are used to assess fire characterization accuracy
  - High quality middle-infrared bands provide fine resolution data (<10m) with minimum saturation allowing full assessment of ABI's fire characterization parameters (size, temperature, Fire Radiative Power)
  - Sampling is limited compared to Landsat-class data
- These same techniques can be used with fires detected by any platform, such as VIIRS on Suomi NPP

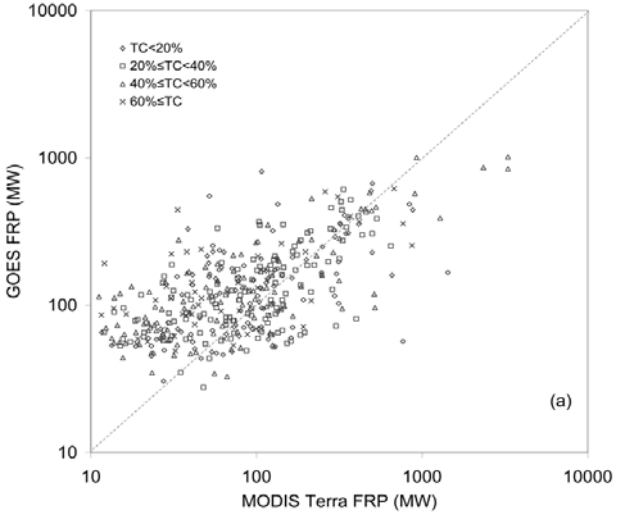
Cross-validation of pixel-level fire characterization data using other similar satellite products proven impractical [Schroeder et al., 2010]

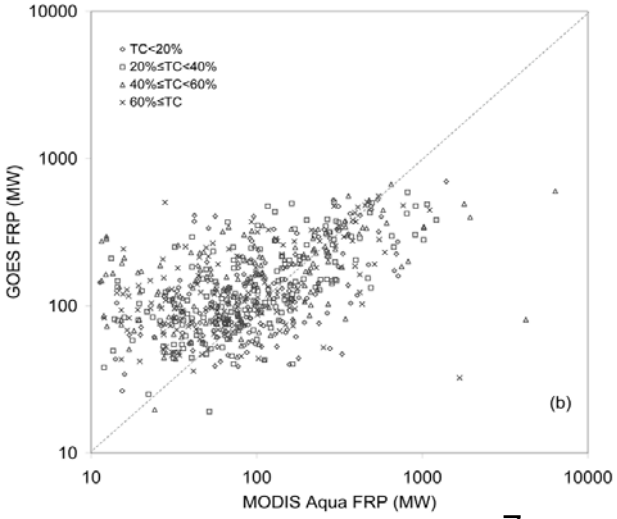
- No single product has been sufficiently validated to date; cross-validation analyses provide little useful information
- Differences in resolution and observation geometry are problematic

4. Results

MODIS×GOES Imager FRP data intercomparison







5. Possible Path to Operations

- The FDCA is a baseline product and has been implemented in the ground system framework. It is expected to be operational on day 1.

6. Future Plans

- Ongoing validation development, particularly of deep-dive tools that use high resolution data from other sensors to validate fire locations and properties.
- Address risk reduction concerns if funded: The algorithm is sensitive to the remapping of ABI data, and additional channels available with ABI may allow improvements to the algorithm.

7. Publication List

- References
  - Schroeder, W., Csiszar, I., Giglio, L., and Schmidt, C. (2010), On the use of fire radiative power, area and temperature estimates to characterize biomass burning via moderate-to-coarse spatial resolution remote sensing data. *Journal of Geophysical Research*, 115(D21121), doi: 10.1029/2009JD013769.