MODIS Active Fire Validation

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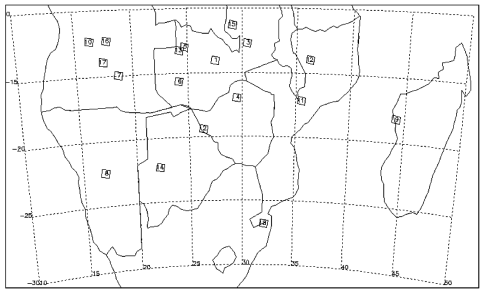
MODIS Science Team Meeting, 27th Jan 2010

Land Breakout Session

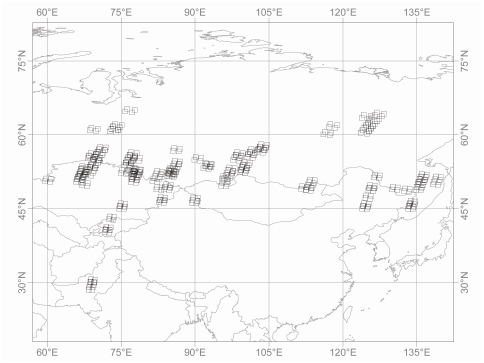
Background



- Sample Size: **18 ASTER scenes**
- Region: **South Africa**

➢ Proof of concept using fixed threshold method applied to ASTER band 9 to derive 30m resolution active fire masks

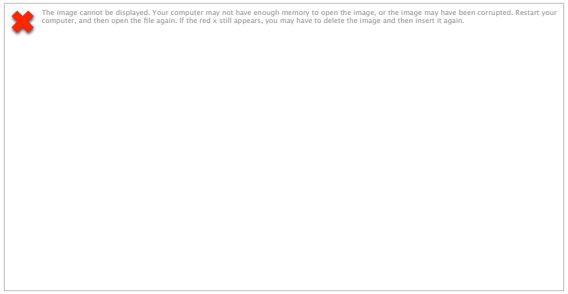
☞Morisette et al. 2005



- Sample Size: **131 ASTER scenes**
- Region: **Northern Eurasia**

➢ Development of active fire validation protocol

☞Csiszar *et al*. 2006

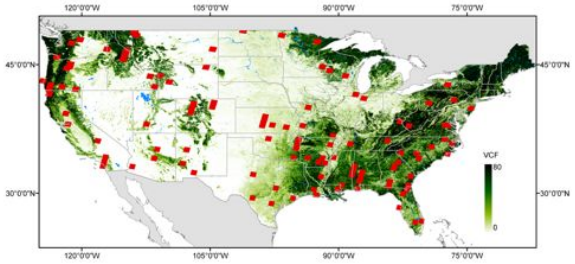


- Sample Size: **100 ASTER scenes**
- Region: **Global**

➢ Development of robust active fire detection algorithm for ASTER

☞Giglio *et al*. 2008

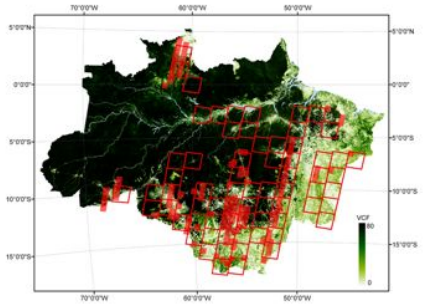
Background



- Sample Size: **115 ASTER scenes**
- Region: **CONUS**

➢ Validation of NOAA/NESDIS operational fire monitoring system including analyst data

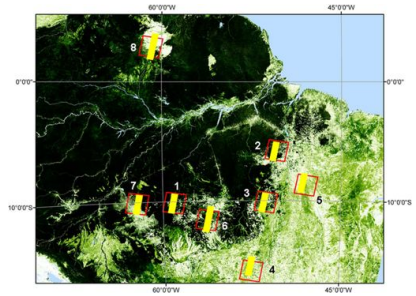
☞Schroeder *et al*. 2008



- Sample Size: **167 ASTER + 123 Landsat ETM+ scenes**
- Region : **Brazilian Amazonia**

➢ Generalization of moderate-coarse resolution fire data validation (MODIS + GOES) using higher resolution imagery

☞ Schroeder *et al*. 2008

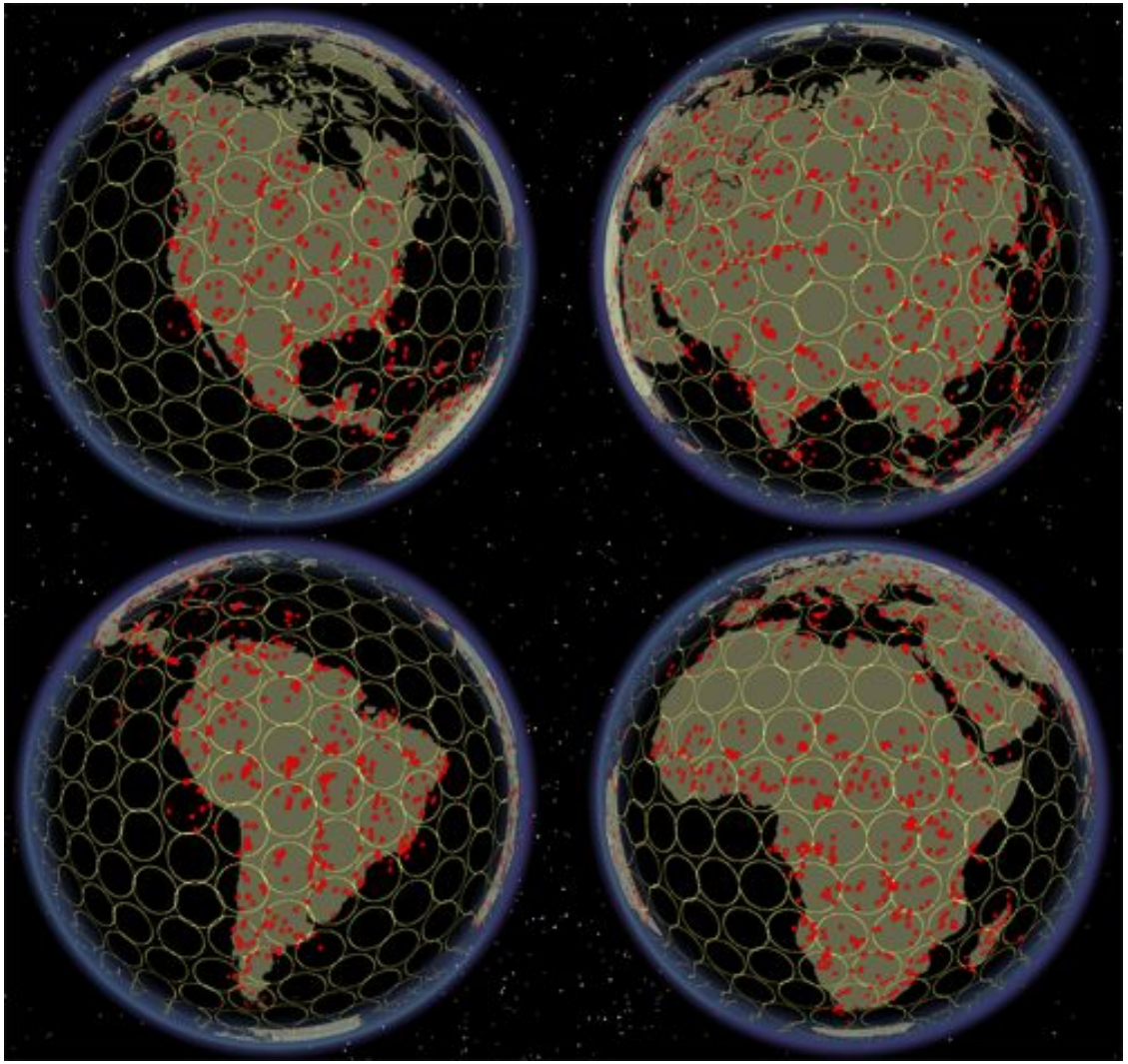


- Sample Size: **24 ASTER + 8 Landsat ETM+ scenes**
- Region : **Brazilian Amazonia**

➢ Assessment of short-term variation in fire behavior – implications to active fire validation

☞ Csiszar *and Schroeder* 2008

Current Status



- Sample Size: **~2500 ASTER scenes**
- Region : **Global**

➢ Stage III validation of MOD14

☞ Schroeder *et al*. (in preparation)

• Daytime & nighttime data

• Data equally distributed across the globe

• Multi-year analysis (2001-2006)

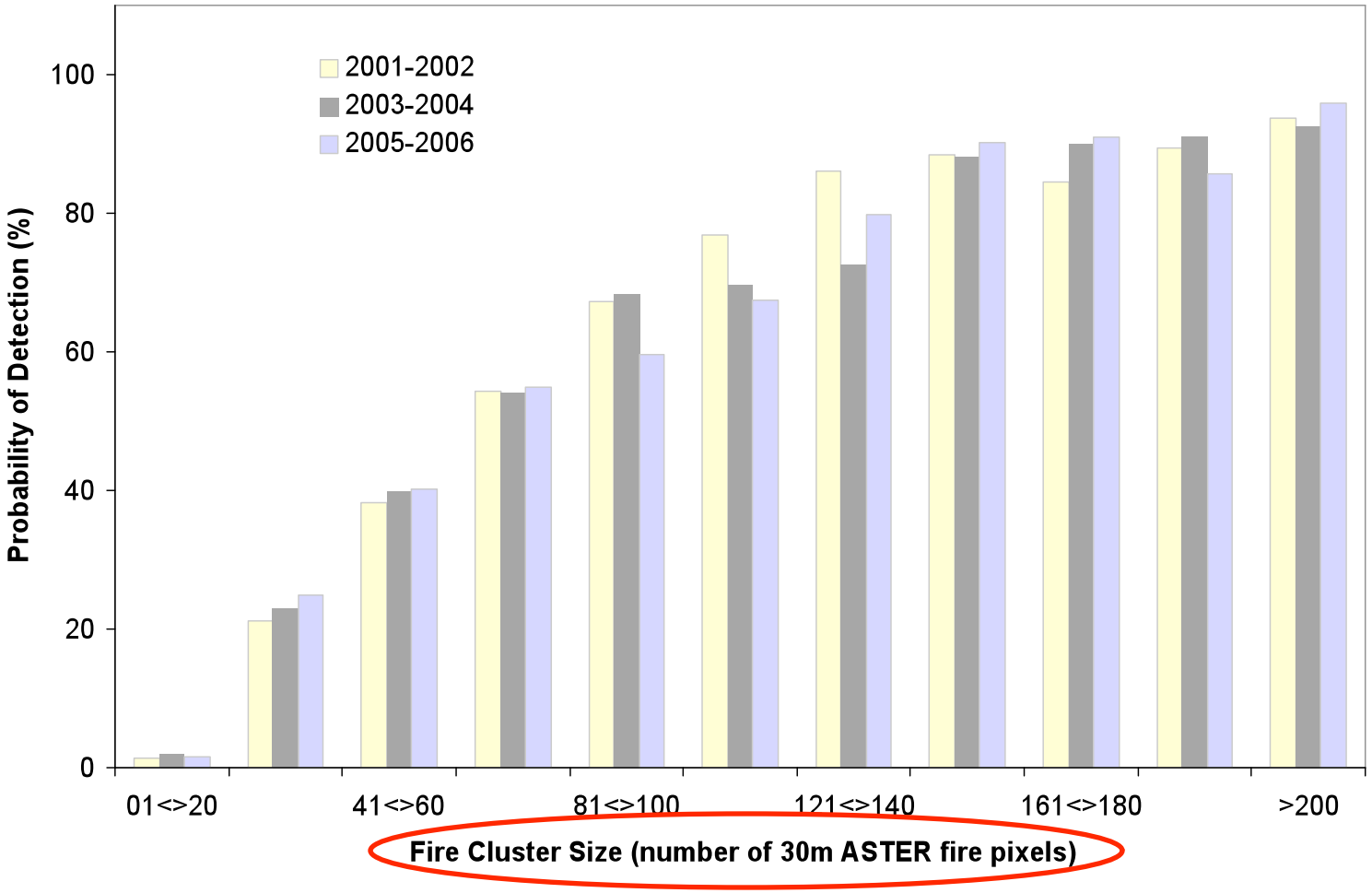
  • ASTER SWIR anomaly May ‘07

• Omission/commission errors derived as a function of percent tree cover

Temporal Consistency of MOD14 Detection Performance

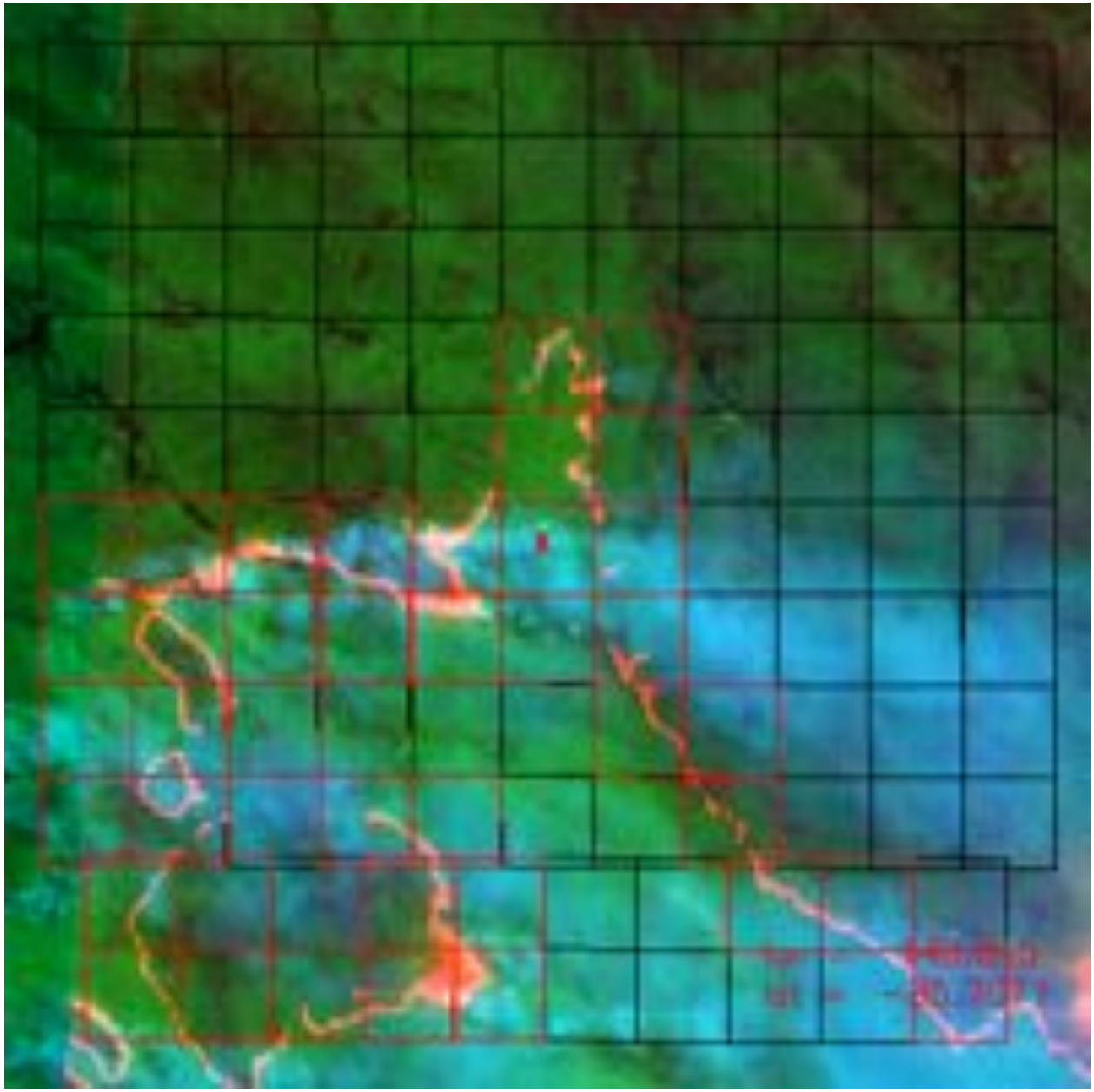
Using a subset of points covering the range of 20-40% tree cover

- No statistically significant difference over time (i.e., $\Delta D_t = 0$; $p < 0.01$)



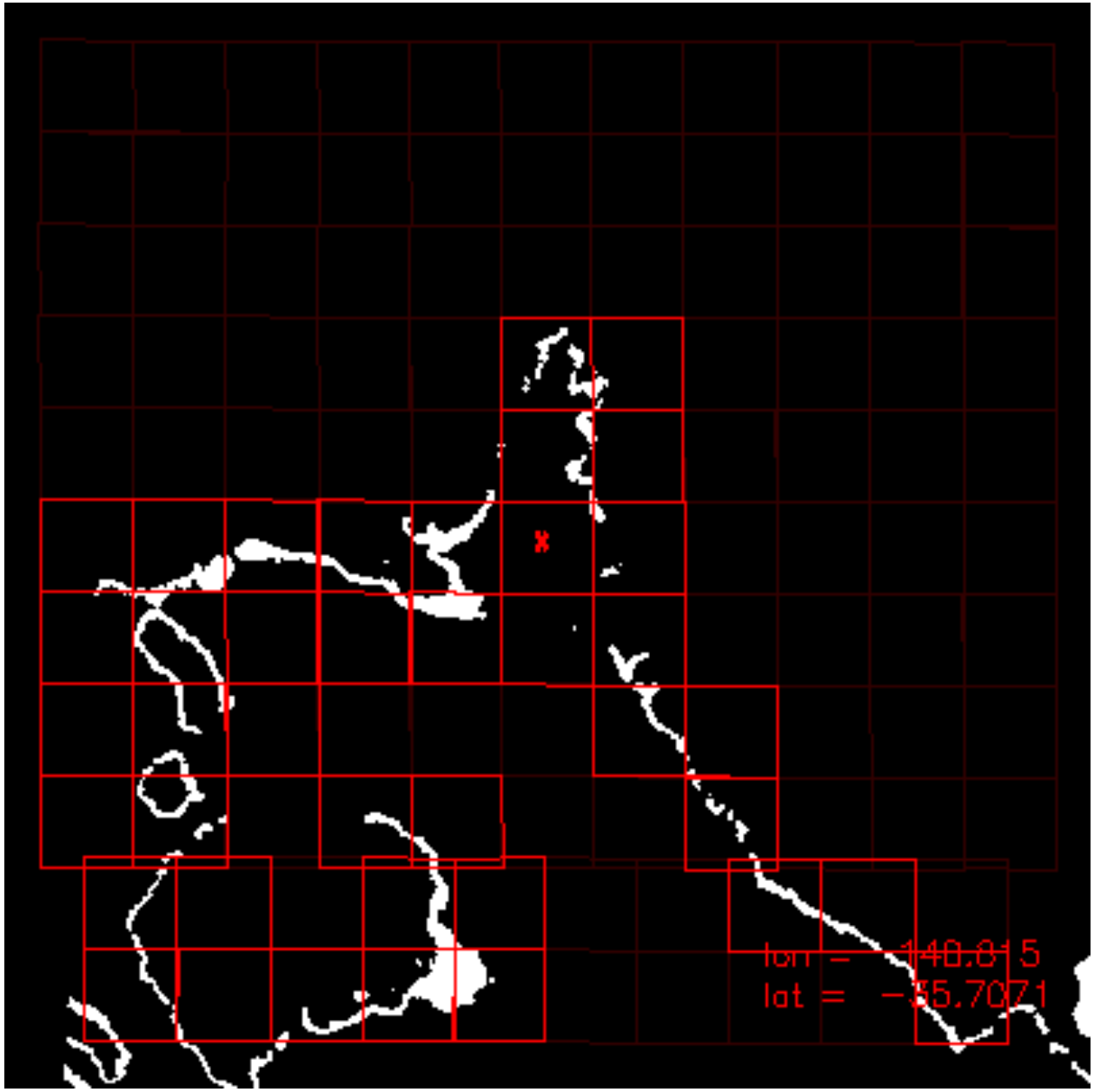
ASTER (RGB 8-3-1) 26 Jan 2003 00:09:09UTC

SE
Australia



ASTER (30m Fire Mask) 26 Jan 2003 00:09:09UTC

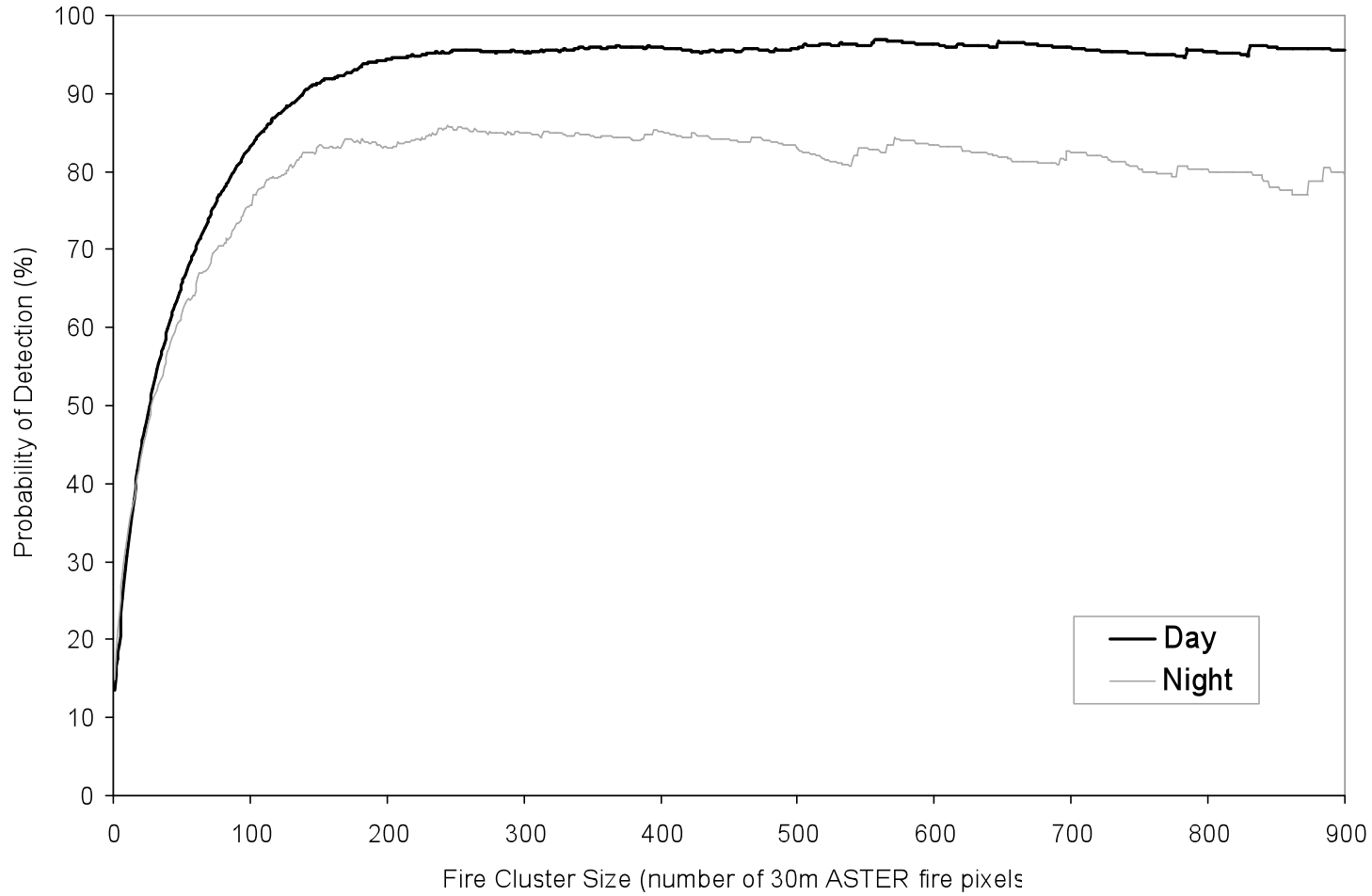
SE
Australia



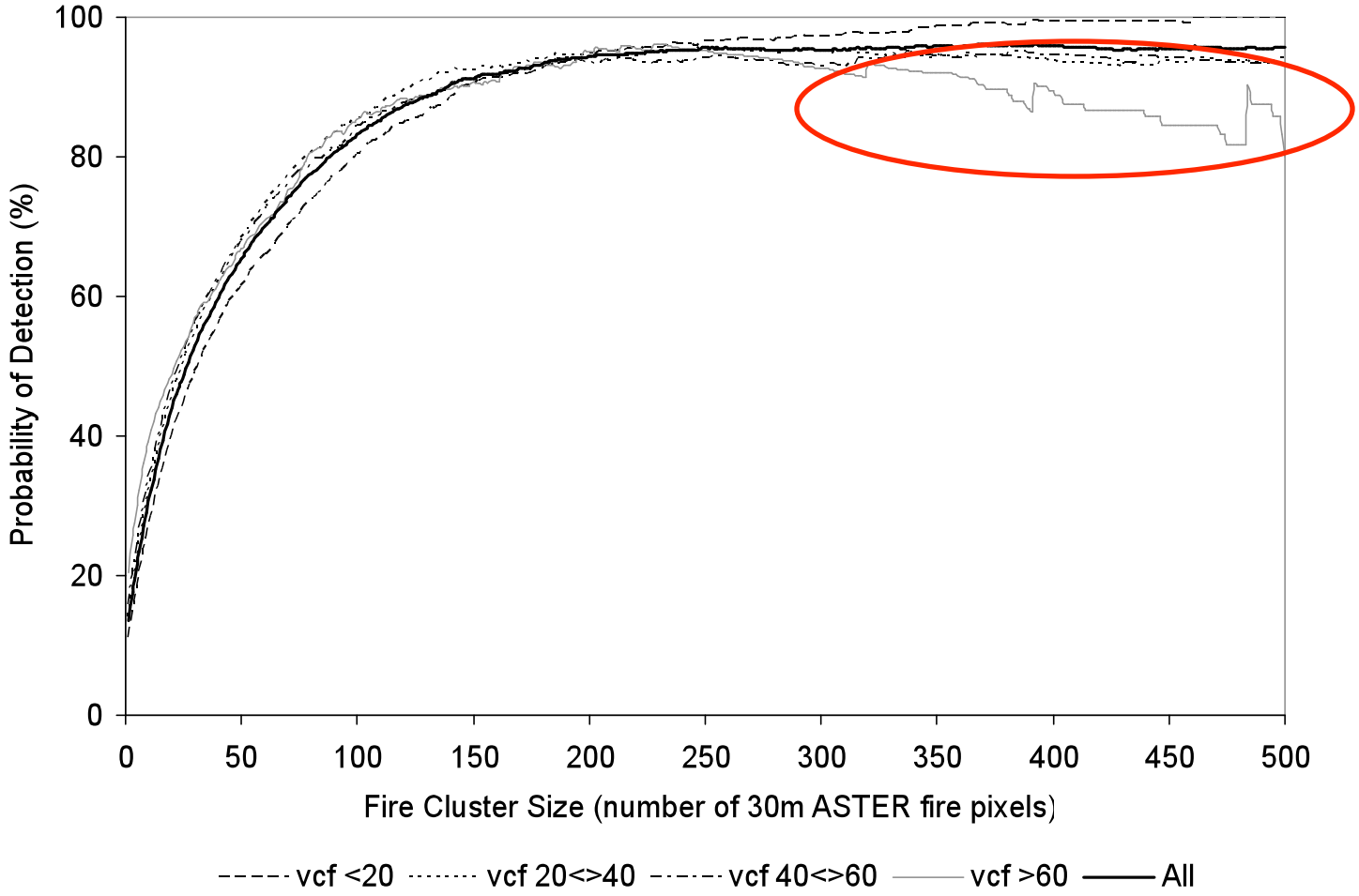
Overall Probability of Detection

Summary curve using all data points

(125K MODIS pixels with >0 ASTER fire pixels including16K MOD14 fire pixels)



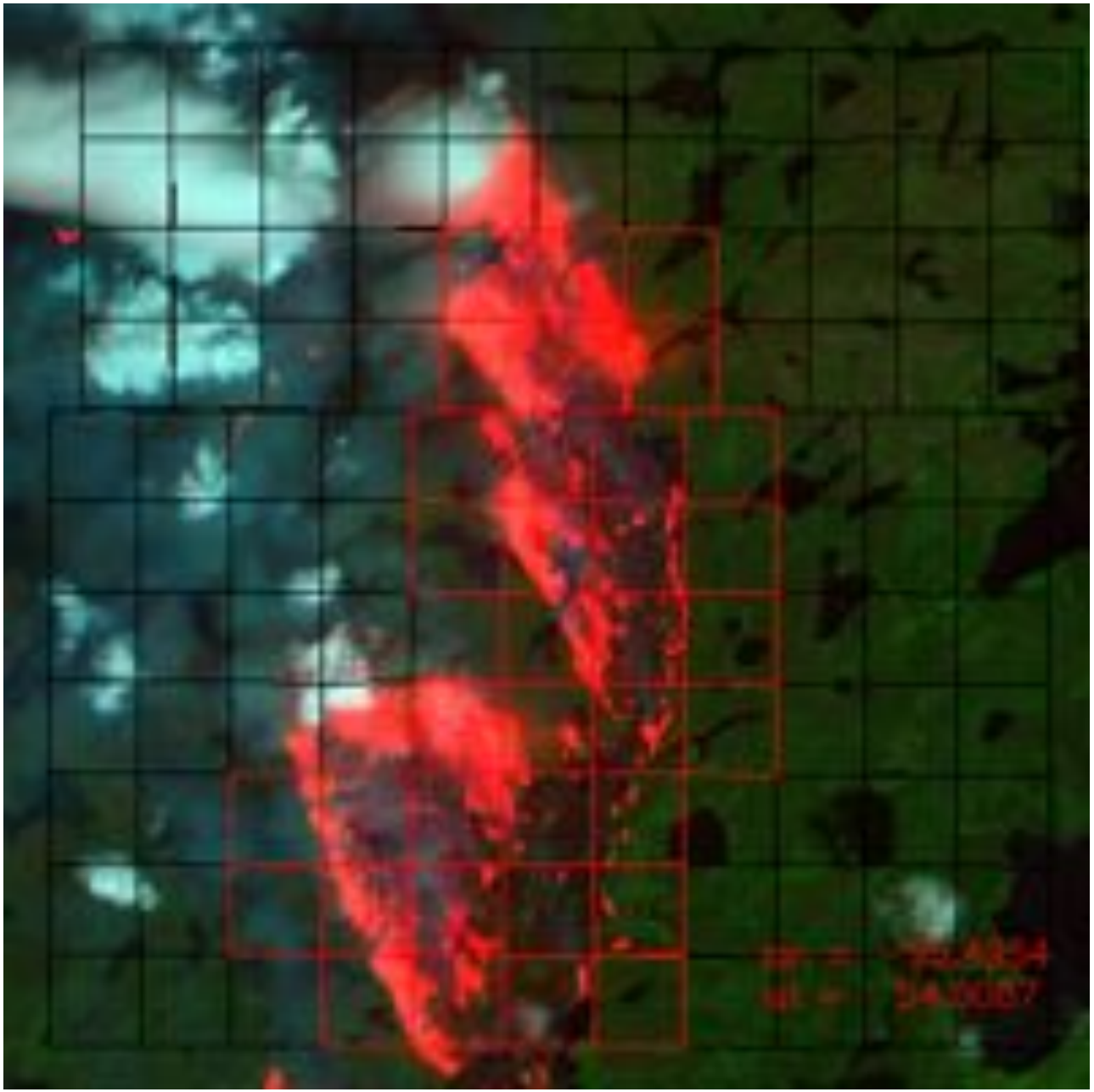
Daytime Probability of Detection as a Function of Percentage Tree Cover**



** average value calculated using a 20x20km window centered on the target pixel

ASTER (RGB 8-3-1) 21 June 2003 17:38:35UTC

Manitoba,
Canada



ASTER (30m Fire Mask) 21 June 2003 17:38:35UTC

Manitoba,
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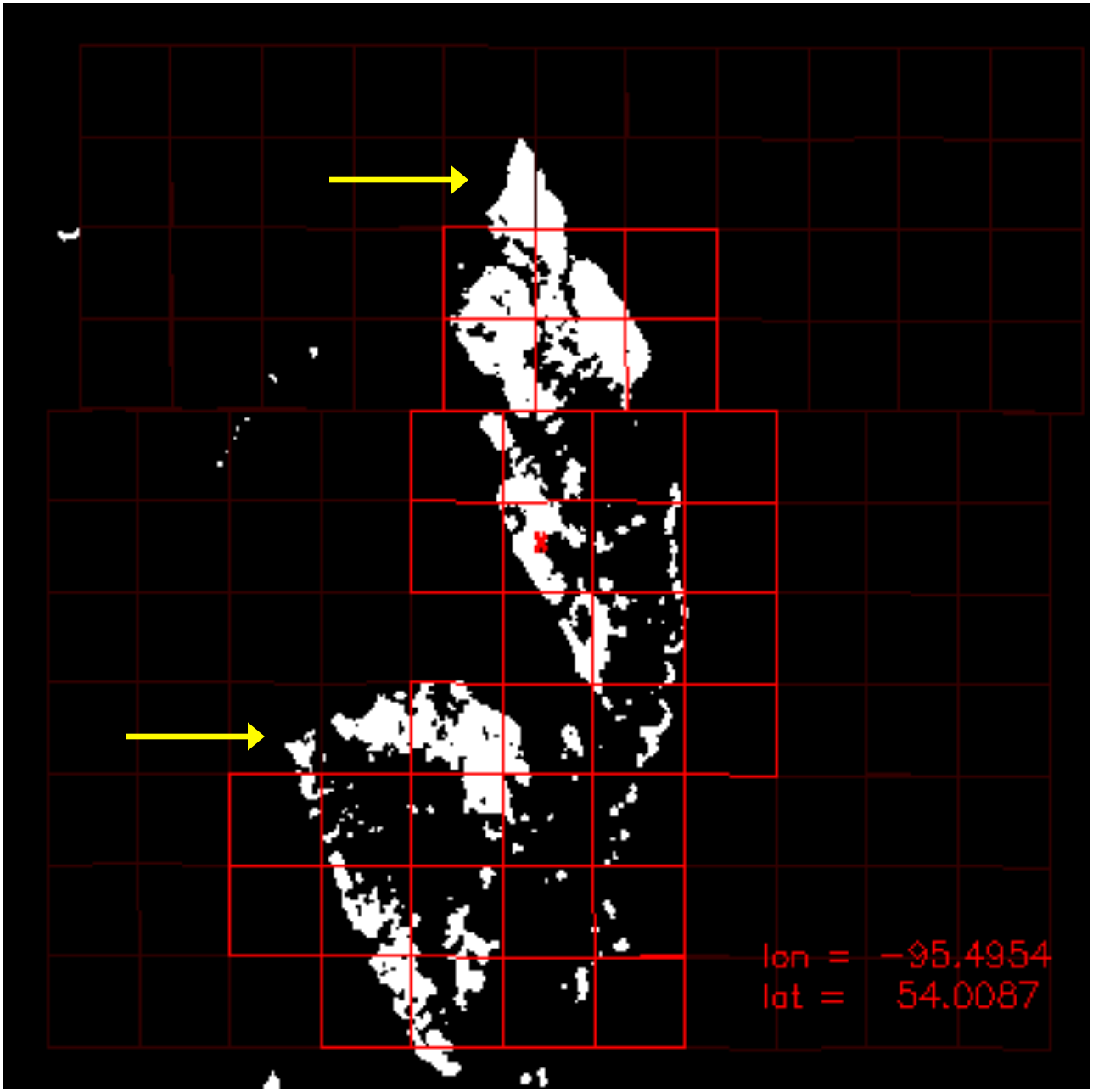
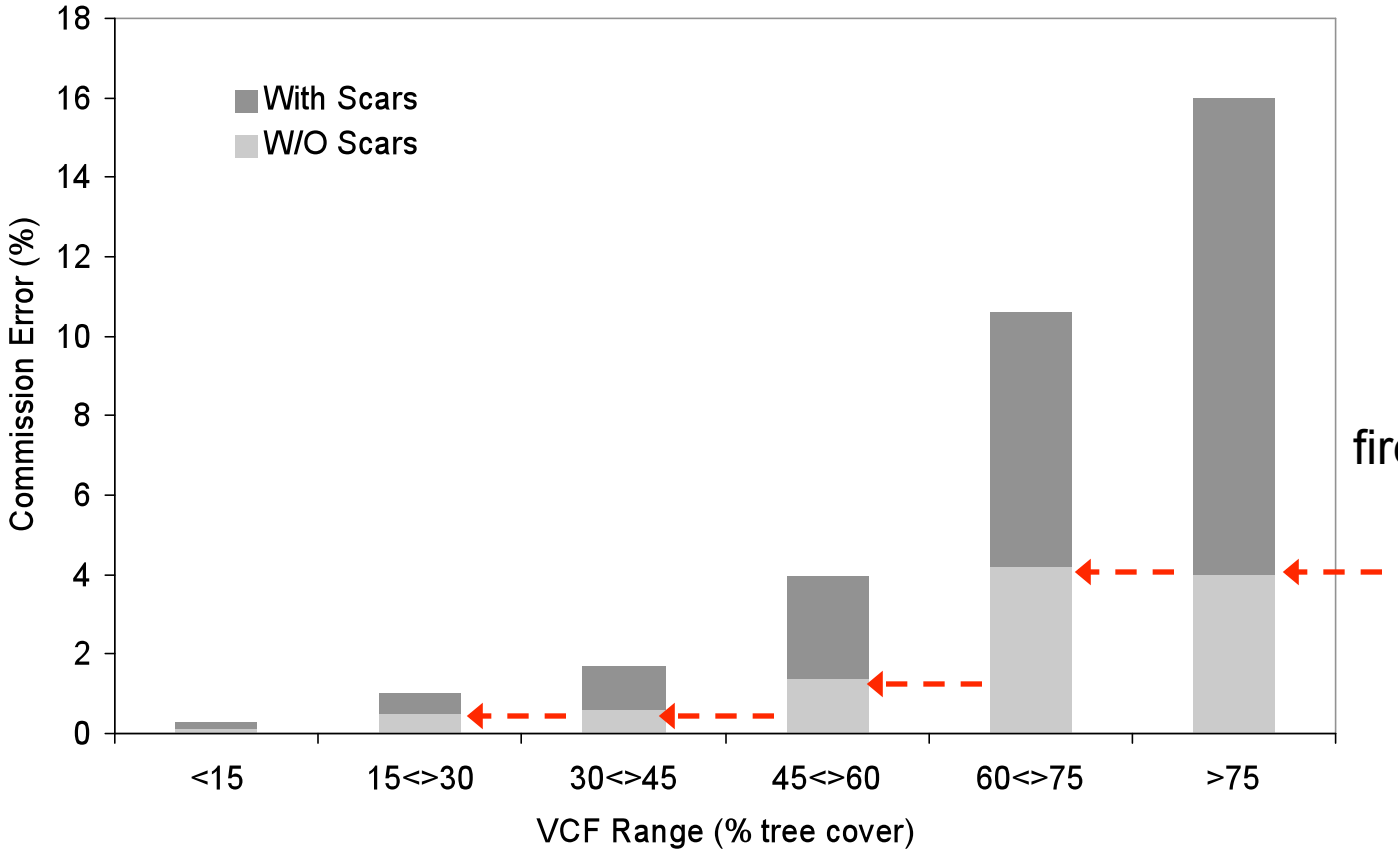


Commission Errors as a Function of Percentage Tree Cover**

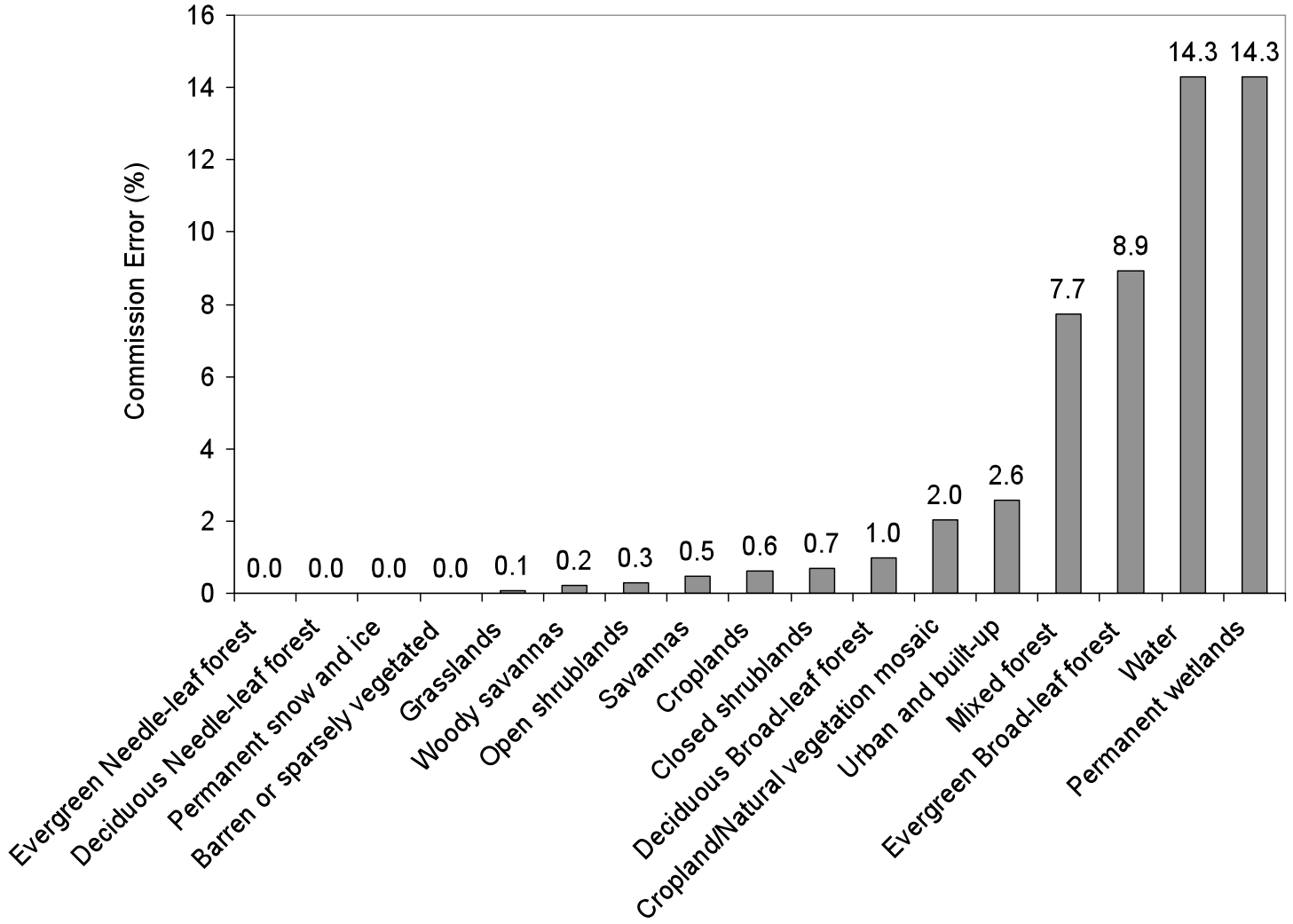
No nighttime commission error (*n* =722)



2% overall fire-unrelated false alarm rate

** average value calculated using a 20x20km window centered on the target pixel

Daytime Commission Errors as a Function of Land Cover Type** (IGBP classes)



** predominant class using a 20x20km window centered on the target pixel

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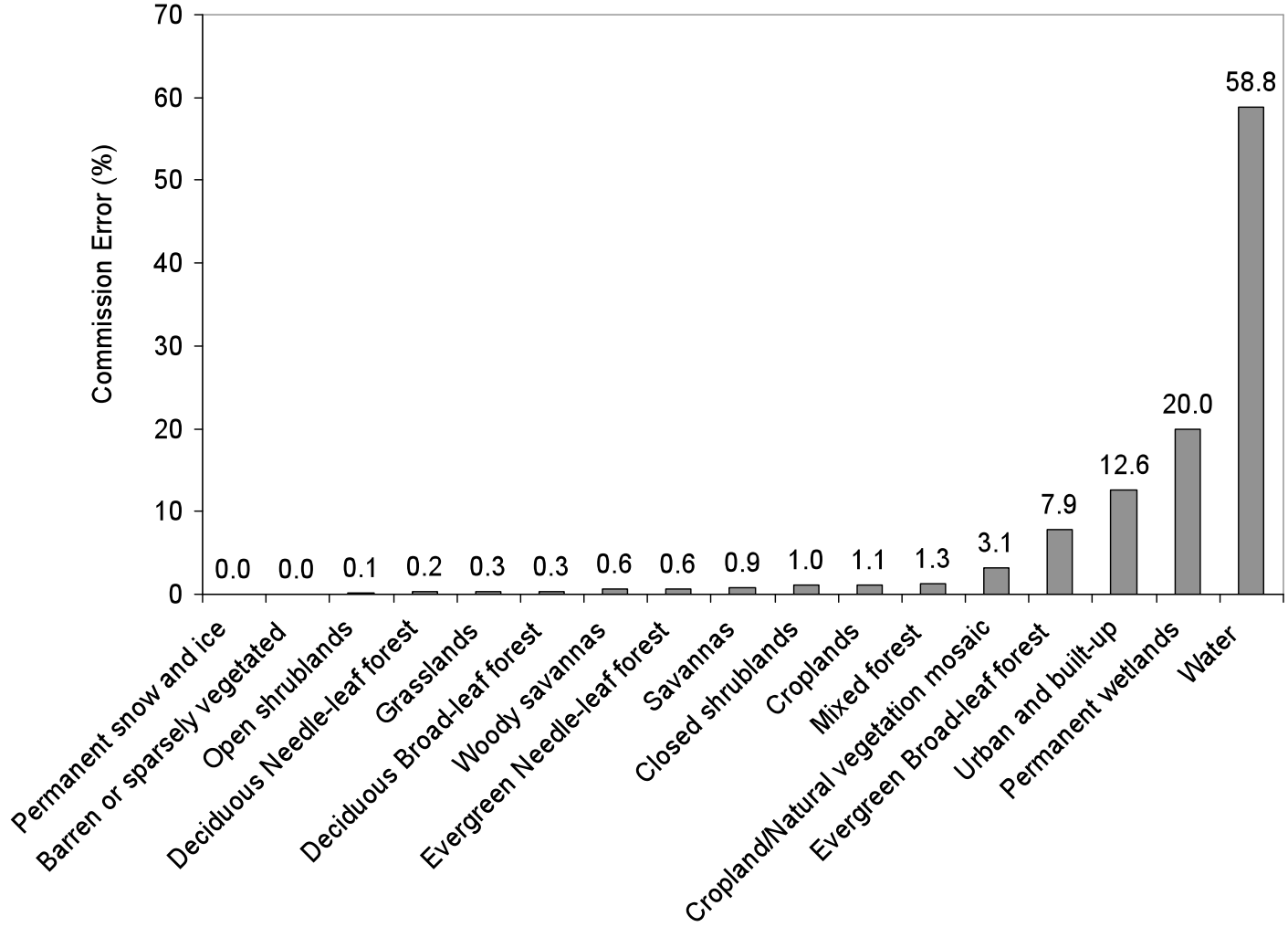


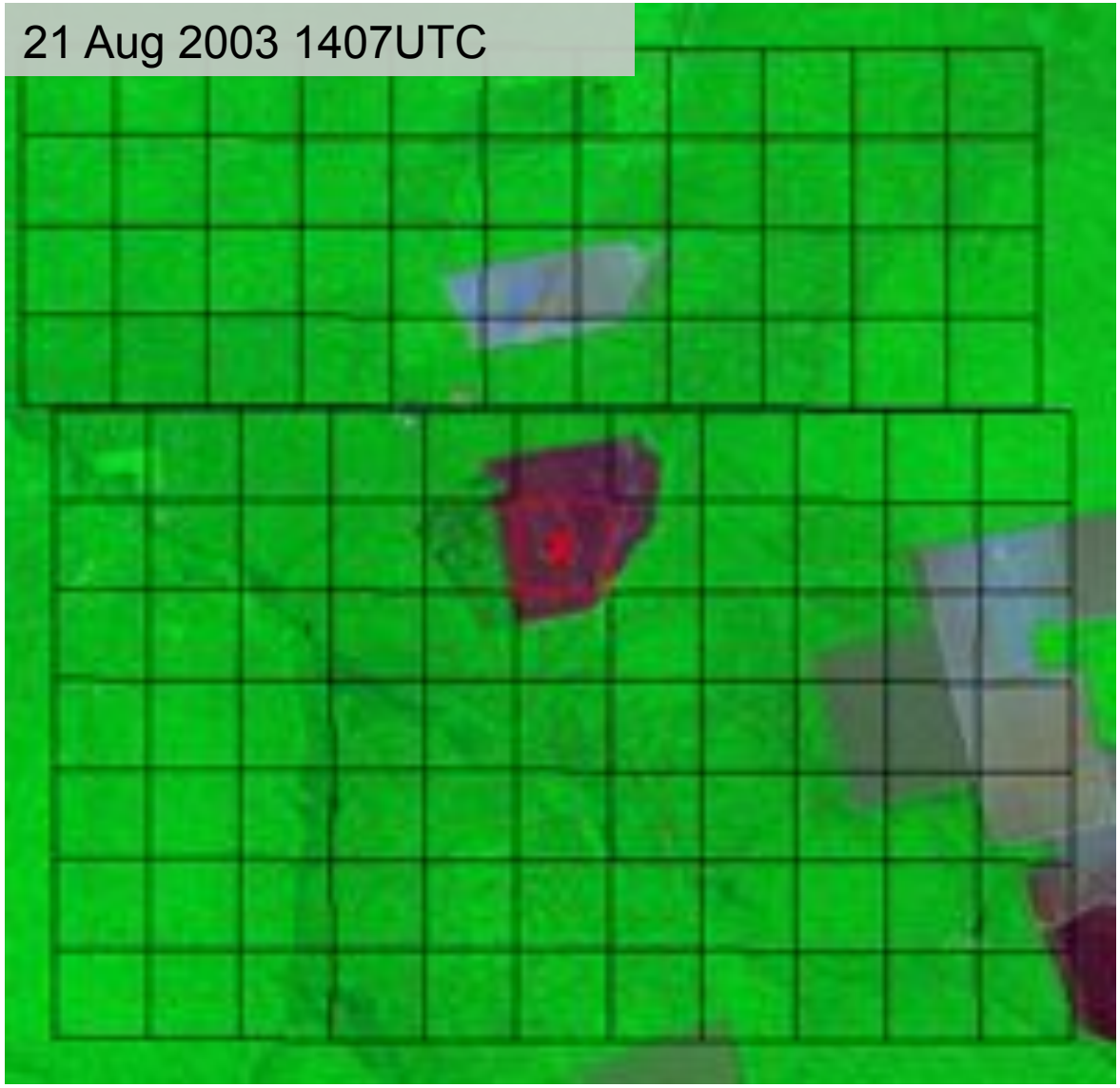
** point value representing the target pixel

Quality Check – Visual Inspection

Typical false detection MODIS/Terra

False alarms can occur more than once at the same location

Some burn scars may also affect the Cloud Mask & LST products

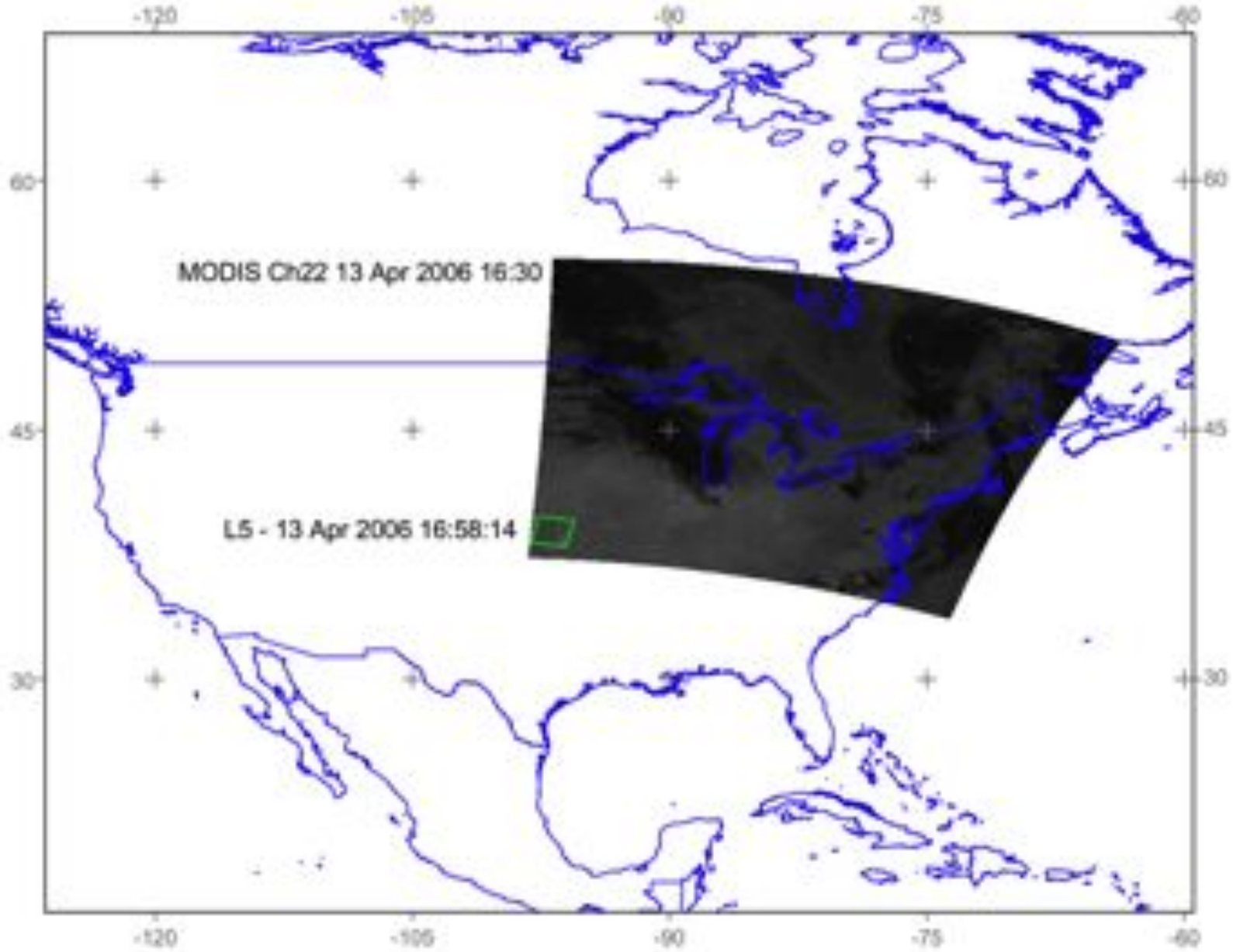


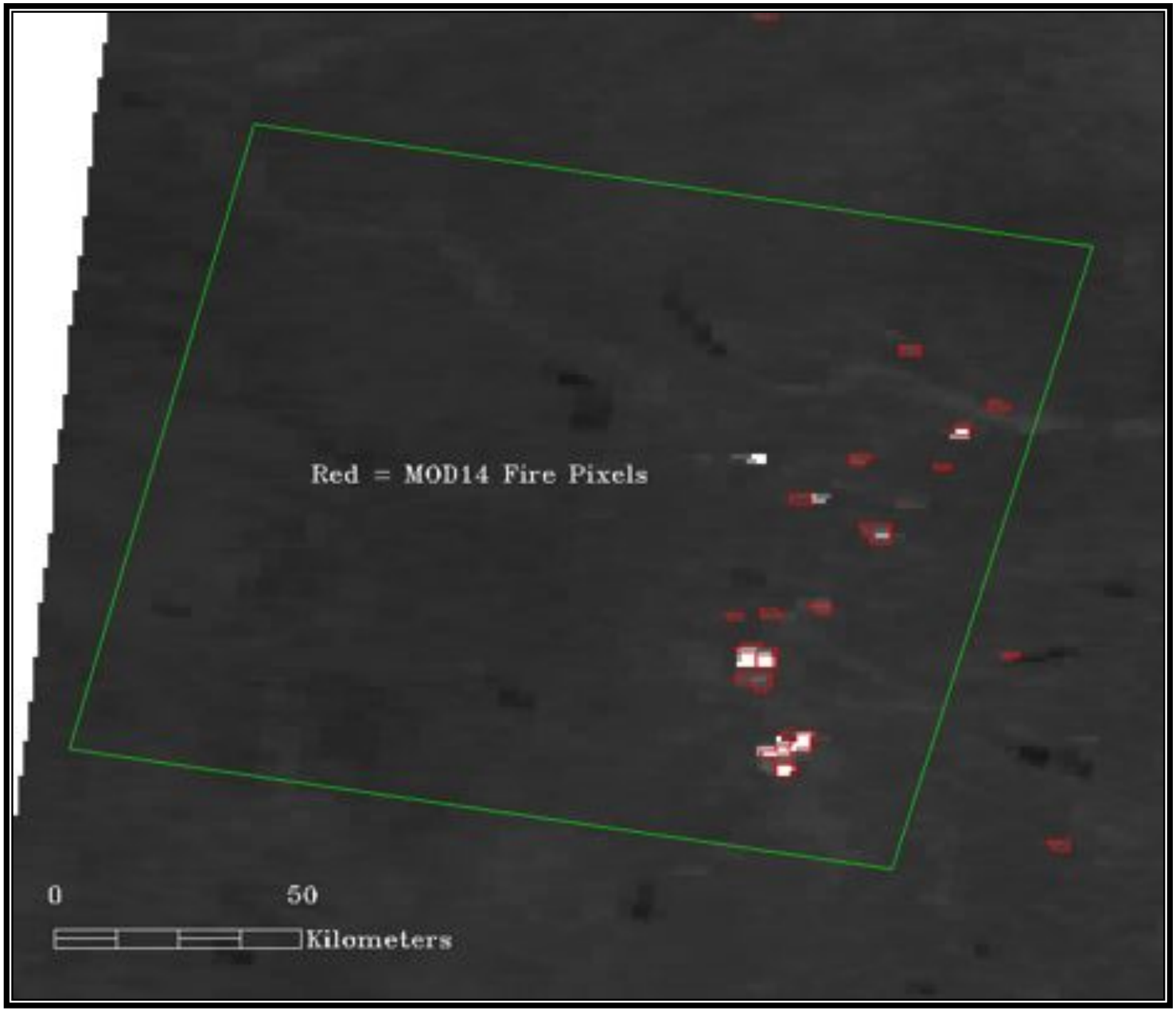
Path Forward

- Development of Landsat-5 TM active fire masks to evaluate MODIS/Terra fire data over far off nadir scan angles
  - Problems with TM data quality must be addressed (radiance bleeding from adjacent fire pixels)

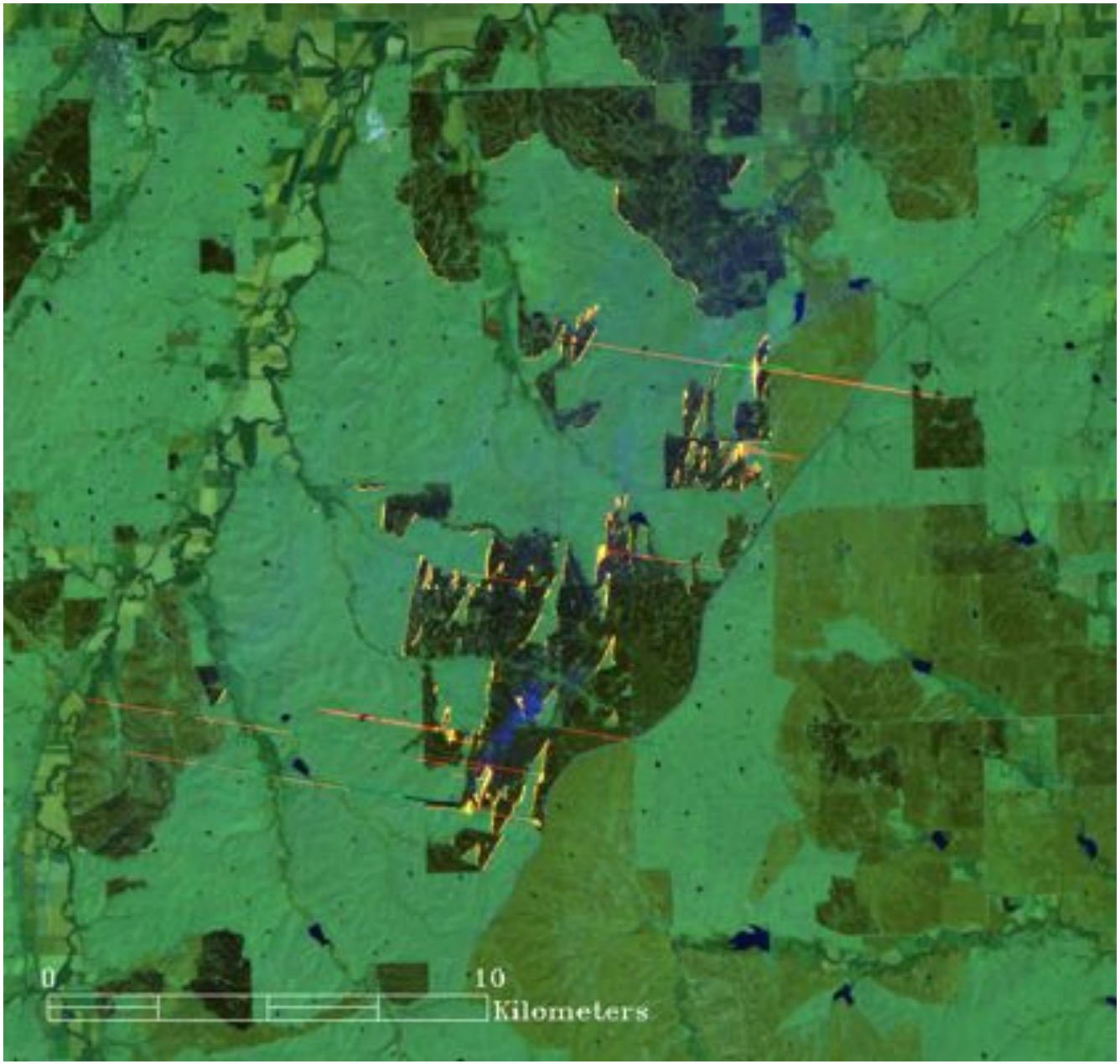
- Use of airborne sensor data
  - Alternative to orbital sensors
  - Quality data enabling fire characterization analyses
  - Potential gap filler : final link between Landsat-class data and surface observations
    - Provide key insight on the relationship between Landsat-class fire pixels and active fire area (ha, m^2, ...)
  - Possibility for sequential mapping of prescribed/wild fires (ideal for diurnal cycle assessment)

- Reproducing MODIS fire pixel data using ASTER imagery
  - Potential for fire characterization validation : applicability must be evaluated using reference airborne and field data
  - Retrospective analysis of large volume of ASTER and MODIS/Terra data : fine look at fire characteristics across different biomes

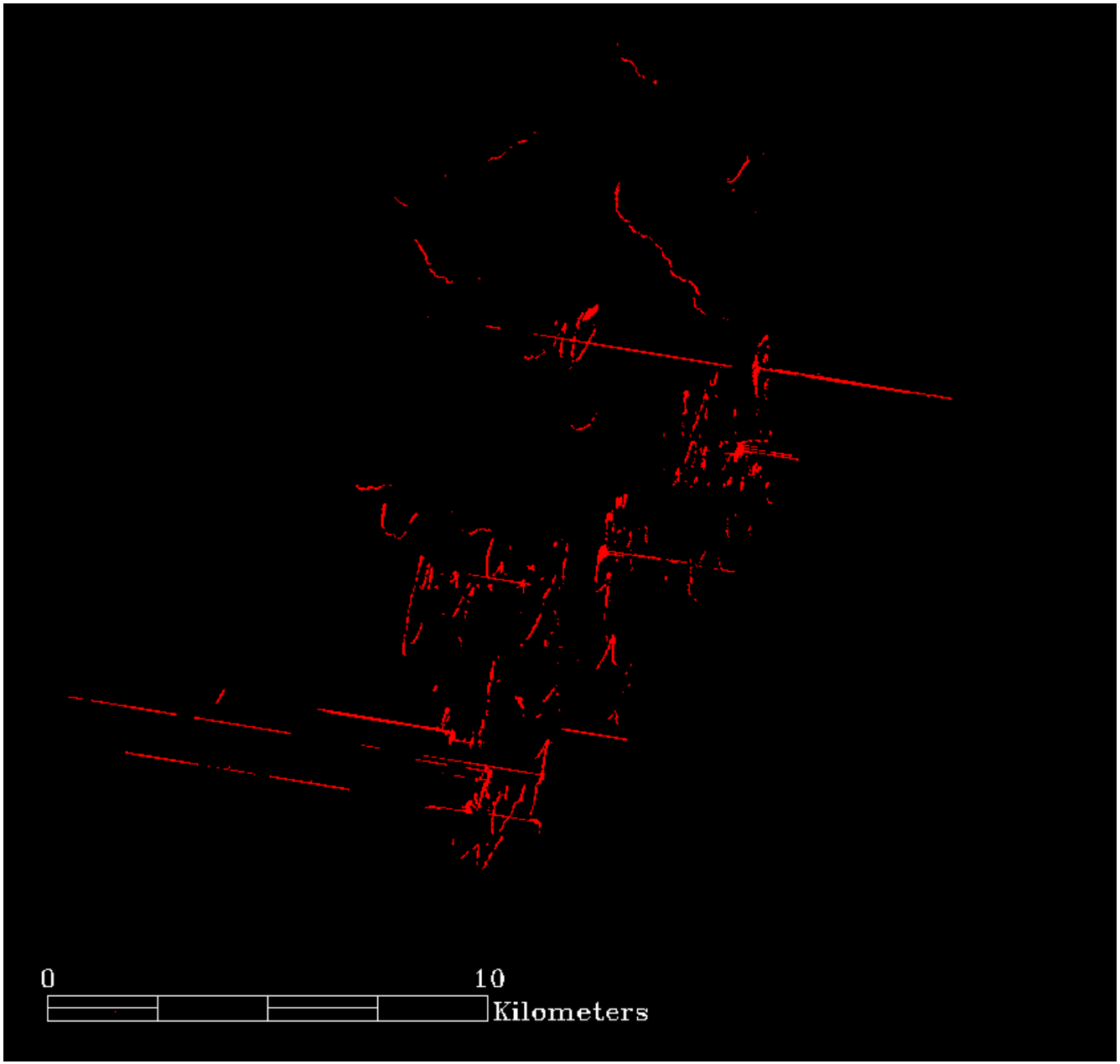

-120
-105
-90
-75
-60
60
45
30
MODIS Ch22 13 Apr 2006 16:30
L5 - 13 Apr 2006 16:58:14


Red = MOD14 Fire Pixels
0
50
Kilometers

Landsat-5 TM (RGB 7-5-2)



Landsat-5 TM (Fire Mask)



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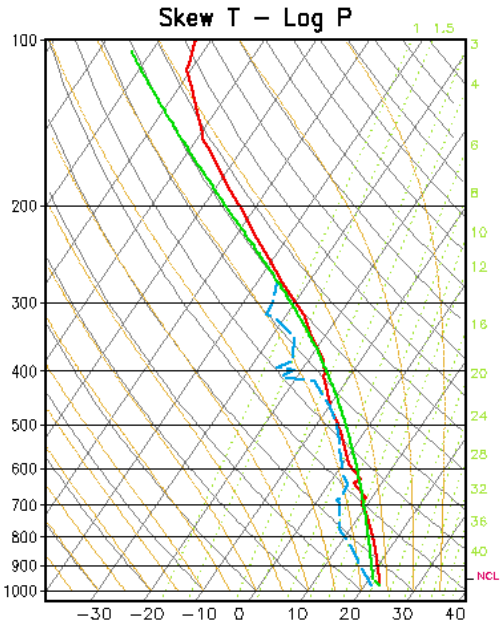
Reproducing MODIS Fire Pixel Radiance



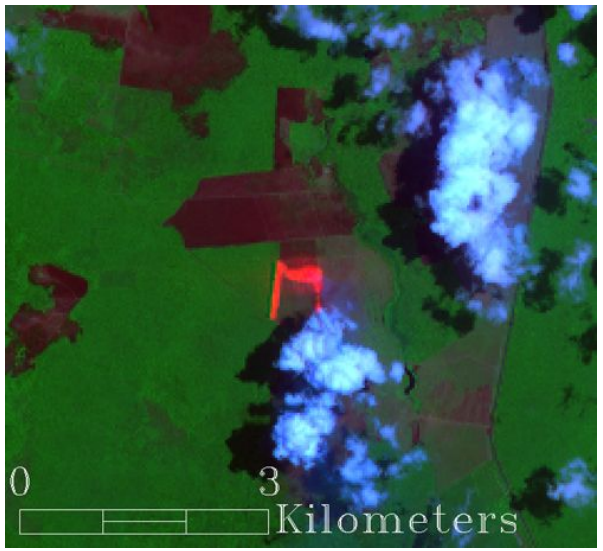
Fire Pixel Radiance =

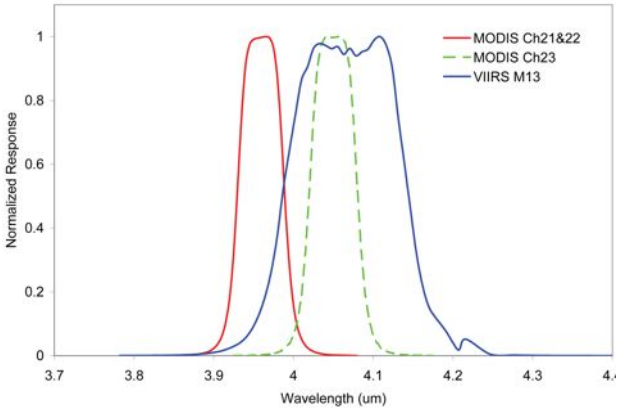
[ASTER Sfc Temp,

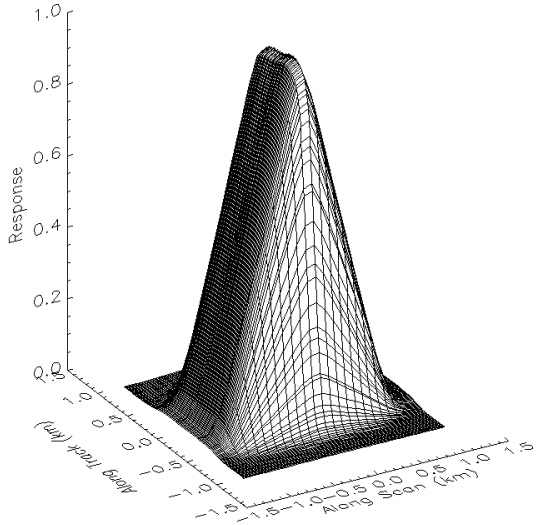
ASTER Fire Mask,

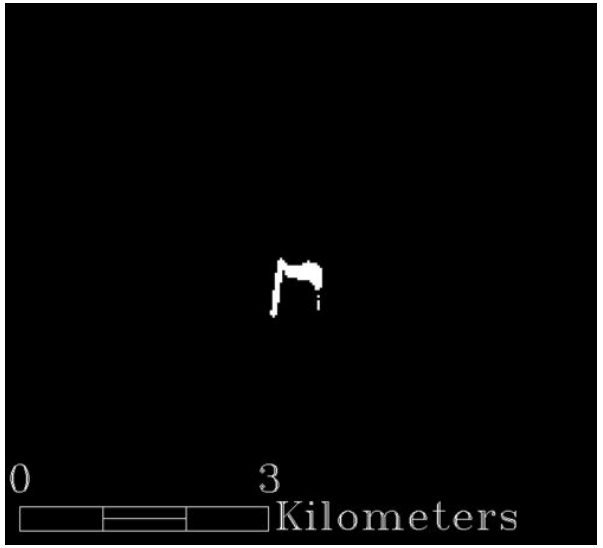
MODIS (PSF + SRF),

(Atm + Solar)]

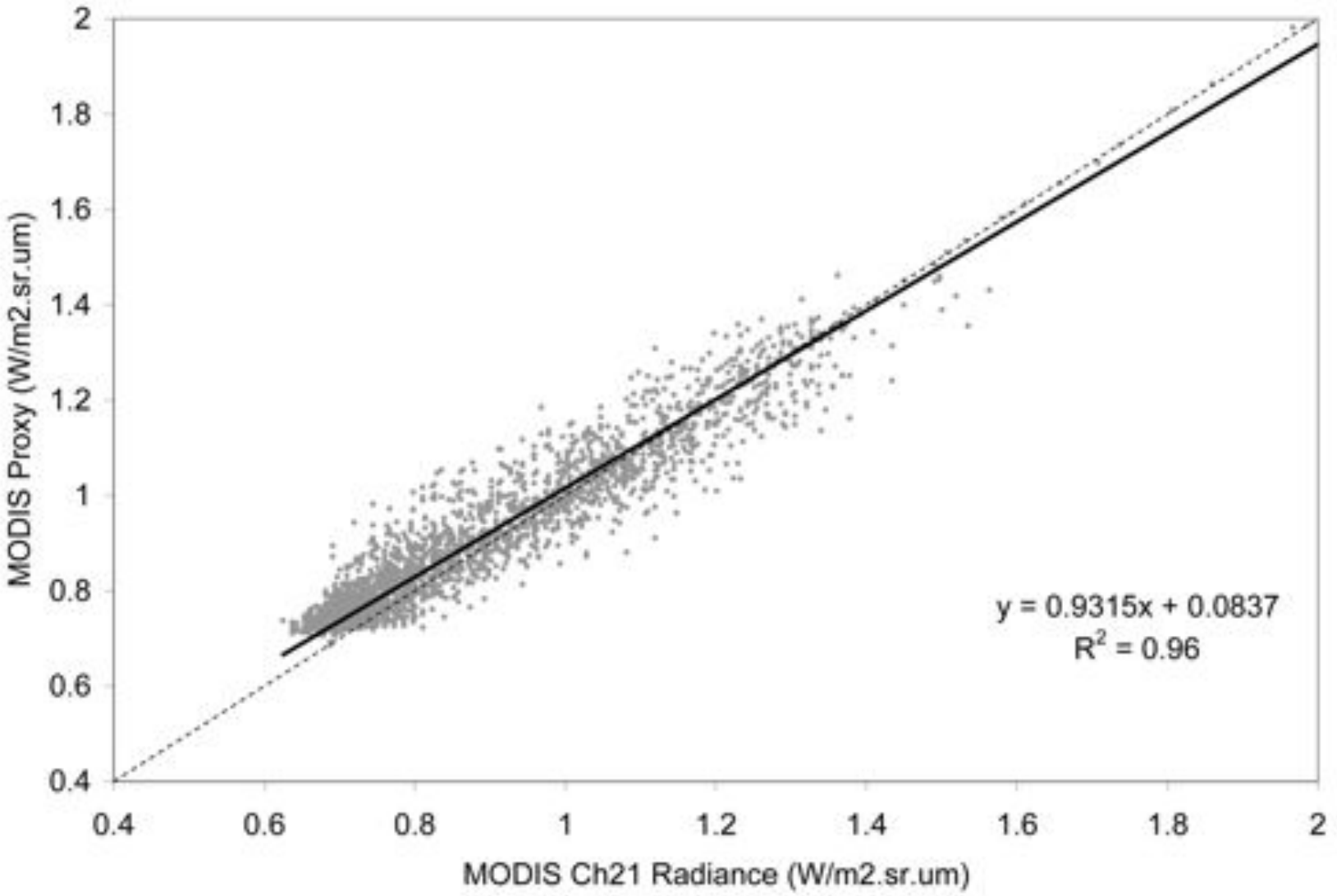








Reproducing MODIS Fire Pixel Radiance



Concluding Remarks

- Increased capacity to ingest and co-locate different datasets
  - ASTER, ETM+, TM, CBERS, Airborne imagery used successfully in combination with MODIS data
  - Optmized use of NASA & international assets (multi-sensor/satellite data integration/fusion)
  - Efficient data mining codes enabling manipulation of large volume of higher resolution imagery data and active fire information from MODIS

- Capacity building towards development/application of sensor networks and next generation datasets
  - Great potential for transition of research methods/techniques/science codes into operations through NOAA/NESDIS
  - VIIRS and GOES-R in advantageous position in regards to active fire data validation
    - Protocols being developed

- Field campaigns and fine resolution airborne data still an important component in the validation of active fires
  - Inter-agency collaboration/coordination is needed (involvement of USFS and other state agencies)
  - Progress with fire characterization depends on the successfull implementation of field work