

Latest updates and research on fire radiative energy products

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Trends in Literature

Multi-platform (polar and/or geo) methods/retrievals:

- Wooster et al. (2005) [JGR]
- Roberts et al. (2005) [JGR]
- Freeborn et al. (2009) [RSE]
- Schroeder et al. (2010) [JGR]
- Xu et al. (2010) [RSE]
- Freeborn et al. (2010) [RSE]
- Roberts et al. (2011) [RSE]
- Kumar et al. (2011) [JGR]

Direct fire emissions estimation:

- Ichoku et al. (2008) [RSE]
- Roberts and Wooster (2008) [IEEE Geosci. Rem. Sens]
- Ellicott et al. (2009) [GRL]
- Vermote et al. (2009) [JGR]
- Kaiser et al. (2011) [Biogeosci. Discuss.]

Data assimilation into emissions models including plume height parameterization:

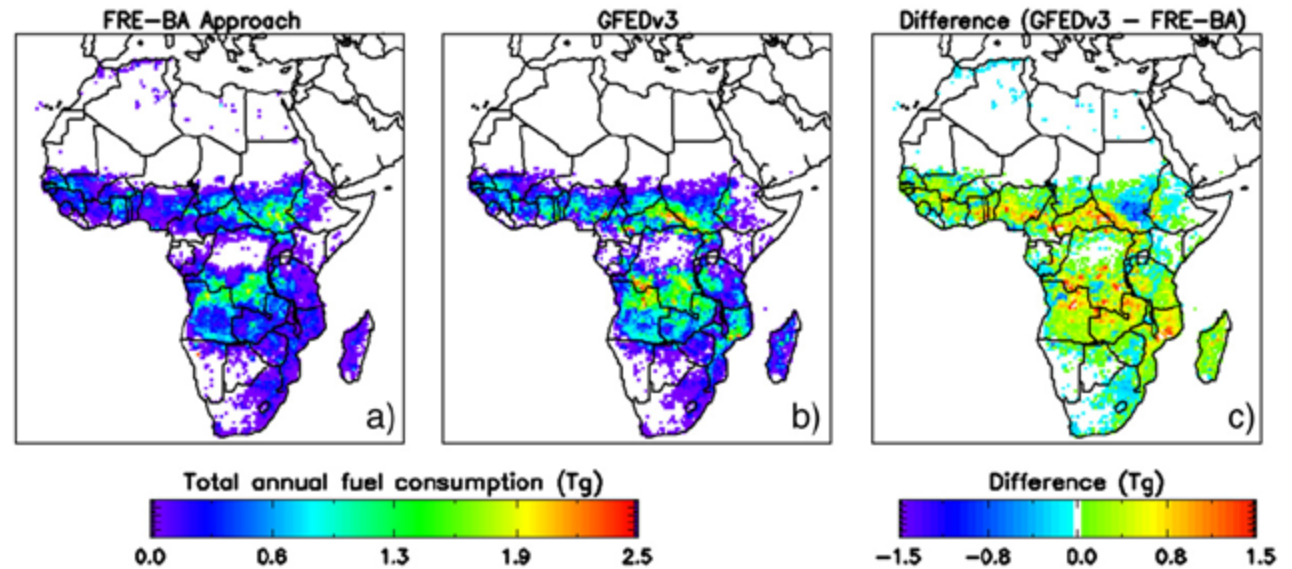
- Pereira et al. (2009) [Atm Env]
- Val Martin et al. (2010) [Atm Chem. Phys.]
- QFEDv2 [NASA/Goddard]
- GBBEP [NOAA]
- FLAMBE [NRL] (Reid et al. 2009, IEEE Sel Top Appl Earth Obs Rem Sens)
- CATT-BRAMS [INPE] (Longo et al. 2009, Atm Chem Phys)

Trends in Literature

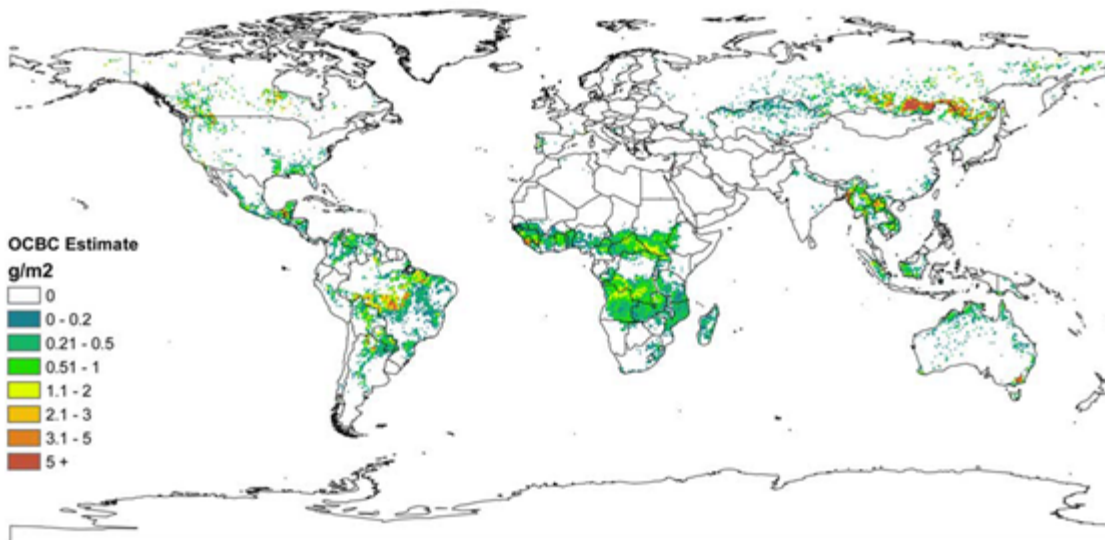
SEVIRI FRE &
MODIS Burned Area
vs
Fuel Consumption



Credit: Roberts et al., 2011



FRE-based Estimated OCBC : 2003



MODIS FRE
vs
OCBC

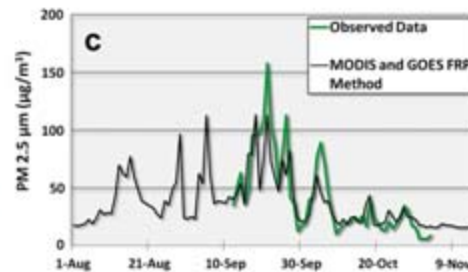
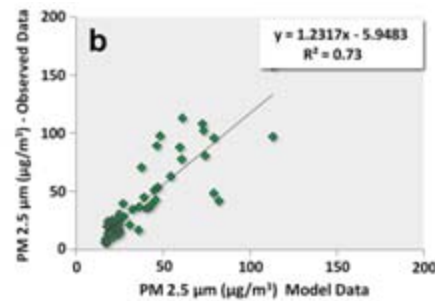
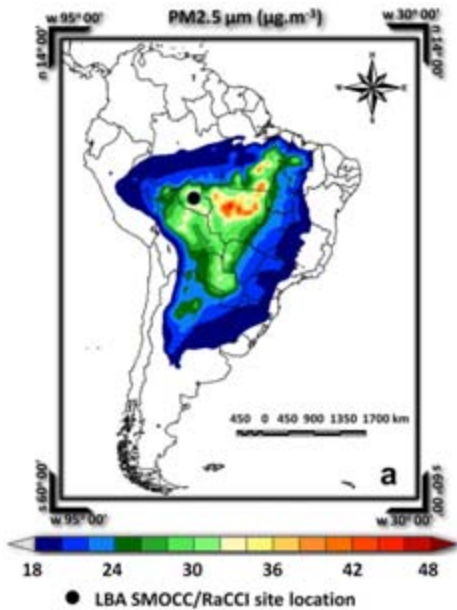
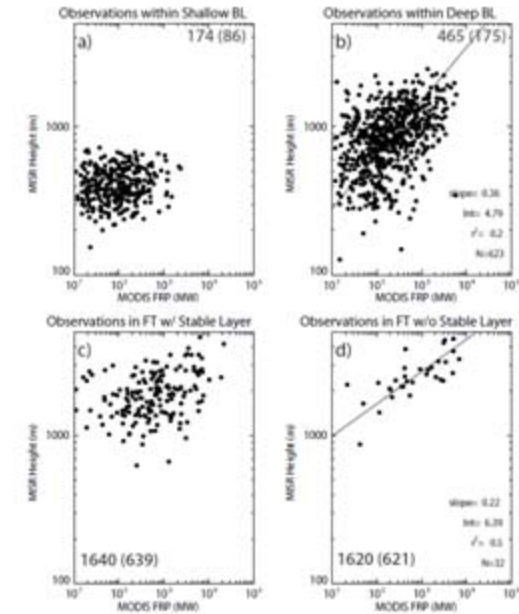
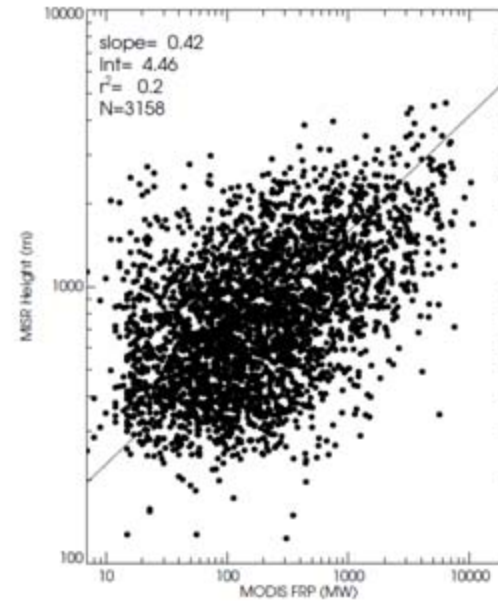
Credit: Vermote et al., 2009

Trends in Literature

MODIS FRP
VS
Plume Injection Height



Credit: Val Martin et al., 2010



MODIS & GOES FRP
VS
Emissions (PM_{2.5} and CO)

Credit: Pereira et al., 2009

Current and Planned FRP Data Sets

Polar Orbiters

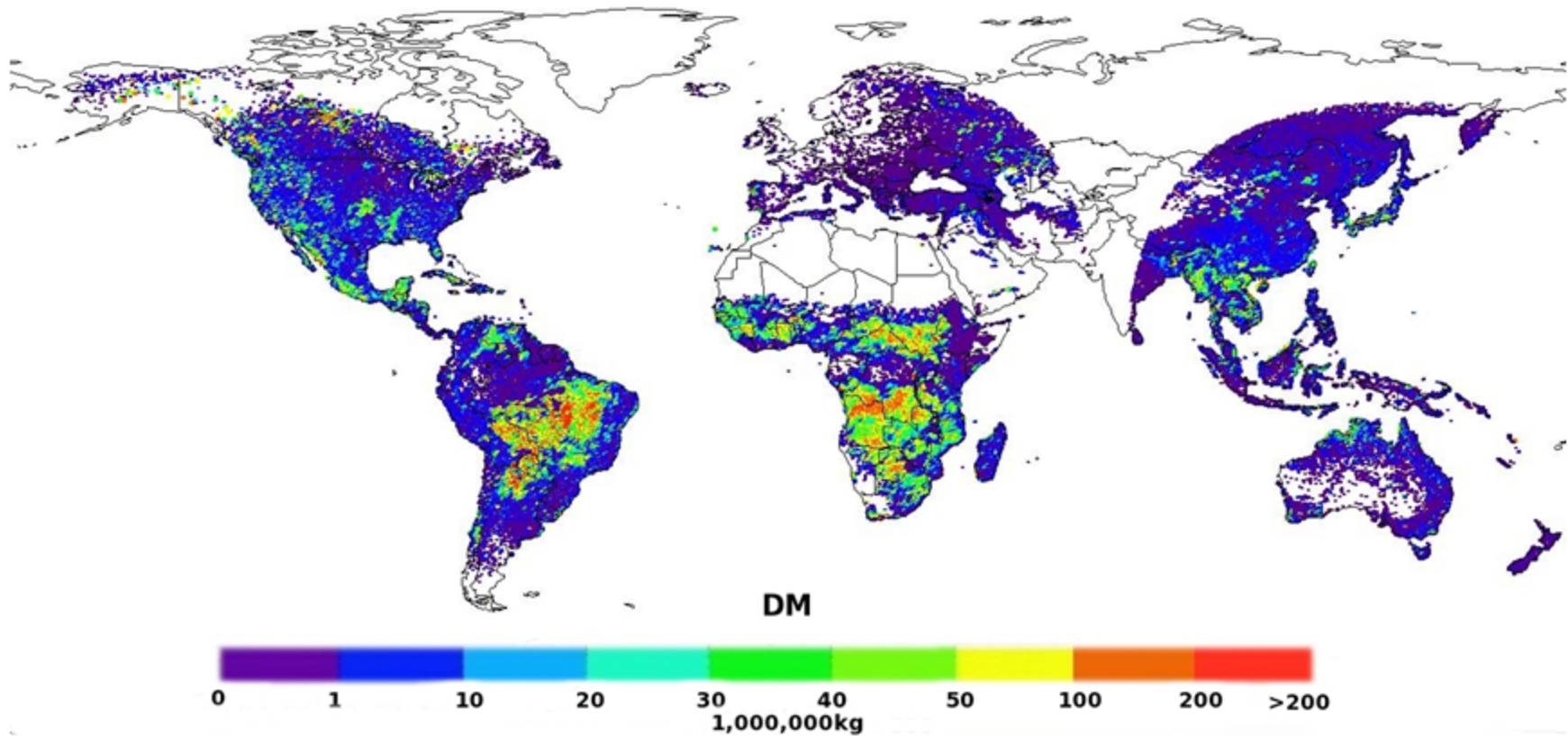
- MODIS [1km]
 - Terra: 2001-present
 - Aqua: 2002-present
- NPP/VIIRS [750m] (FRP retrieval being incorporated to baseline product)
 - Implementation sometime mid-to-late 2012?
- Sentinel-3 [1km]
 - Launch scheduled for 2013
- Other data sets with reduced spatial coverage:
 - NIRST (Aquarius) [350m]
 - Commissioning phase (as of Oct 2011)
 - TET-1, BIROS small satellite missions (DLR) [\cong 355m]
 - TET-1 launch scheduled for Spring 2012 - fire instrument to be activated 12 months after launch
 - BIROS launch scheduled for 2013

Geostationary Sensors

- GOES (East/West) Imager [4km]
 - WF_ABBA 1996-present
 - KCL 200?-present
- MSG [3km]
 - KCL 200?-present
 - WF_ABBA 2009-present
- MTSAT [5km]
 - WF_ABBA 2009-present

Current and Planned FRP Data Sets

GOES + MSG + MTSAT Geo Product
(2010 Data)

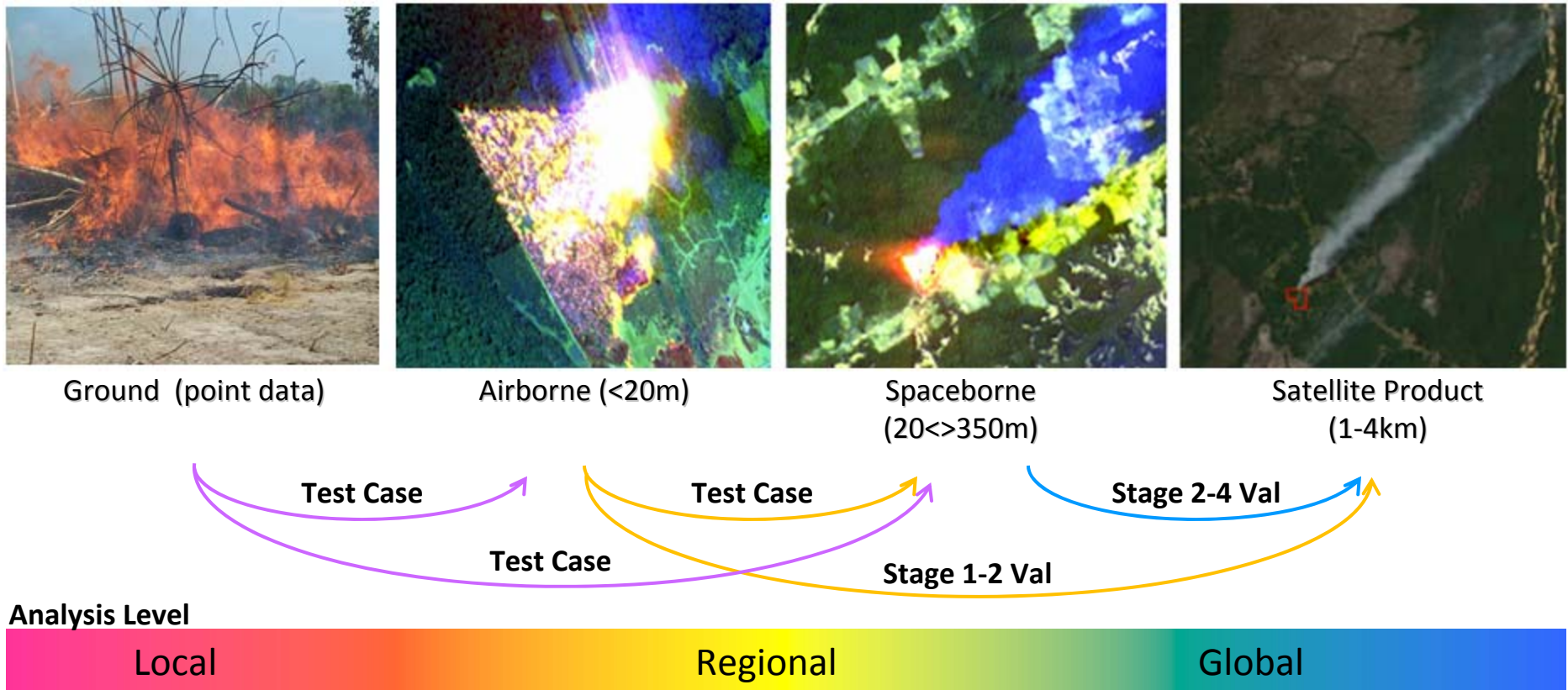


Credit: Zhang & Kondragunta
(NOAA)

Primary Validation: Data Requirements

- Near-coincident acquisition (<15min)
- Good quality
 - Adequate spectral data
 - No pixel saturation
 - Well navigated (<1 pixel)
- Spatially representative
 - Map both fire and background
 - Fine enough resolution to resolve sub-pixel fires

Layers Normally Required When Scaling-up Fire Data

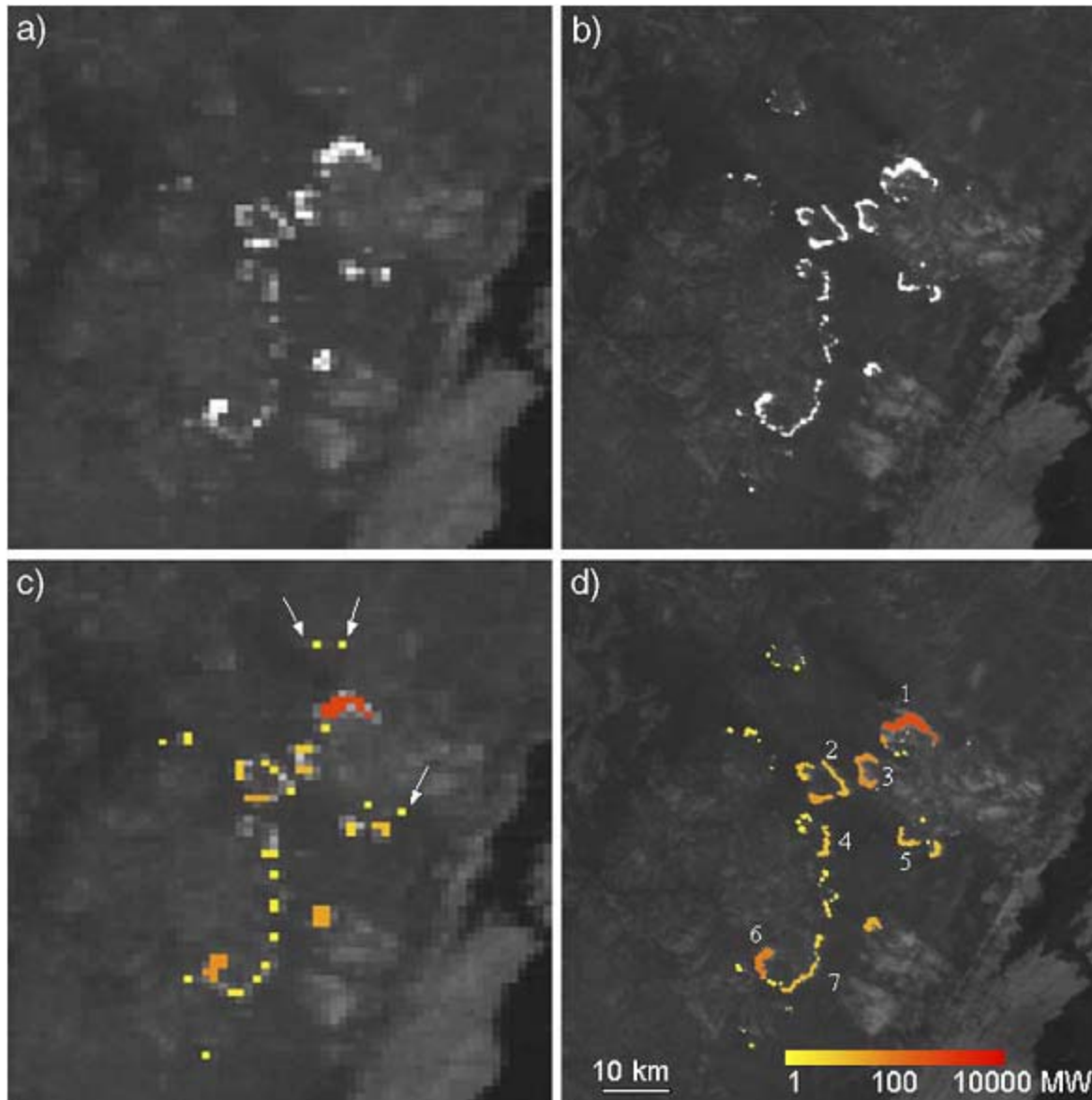


Primary Validation: Reference Data Sets

Relatively limited resources available:

- Field campaigns are sparse and difficult to coordinate
 - Collaboration with forestry departments is a good alternative
 - Use of prescribed burns
 - Good way to engage end-user during the process
- Airborne assets usually require significant investment (\$\$)
 - Collaboration with instrument teams & forestry departments must be expanded
 - Large volumes of data may be collected by instrument and/or fire incident teams
 - Not always in sync with satellite applications (near-coincident acquisition)
 - Sensor characteristics may not meet reference data requirements
- Growing number of fire-dedicated spaceborne sensors
 - DLR's BIRD small satellite mission provided quality fire data from 2001-2004 over selected regions
 - TET-1 and BIROS follow-up missions could provide valuable reference fire data
 - NIRST sensor onboard the Aquarius mission is a new option
 - New sensor technology must be tested/verified
 - HysPIRI mission still in the concept development phase

MODIS-BIRD Coincident Acquisition : Lake Baikal (Russia/2003)

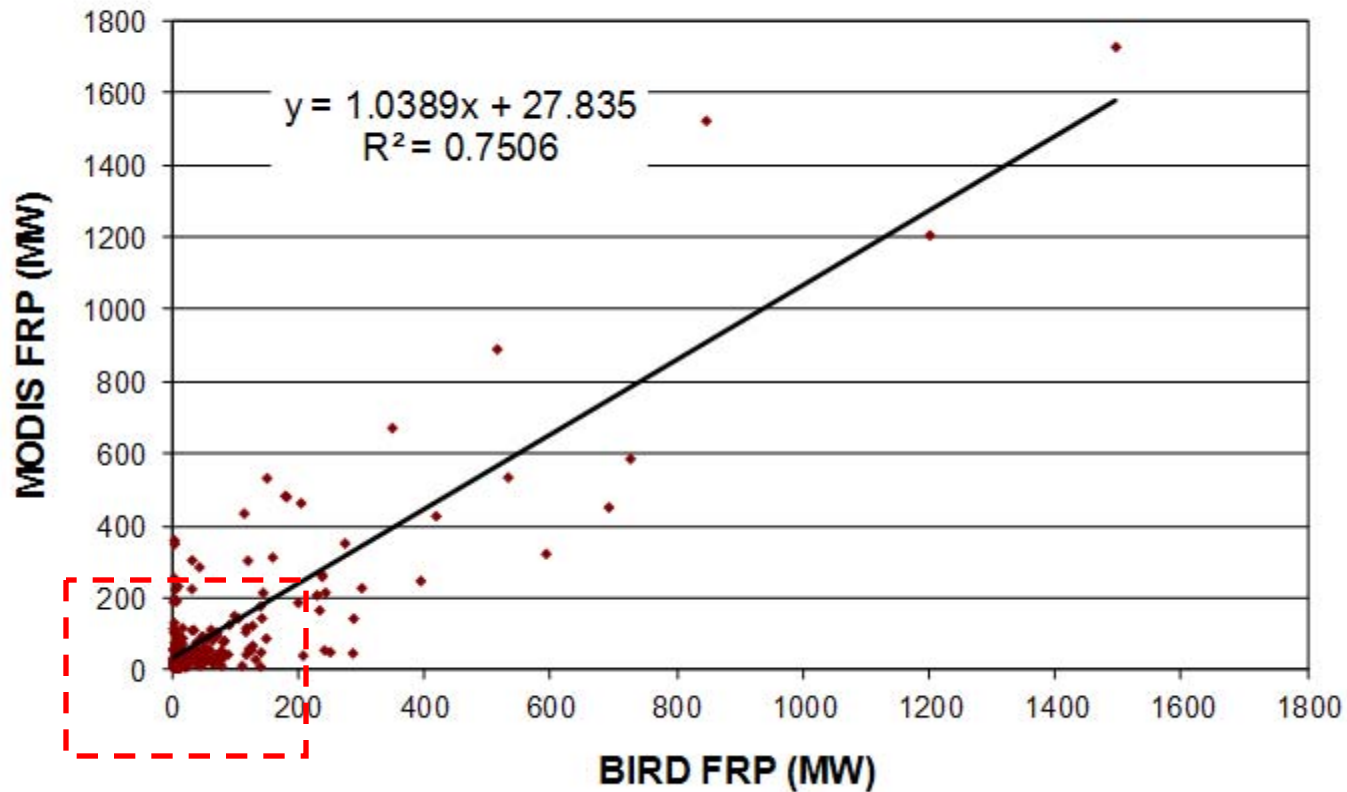


- a) MODIS middle-infrared (fire) band
- b) BIRD middle-infrared (fire) band
- c) MODIS fire detection pixels
- d) BIRD fire detection pixels

Credit: Zhukov et al., 2006

MODIS vs BIRD FRP Retrievals

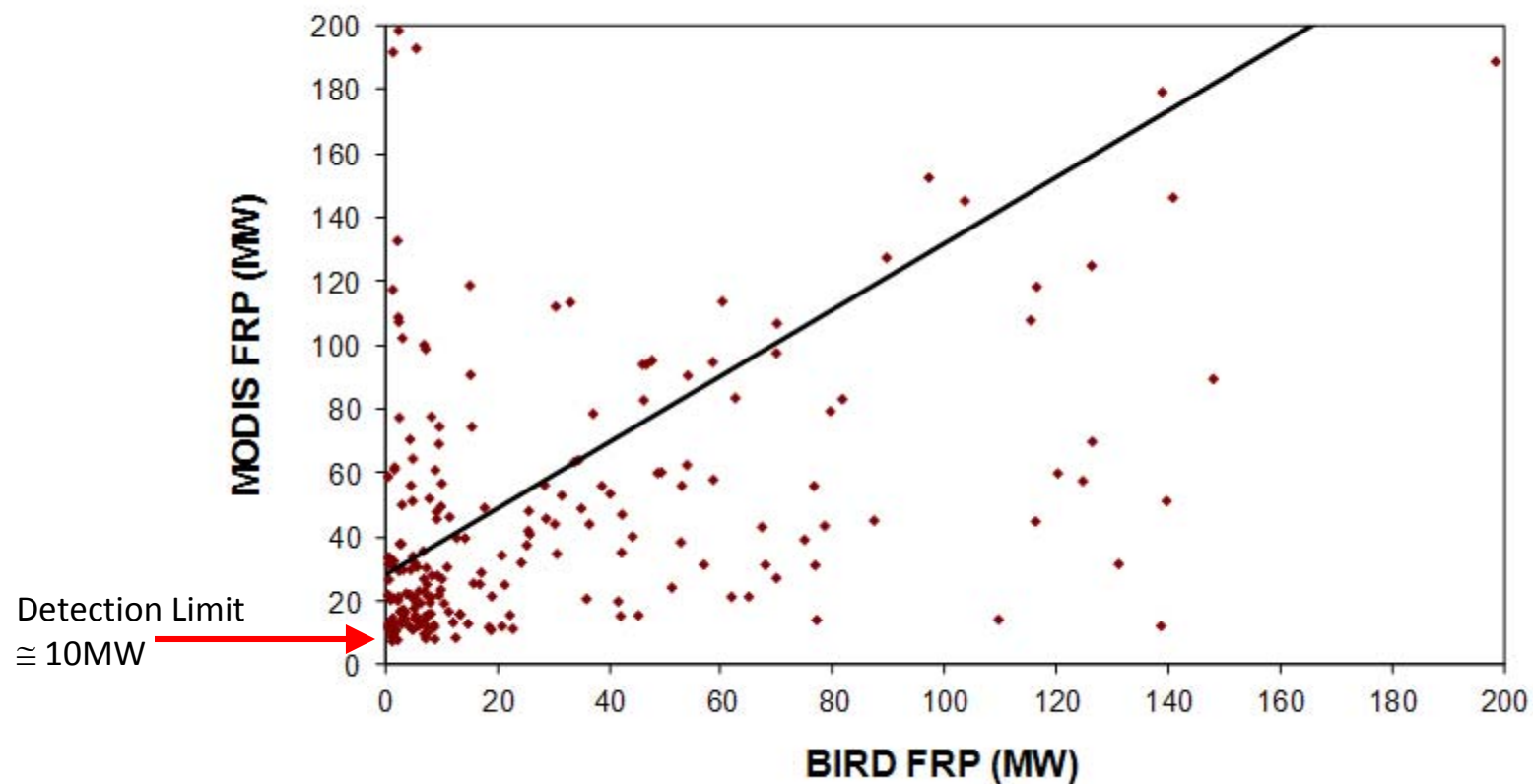
Near coincident scene comparison on cluster level



Courtesy of G. Ruecker

MODIS vs BIRD FRP Retrievals

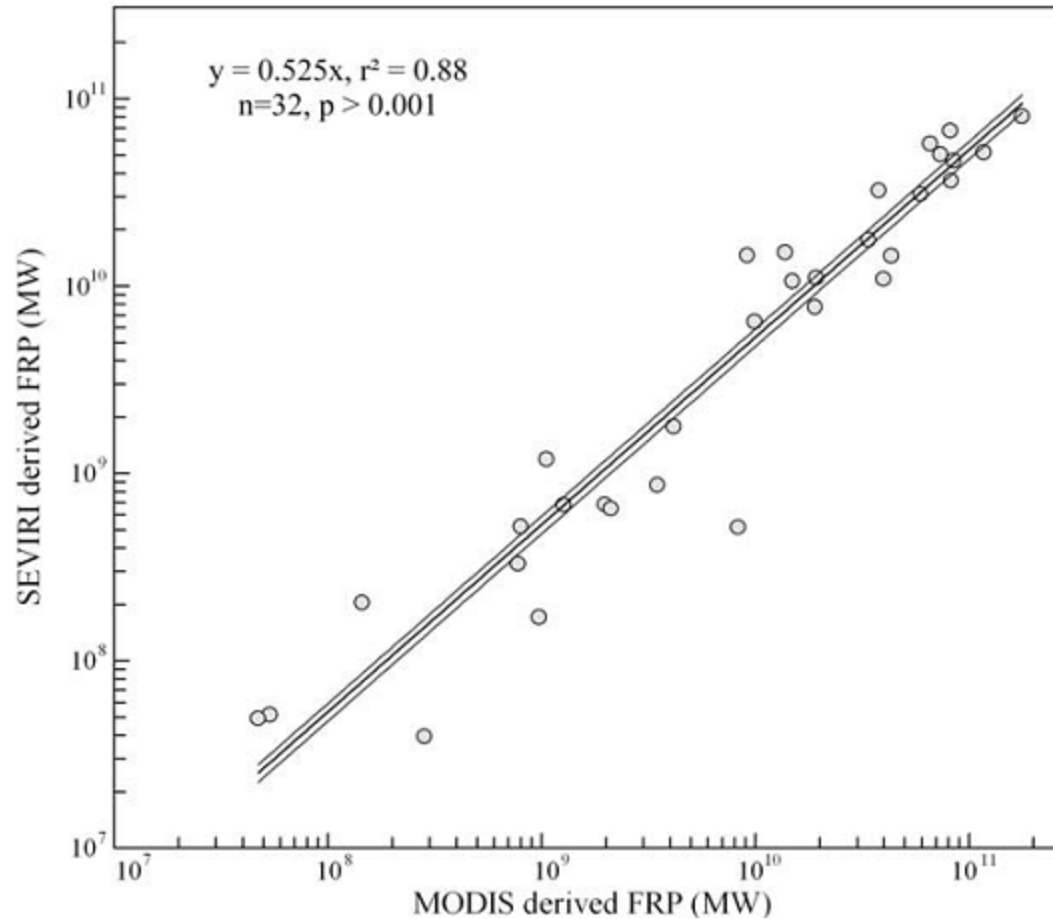
Near coincident scene comparison on cluster level



95% of MODIS Fire Pixels <200MW
(single pixel fires +50%)

MODIS-SEVIRI Intercomparison (Southern Africa)

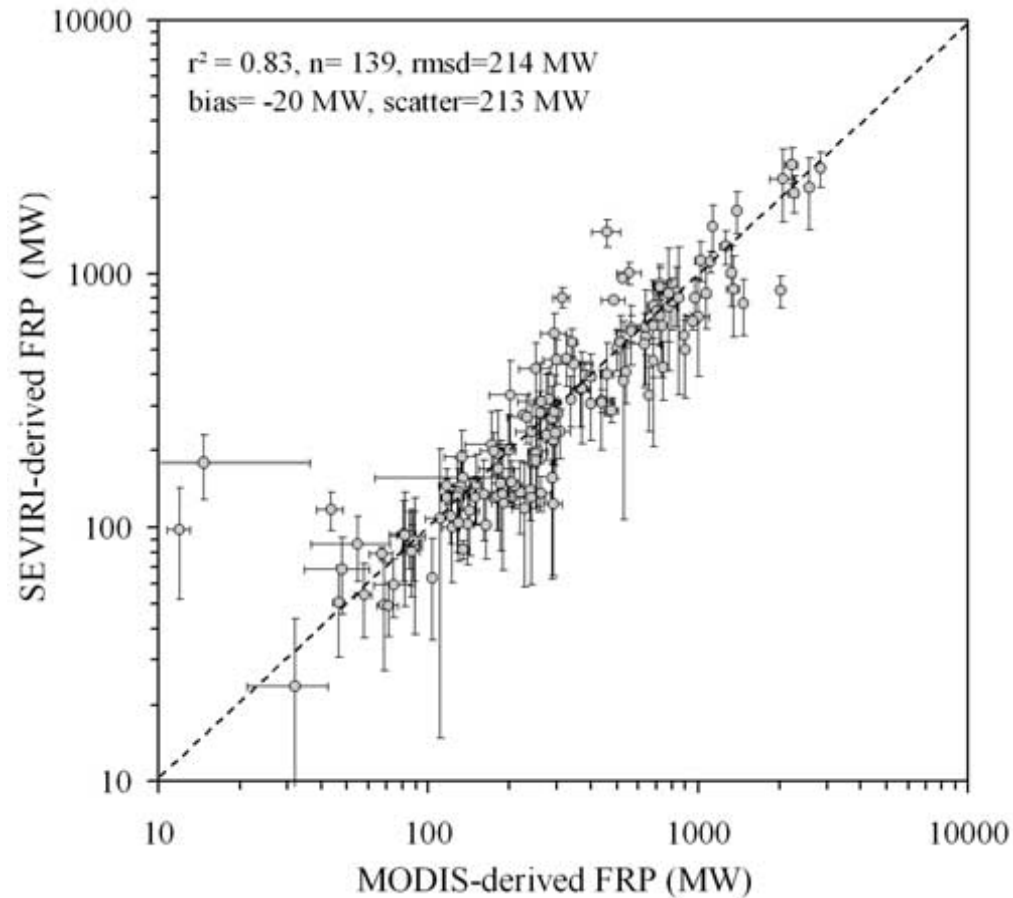
Near-coincident scene comparison (1900x2030km)



Credit: Roberts et al. (2005)

MODIS-SEVIRI Intercomparison (Southern Africa)

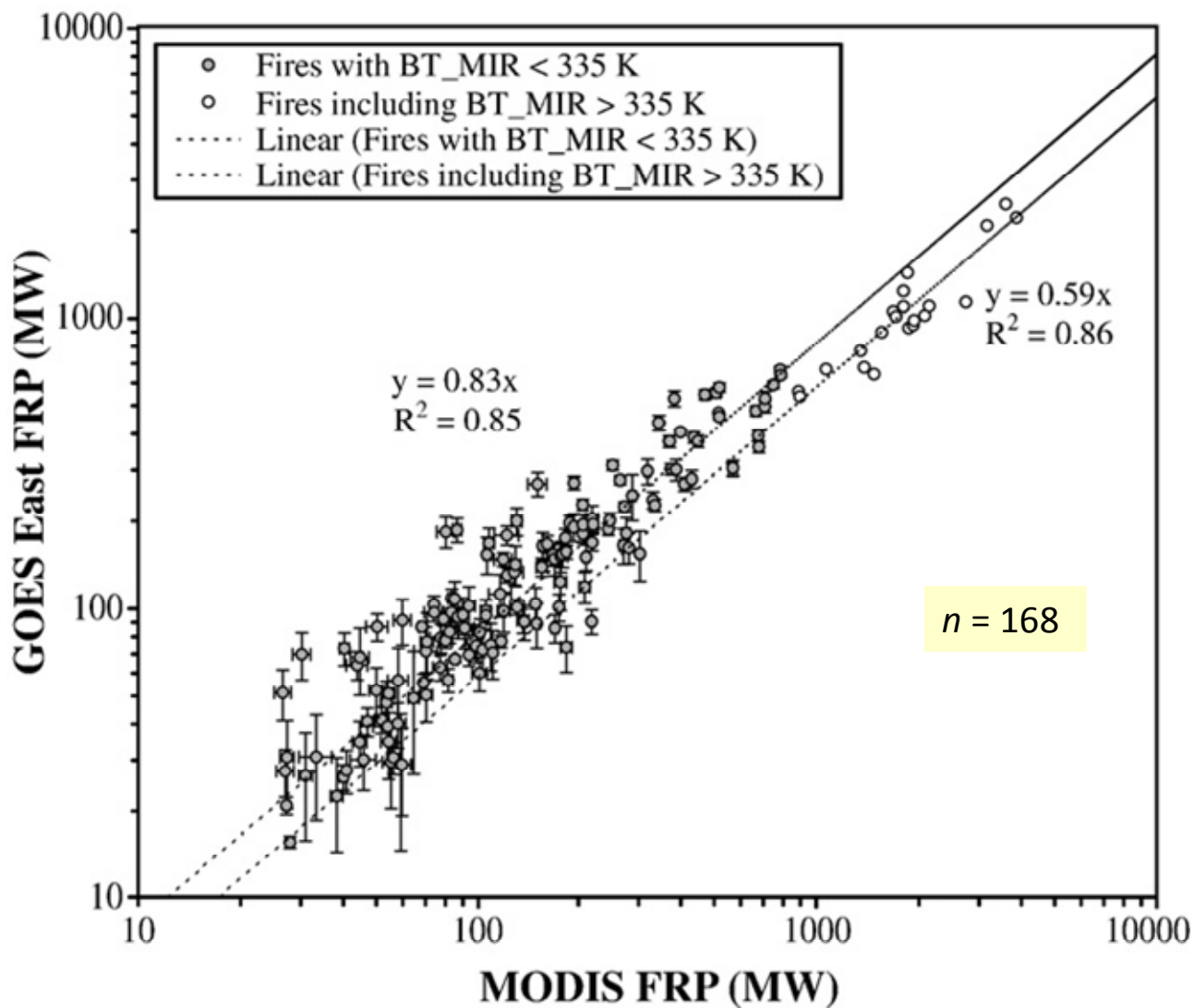
Near-coincident scene comparison on cluster level



Credit: Roberts et al. (2005)

MODIS-GOES Intercomparison (Western Hemisphere)

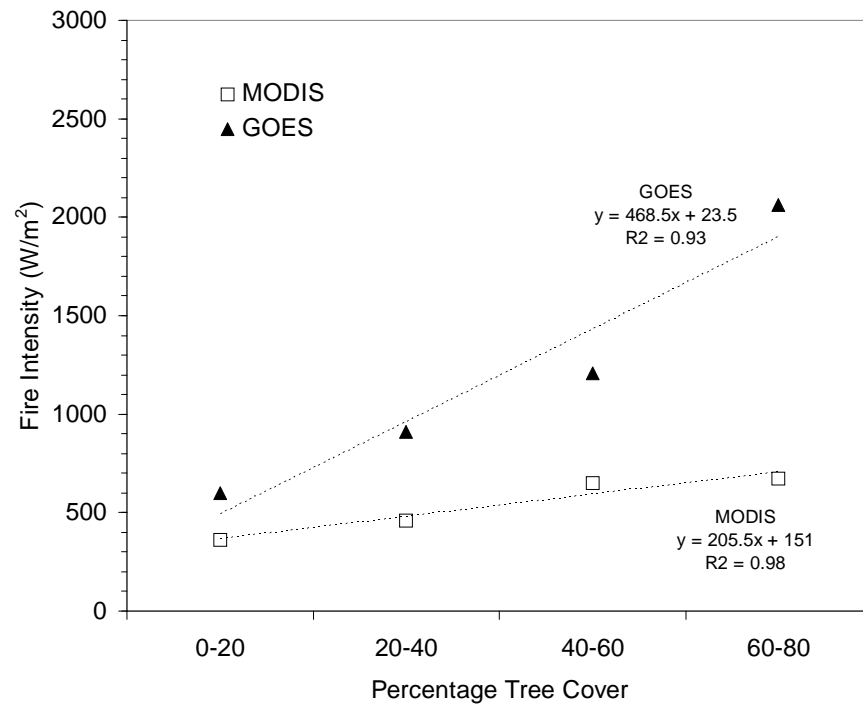
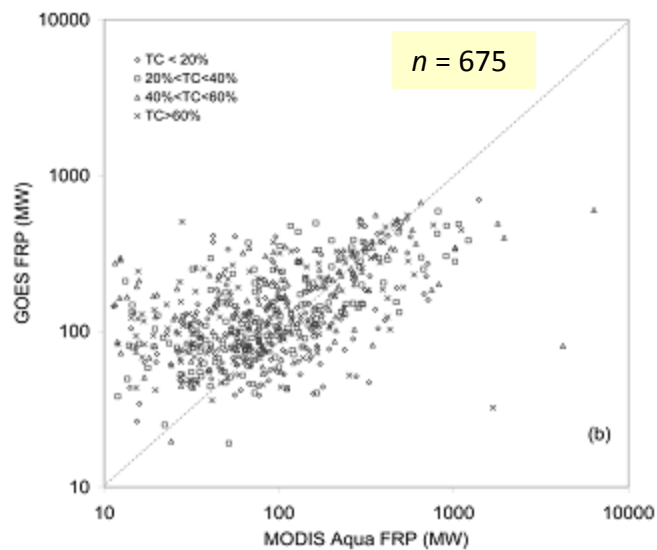
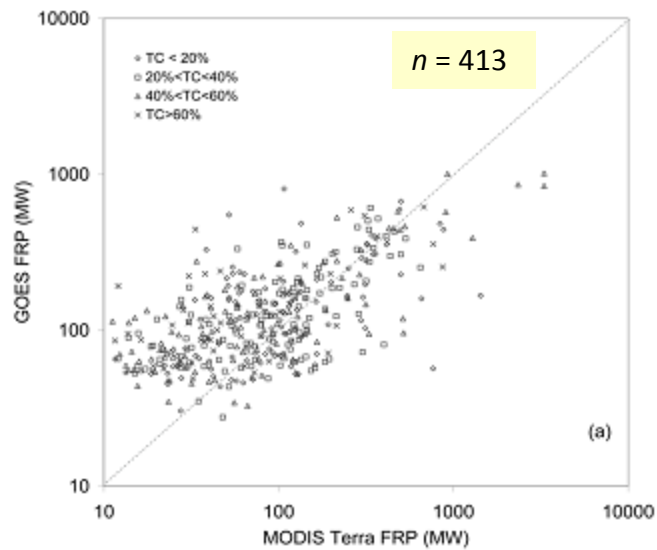
Near-coincident scene comparison on cluster level



Credit: Xu et al. (2010)

MODIS-GOES Intercomparison (Brazilian Amazon)

Near-coincident scene comparison on cluster level



12 paired Terra/MODIS x GOES

11 Aqua/MODIS x GOES

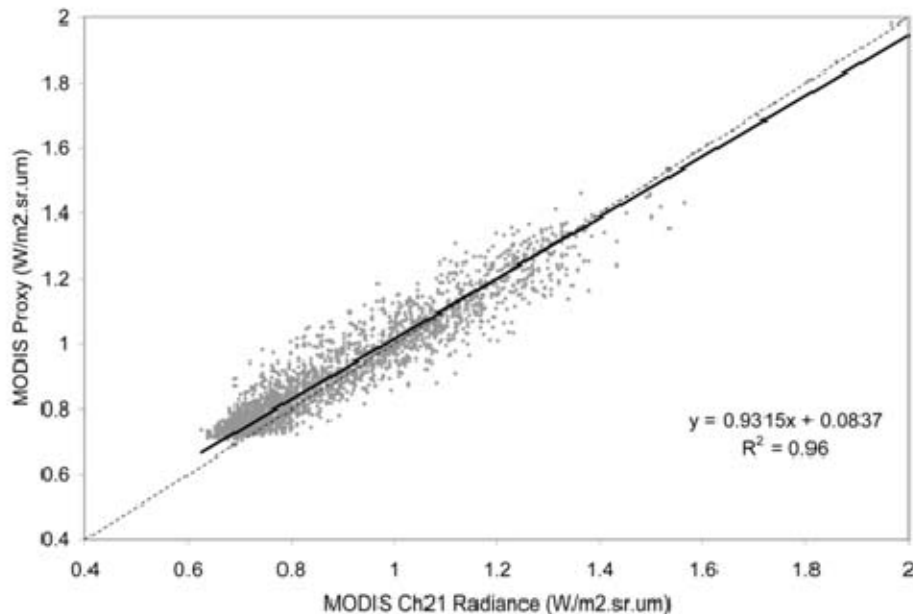
Credit: Schroeder et al. (2010)

Data Simulation

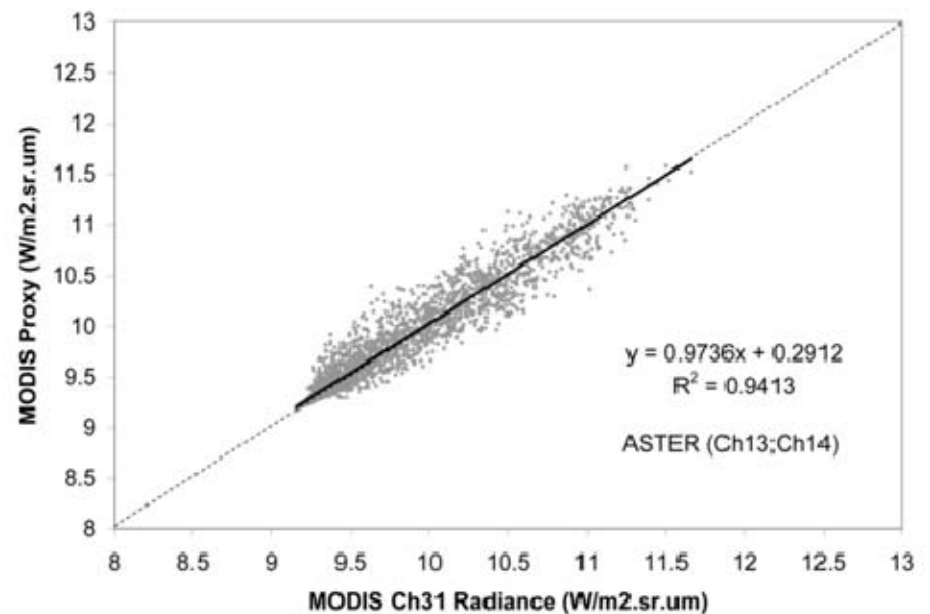
Higher spatial resolution airborne and spaceborne data are used as input to simulate coarser resolution satellite active fire products

- Improved representation of fire and background conditions (landscape features)
- Simulation of more complex/realistic environments
- Greater flexibility to assess the effects of PSF and pixel geometry, background and atmospheric influence on FRP retrievals

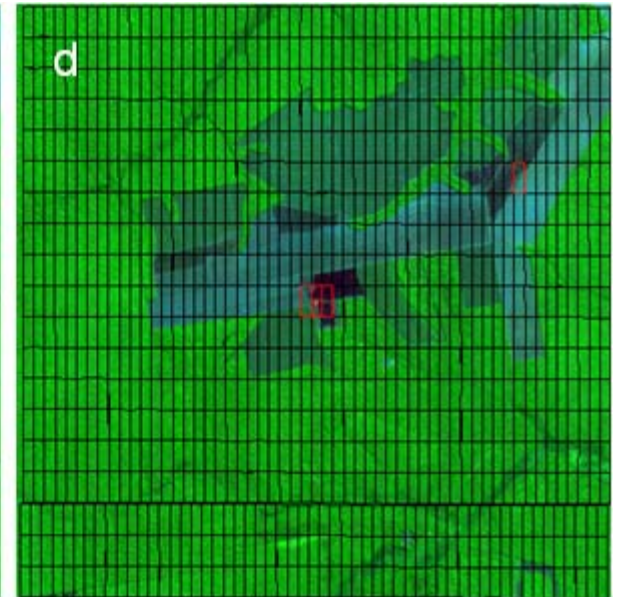
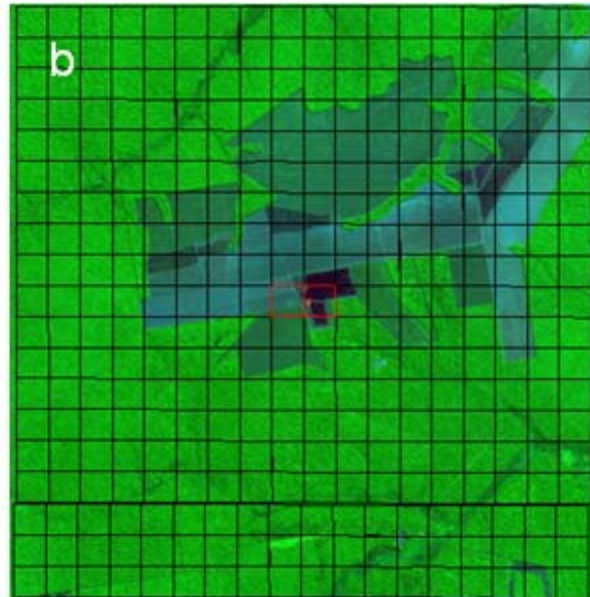
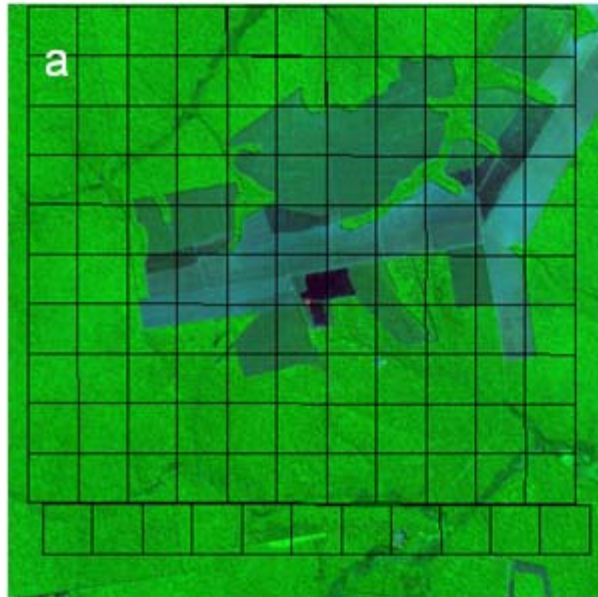
MIR (MODIS Ch21)



TIR (MODIS Ch31)



Data Simulation: NPP/VIIRS

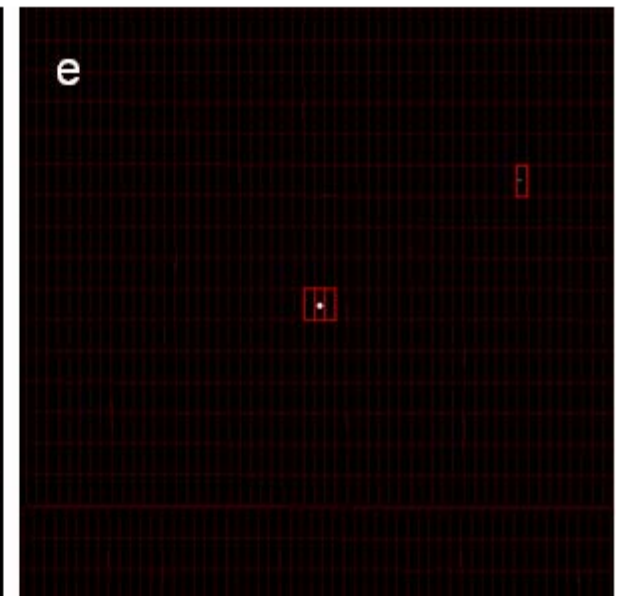
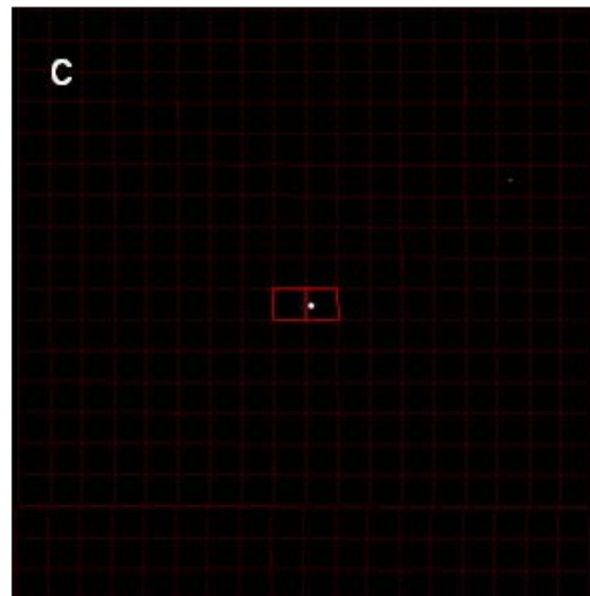


a \Rightarrow MODIS/Terra (1km)

b, c \Rightarrow VIIRS (750m)

d, e \Rightarrow VIIRS (250x750m)

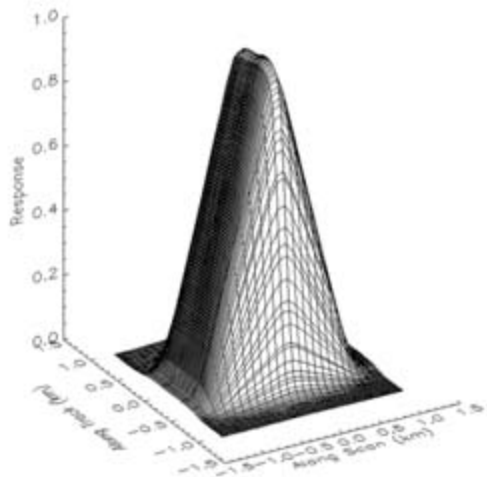
Background \Rightarrow ASTER
(RGB 8-3-1)



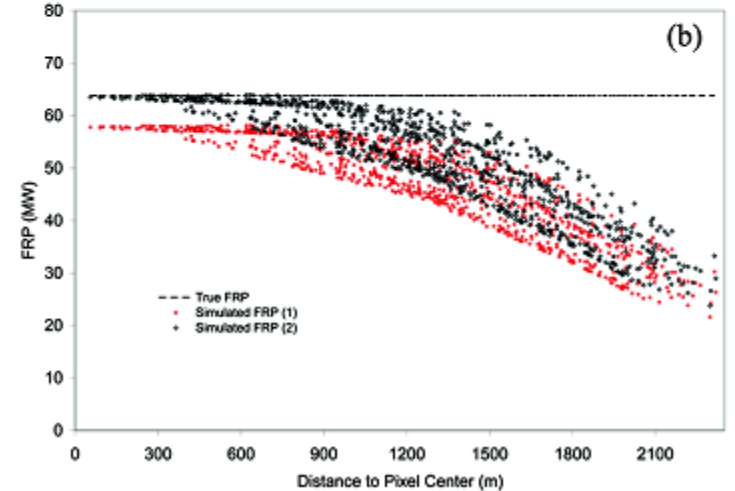
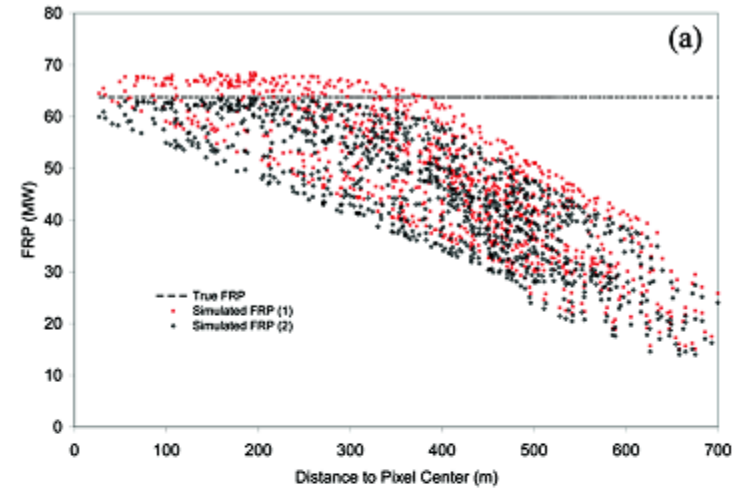
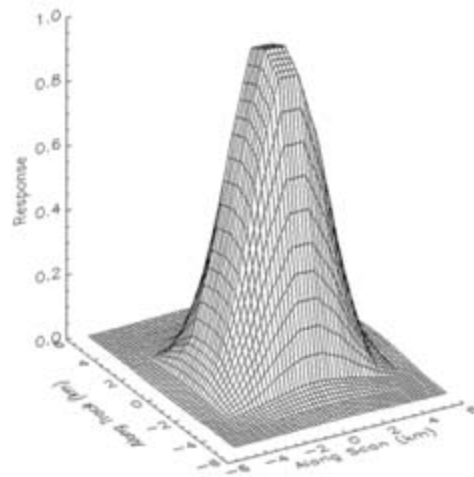
Backup Slides

Spatial Considerations

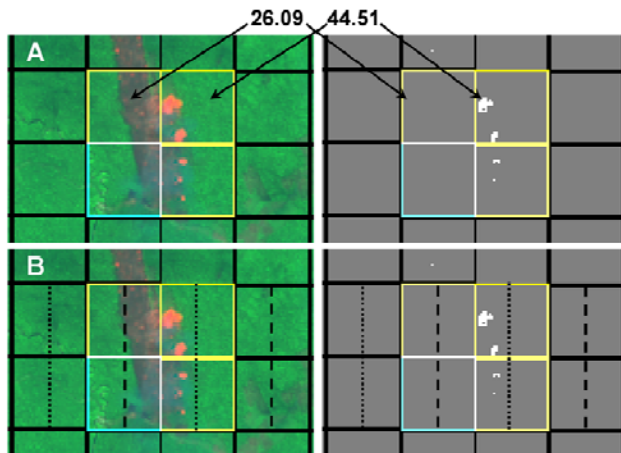
MODIS Pixel Spatial Response



GOES Imager Pixel Spatial Response



FRP Retrievals (MW)



MODIS/Terra FRP (MW)

A = Nominal pixel area

B = Effective pixel area

Adjusted Values:

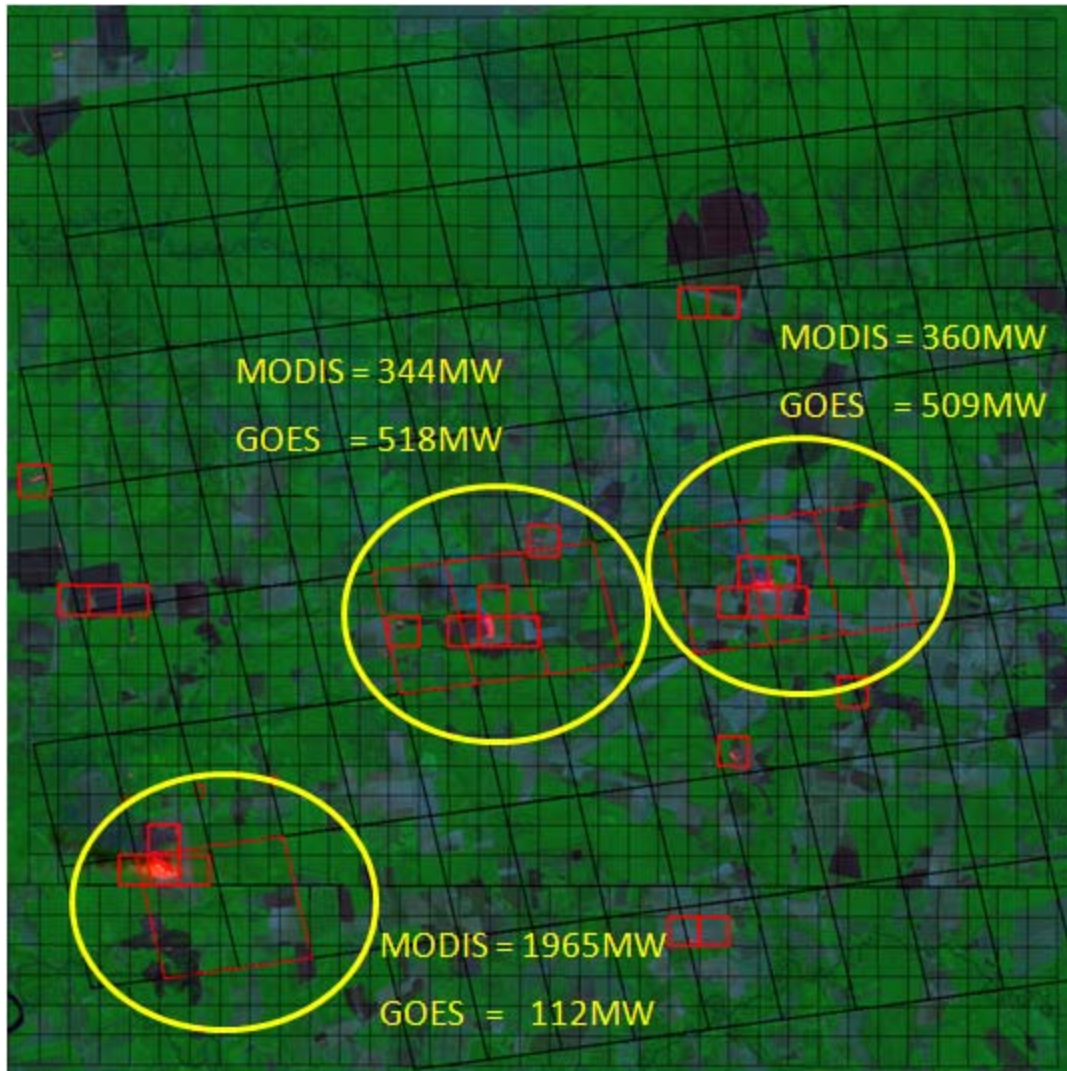
Left pixel = 69.81 MW

Right pixel = 63.03 MW

Credit: Schroeder et al. (2010)

Challenging Environments (Brazilian Amazon)

Inter-comparison of MODIS/Terra FRP with near-coincident GOES Imager data

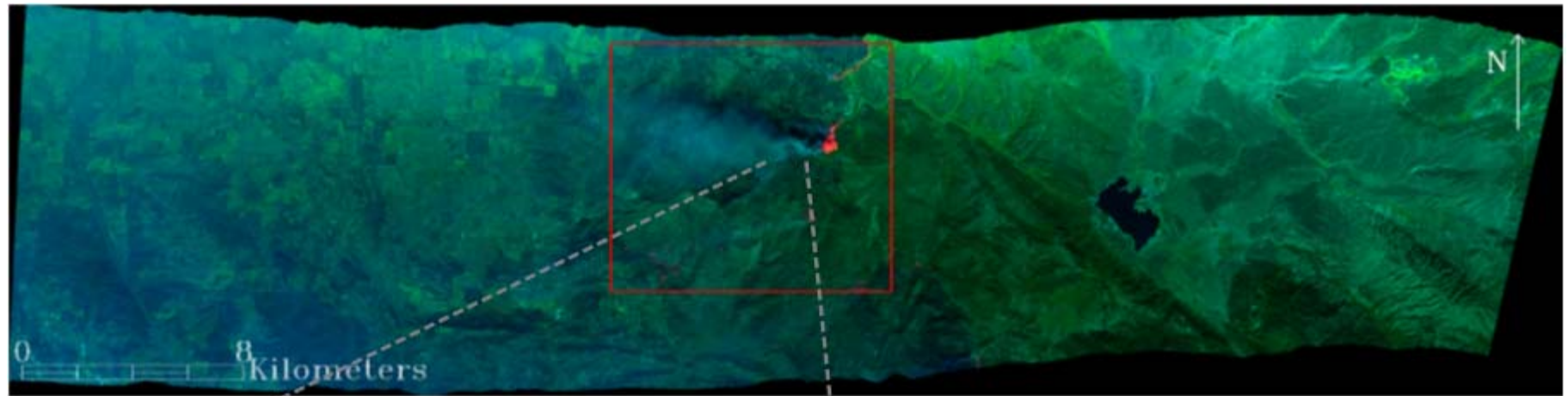


Mix of:

- Omission Errors
- Commission Errors (false alarms)
- Background characterization
- Spatial response (PSF)
- Atmospheric contamination

Airborne Reference Data

Airborne fire retrievals must also be verified/calibrated



NASA/Ames
AMS image
of California
fire in 2007

