Active Fire and Burned Area Products: Extending MODIS to VIIRS

Wilfrid Schroeder & Louis Giglio

Department of Geographical Sciences

University of Maryland – College Park

Active Fire Co-investigators/Collaborators:

Ivan Csiszar, Patricia Oliva, William Walsh, Evan Ellicott,

Patrick Coronado, Kelvin Brentzel, Brad Quayle

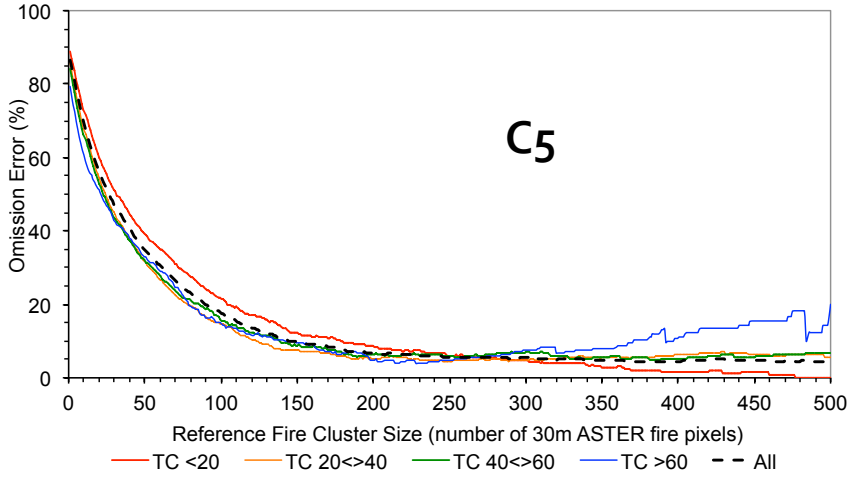
VIIRS Active Fire Background

- **Baseline 750 m product** builds on MODIS C6 *Fire and Thermal Anomalies* (MOD14/MYD14) algorithm
  - Provides fire mask, fire radiative power retrievals, plus additional metadata
    - Mimics MOD14/MYD14 science data format & nomenclature
  - Currently implemented/maintained at Land SIPS (**NPP_VAFIRE_L2D**)
  - Currently implemented/maintained in IPOPP serving the DB community
  - Latest algorithm being ported to NESDIS in order to replace operational version in IDPS (based on outdated Collection 4 version)

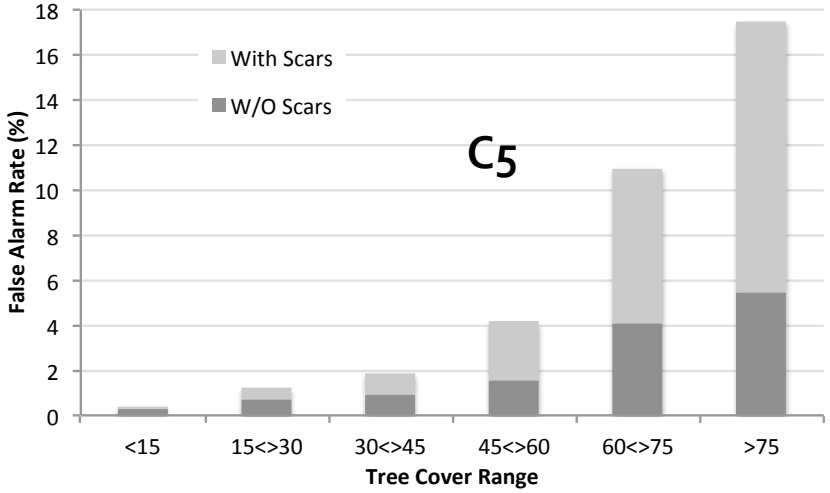
- **New 375 m product** based on similar MOD14/MYD14 architecture
  - Provides fire mask, limited fire retrievals (frequent saturation), plus additional metadata
    - Resembles MOD14/MYD14 science data format & nomenclature
  - Currently running at the USDA Remote Sensing Applications Center (RSAC), and in fire monitoring systems in South Africa and Brazil
  - Being ported to IPOPP
  - To be ported to Land SIPS

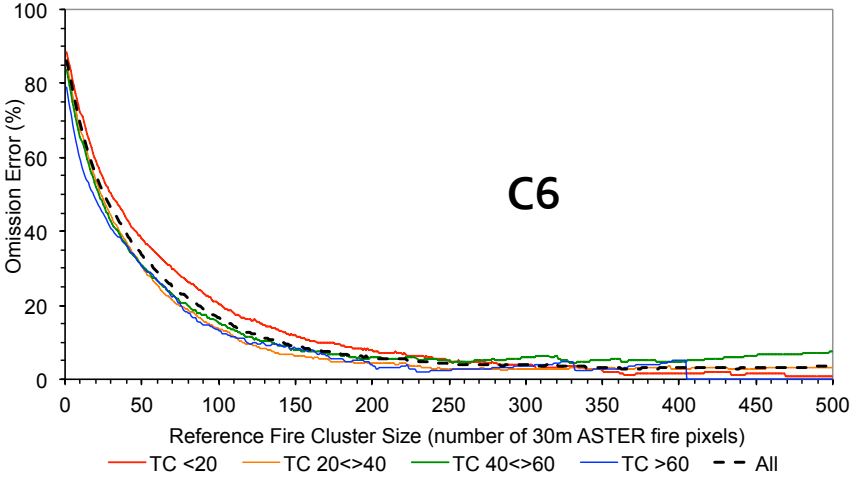
Collection 5 -> 6 Improvements

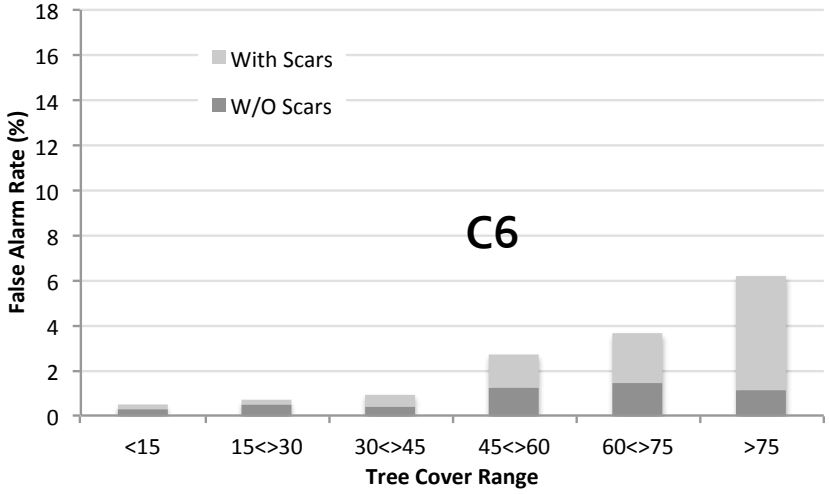
Omission Errors



Commission Errors

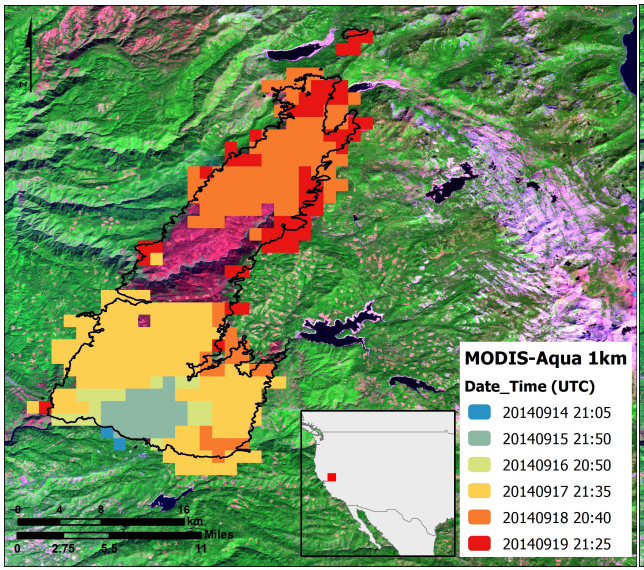




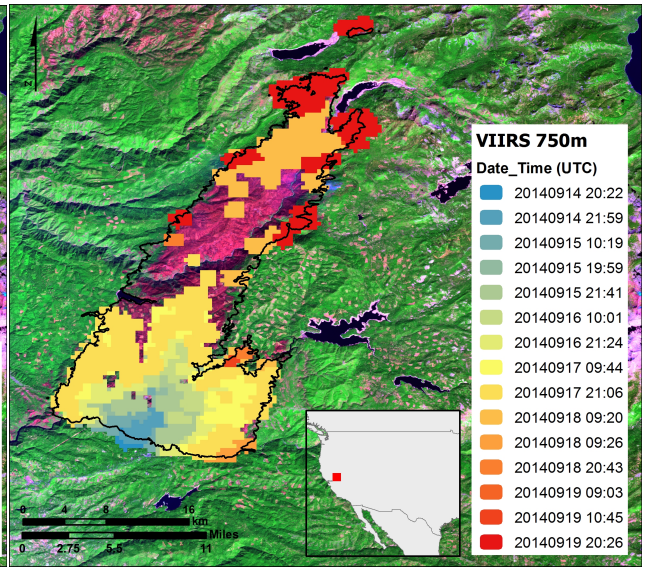


MODIS 1 km × VIIRS 750 m × VIIRS 375 m Active Fire Data Inter-comparison

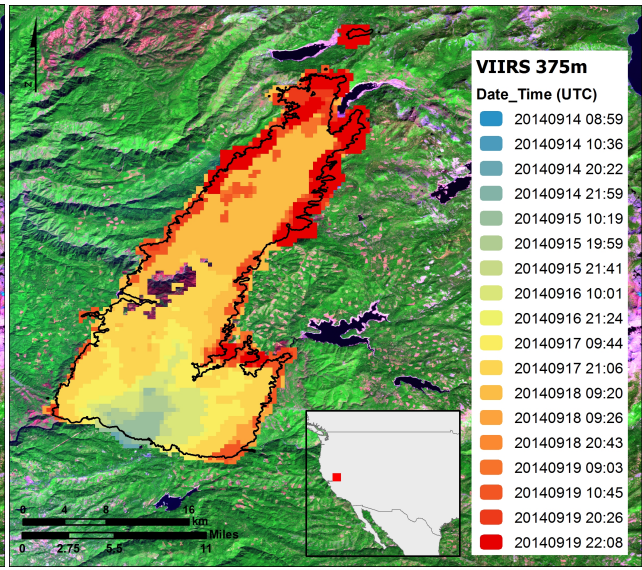
King Fire, California (September 2014)



Aqua/MODIS 1 km



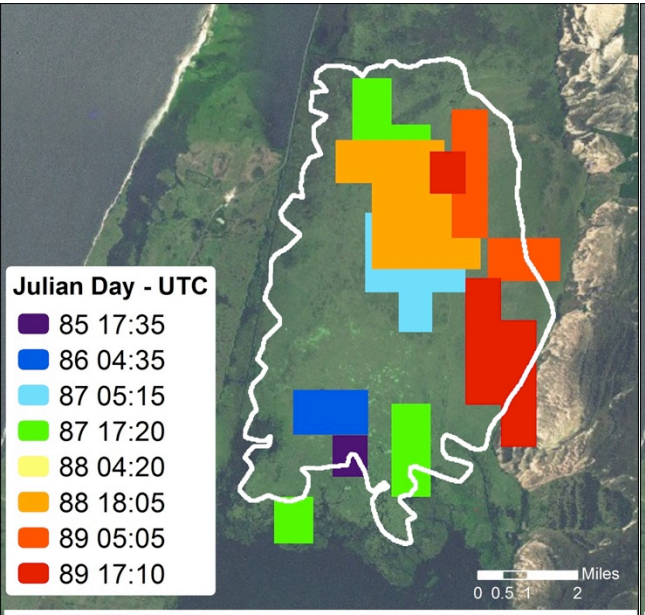
NPP/VIIRS 750 m



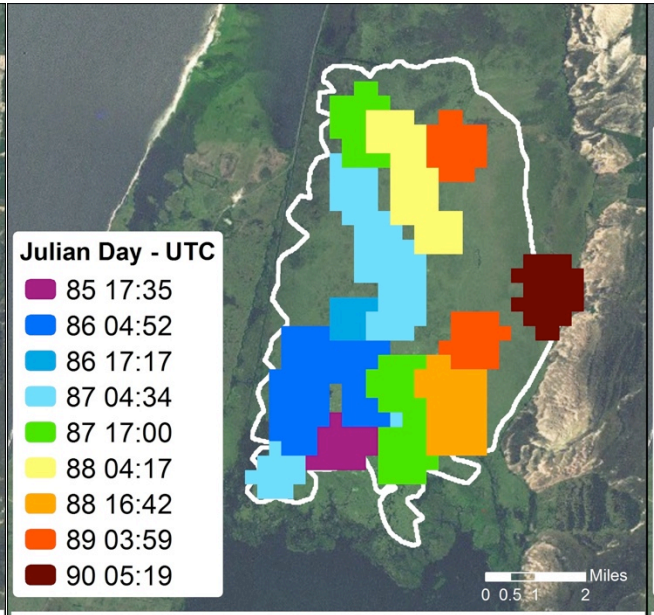
NPP/VIIRS 375 m

MODIS 1 km × VIIRS 750 m × VIIRS 375 m Active Fire Data Inter-comparison

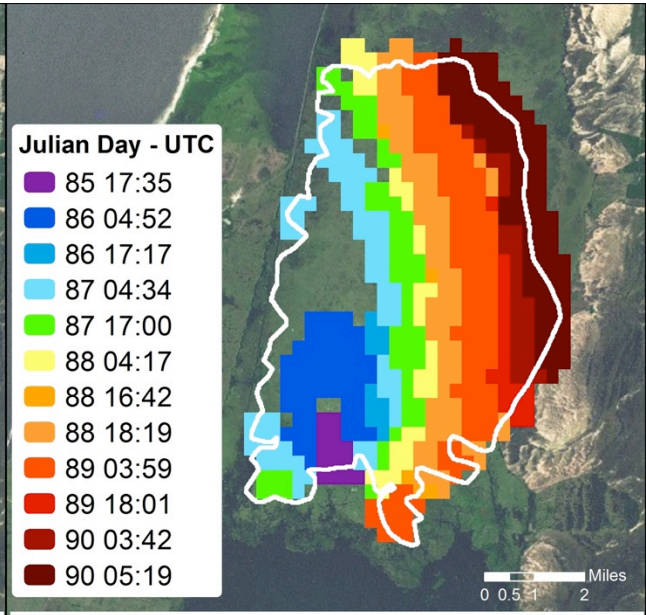
Taim Ecological Reserve, Southern Brazil (March 2013)



Aqua/MODIS 1 km



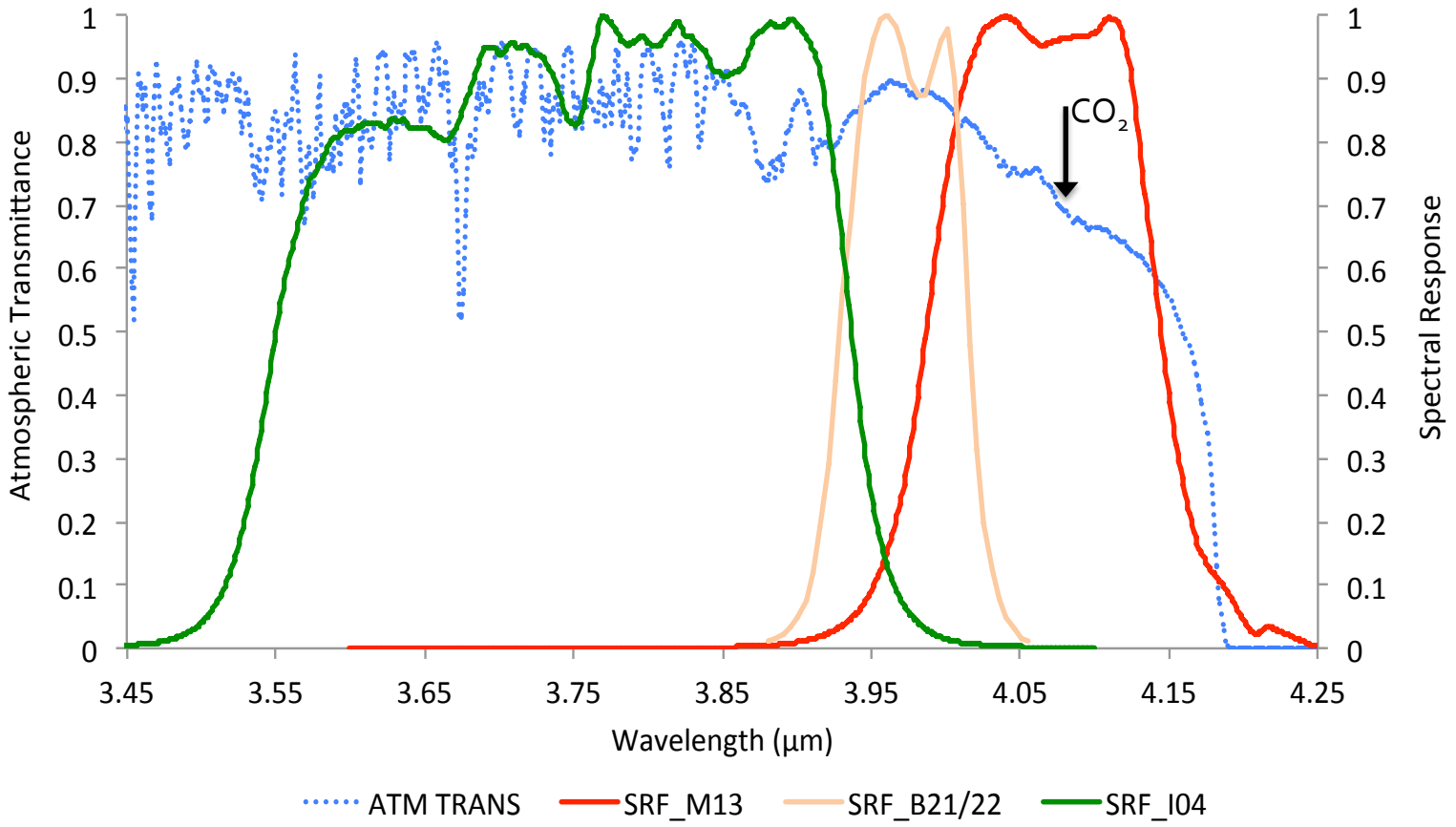
NPP/VIIRS 750 m



NPP/VIIRS 375 m

MODIS-VIIRS Fire Data Continuity: Important SRF Differences

Standard atmospheric transmittance and
mid-infrared channel spectral response functions for
VIIRS 375m (I04), VIIRS 750m (M13), and MODIS 1km (B21/22)



Active Fire Data Status

Several Level 1 data quality issues affecting input files, in particular dual-gain M13 channel, were addressed since launch

- Data aggregation in brightness temperature domain leading to cold bias and consequent omission errors
- Data anomalies (bad quality flags, missing/corrupted scans, lunar calibration maneuvers) resulting in bands of spurious fire pixels

Outstanding issues continue to be addressed

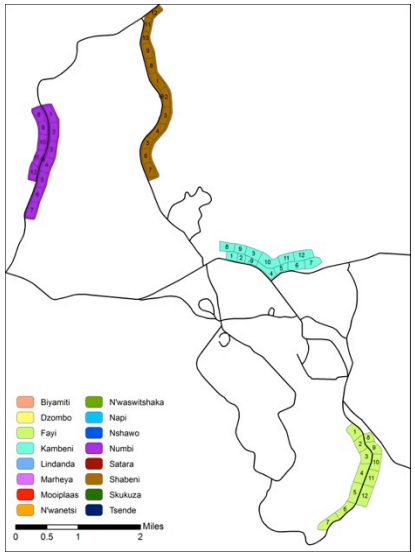
- Incorrect radiance to brightness temperature calculation at/near saturation
  - Mx8.9 appeared to have addressed the problem, although initial inspection still indicate potential inconsistency in channel I04
- Though greatly reduced, outstanding dual-gain channel data anomalies originate from same calibration error
  - Use of nearby scans to fill-in missing calibration data
  - Affecting both regular stream and DB data
- Flagging of saturated pixels during data aggregation for single gain channels
  - Problem cannot be solved for NPP and J1 due to flight software/hardware architecture
  - Problem unlikely to be solved for J2 (flight software/hardware already built using same architecture)
    - Alternative transmission of full un-aggregated data proposed

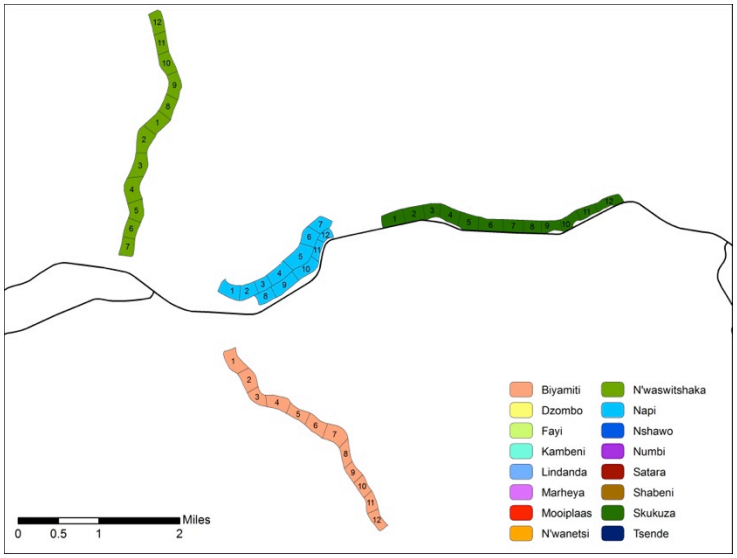
Active Fire Data Validation

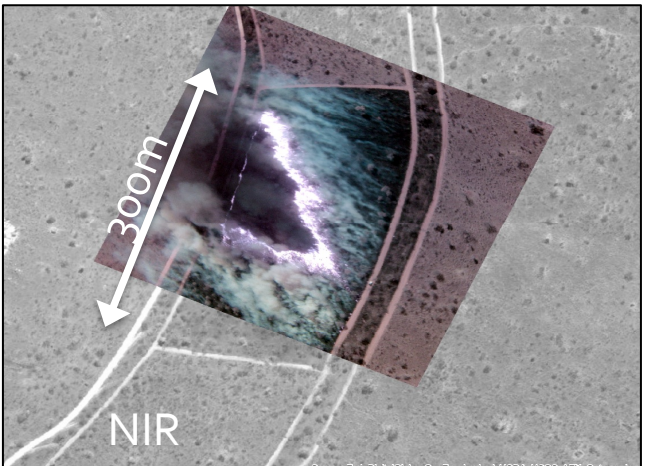
- *Use of Landsat-class data to validate VIIRS is **not an option** due to prohibitively large time separation between same-day acquisitions*
  - *We won't match the MODIS validation status for VIIRS (≤ stage 2)*
- *Use of **prescribed fires** (easy/accessible)*
- ***Coincident** ground, airborne, spaceborne data acquisitions*
- ***Community-organized** (reduce spending, maximize output)*

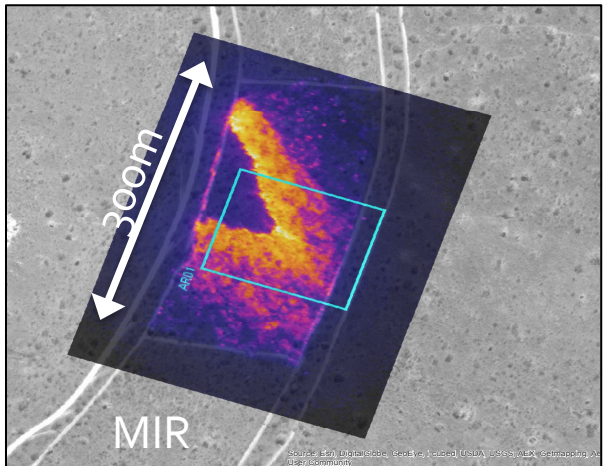
Experimental Fires in Kruger National Park/South Africa August 2014

Several plots averaging **7 ha** in area

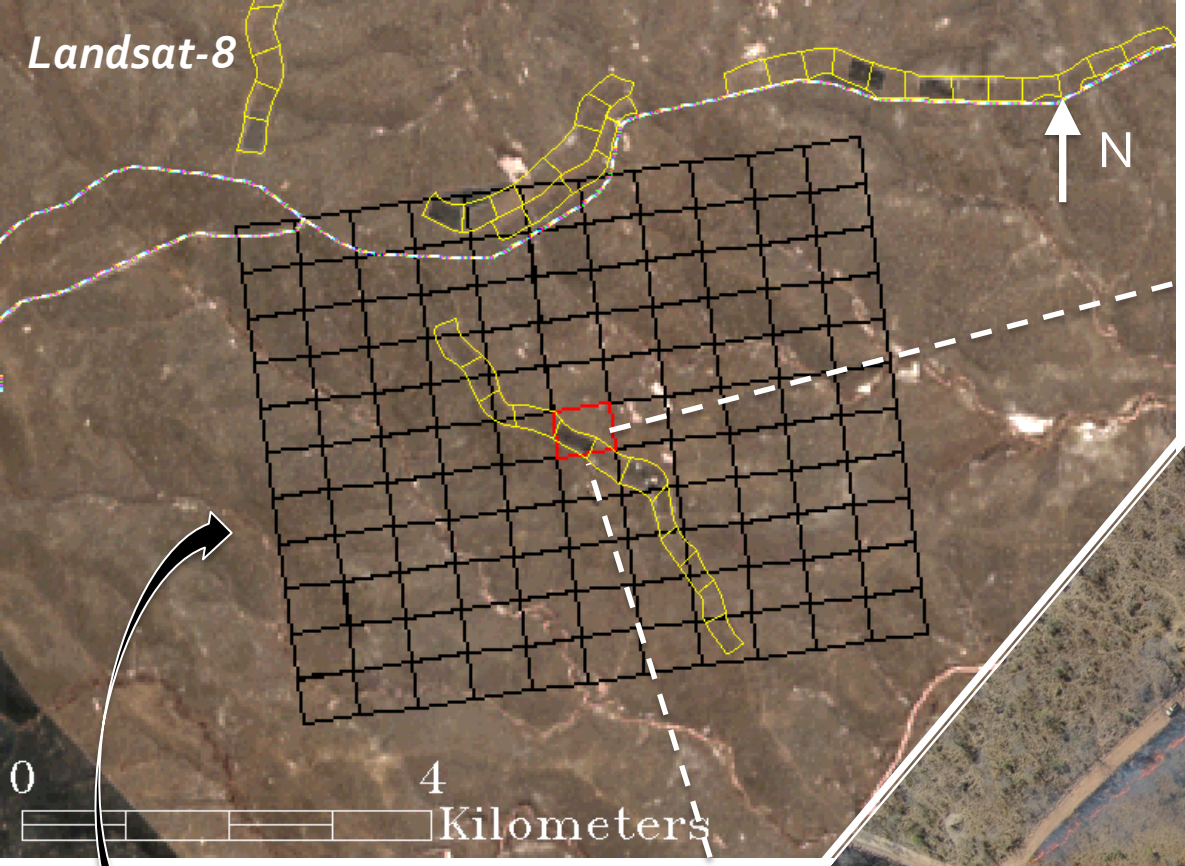






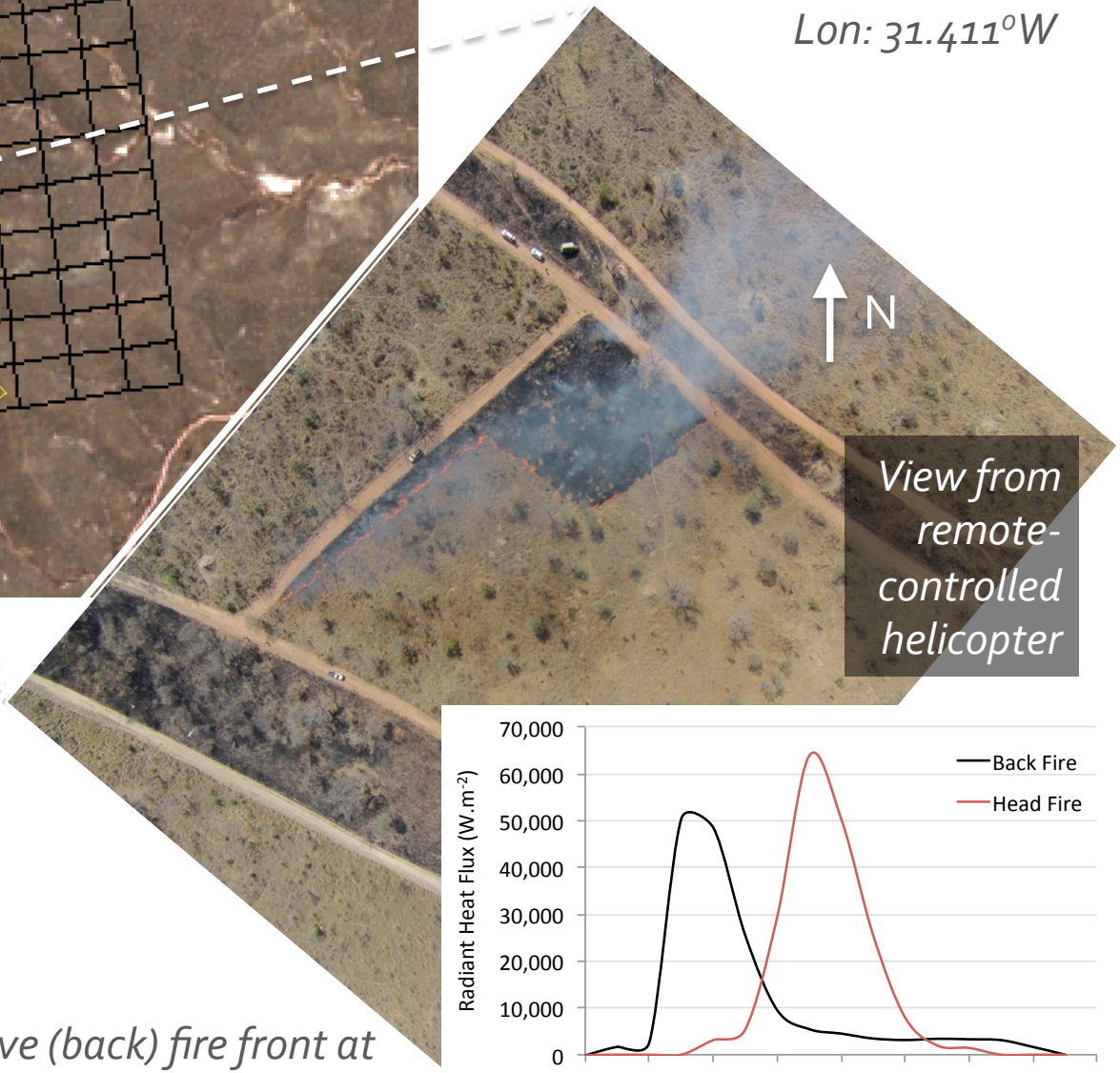



Kruger National Park,
26 Aug 2014
Lon: 31.442° E
Lat: 25.099° S
4ha plot
5min duration



Kruger National Park
19 August 2014
Lat: 25.131° S
Lon: 31.411°W

Subset of VIIRS 375 m pixel grid (fire detection in red)



View from remote-controlled helicopter

Surface-leaving FRP (VIIRS):
4.4±0.2MW
@ 13:24:26 h local time

Length of active (back) fire front at time of VIIRS overpass: 200 m

VIIRS Active Fire – University of Maryland

http://viirsfire.geog.umd.edu/

VIIRS Active Fire | Home | About | FAQ | VIIRS AF Products | VIIRS vs MODIS | Maps & Data | Contact Us

Active Fire Team

Ivan Csiszar

Chris Justice

Louis Giglio

Evan Ellicott

Wilfrid Schroeder

Krishna Vadrevu

Jon Nordling

Links

JPSS

VIIRS

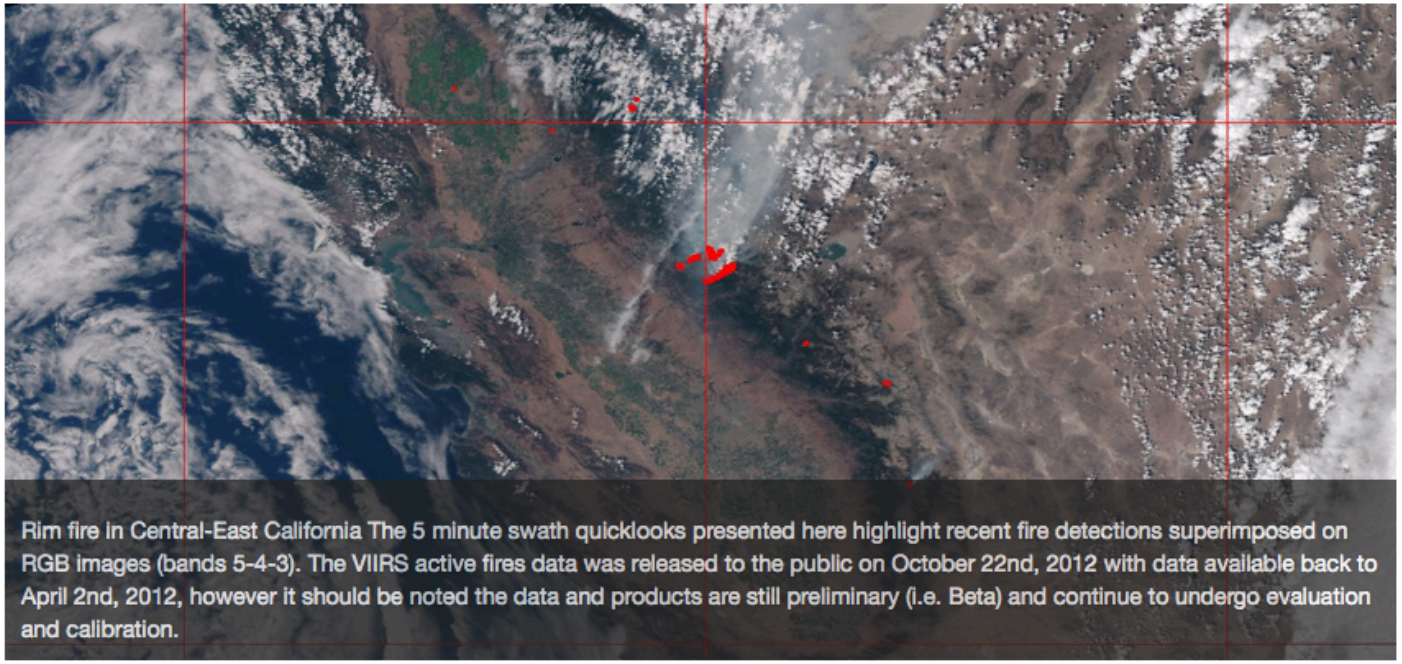
University of Maryland

NOAA

NOAA-STAR

USFS RSAC

GOFC Fire



Rim fire in Central-East California The 5 minute swath quicklooks presented here highlight recent fire detections superimposed on RGB images (bands 5-4-3). The VIIRS active fires data was released to the public on October 22nd, 2012 with data available back to April 2nd, 2012, however it should be noted the data and products are still preliminary (i.e. Beta) and continue to undergo evaluation and calibration.

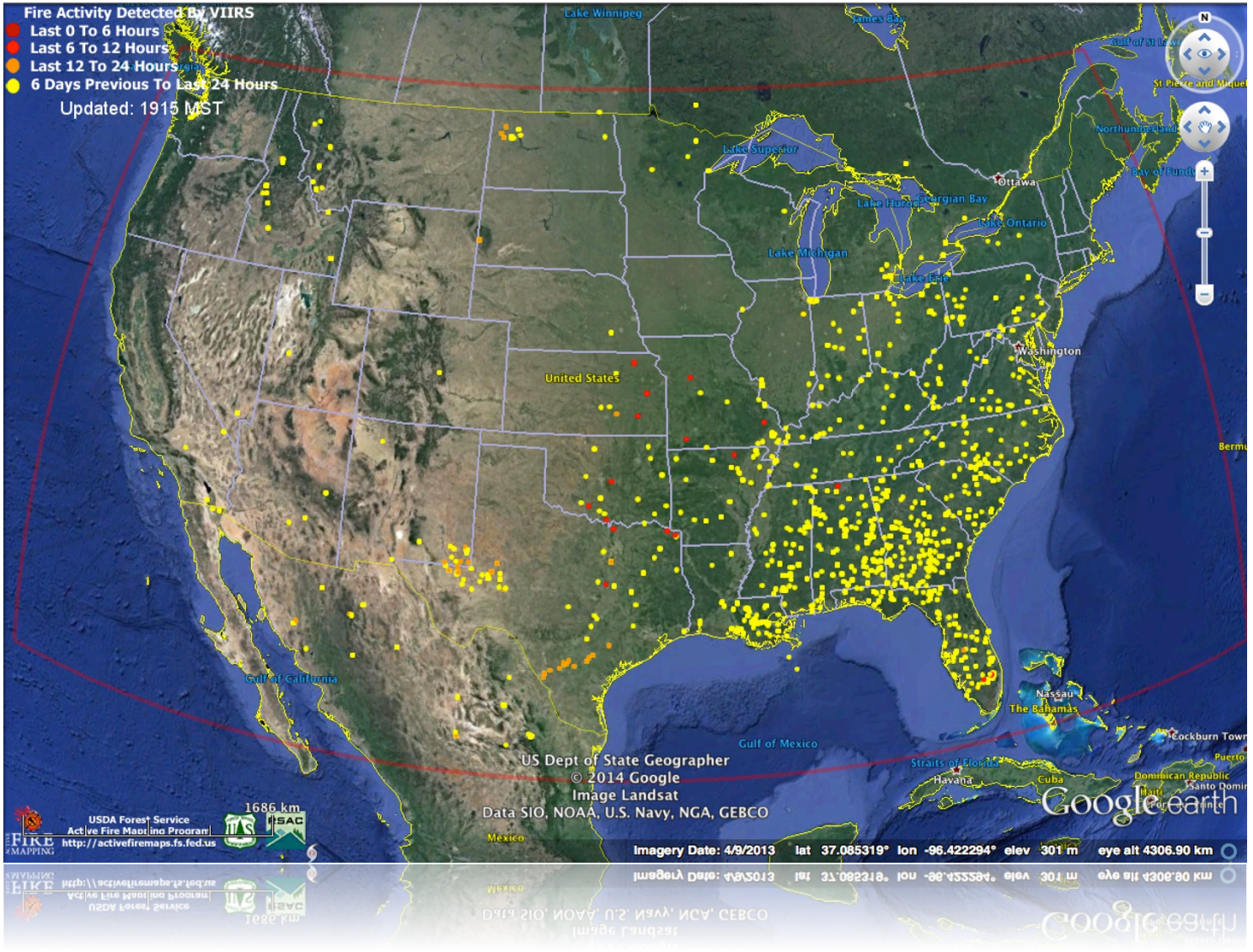
About

The Visible Infrared Imaging Radiometer Suite (VIIRS) sensor was launched aboard the Suomi National Polar-orbiting Partnership (NPP) satellite on October 28th, 2011 and on January 18th, 2012 cooler doors for the thermal sensor were opened. Within hours data were being retrieved and fire detections produced. The 5 minute swath quicklooks presented here highlight recent fire detections superimposed on RGB images (bands 5-4-3).

Read more

VIIRS 375 m NRT Fire Data Implemented for North America
USDA-Remote Sensing Applications Center

http://activefiremaps.fs.fed.us/



Conclusions

- VIIRS active fire products on track
  - Both algorithms (375 m and 750 m) successfully implemented
  - Fire user community already benefiting from VIIRS data
  - Inter-comparison with MODIS fire product and initial validation results indicating good overall performance
  - Provisions added to MODIS (C6) and VIIRS active fire product files in order to facilitate atmospheric correction of fire retrievals
  - Latest science algorithm ported to NESDIS
- Future work
  - Continue monitoring of/responding to outstanding issues affecting Level 1 input data
  - Implement tuning of 750 m fire algorithm
  - Further develop/promote 375 m fire algorithm, continue investigation of hybrid algorithm
  - Begin implementation of Level 3 product
  - Expand validation analyses
    - Using drones over relatively small (< 10 ha) fires
    - Using field data to verify data simulation techniques

A Global Burned Area Data Record: Extending MODIS to VIIRS

Louis Giglio[1], Luigi Boschetti[2], David Roy[3], Krishna Vadrevu[1], Chris Justice[1]

[1]University of Maryland, [2]University of Idaho, [3]South Dakota State University

MODIS/VIIRS Science Team Meeting

May 2015

MODIS Burned Area Products

MCD45A1	500-m Monthly L3
MCD45A1-based GIS Products (SCF)	Shapefiles + 500-m GeoTIFF
MCD64A1 (SCF)	500-m Monthly L3

For all products burning is mapped to the nearest day.

Algorithm/Product Characteristics

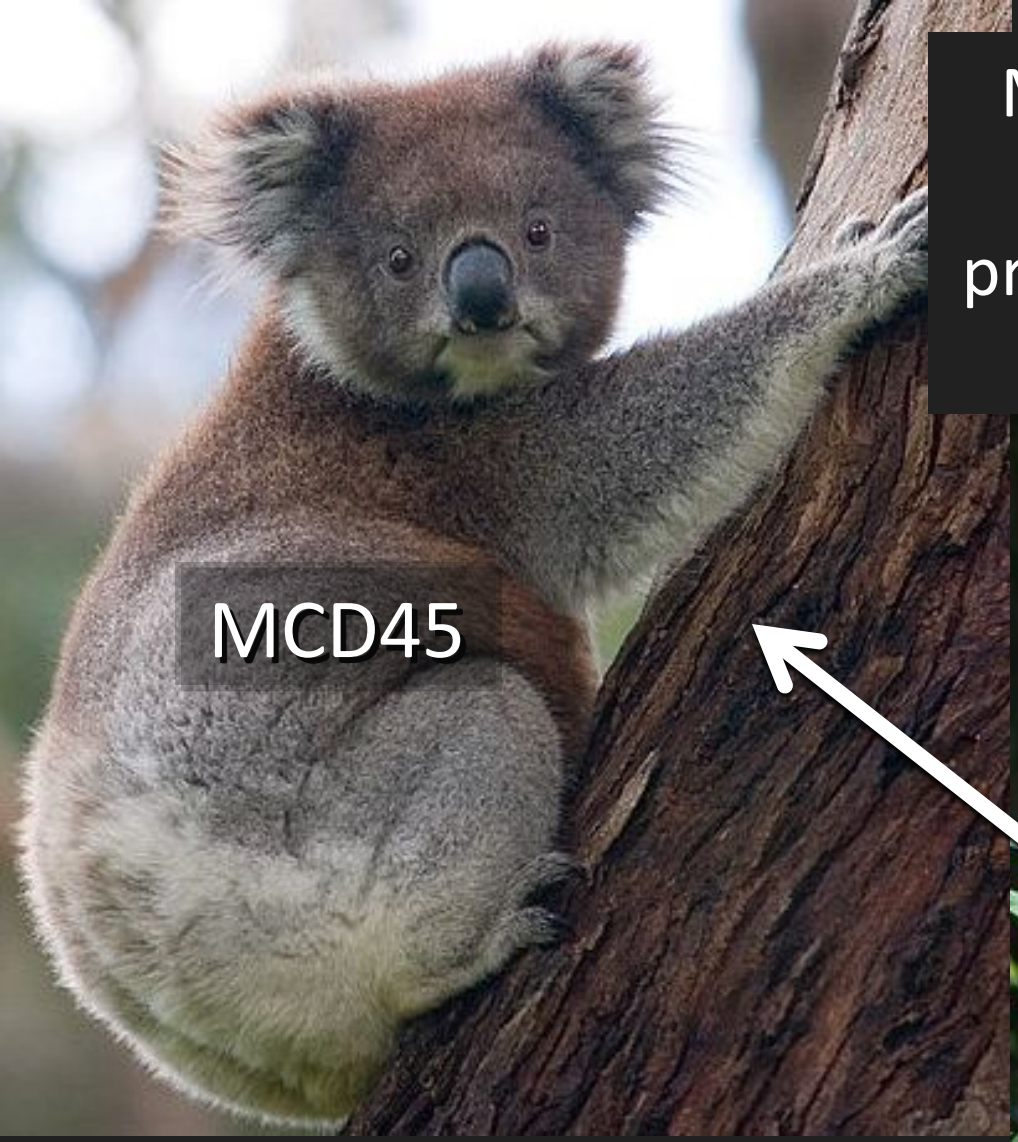
MCD45A1

- Predictive BRDF model
- 500-m, daily
- Uses no active fire data
- Less noise-tolerant
- Poorer mapping under cloudy conditions
- Better mapping of cropland burning

MCD64A1

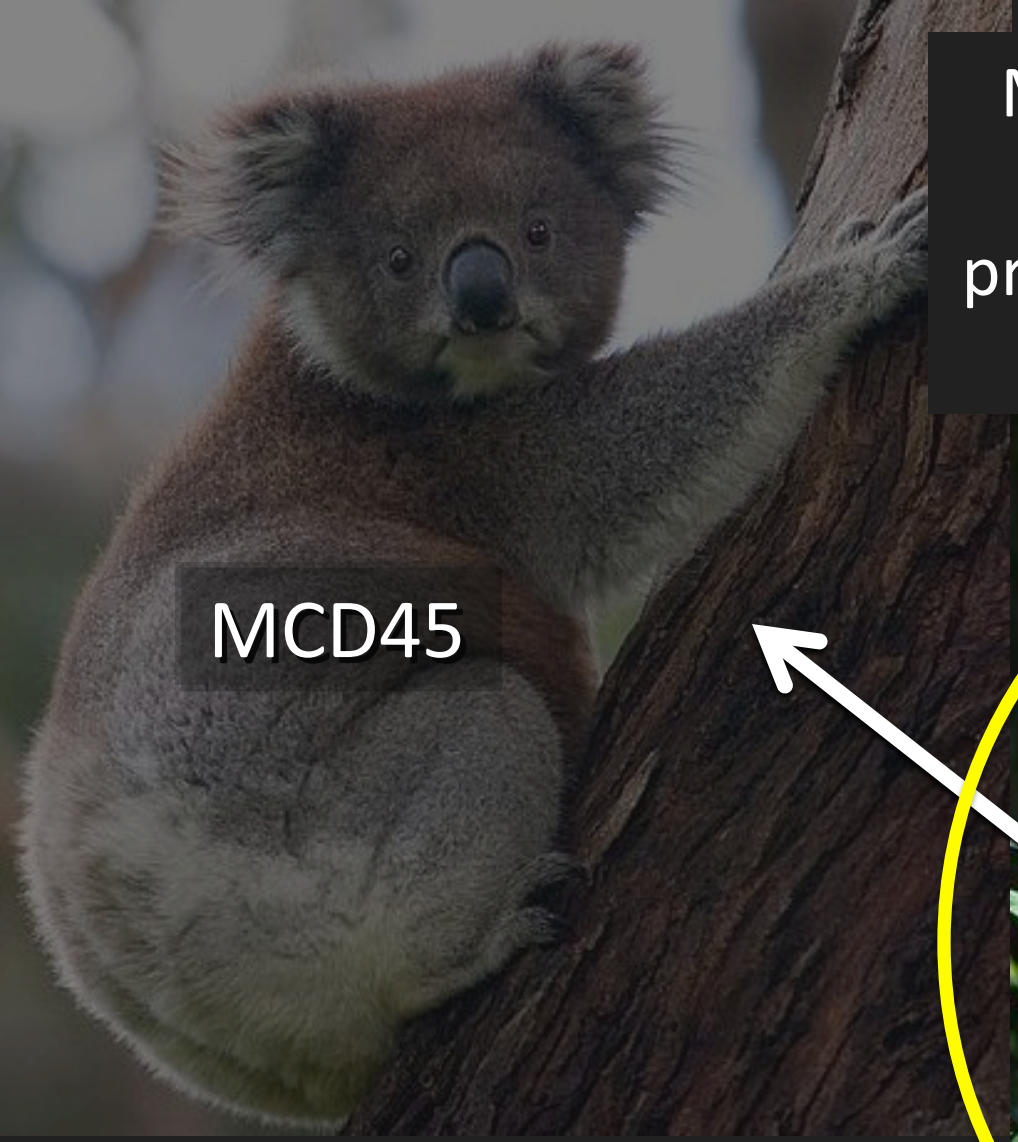
- Supervised classifier
- 500-m, daily
- Exploits active fire data
- More noise-tolerant
- Better mapping under cloudy conditions
- Poorer mapping of cropland burning

Merge features of the two different approaches to produce a better C6 product, i.e., a “Koala Goat”.



Wikimedia Commons

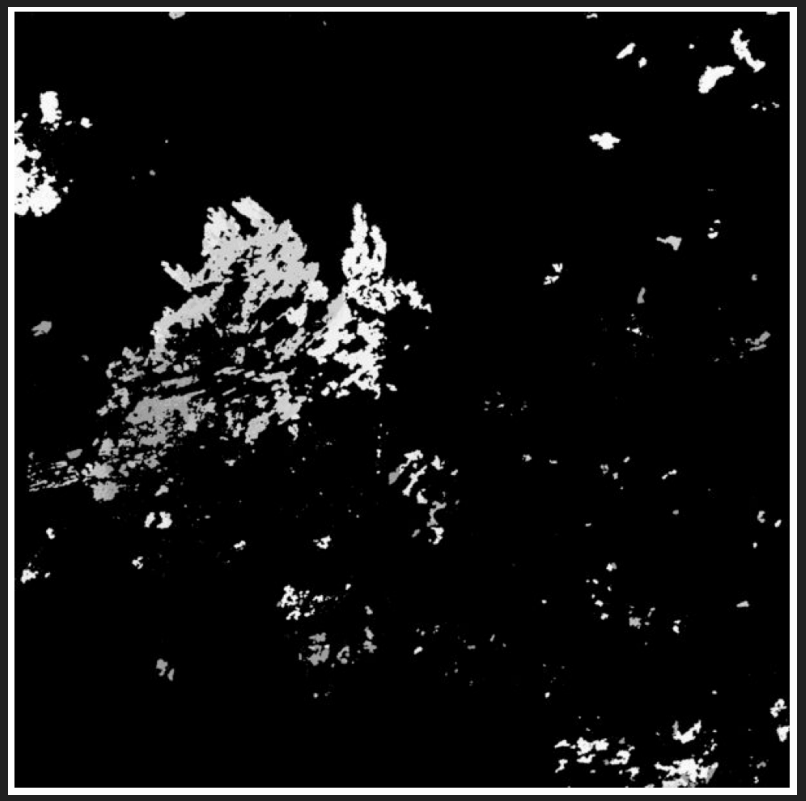
Merge features of the two different approaches to produce a better C6 product, i.e., a “Koala Goat”.



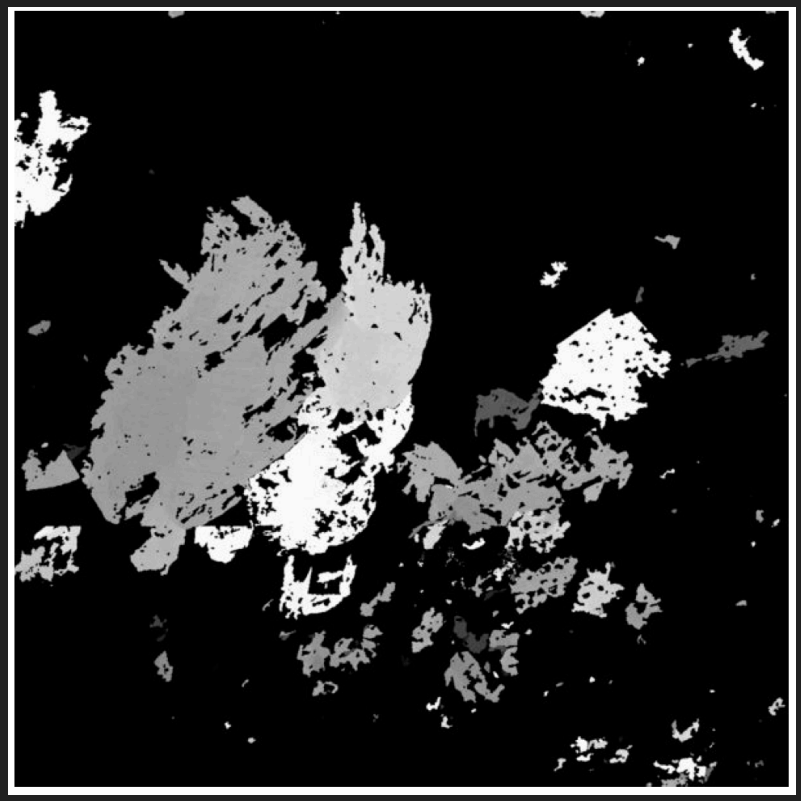
Wikimedia Commons

Large burn in Botswana, Aug.-Sep. 2008

~ 100 km



C5.1 MCD45



C5.1 MCD64

MCD64A1 C6 Changes (So Far)

- More smaller burns detected
  - 5%-10% increase in total burned area
  - 30%-100% increase in agricultural burned area

VIIRS Burned Area Product

- Level 3: Monthly 10° × 10° tiles (sinusoidal projection); burns mapped on a daily basis
  - 500-m spatial resolution for consistency with C6 MCD64A1 burned area product
  - Compromise between M- and I-band spatial resolution
- Additional QA and temporal uncertainty layers
- 0.25° CMG
- Shapefiles and GeoTIFF files produced at SCF

VIIRS Burned Area Product

- Will use VIIRS bands M5, M7, M8, and M11
  - Alternate 375-m I-bands will be considered
- VIIRS MCD64A1 prototyped with daily, 1-km NPP_DSRFIP_L3 surface reflectance product from Land SIPS as placeholder

MCD64A1 Burn Date
Australia (h30v10), 1 March – 31 August 2014