MODIS Global Burned Area Validation and Product Status

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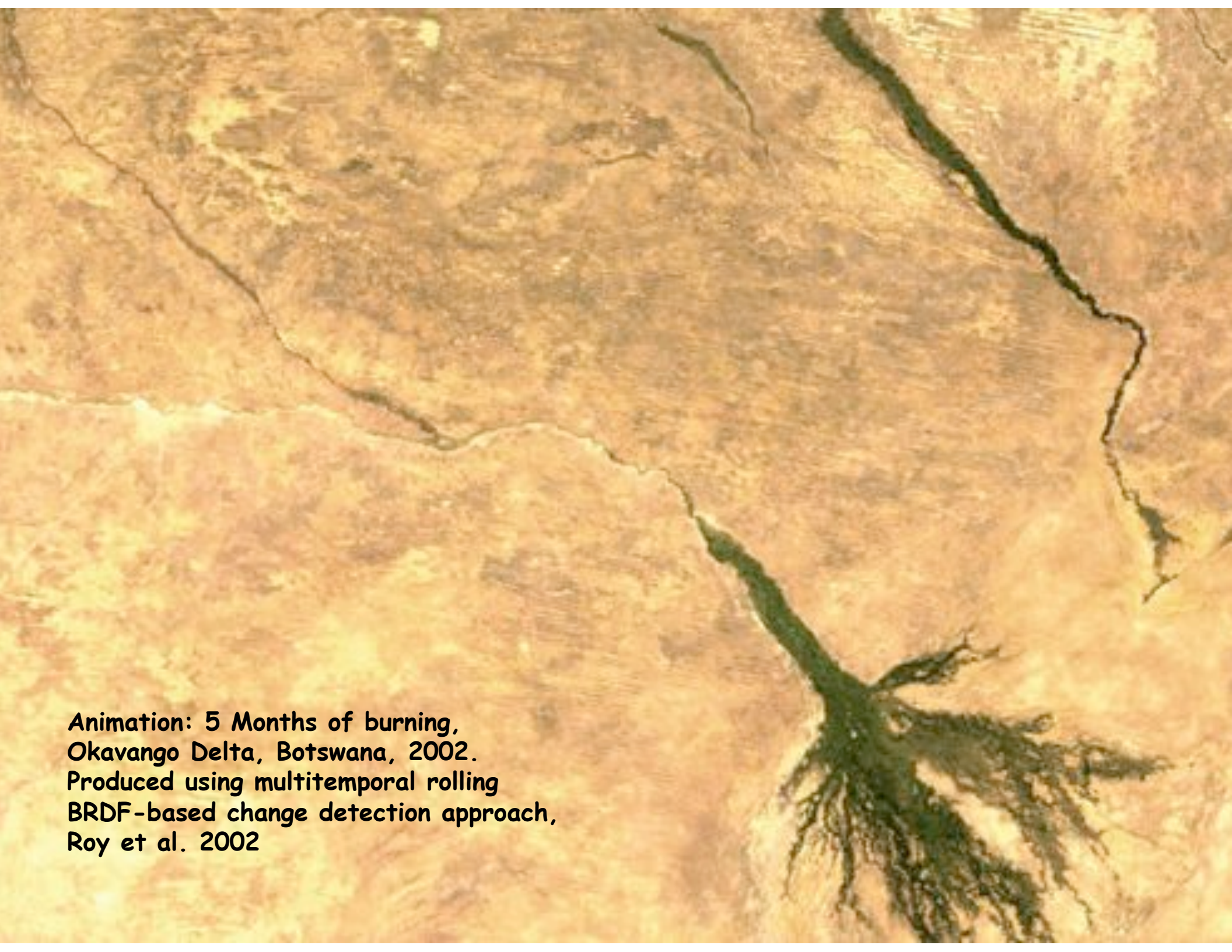
http://modis-fire.umd.edu

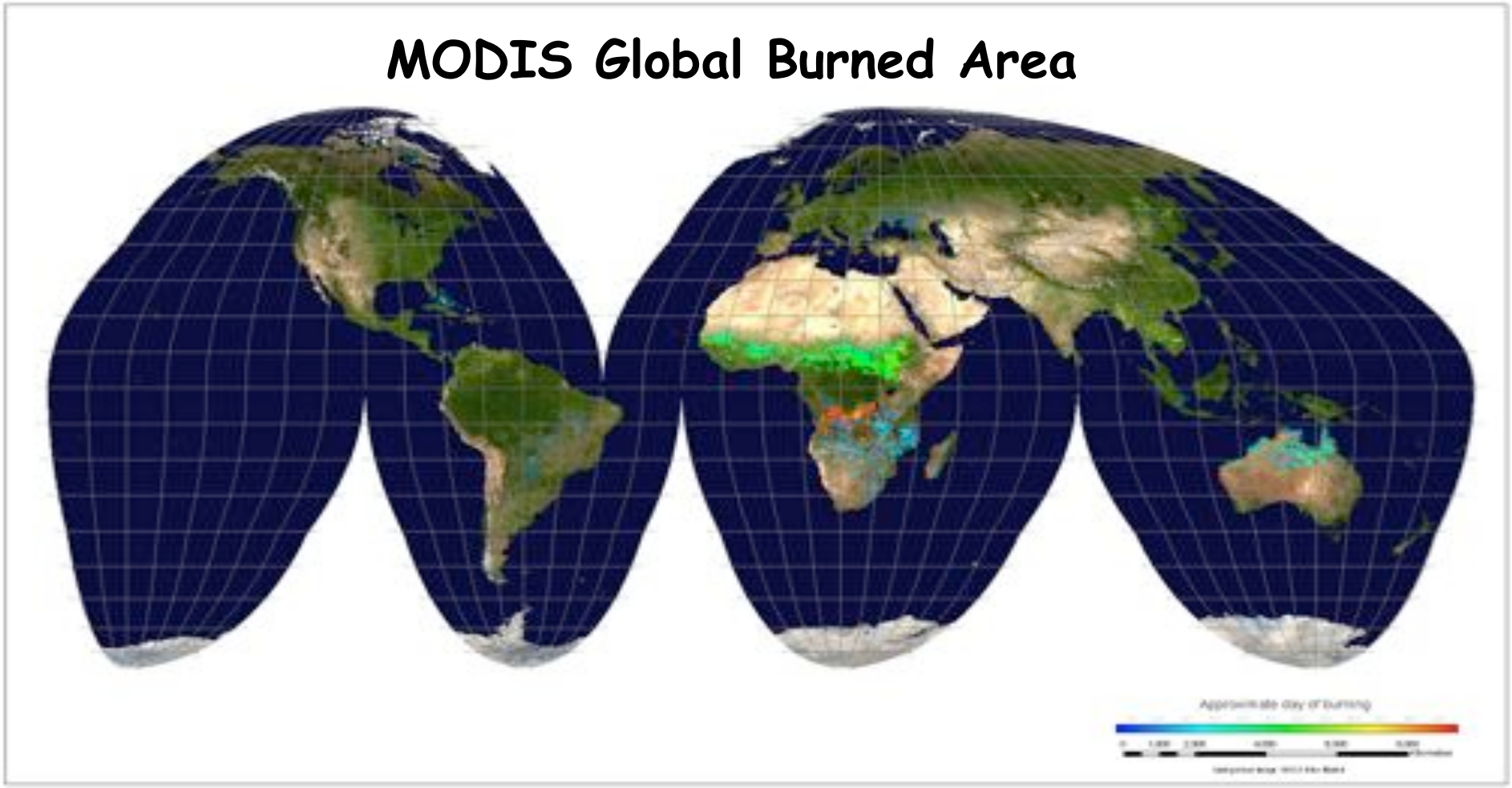
Global 500m MODIS Burned Area Product (MCD45)

- Status
- Validation
  - Accuracy of areal extent
  - Accuracy of time of detection
- Algorithm refinement



Animation: 5 Months of burning,
Okavango Delta, Botswana, 2002.
Produced using multitemporal rolling
BRDF-based change detection approach,
Roy et al. 2002

MODIS Global Burned Area



- Algorithm run globally for first time in MODIS C5 - purposefully running to map burned areas conservatively
- **Validation** currently Stage 2
- **QA and Testing underway** to incrementally improve product and reduce the impact of known issues through C5

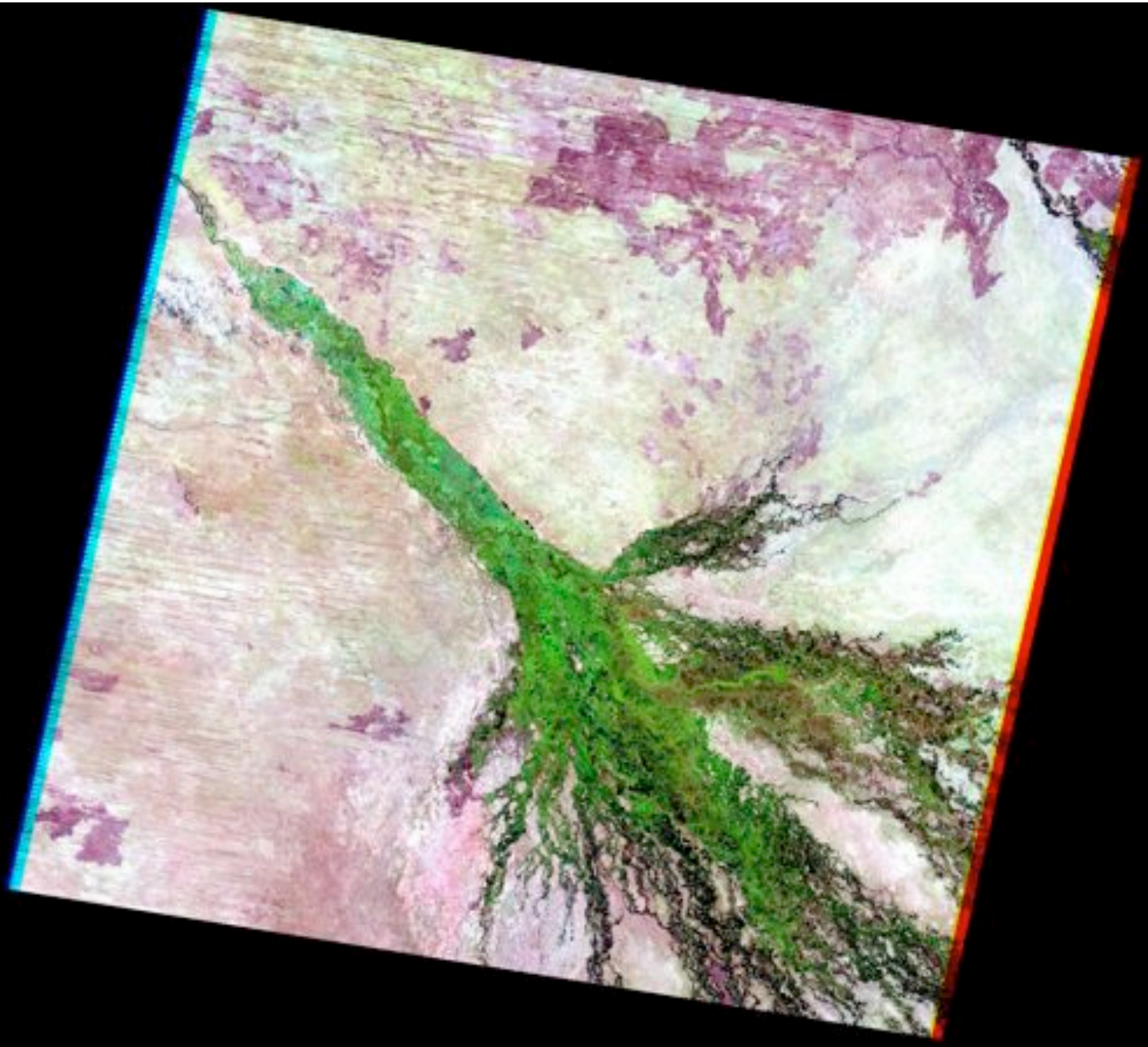
Validation Protocol

- Landsat-based validation protocol
  - Developed in SAFARI2000 with SAFNet
  - Expanded to other GOFC-GOLD regional networks
  - Protocol advocated & now adopted by the CEOS Cal/ Val program
- Multi-temporal Landsat data
  - interpreted by regional experts
  - map the area burned between acquisitions
  - generate independent reference data set
- All independent reference data to be made available to the community via the MODIS fire web site

Time 1:

Landsat ETM+

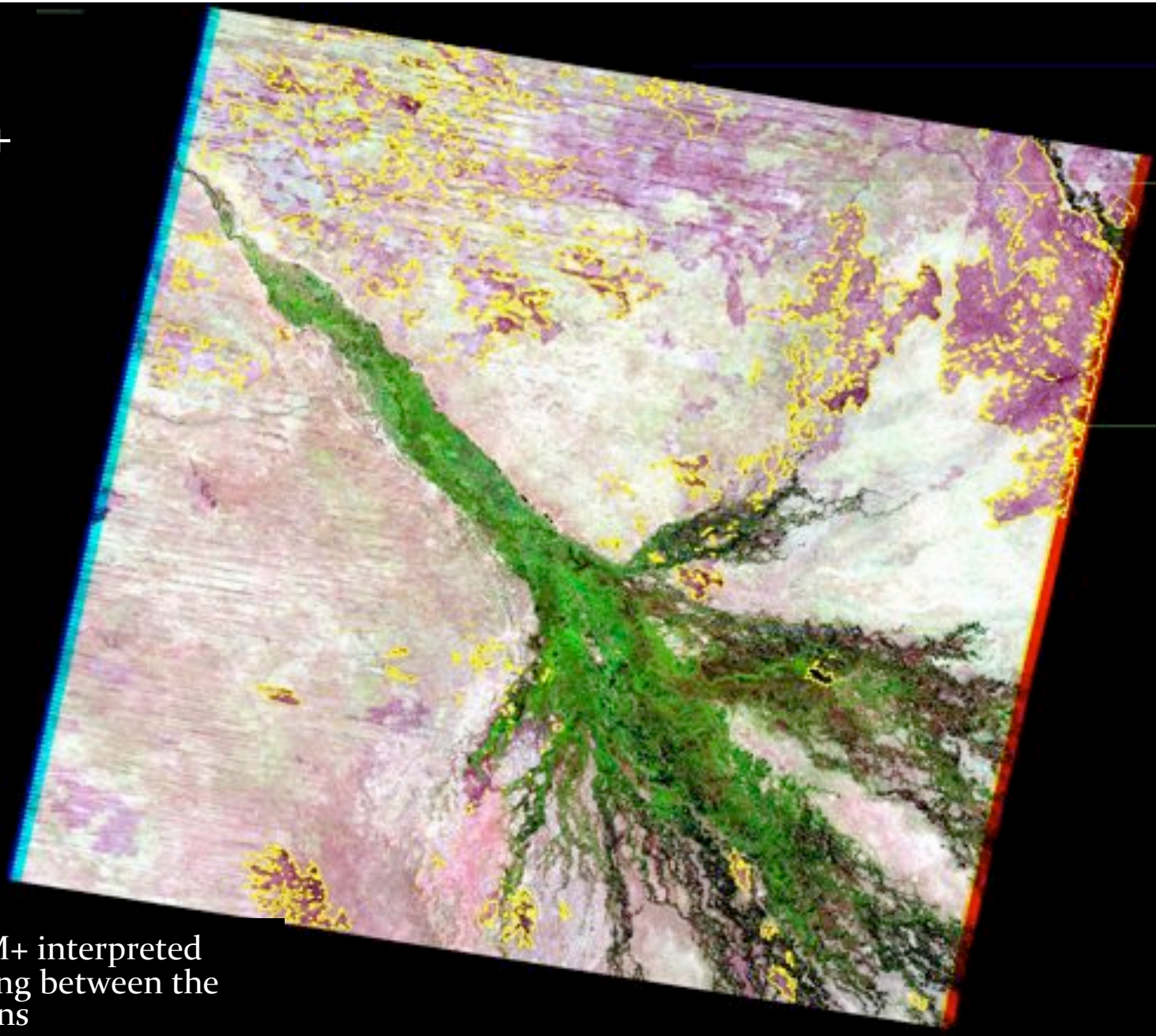
Sept. 4th



Time 2:

Landsat ETM+

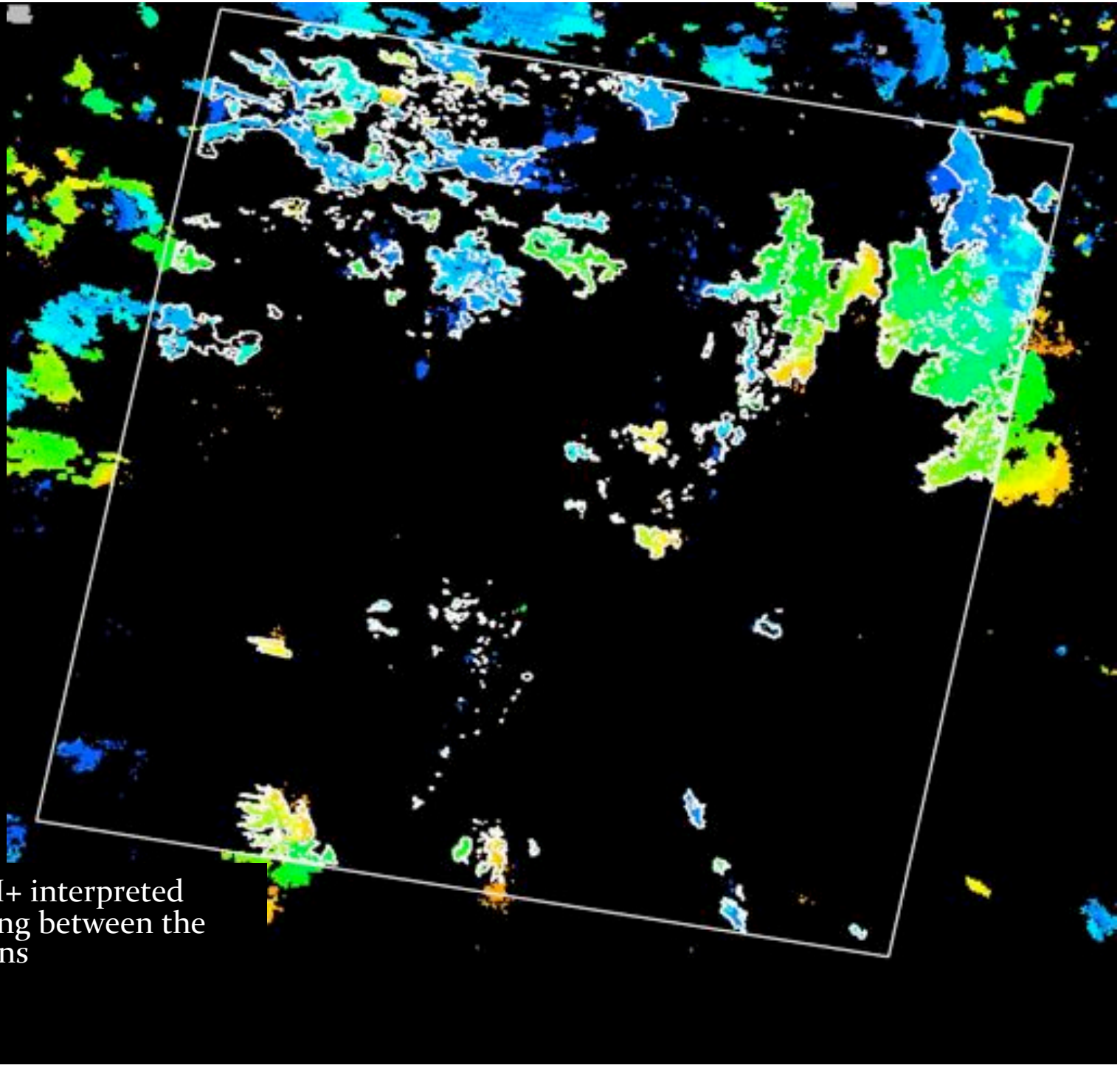
Oct 6th



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

MODIS
500m
Burned Areas

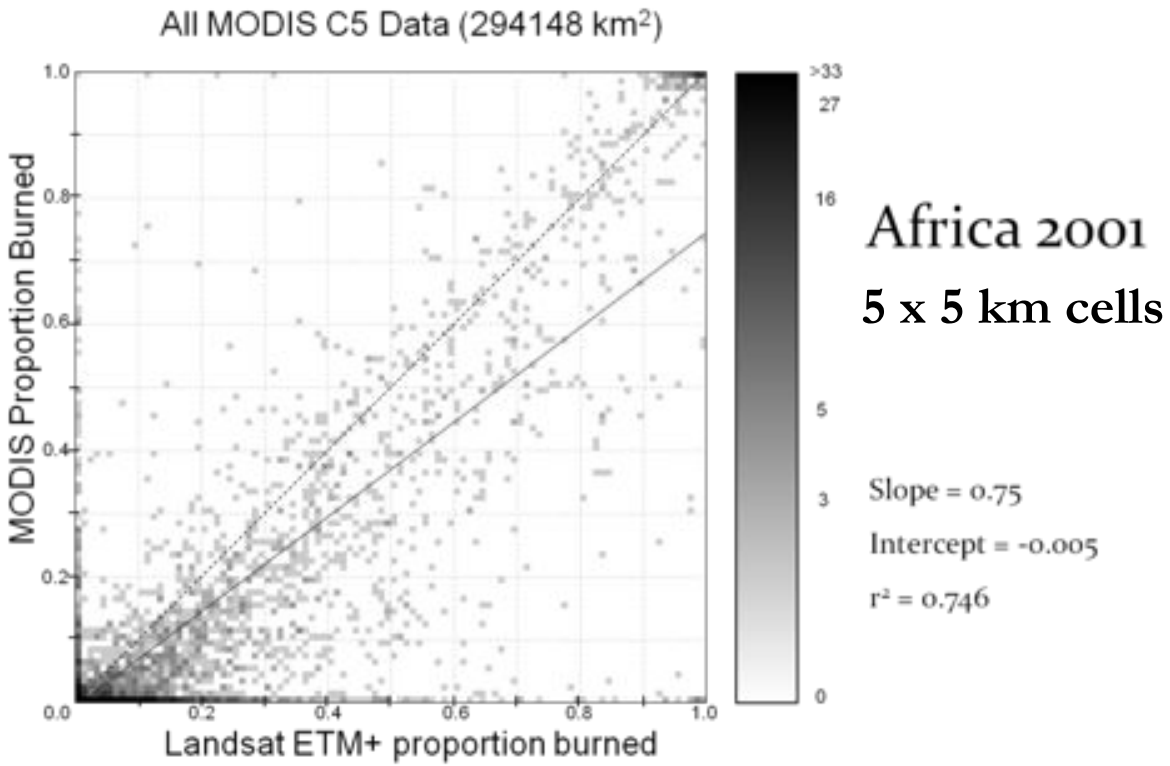
Time 1 Sept. 4
to
Time 2 Oct. 6



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

Validation Metrics

- Regression – regional spatial accuracy assessment



- Confusion matrix statistics (overall, user's & producer's accuracy) – pixel level accuracy assessment

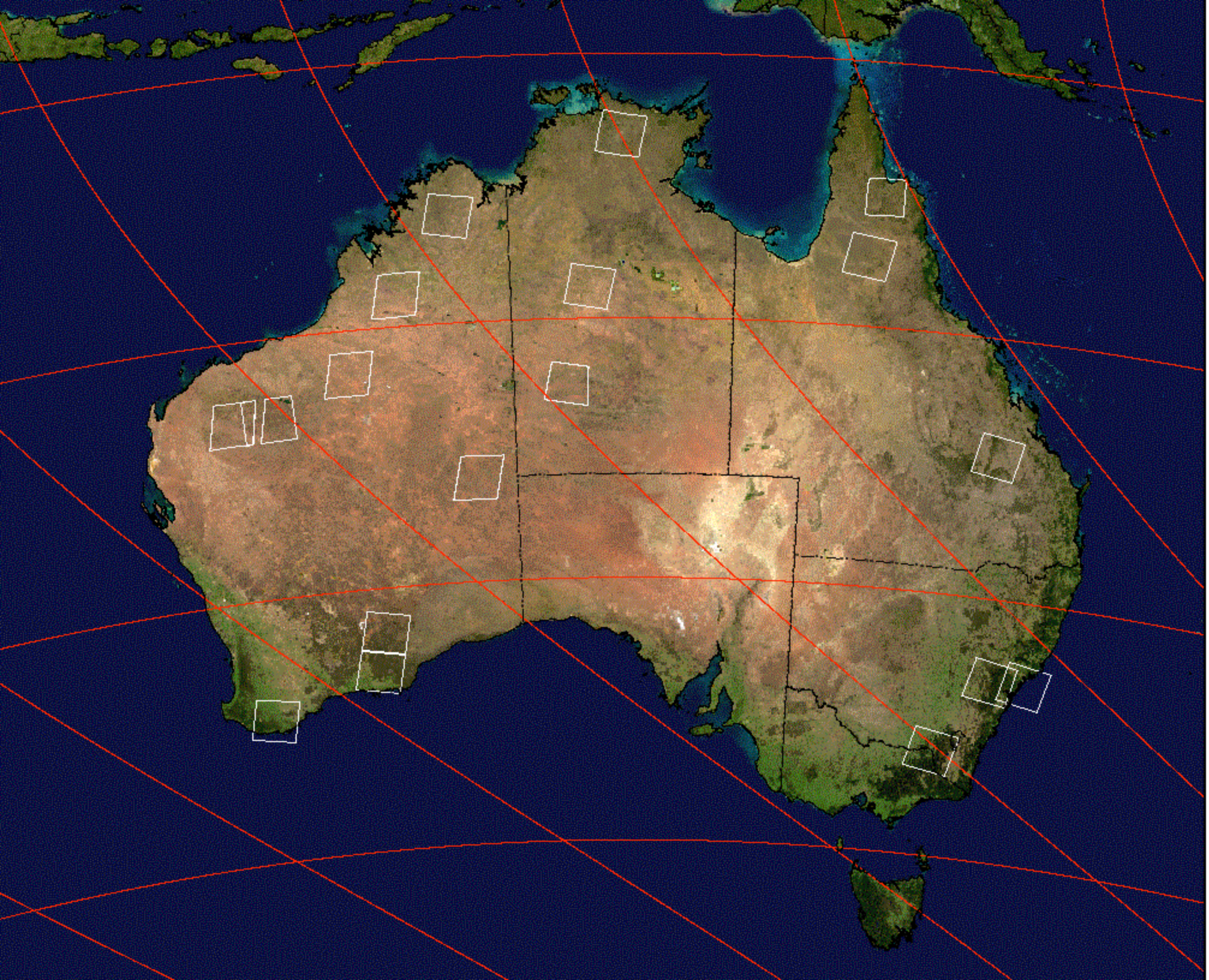
Validation Sites

- Stage 2 independent reference dataset processed; with extensive network of GOFC-GOLD partners

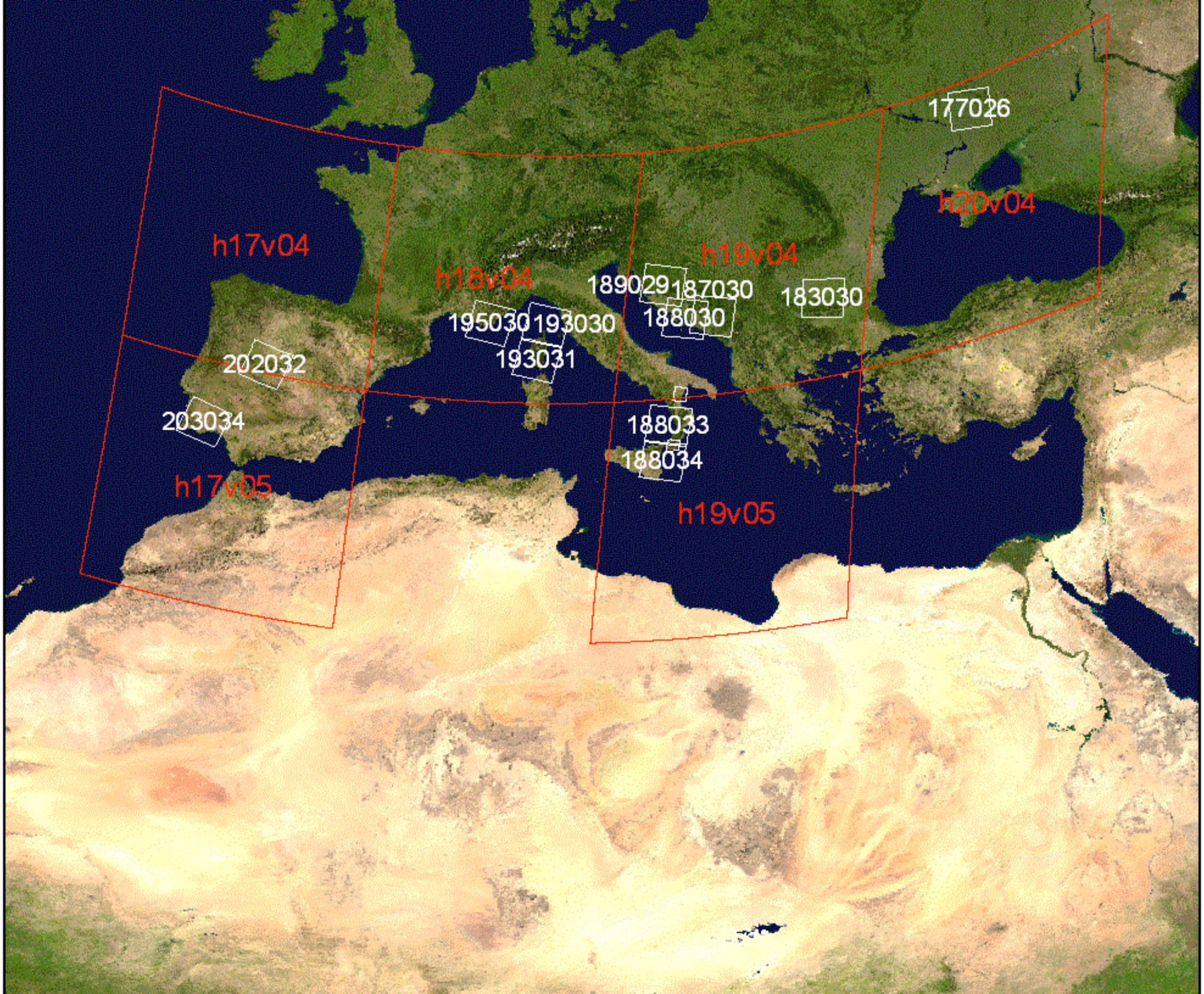
- Completed
  - Africa
  - Europe
  - Siberia
  - Central and South America
  - Australia

- In progress
  - India
  - China
  - South East Asia
  - US


h16v07
P203_R51
P181_R54
h19v08
P177_R55
h20v08
P169_R69
h19v10
h20v10
P165_R70
h21v10
P175_R73
P172_R73
P180_R73
P169_R74
P179_R73
P174_R74
P171_R73
h20v11
P168_R77
P168_R78
h21v11

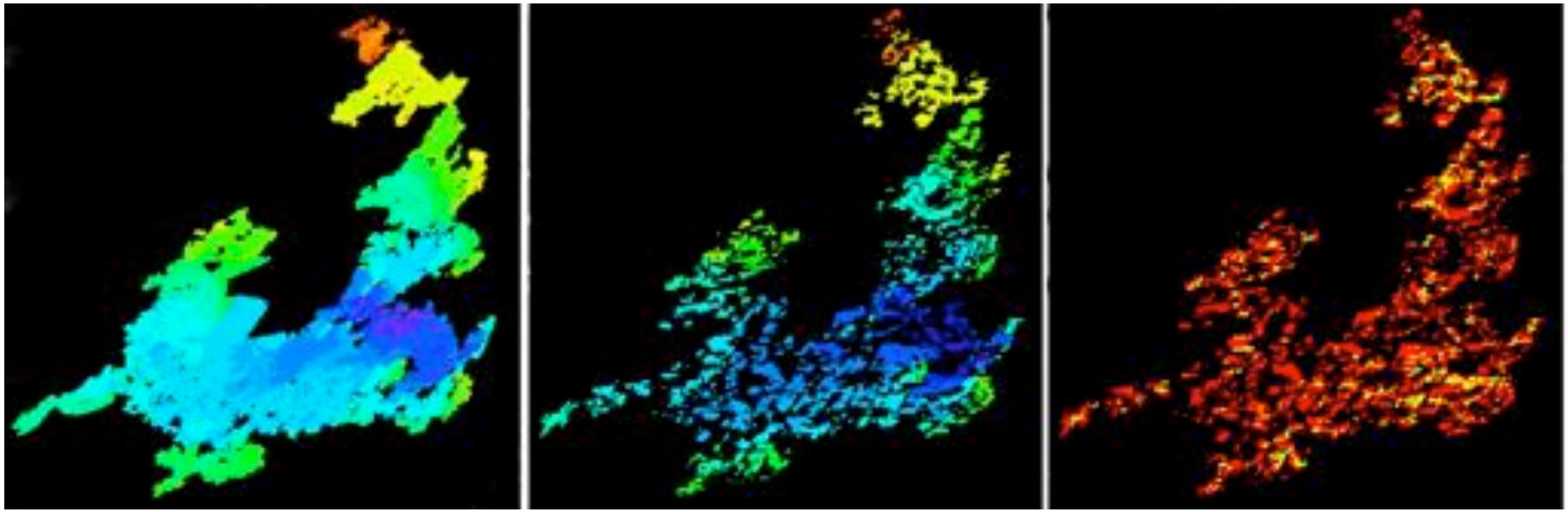



h08v06
P32_R43
P31_R44
P28_R47
h08v07
P5_R55
P4_R55
P5_R56
h11v08
h13v09
P220_R66
P231_R70
P228_R70
h11v10
h12v10
P224_R70
P224_R71
P220_R75
h13v11
h12v12
P230_R84
P229_R85
P230_R85


177026
h20v04
h17v04
h18v04
h19v04
189029
187030
183030
188030
195030
193030
193031
202032
203034
188033
188034
h17v05
h19v05

Validation of Burned Area Product
Temporal Reporting Accuracy

- To date we have concentrated on product spatial reporting accuracy
- The product also reports the ~day of detection
- The nominal uncertainty due to the daily rolling BRDF inversion window is 8 days
- Temporal product accuracy increasingly relevant to user community
  - near real time air quality
  - atm. transport models (weather on day of burn, plume injection height)
  - some regional assessment applications (nat. resource, disaster management)



Burned Area

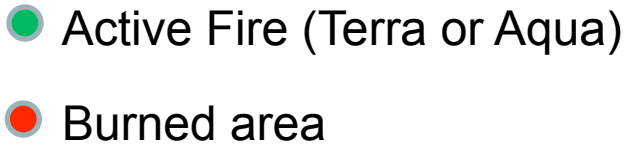
Active Fire

# Active Fire
Red=1, Yellow= 2

- MODIS active fire product
  - validated to stage 3
  - very low commission error
  - date & time of active fire detection defined by orbit overpass

MODIS Burned Area Temporal Reporting Validation Approach

Comparison at all global locations where there is a burned area detection and an active fire detection



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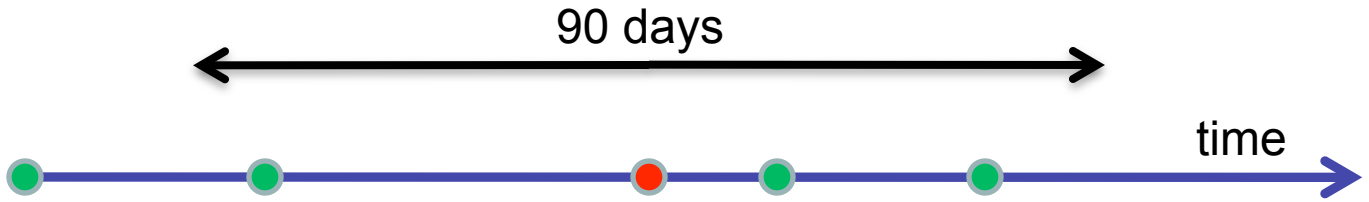

- Active Fire (Terra or Aqua)
- Burned area

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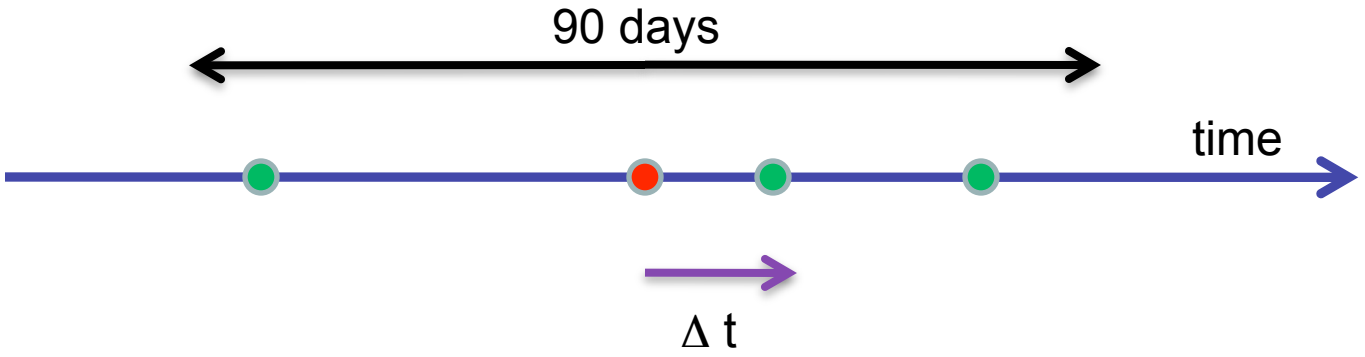

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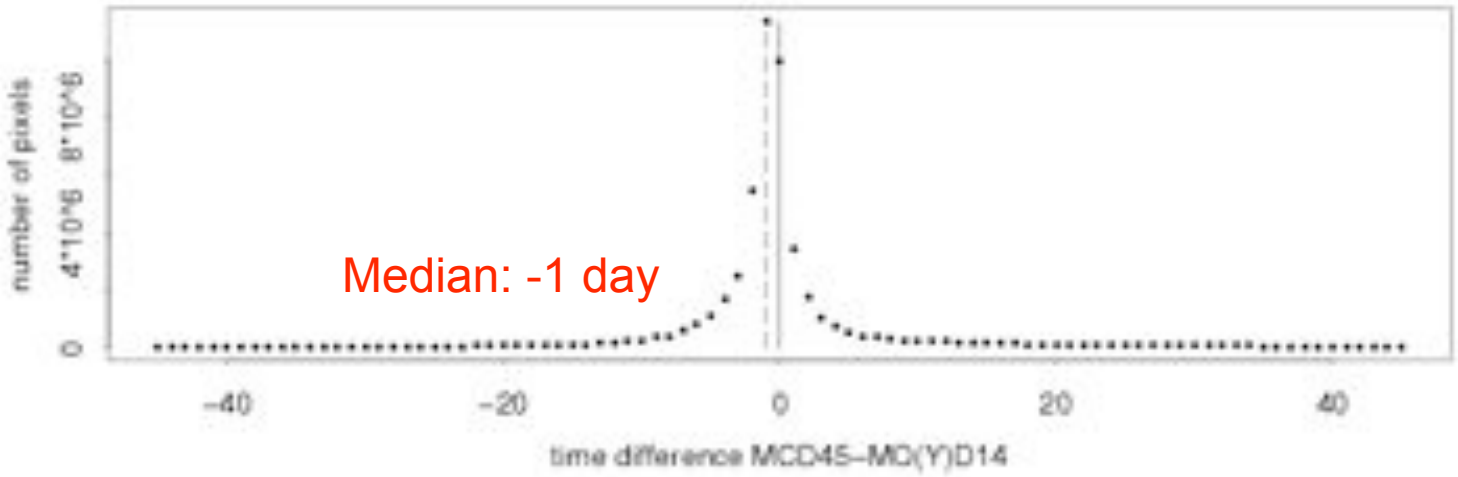
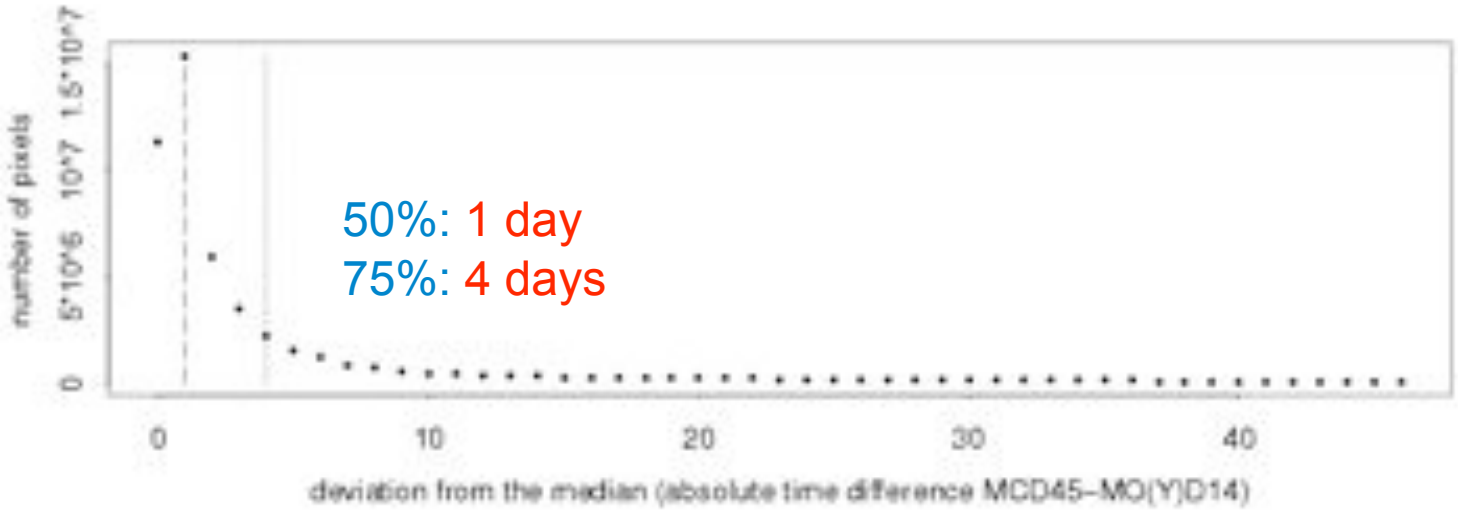
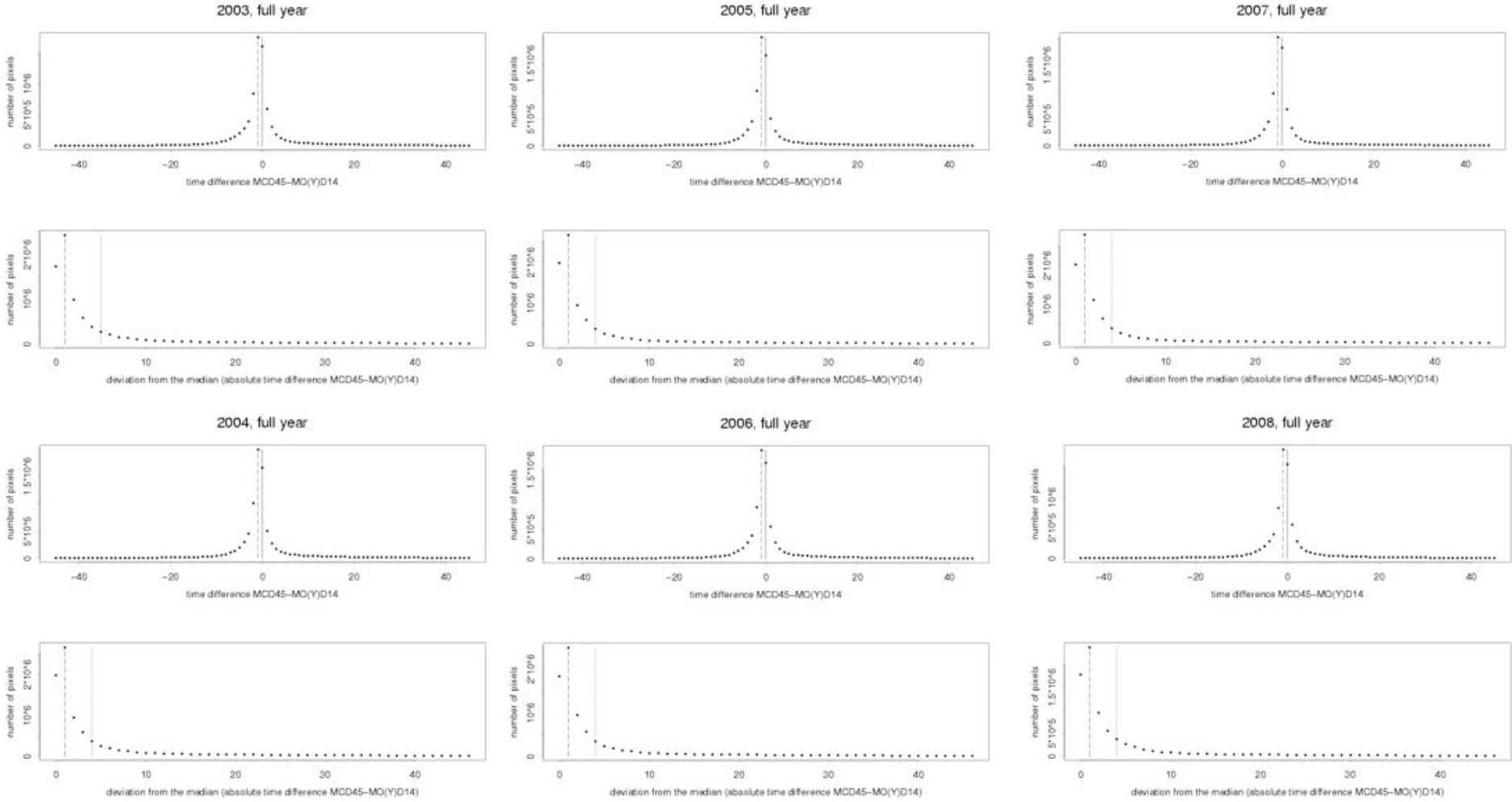
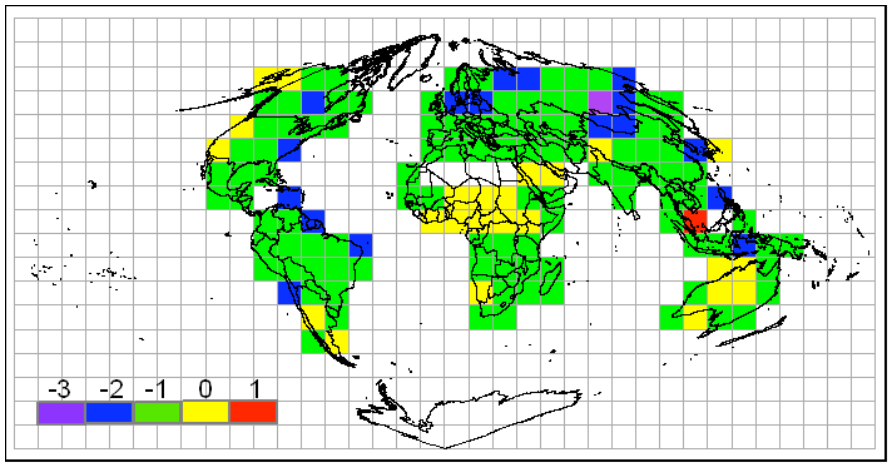
Time difference analysis global, 6 years



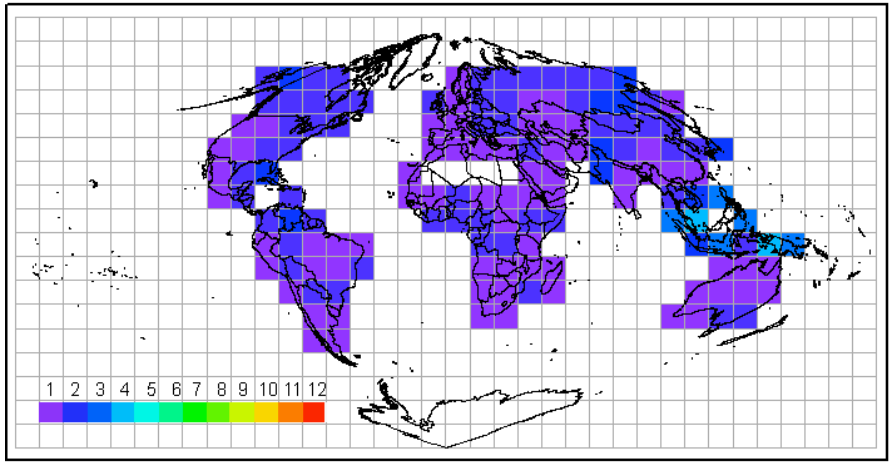


Consistent annual results

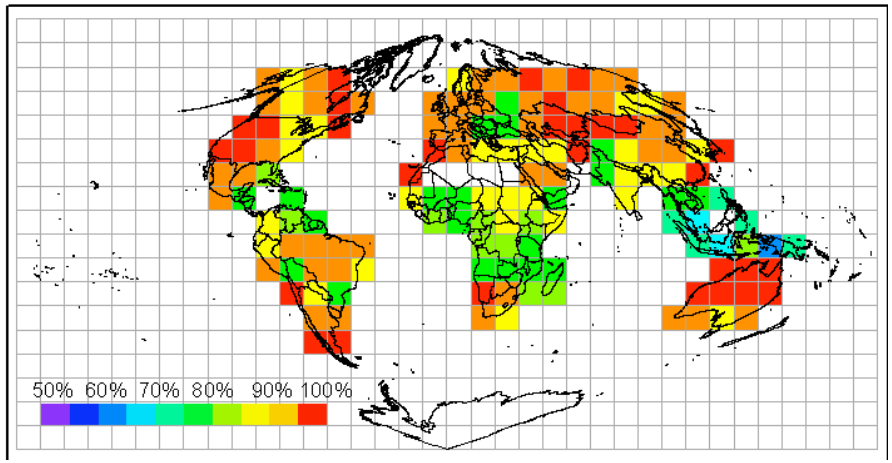




Median difference

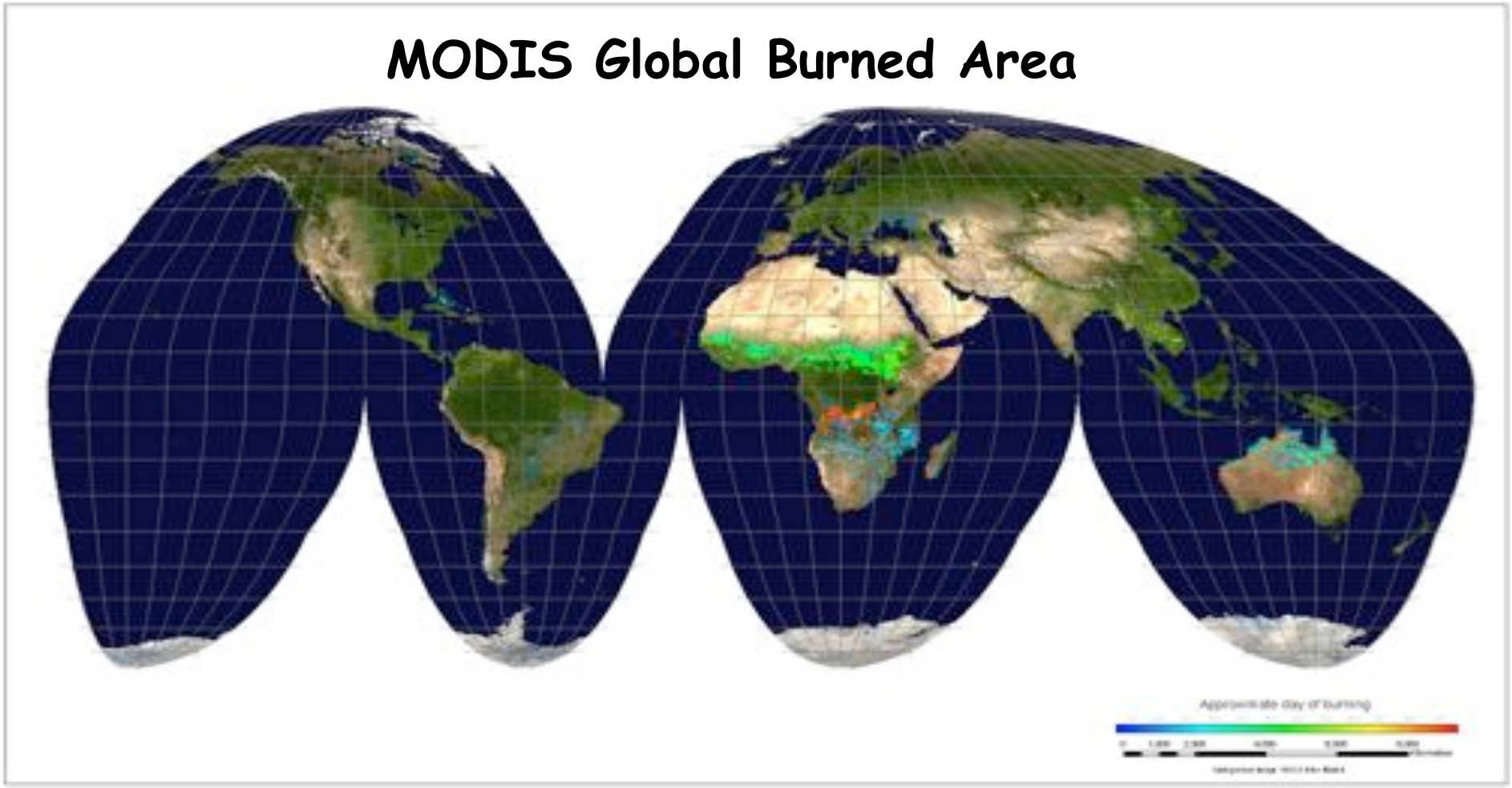


50% of deviation from the median



% of pixels within the nominal 8 day uncertainty

MODIS Global Burned Area



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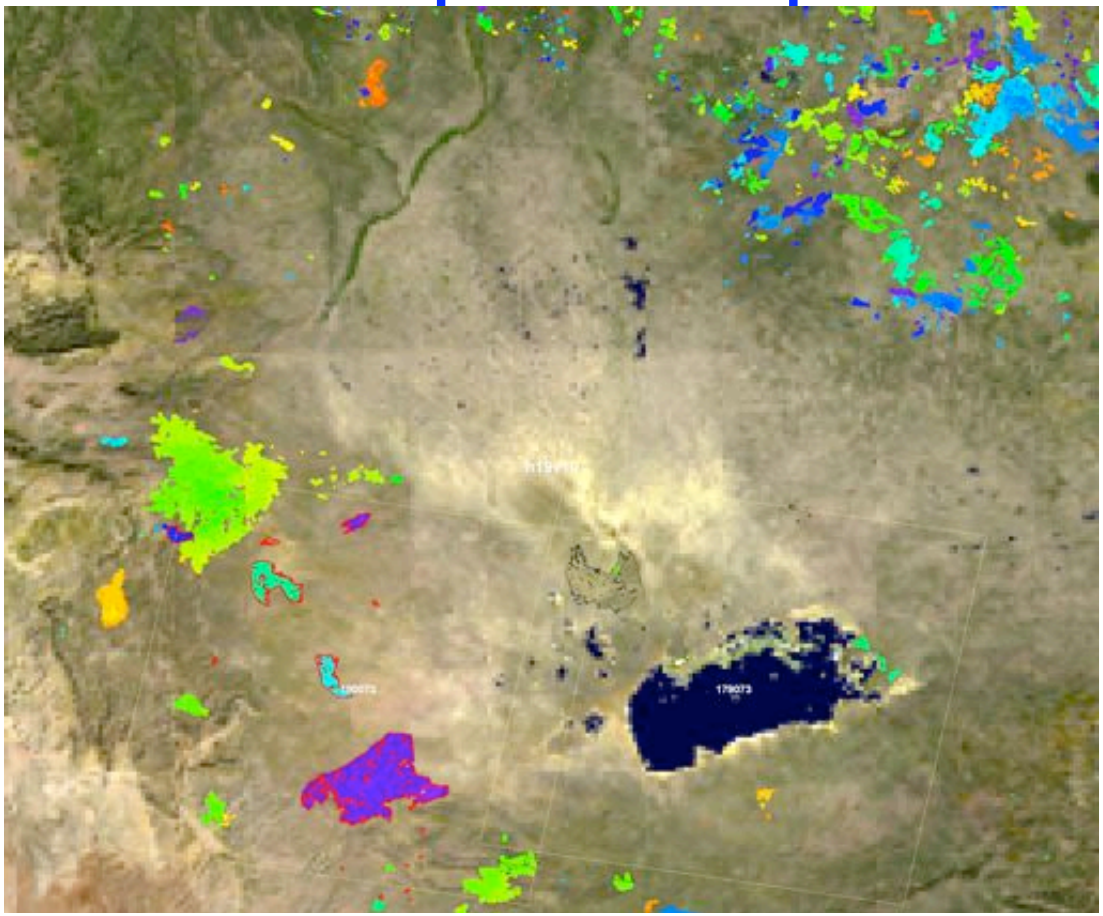
Burned Area Algorithm Refinement

Example –Stupid Coding Error



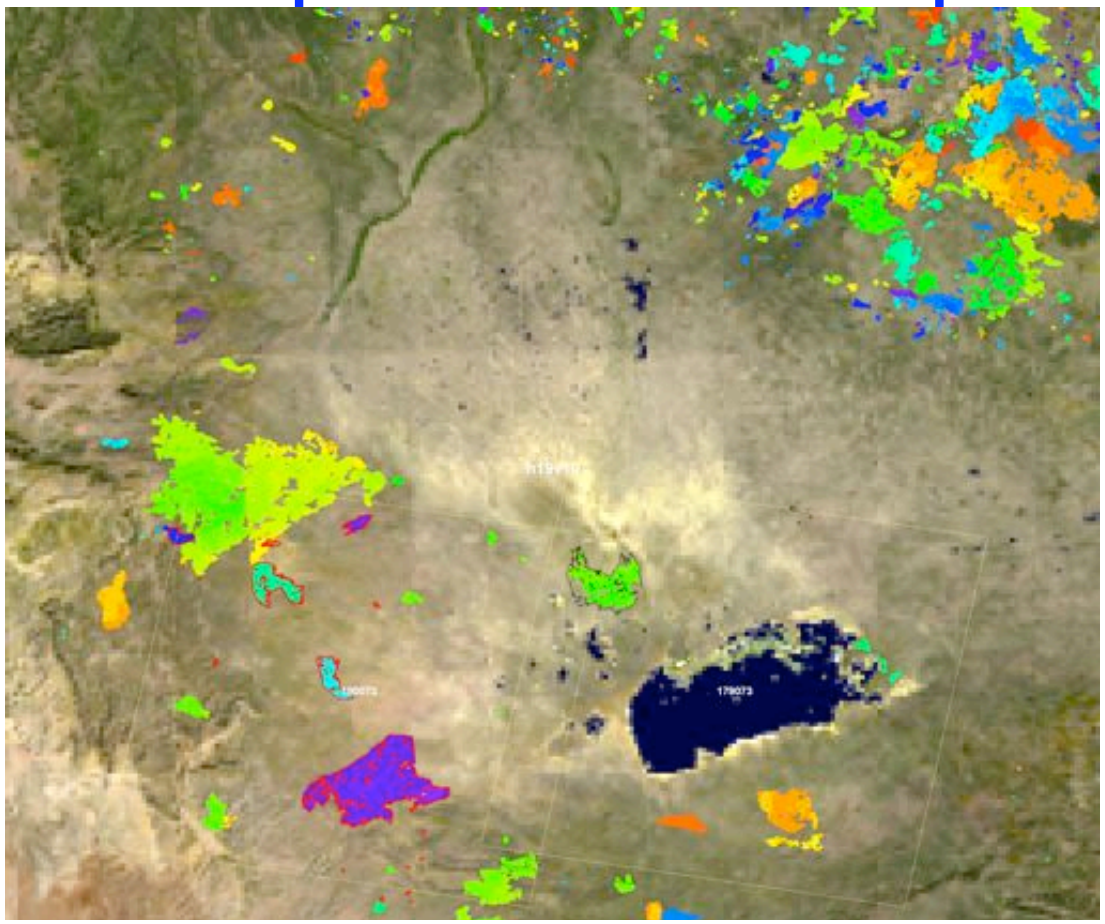
Burned area emission errors occur where the 3.66-3.84 μm brightness temperature > 327.67 K

This bug took ~3 years to be discovered.

CAUSE: the pixel values brightness temperature*100 are stored as Unsigned Integers (a number 0-65535) but were *incorrectly* read into the MODIS burned area algorithm as Signed Integers (number 0 to +/- 32767). Thus, values >32767 were converted by this inconsistency in the burned area code to negative values and so were considered very cold and could not possibly be burns.

Burned Area Algorithm Refinement

Example – Fixed Stupid Coding Error



Map many more burns

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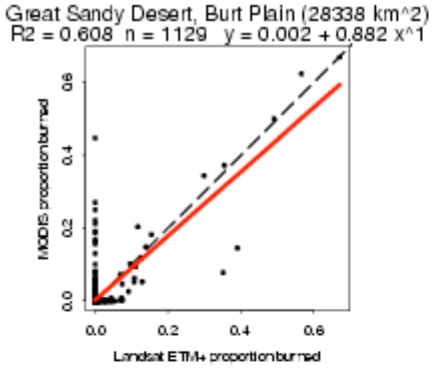
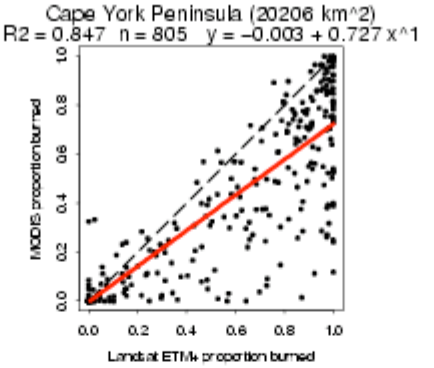
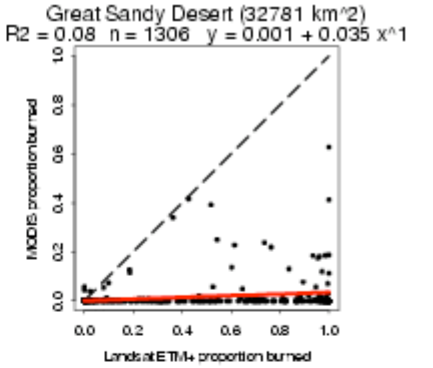
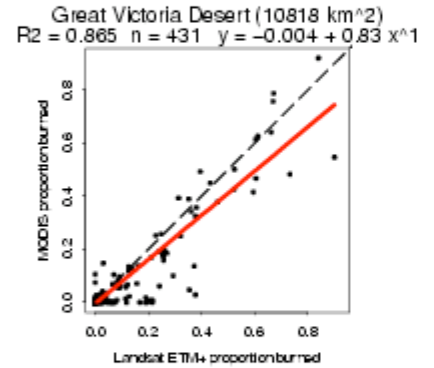
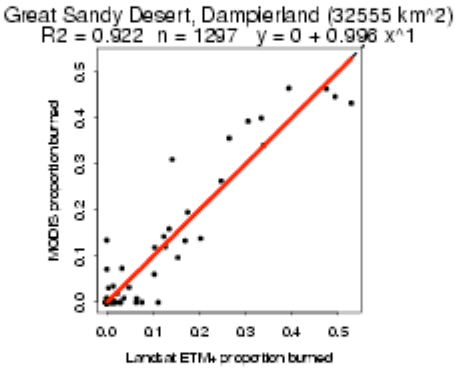
Australia (C5)

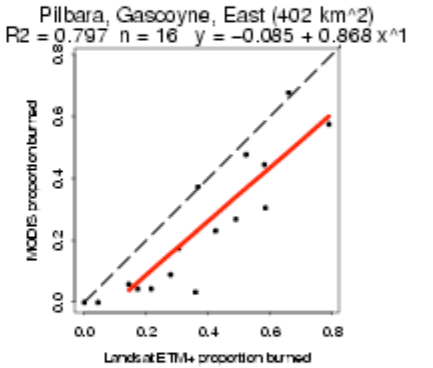


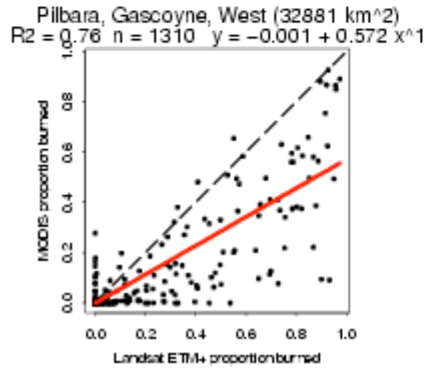




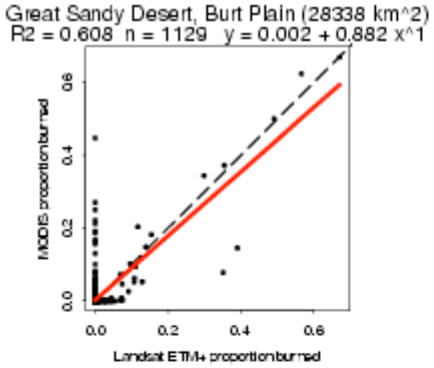


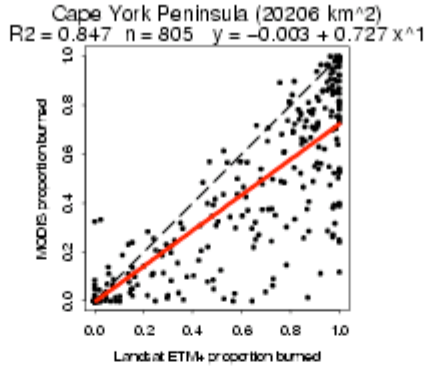


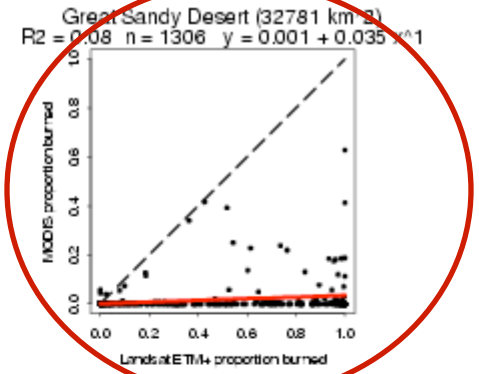


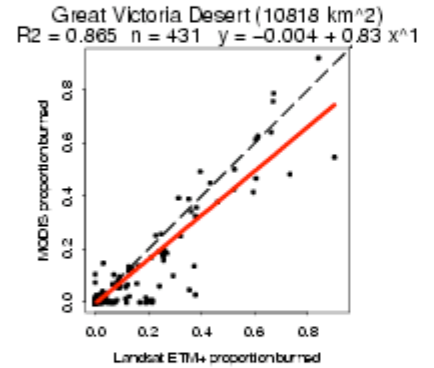


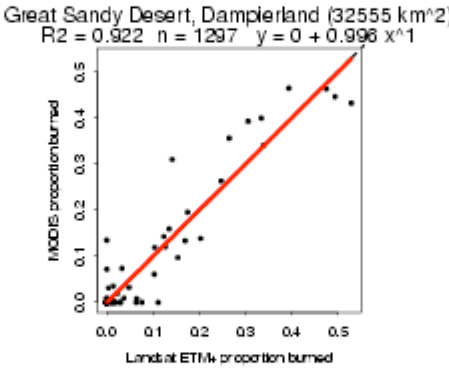
Australia (C5)

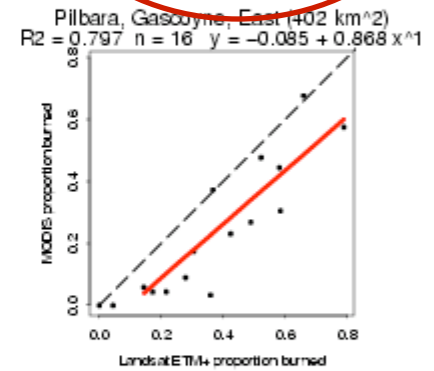


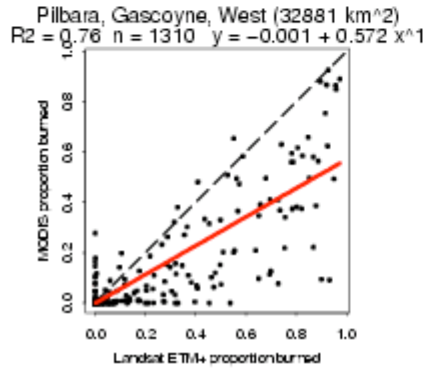




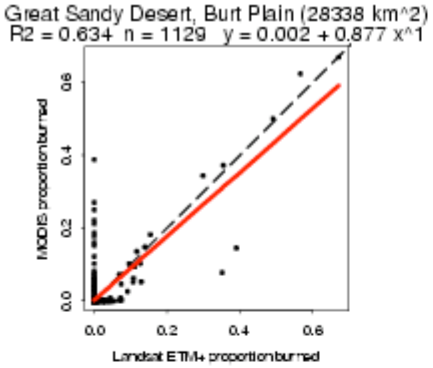


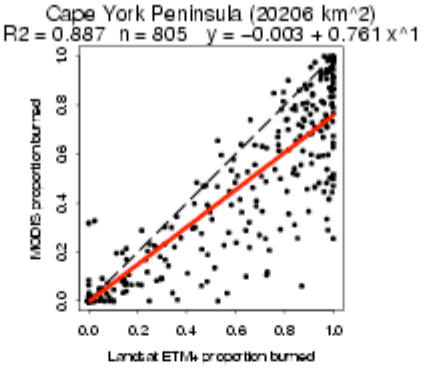


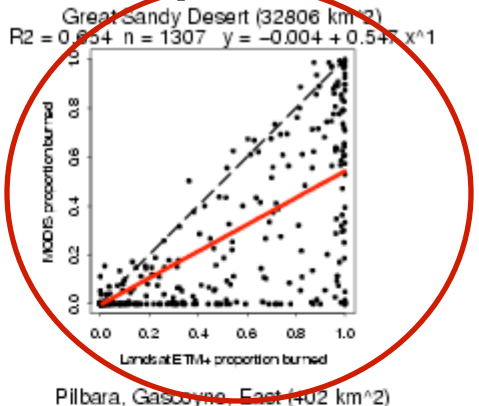


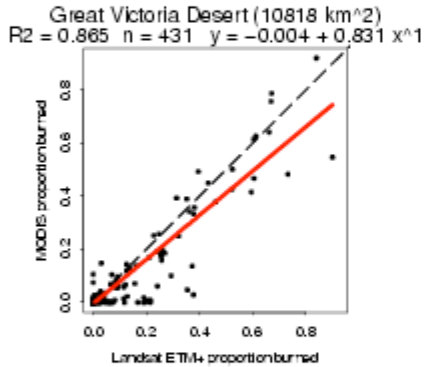


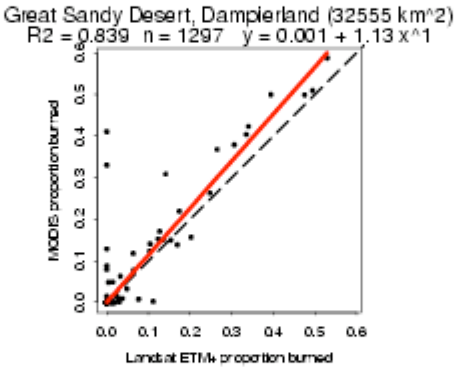
Australia (bug fixed)

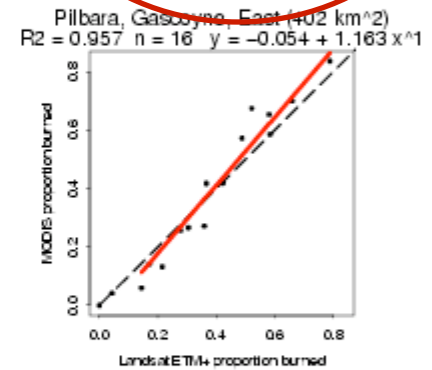


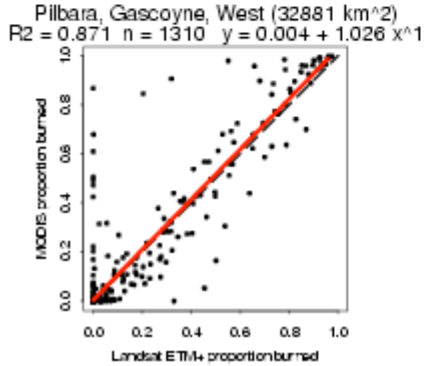












Burned Area Algorithm Refinement

Changes in the algorithm

C5 code:
assumption that
Band 6
reflectance drops
post –fire.
Not the case in
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Greece August
2007

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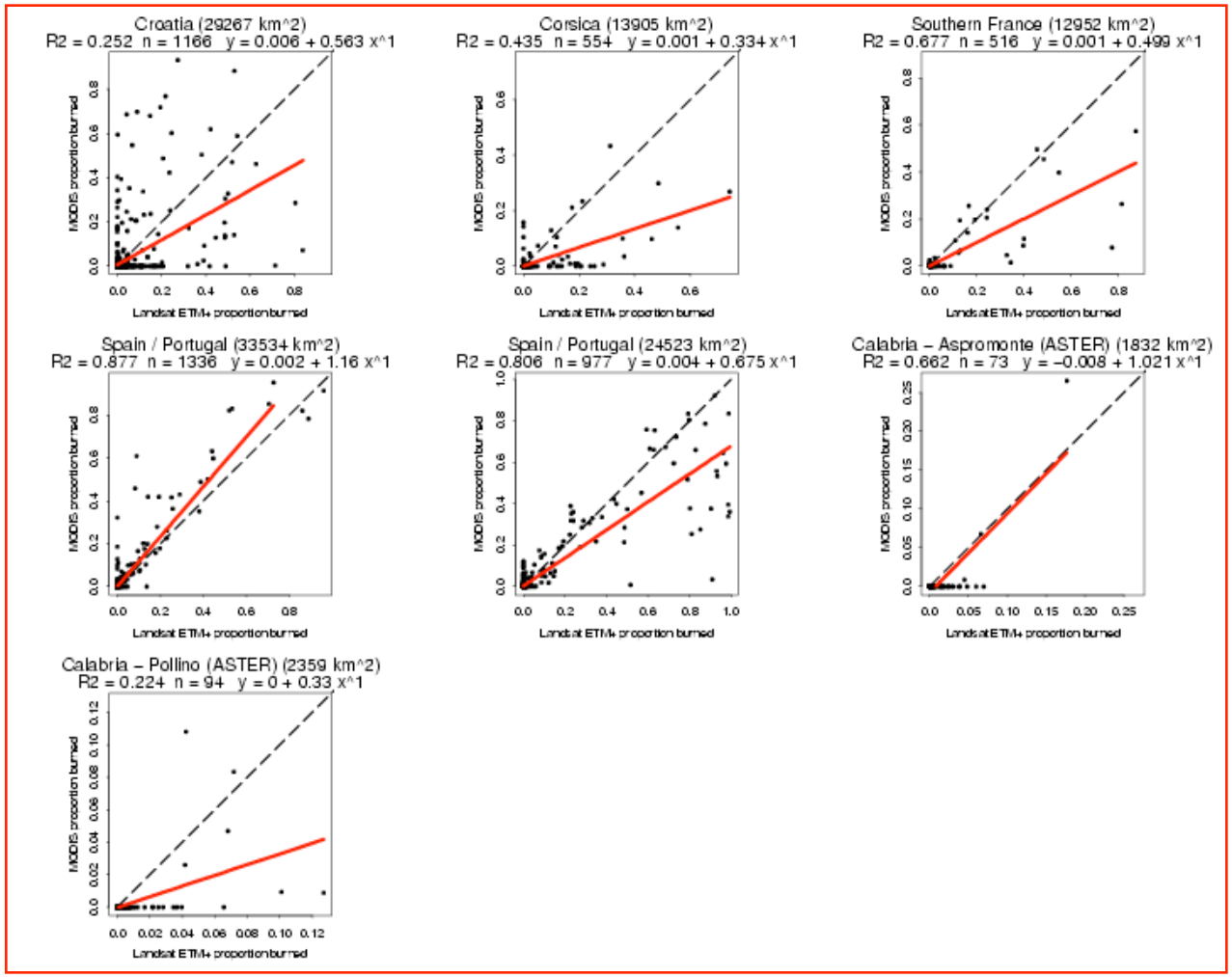
Comparison with polygons by the European Forest Fire Service

Europe (C5)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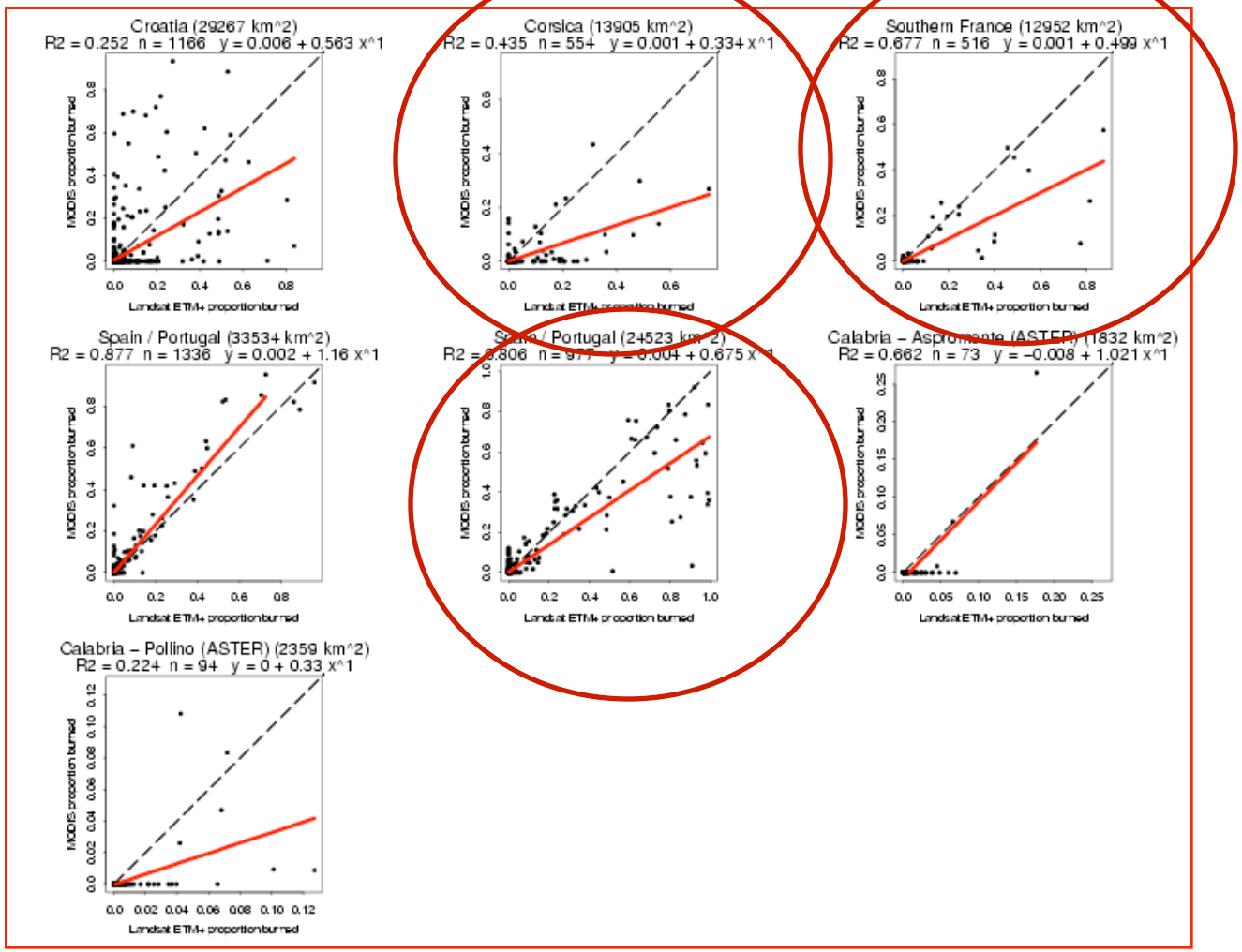
R2 = 0.252 n = 1166 y = 0.006 + 0.563 x^1
Corsica (13905 km^2)
R2 = 0.435 n = 554 y = 0.001 + 0.334 x^1
Southern France (12952 km^2)
R2 = 0.677 n = 516 y = 0.001 + 0.499 x^1
Spain / Portugal (33534 km^2)
R2 = 0.877 n = 1336 y = 0.002 + 1.16 x^1
Spain / Portugal (24523 km^2)
R2 = 0.806 n = 977 y = 0.004 + 0.675 x^1
Calabria – Aspromonte (ASTER) (1832 km^2)
R2 = 0.662 n = 73 y = −0.008 + 1.021 x^1
Calabria – Pollino (ASTER) (2359 km^2)
R2 = 0.224 n = 94 y = 0 + 0.33 x^1
MODIS proportion burned
Landsat ETM+ proportion burned

Europe (C5)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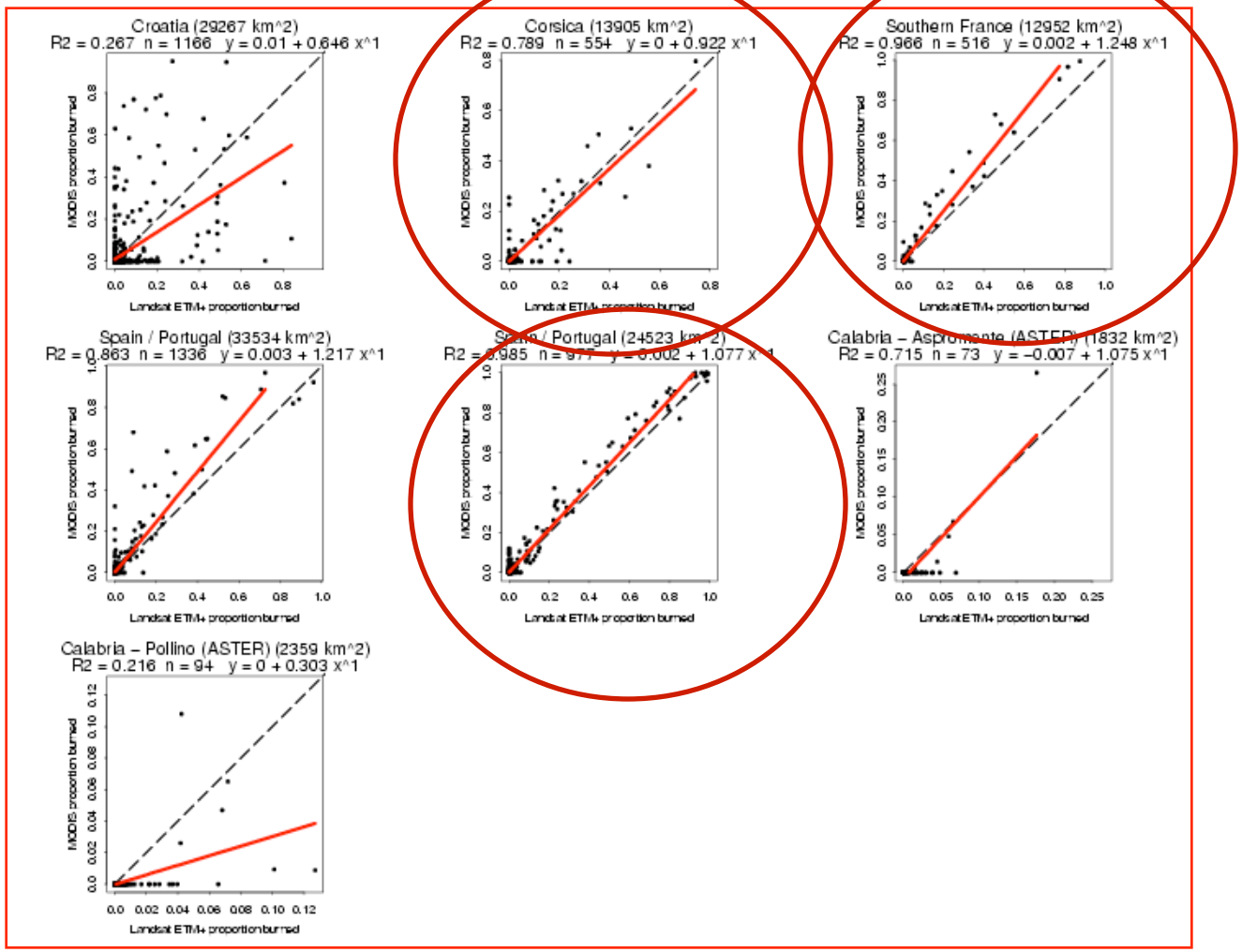
MODIS proportion burned
Landsat ETM+ proportion burned

Europe (B6 off)



The path forward:

• Collection 5.1 reprocessing of the MODIS Aqua Terra time series using Collection 5 inputs and improved code (bug fixed and minor improvements).

• Processing start end of Spring 2010

• Stage 2 Validation to be completed globally by the end of 2010

• All independent reference data to be made available to the community via the MODIS fire web site

• Temporal validation will be advocated for inclusion in future versions of the CEOS Cal/Val protocol