Proposal for an *International protocol* for coarse resolution Burned Area product validation

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MODIS
Global Burned Area Product:
Product Inter-comparison &
Validation Protocol

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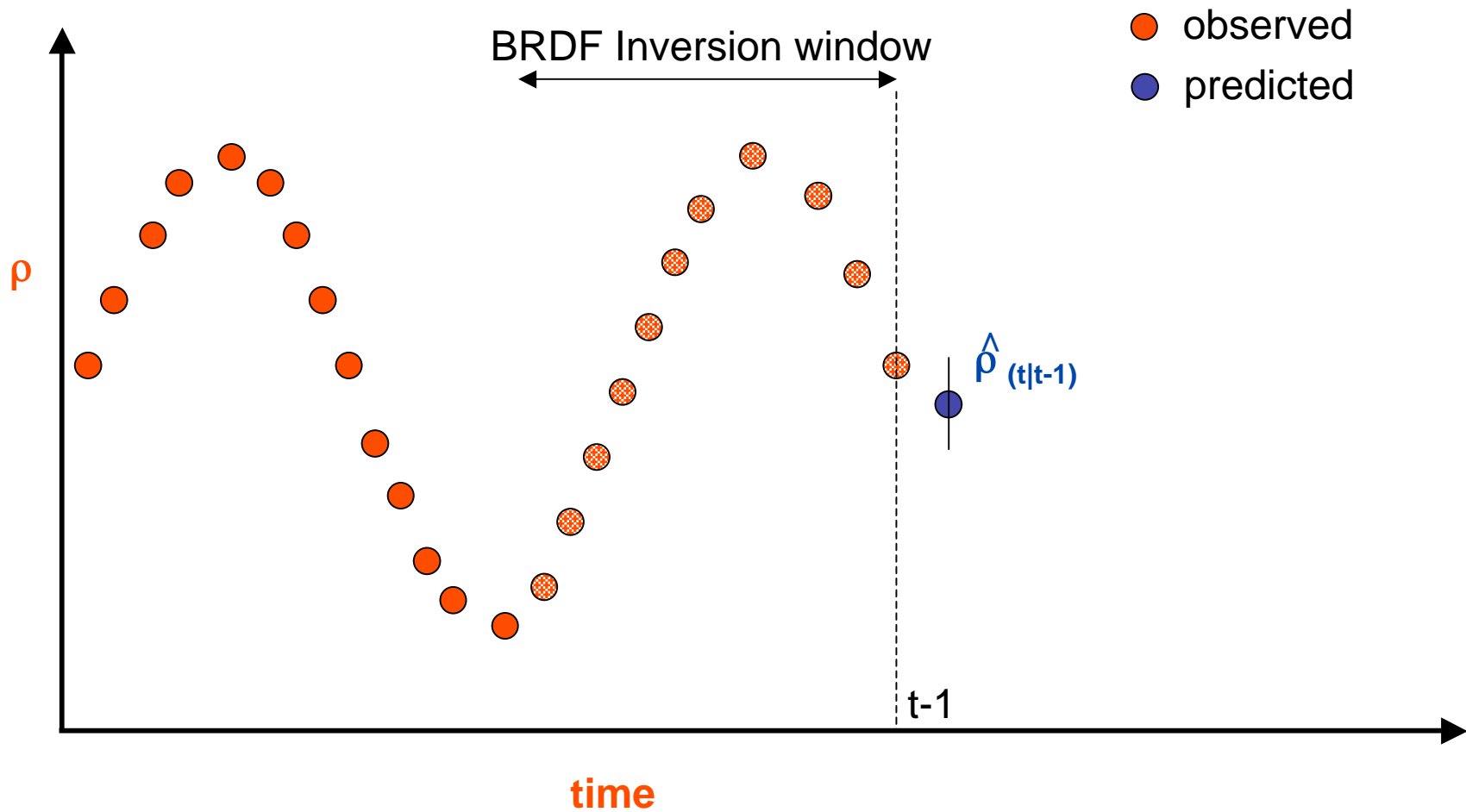**http://modis-fire.umd.edu/MCD45A1.asp**

Global C5 MODIS Burned Area Product

- Funded as part of NASA MODIS Fire Science Team (Justice *et al.*) to complement the MODIS 1km active fire product

- Global applications
  - Green house gas & aerosol emissions estimation
  - Applied users (e.g., natural resource management)
  - LCLUC research (e.g., Fire – Climate – People)

- Product prototyping by regional algorithm development during the MODIS Collection 4 era

- Collection 5 processing now completed for the whole MODIS record (year 2000 onwards)
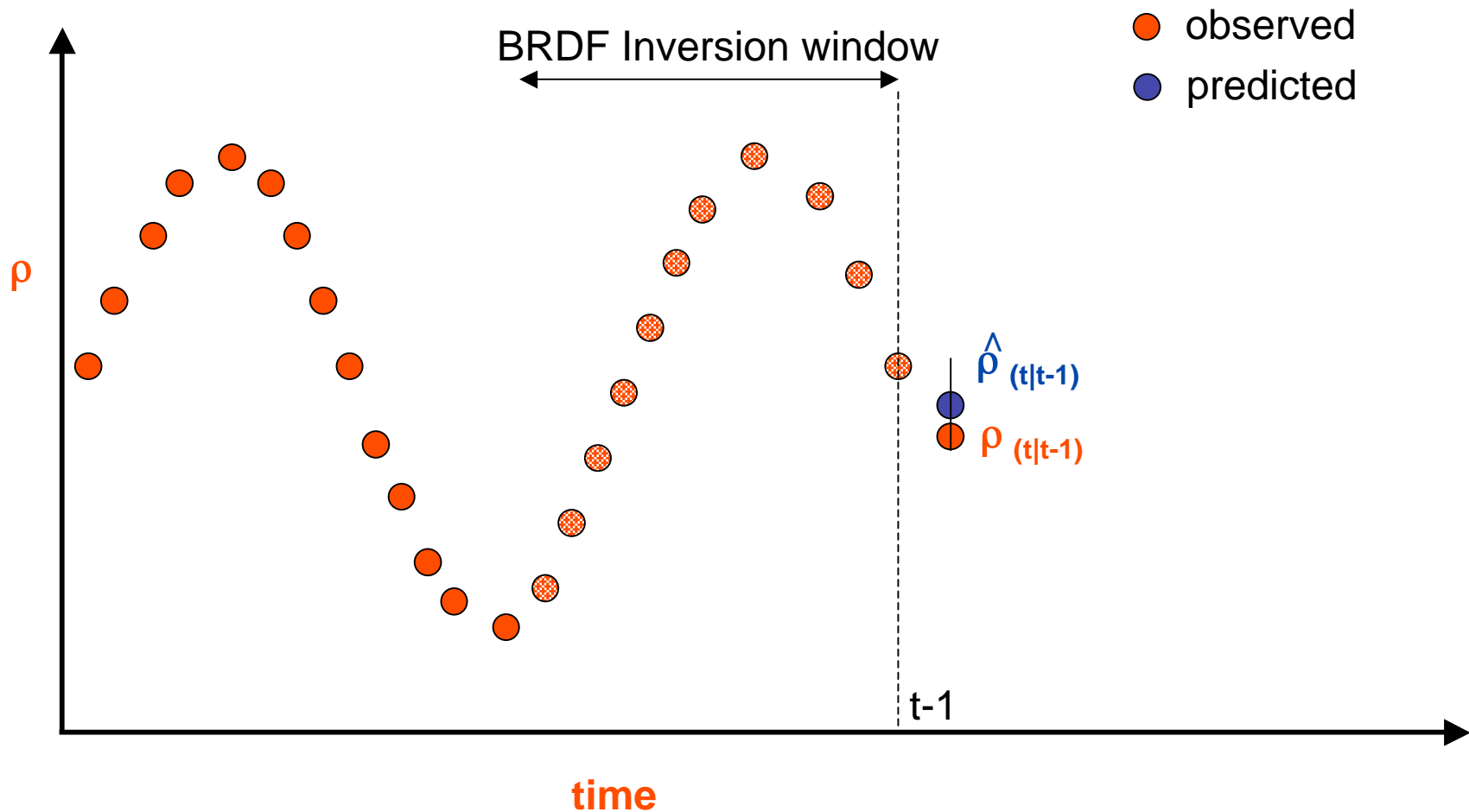
Algorithm

- Rolling BRDF based expectation change detection

- Semi-Physically based; less dependent upon imprecise but noise tolerant classification techniques; very few thresholds

- Automated, without training data or human intervention

- **Applied independently per pixel to daily gridded MODIS 500m land surface reflectance time-series**

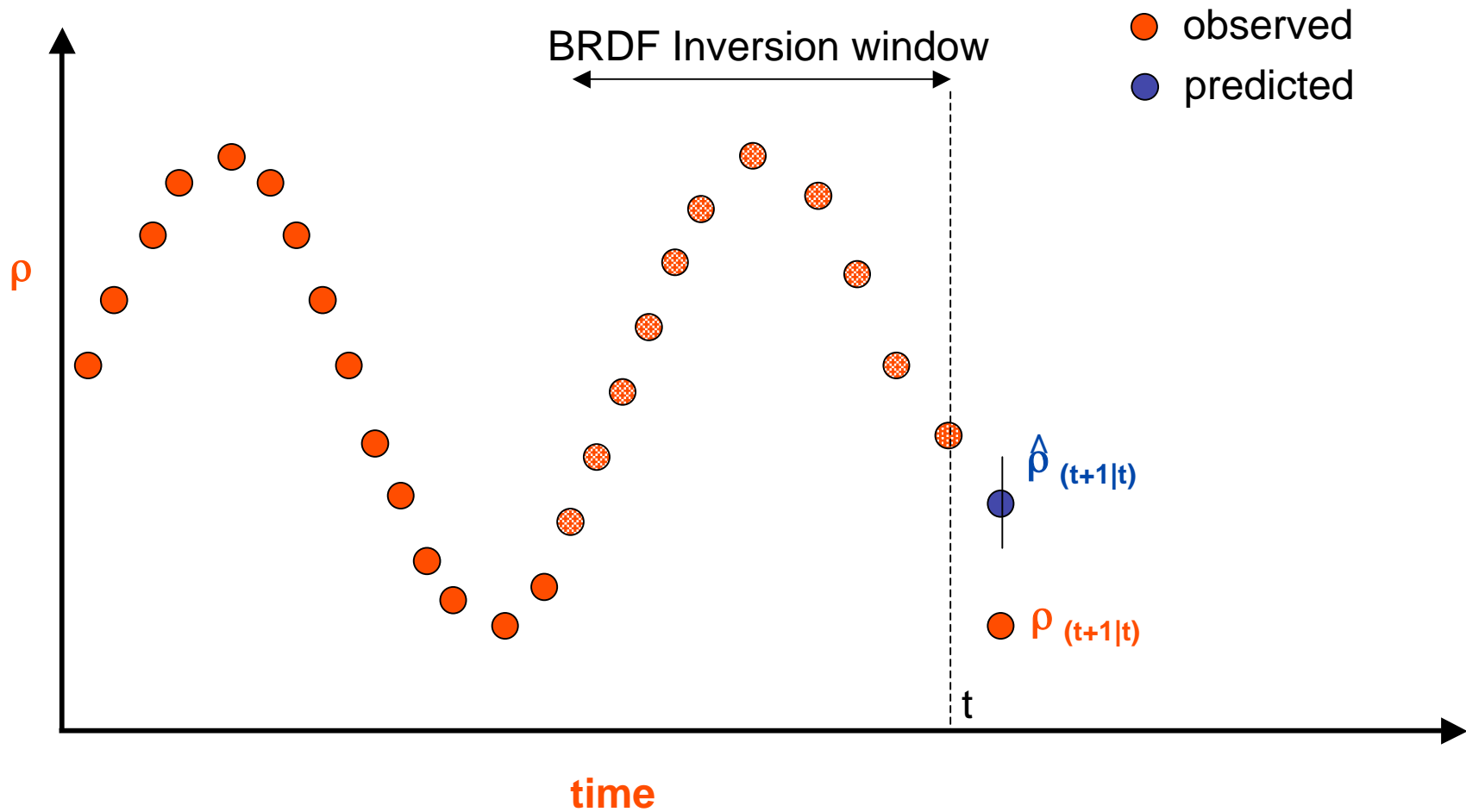 **- Globally map 500m location and approximate day of burning**
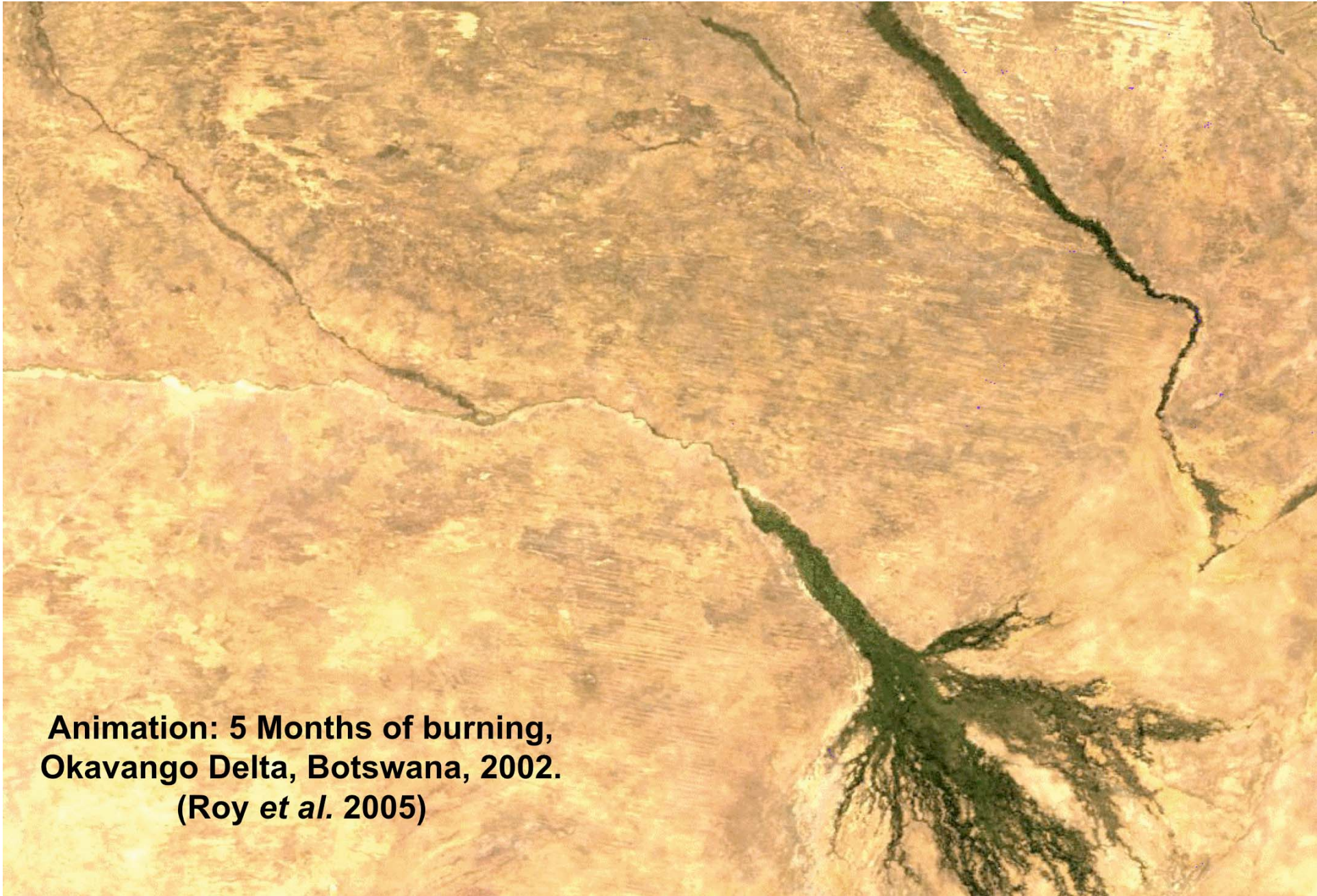
Conceptual Scheme

BRDF Inversion window

observed

predicted

ρ

$\hat{\rho}_{(t|t-1)}$

t-1

time

Conceptual Scheme

BRDF Inversion window

observed
predicted

ρ

$\hat{\rho}_{(t|t-1)}$

$\rho_{(t|t-1)}$

t-1

time

Conceptual Scheme

Animation: 5 Months of burning, Okavango Delta, Botswana, 2002. (Roy *et al.* 2005)

MODIS burned area validation
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Global Burned Area Product
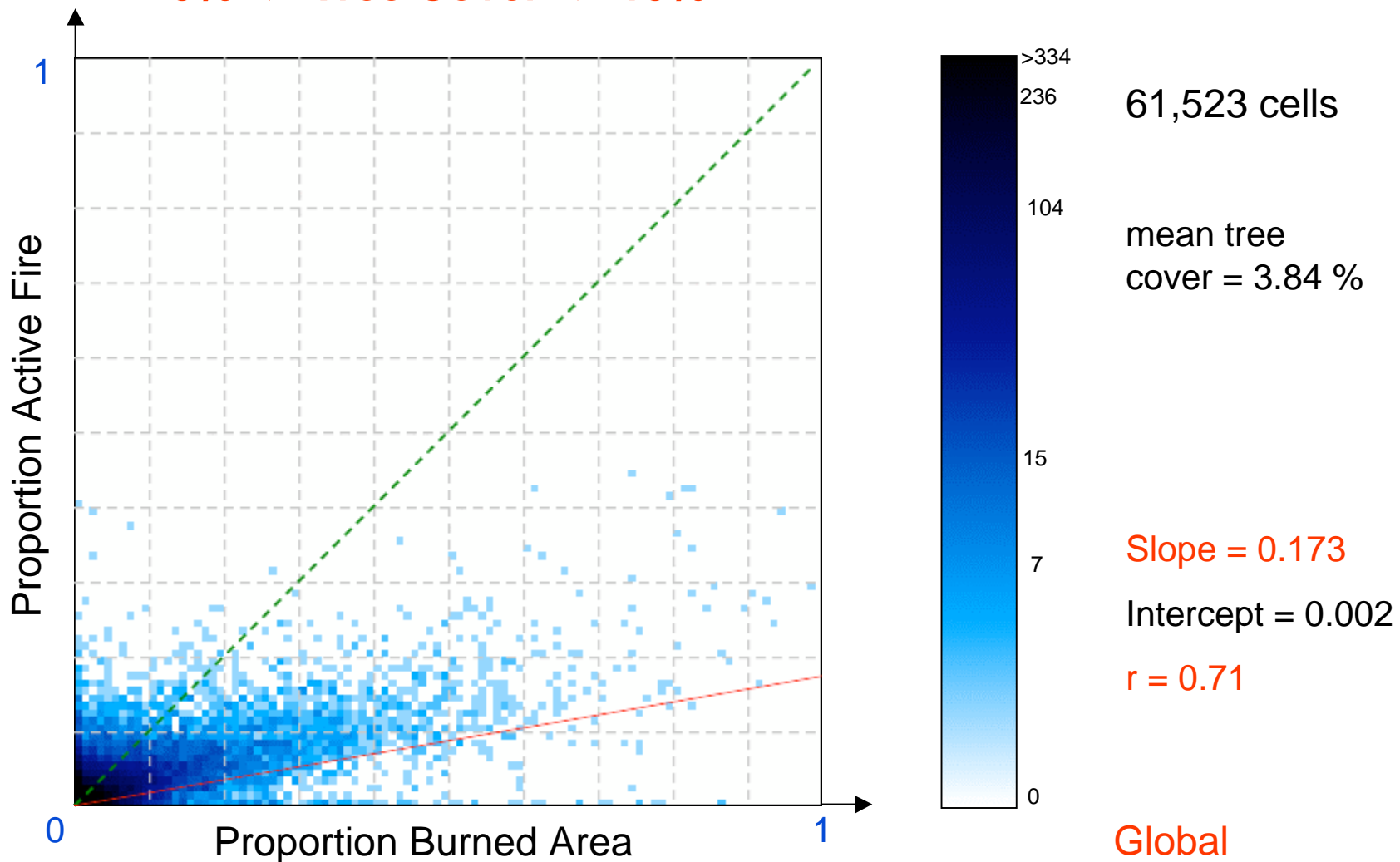
MODIS Burned Area C5 Global Evaluation

Inter-Comparison with
MODIS 1km Active Fire Detections
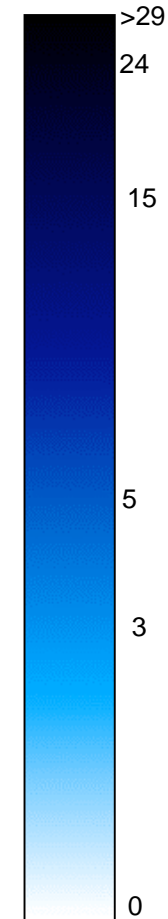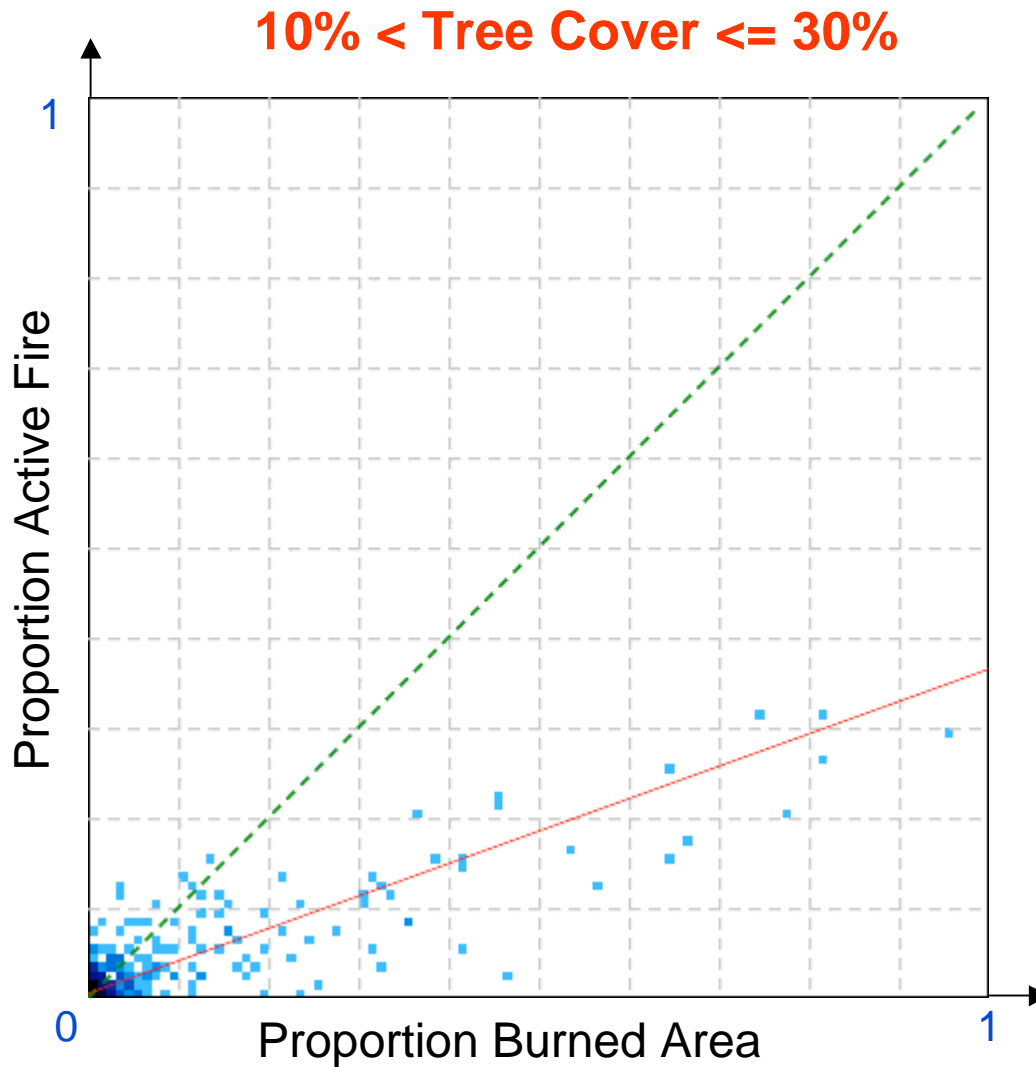
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Global
Evaluation

0% <= Tree Cover <= 10%

Proportion Active Fire

Proportion Burned Area

>334
236
104
15
7
0

61,523 cells

mean tree cover = 3.84 %

Slope = 0.173

Intercept = 0.002

r = 0.71

Global

2001-2002

Scatter plot of proportion of active fire against proportion burned area detected in 40km x 40km cells. Robust (Theil Sen) regression line is plotted in red; the white blue logarithmic color scale represents the point density distribution of the scatter plot.
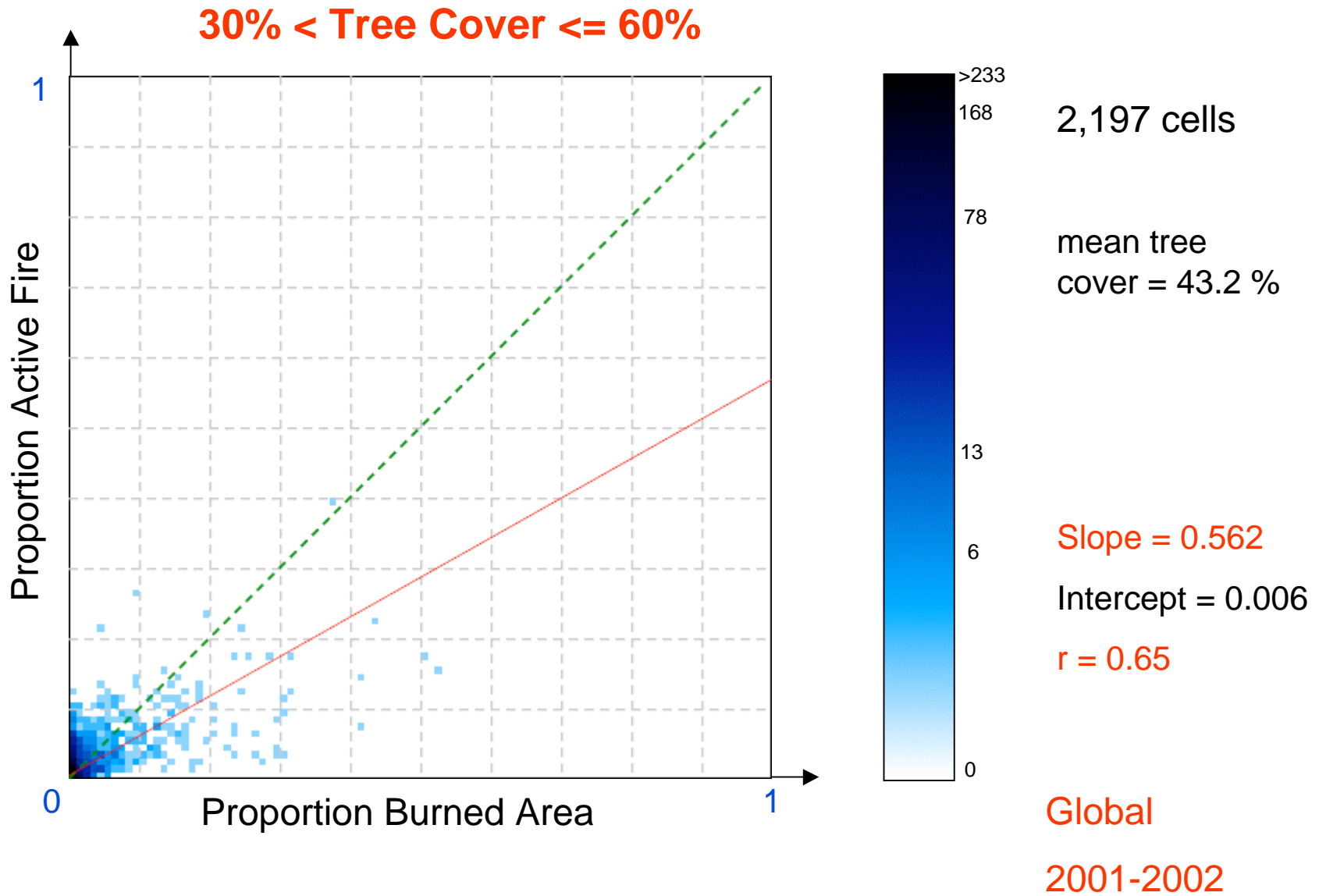
10% < Tree Cover <= 30%

Proportion Active Fire

Proportion Burned Area

417 cells

mean tree cover = 22.5 %

Slope = 0.359

Intercept = 0.006

r = 0.87

Global

2001-2002

>29
24
15
5
3
0

30% < Tree Cover <= 60%

2,197 cells

mean tree cover = 43.2 %

Slope = 0.562

Intercept = 0.006

r = 0.65

Global

2001-2002

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Global
Evaluation

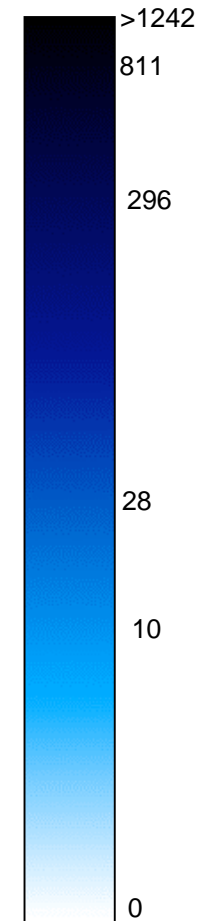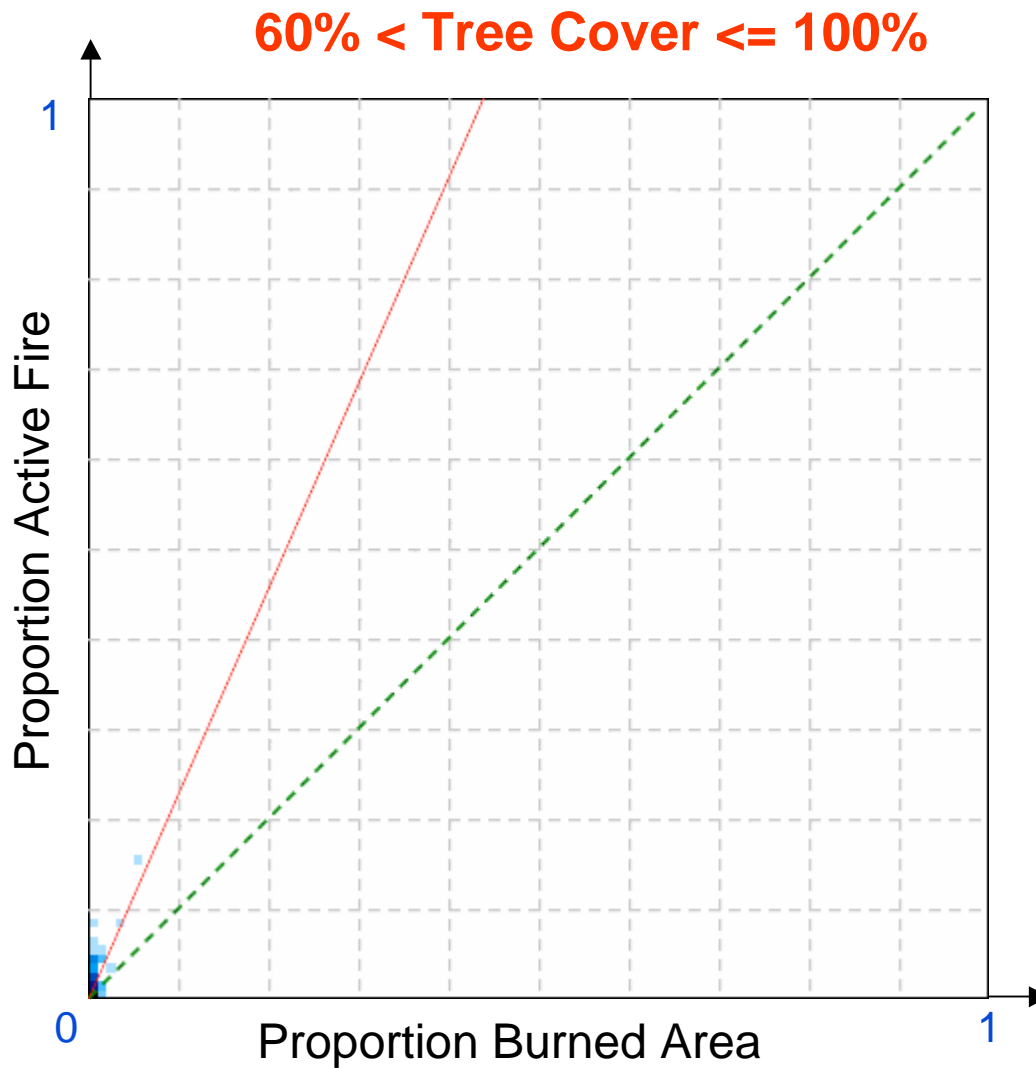**60% < Tree Cover <= 100%**

Proportion Active Fire

Proportion Burned Area

>1242
811
296
28
10
0

1,403 cells

mean tree cover = 76.2 %

Slope = 2.276

Intercept = 0.002

r = 0.67

Global

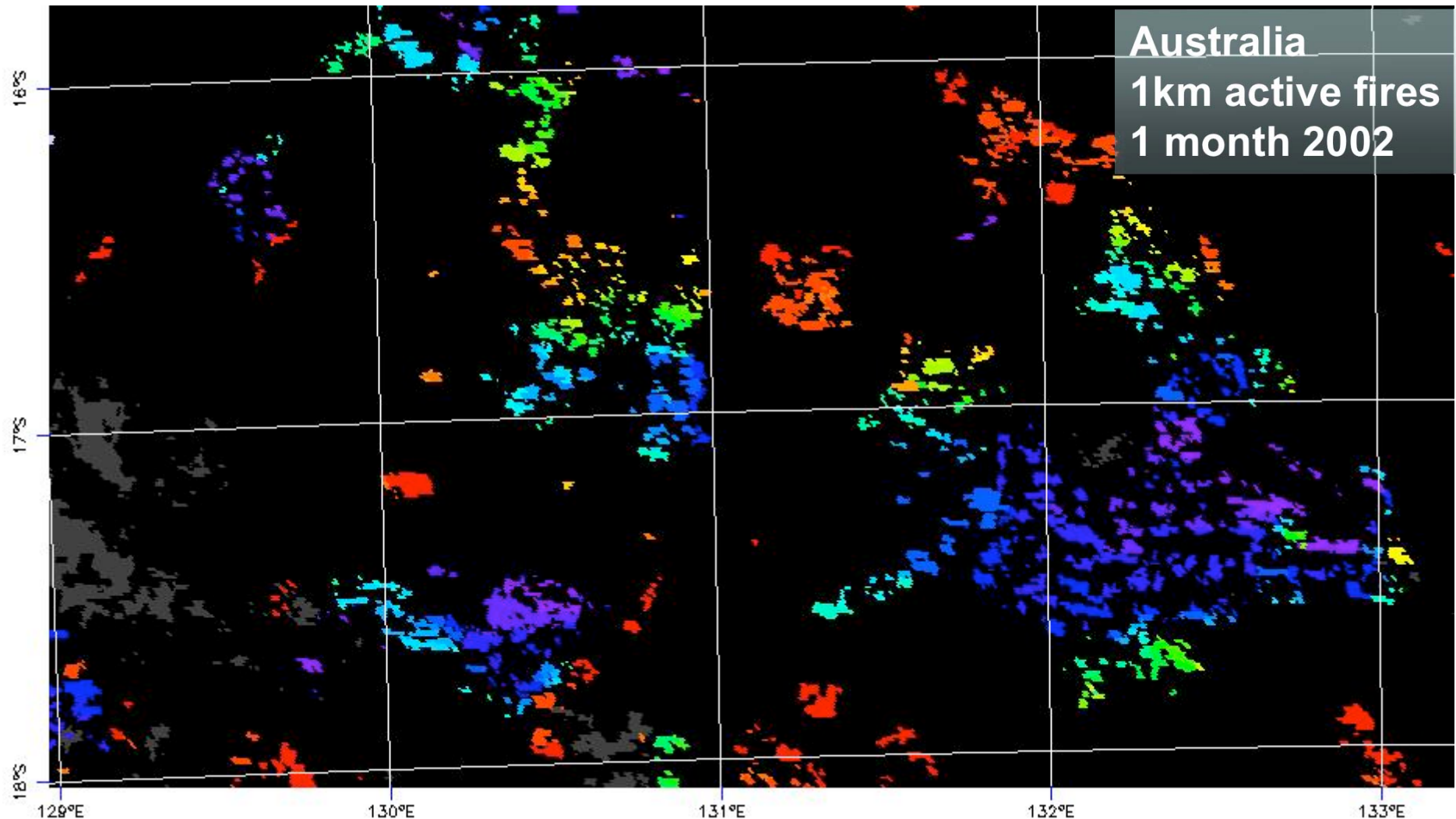2001-2002

Sparse vegetation = Good detection of burned area
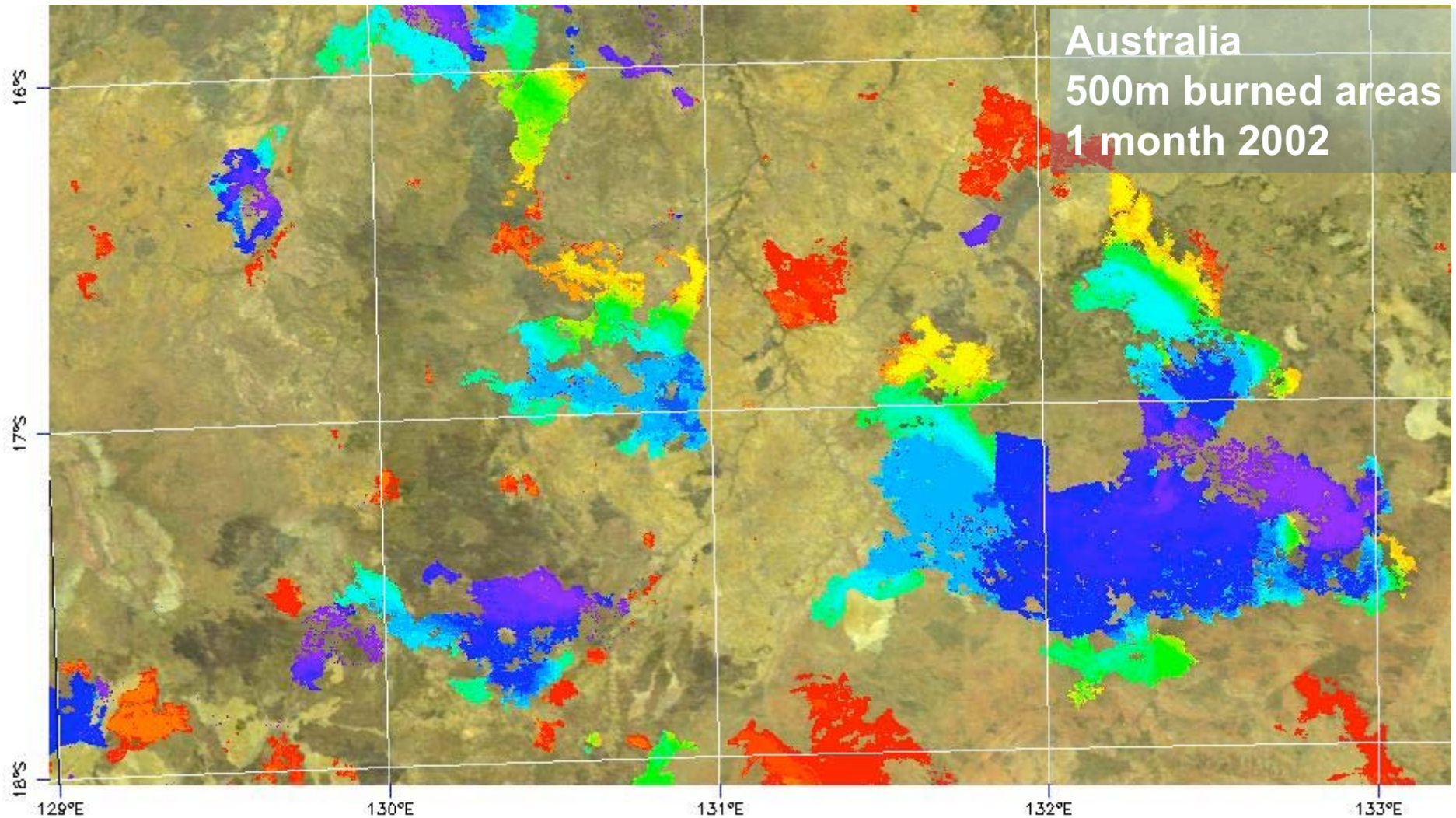
Australia
500m burned areas
1 month 2002

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*Global
Evaluation*

Sparse vegetation = Poor detection of active fires
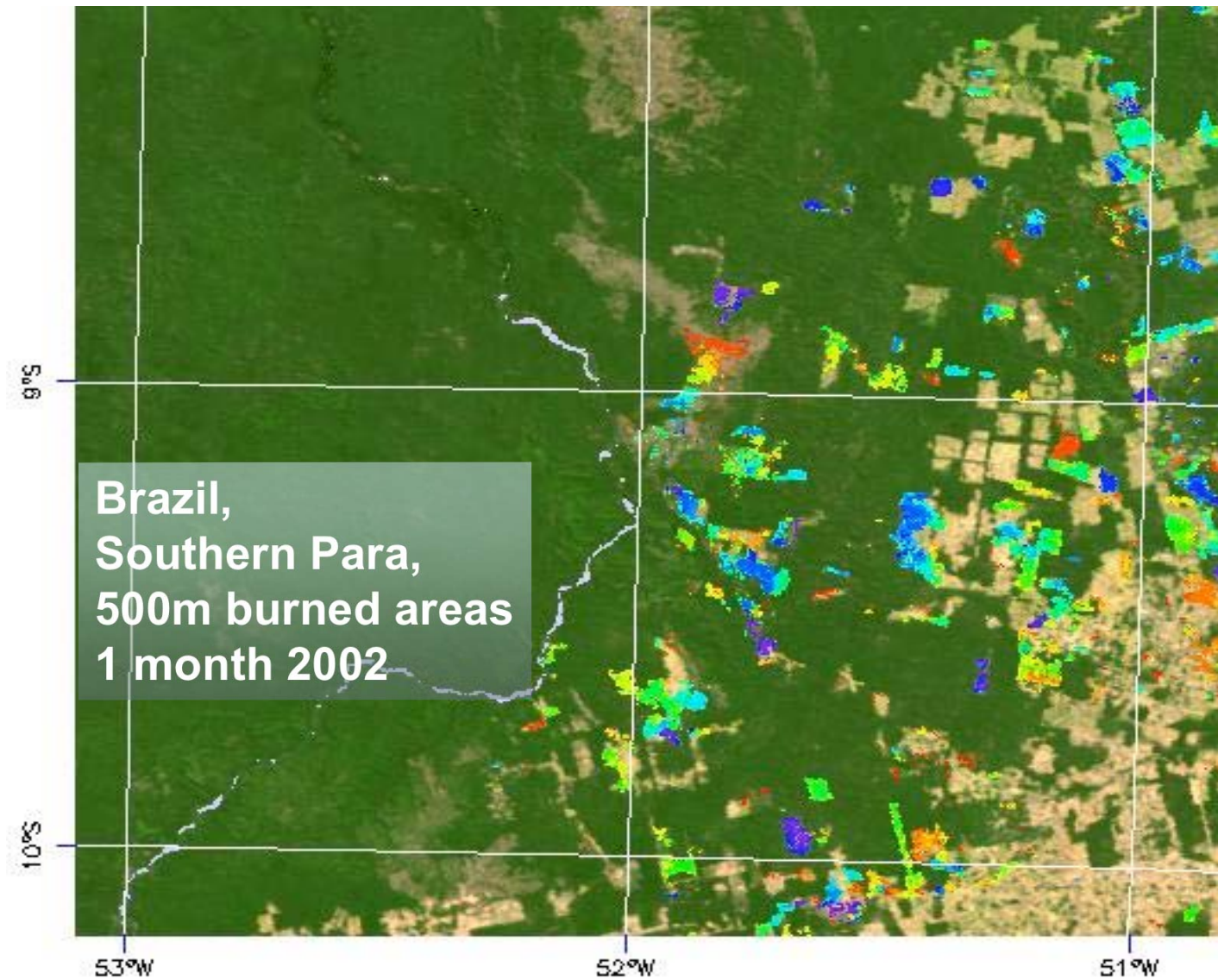

**Australia
1km active fires
1 month 2002**

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Dense vegetation = Poor detection of burned area

Brazil,
Southern Para,
500m burned areas
1 month 2002

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MODIS burned area validation
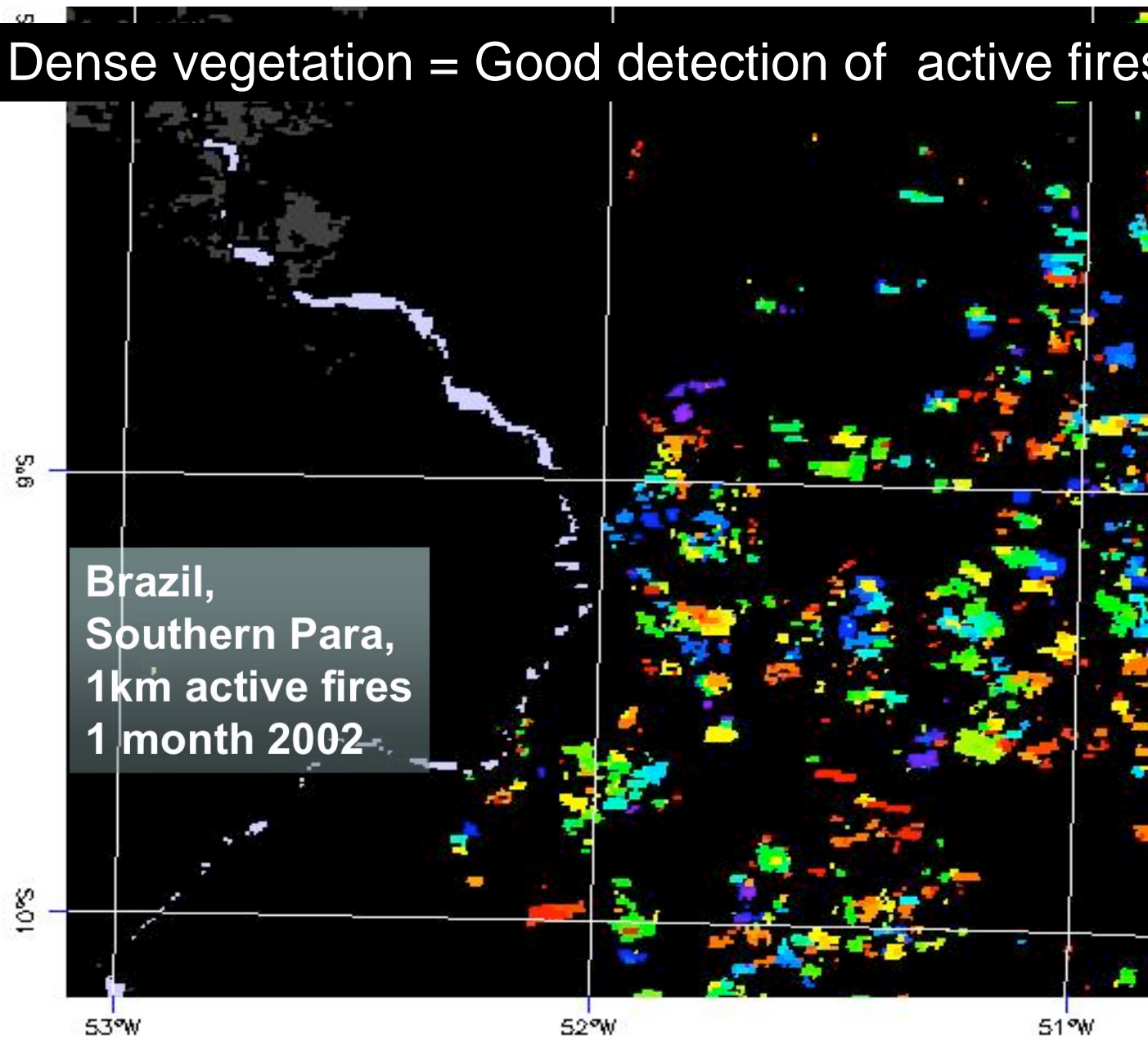Boschetti, Roy, Justice

*Global
Evaluation*

Dense vegetation = Good detection of active fires

Brazil,
Southern Para,
1km active fires
1 month 2002

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Evaluation

C5 Burned Area Product Validation Protocol

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Validation
Protocol

One Burned Area Validation Protocol Everywhere ?

- In different fire regimes the pre-fire conditions and the physical characteristics of fires and their remotely observable characteristics vary considerably

- Cloud persistence varies regionally in space & time

- Ambiguous changes of a similar direction and magnitude not caused by fire also vary in space & time

- Implications:

  – For the temporal and spatial derivation of independent reference data

  – Define a common protocol with different regionally dependent specifics

Burned Area Product Validation Protocol

- Compare MODIS burned area product with independent burned area data derived from multi-temporal Landsat ETM+ data

- SAFNet field trip held to develop the mapping protocol and African fire information needs, Zimbabwe-Zambia, July 2000

- Consensus mapping protocol to ensure regionally consistent independent validation data

- Protocol followed 2000-2002 at ~11 ETM+ scenes/year

Roy, D. et al. 2005

Reference dataset produced using pre-burn and post-burn data

Priorities:

1- ensure the accuracy of the reference data: local partners involved in the interpretation of the high resolution data

2- temporal consistency: map the changes between two acquisitions

3- spatial consistency: differentiate between unburned areas and areas that could not be interpreted due to data quality issues, or not visible because of clouds or shadows

Examples: Time difference between the two images
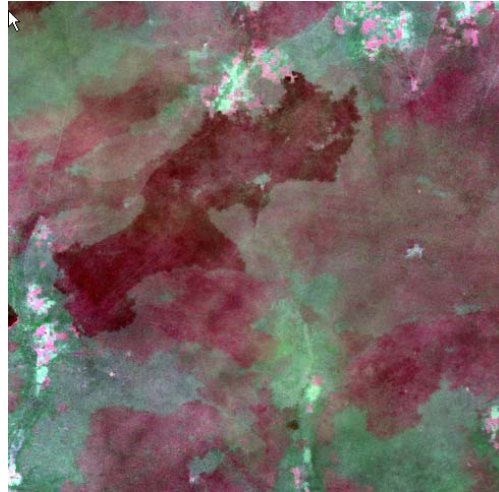
Image 1: 23 Oct 2000
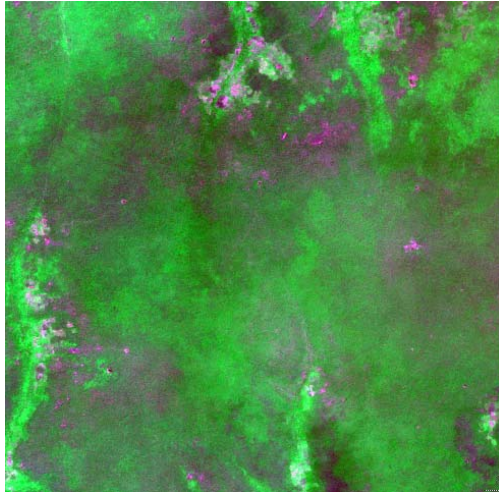
Image 2: 11 Jan 2001

INCORRECT: Images too far apart, the time interval is longer than the persistence time of the burned area spectral signal, and some burned areas in image 2 cannot be reliably identified
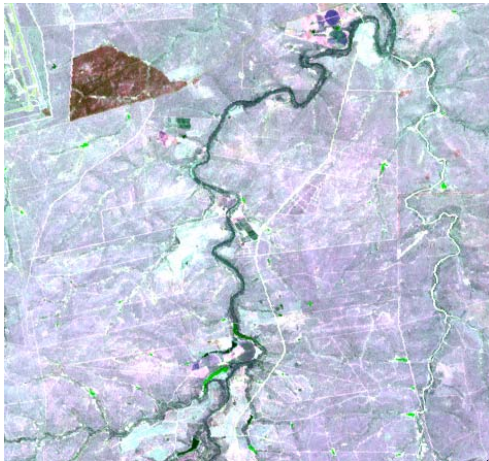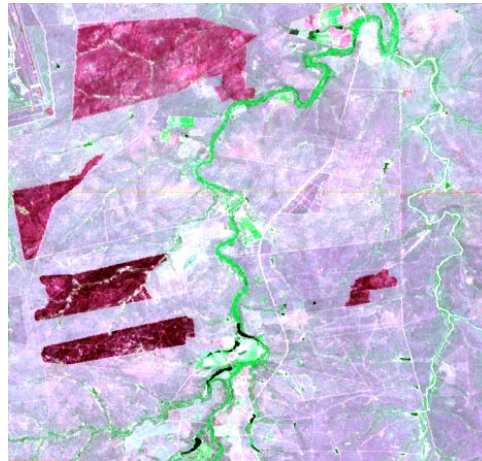
Image 1: 3 Sept 2001

Image 2: 5 Oct 2001

CORRECT: the time interval is shorter than the persistence time of the burned area spectral signal, and all the areas burning between the 2 dates are clearly identifiable

Landsat ETM+ validation scenes distributed from dry savanna to wet miombo woodland to quantify product accuracy over range of representative biomass burning conditions
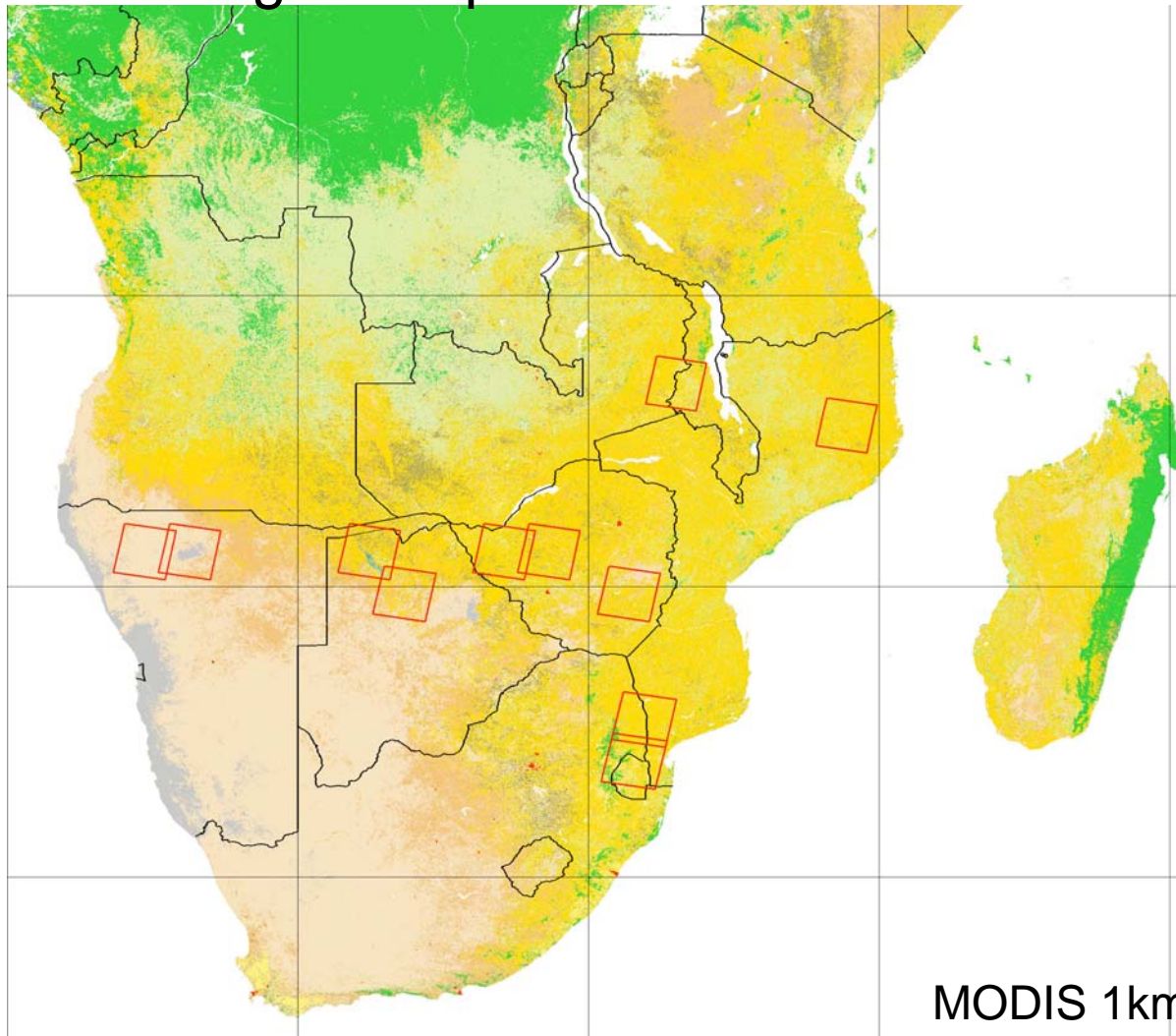
ETM+ scene
~185 * 185 km

Each ETM+ scene has a local SAFNet collaborator

11 scenes = ~3% of southern African surface

MODIS 1km land cover product

Image 1:

Landsat ETM+

Sept. 4th
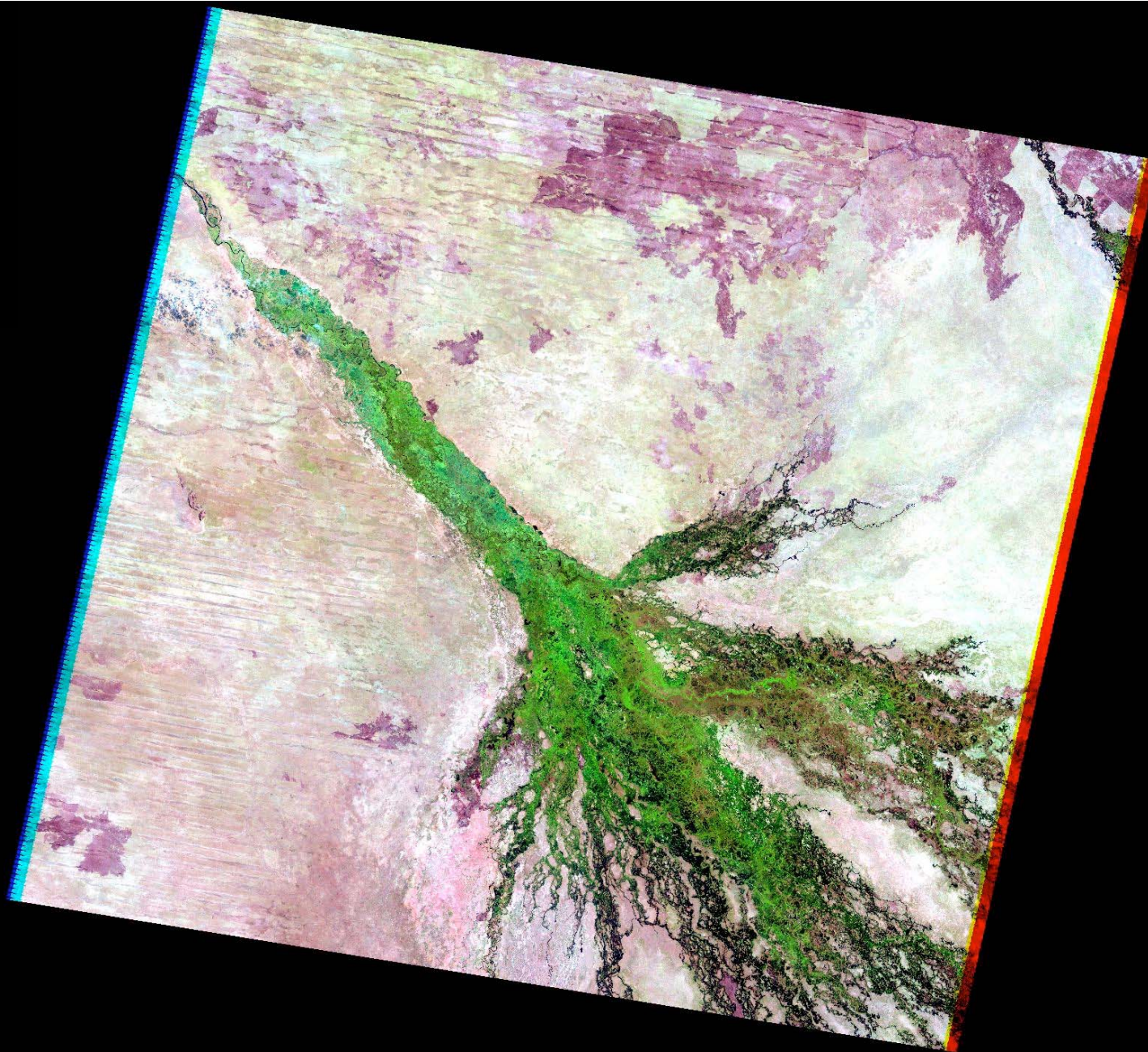
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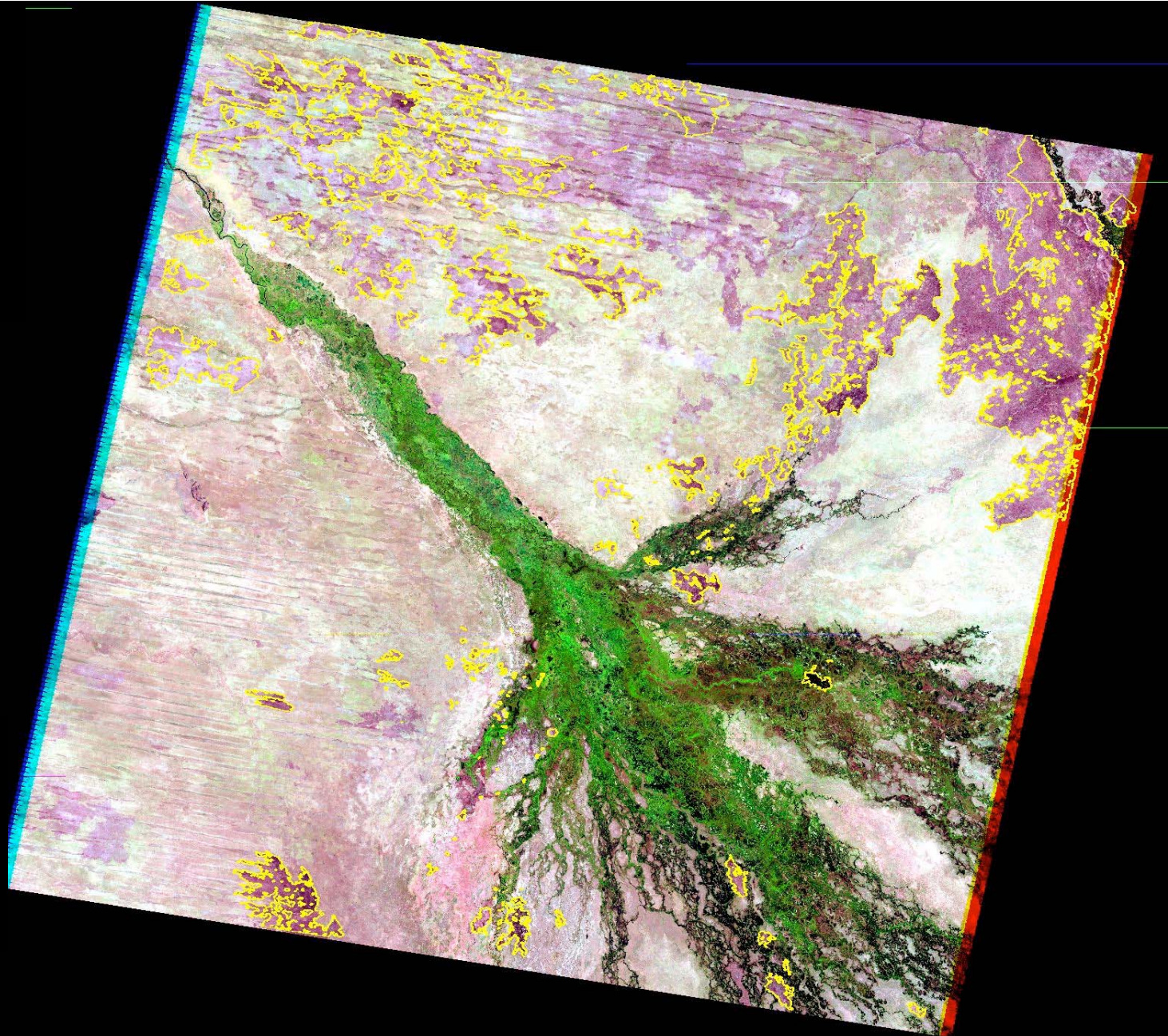
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Image 2:

Landsat ETM+

Oct 6th

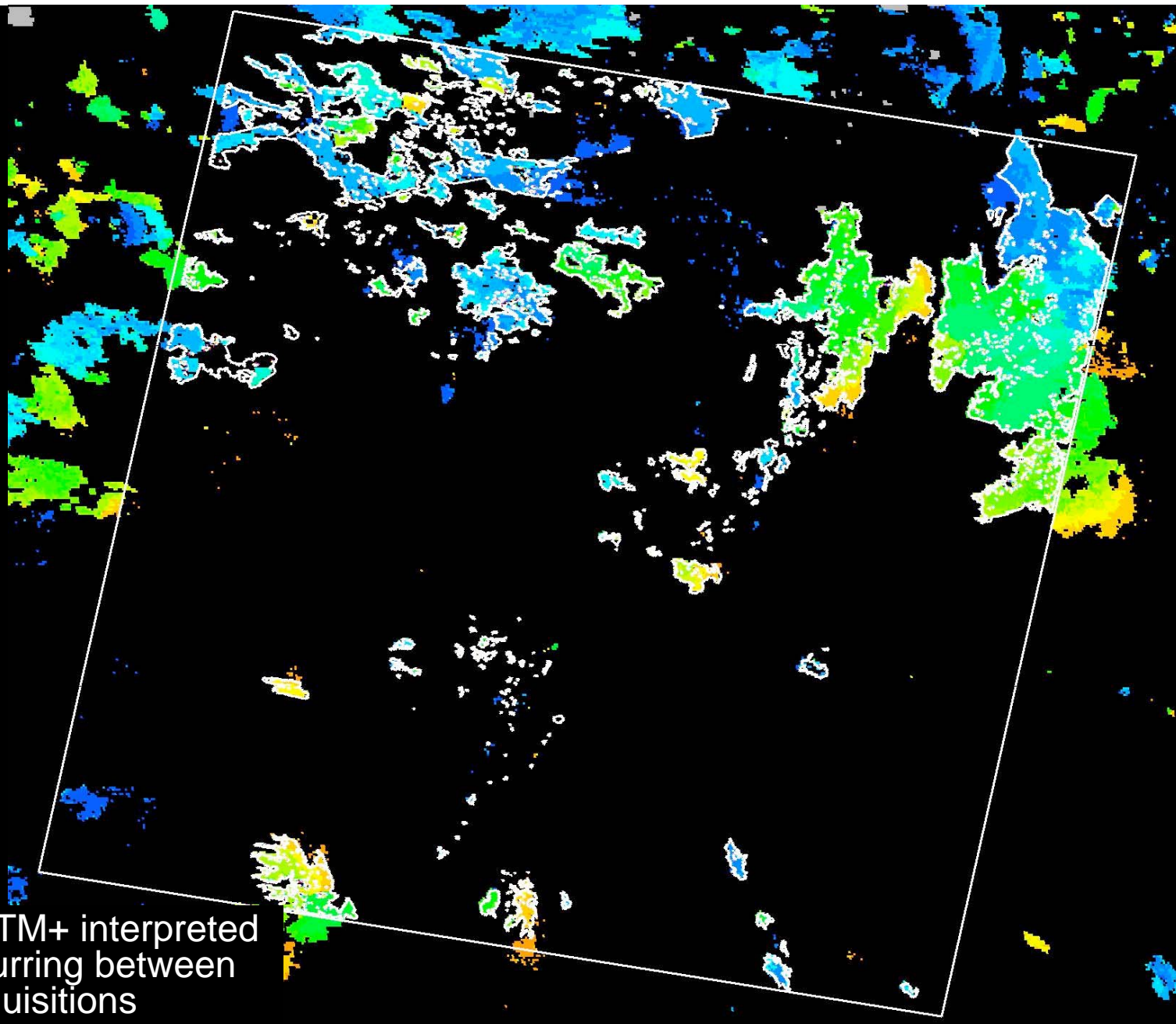Yellow vectors = ETM+ interpreted burned areas occurring between the two ETM+ acquisitions

MODIS
500m
Burned
Areas

Sept. 4
to
Oct. 6

White vectors = ETM+ interpreted
burned areas occurring between
the two ETM+ acquisitions

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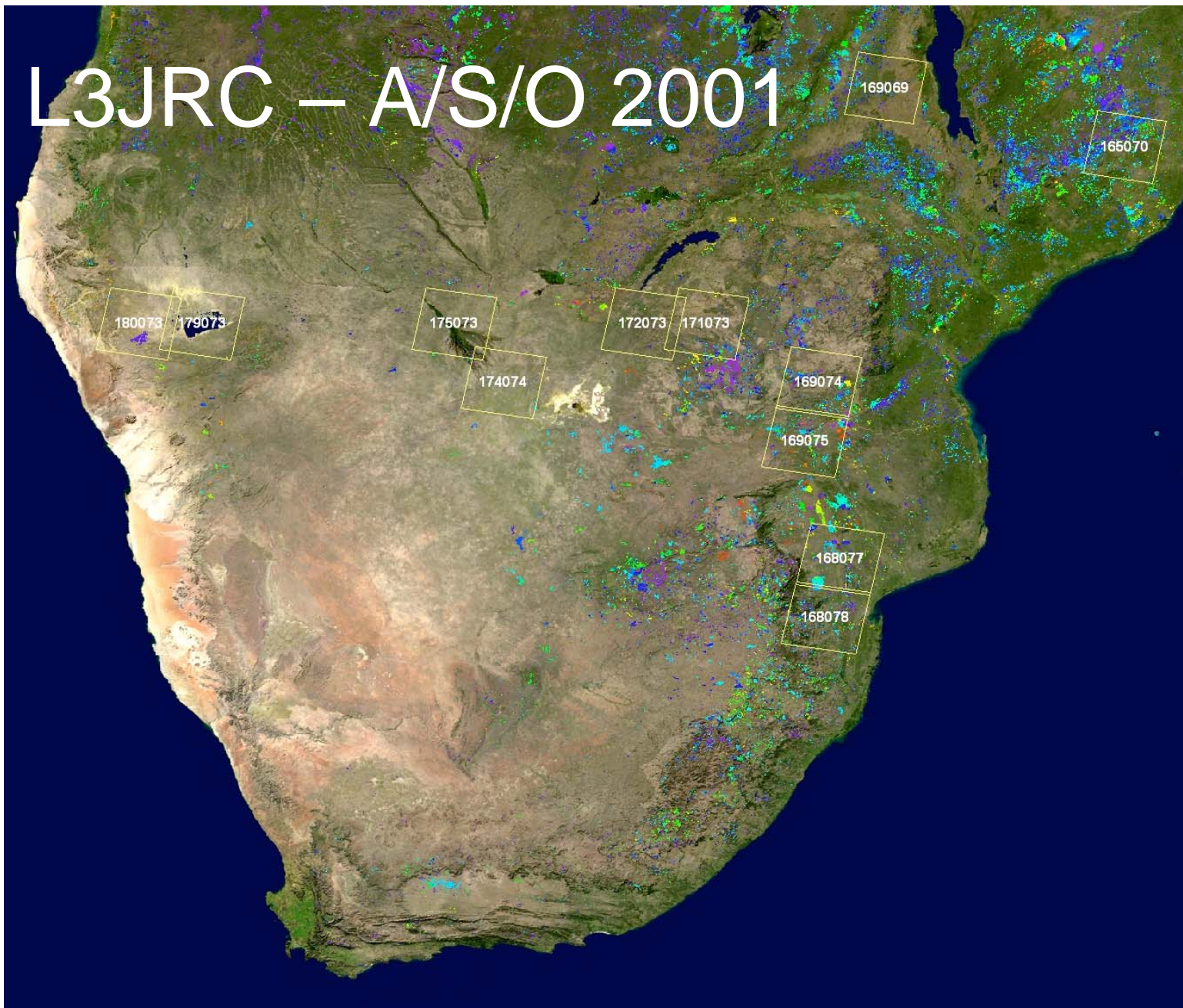*MODIS burned area validation*
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Protocol*

C5 Burned Area Product Inter-Comparison and validation

L3JRC – SPOT VEGETATION 1km

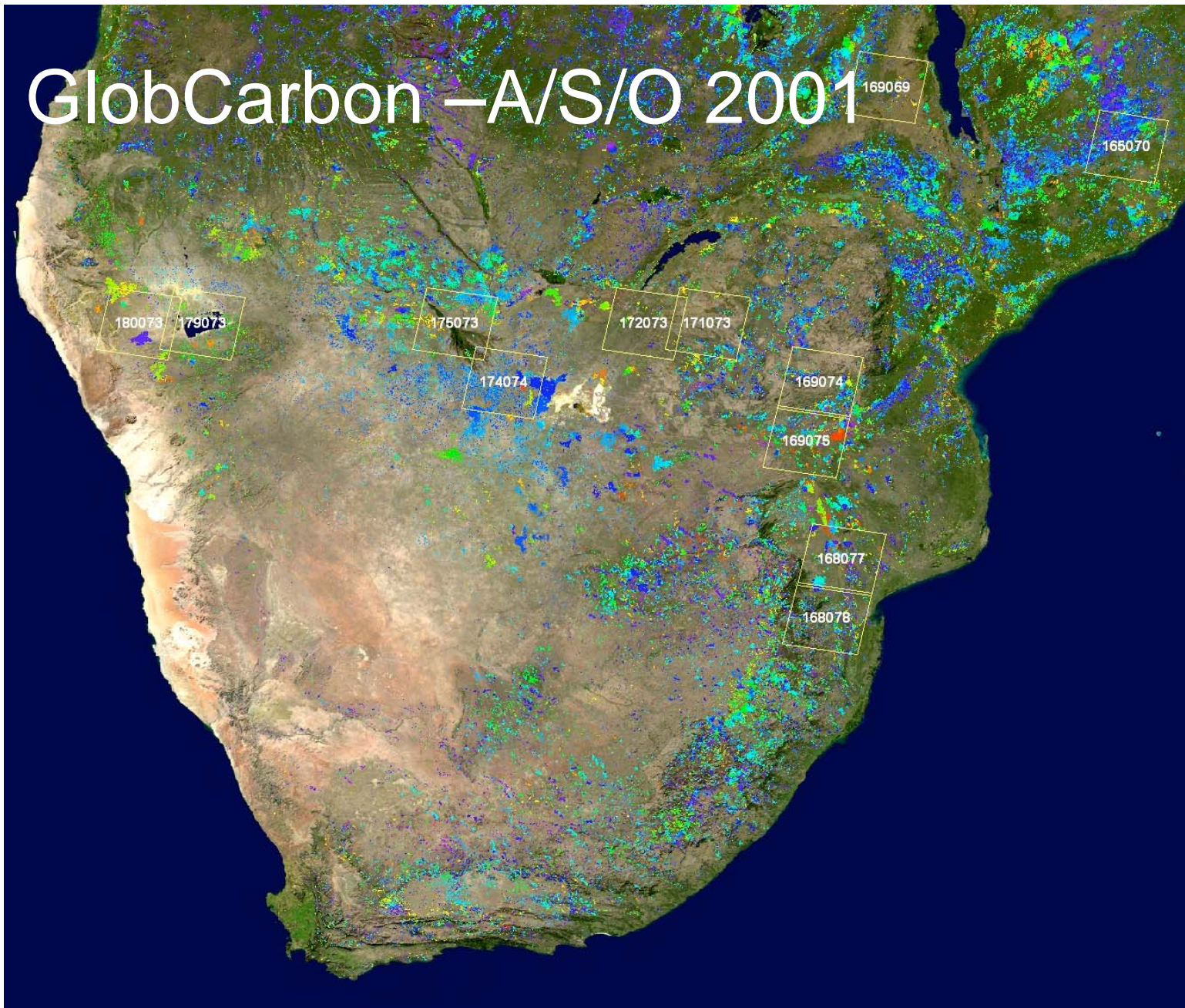## GLOBCARBON – SPOT VEGETATION and ATSR 1km

L3JRC – A/S/O 2001

169069
165070
180073 179073
175073
172073 171073
174074
169074
169075
168077
168078

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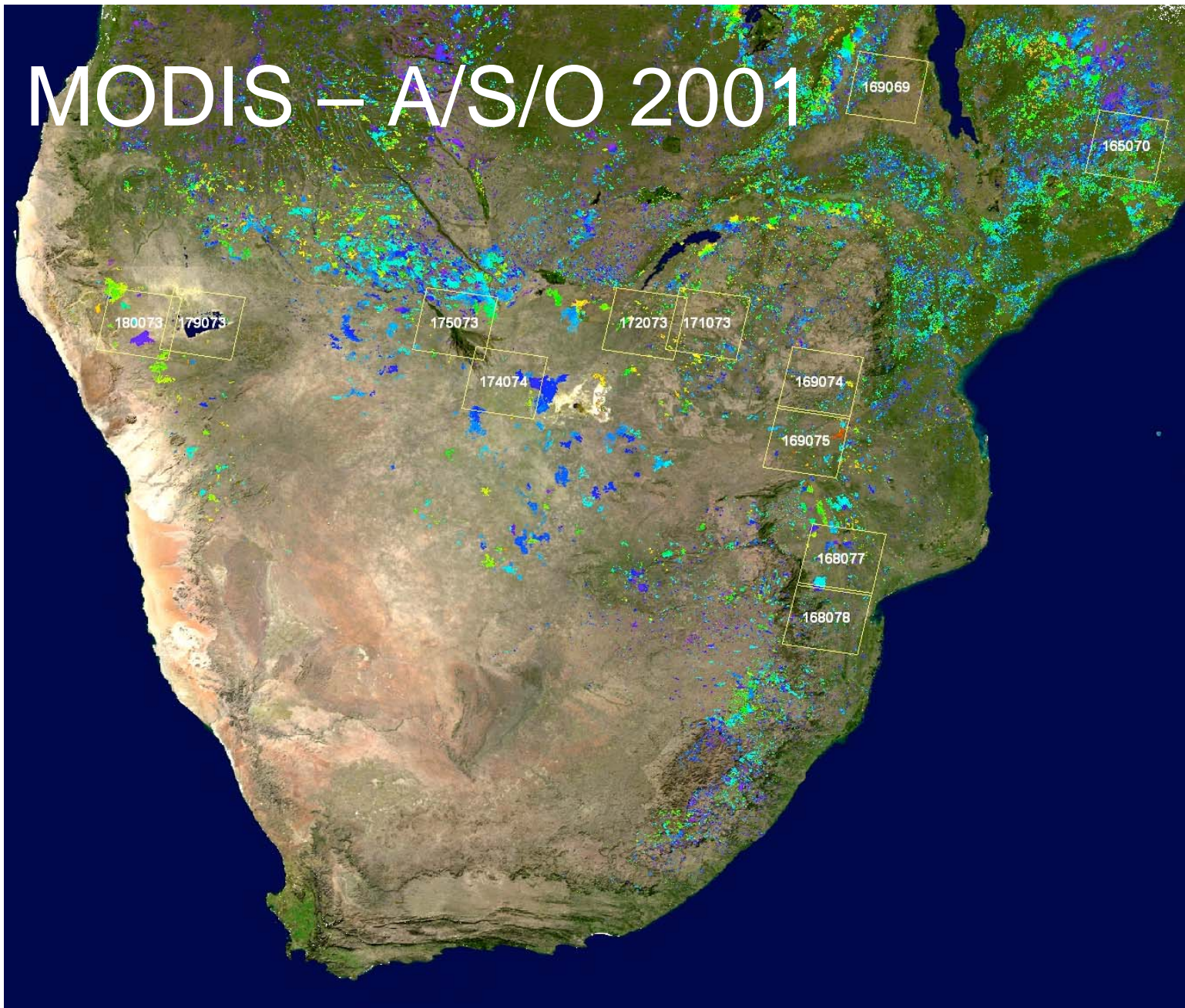
*Inter-comparison
and Validation*

GlobCarbon –A/S/O 2001

169069
165070
180073 179073
175073
172073 171073
174074
169074
169075
168077
168078

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MODIS burned area validation
Boschetti, Roy, Justice

*Inter-comparison
and Validation*

MODIS – A/S/O 2001

169069
165070
180073 179073
175073
172073 171073
174074
169074
169075
168077
168078
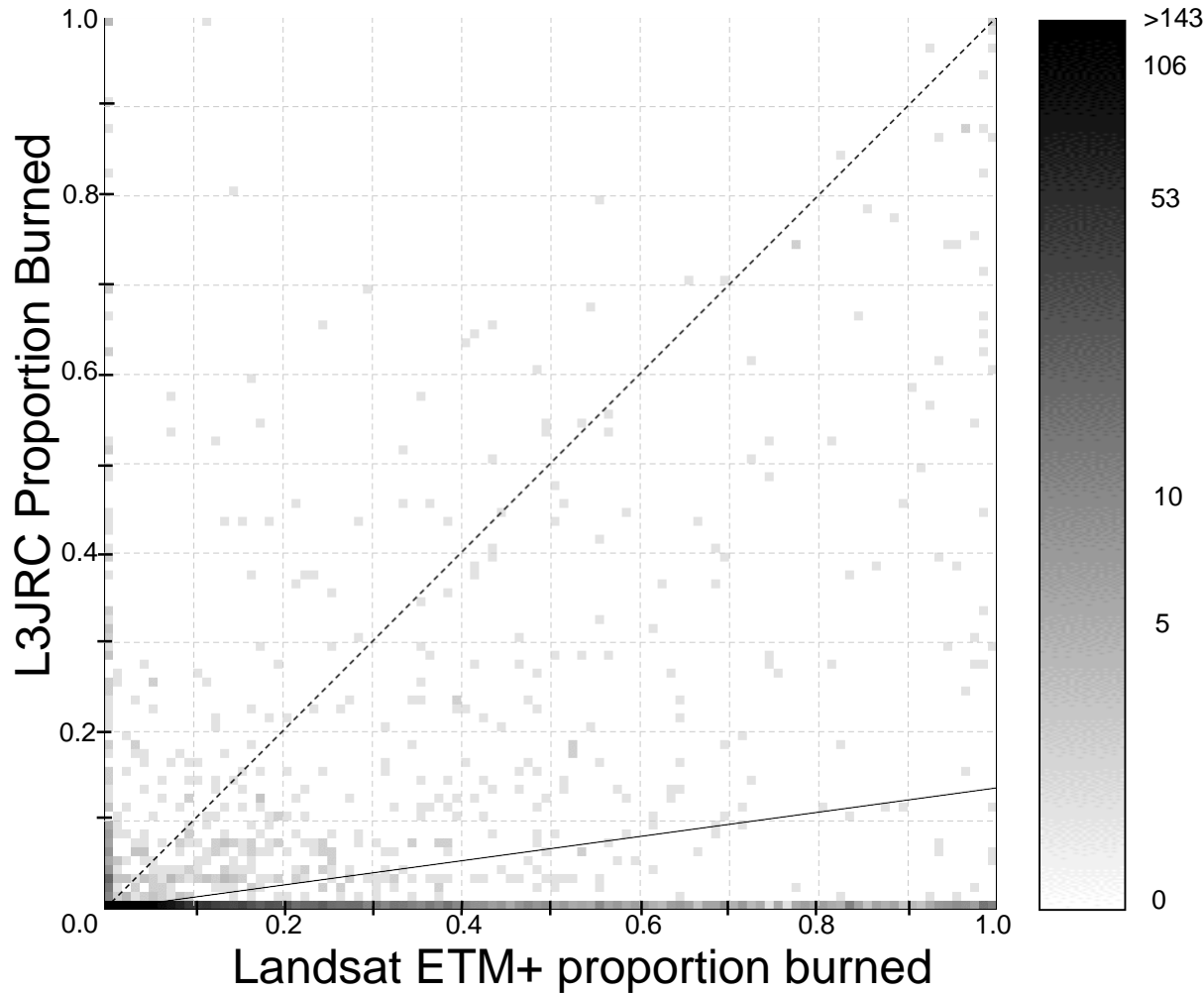
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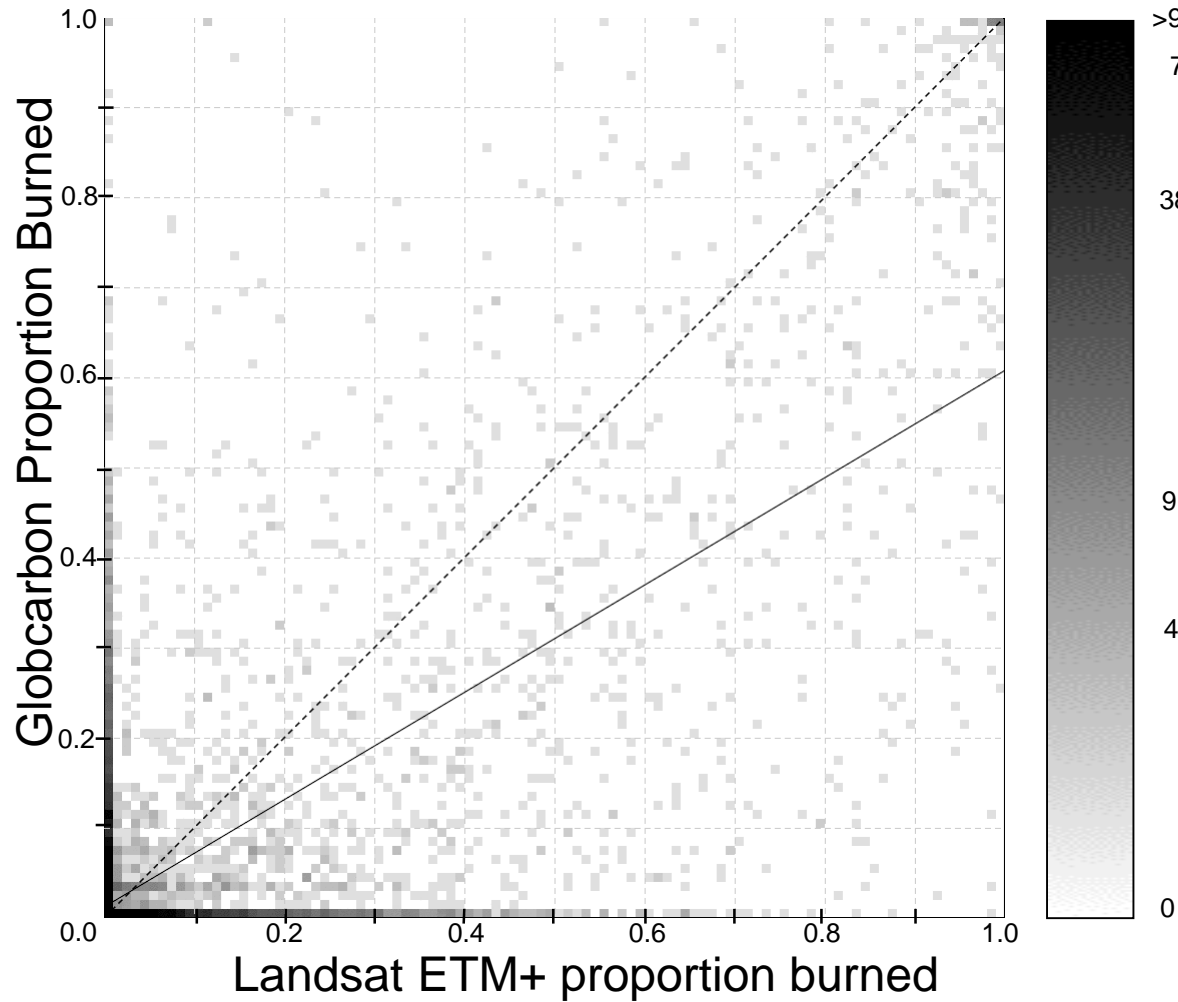*Inter-comparison
and Validation*

All L3JRC Data (294148 km^2)

Africa 2001

5km x 5km

grid cells

Slope = 0.136

Intercept = 0.136

r^2 = 0.13

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MODIS burned area validation
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Inter-comparison
and Validation

All Globcarbon Data (294148 km^2)

Africa 2001

5km x 5km

grid cells

Slope = 0.509

Intercept = 0.013

r^2 = 0.51

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