Progress on Moving Multi-Source Land Imaging of Africa area burned to production

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2019 NASA LCLUC Spring Science Team Meeting, Rockville MD, April 9-11 2019

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Center for GLOBAL CHANGE & Earth Observations Michigan State University

SDSU

NASA

GOFC-GOLD
GLOBAL OBSERVATION OF FOREST AND LAND COVER DYNAMICS

L C L U C


Deadliest fires in
CA history
Camp Fire
MODIS satellite image
November 9 2018
Woolsey Fire

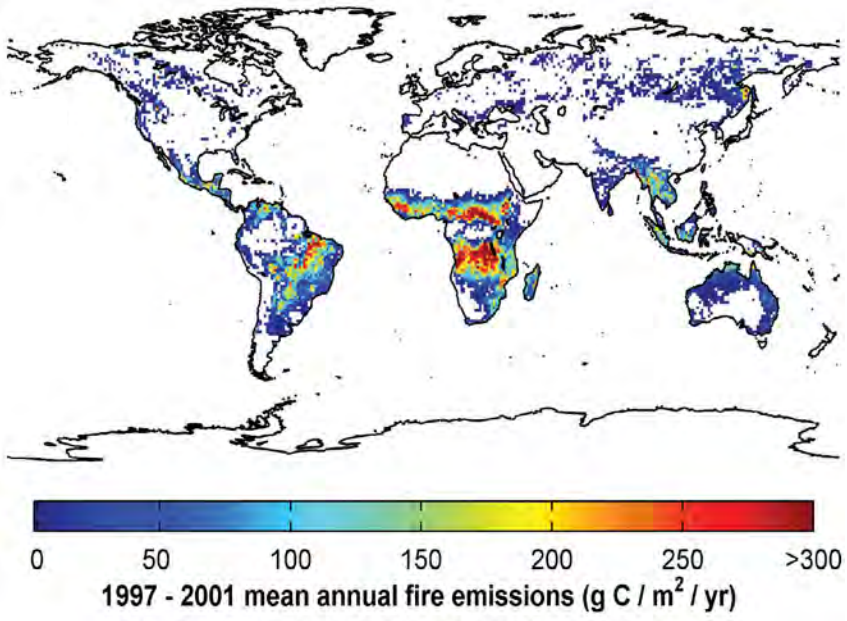
Fire and Climate

Wildfires cause ~35% of all global carbon emissions

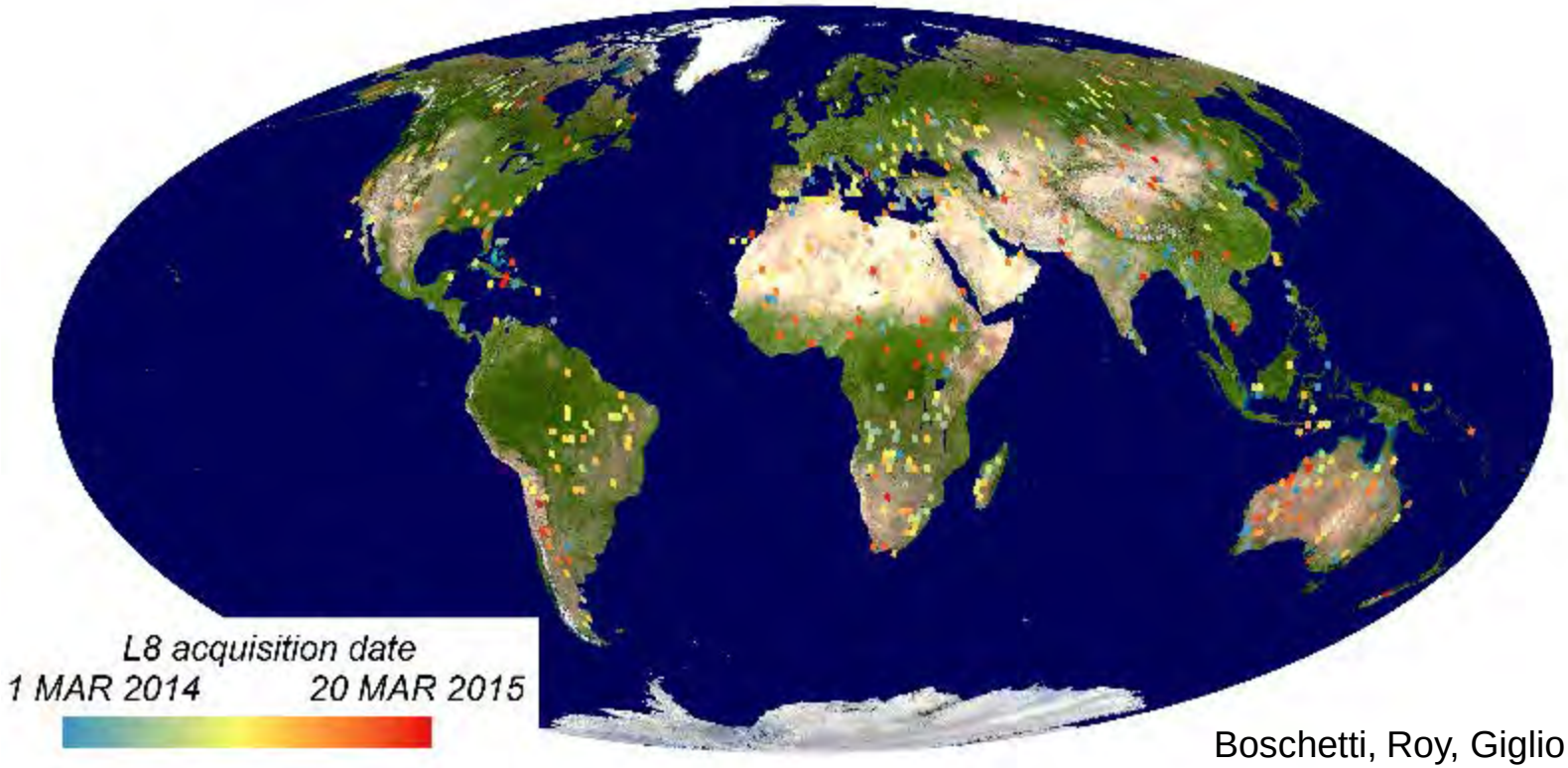
Inter-annual variability in emissions linked primarily to rainfall variability

Estimated from the MODIS burned area product

	Fire emissions (10^{15} g C yr^{-1})
Central and northern South America	0.27
Southern South America	0.80
Northern Africa	**0.80**
Southern Africa	**1.02**
Southeast Asia	0.37
Boreal (north of 38°N)	0.14
Other	0.13
Global	3.53



MODIS Collection 6 500 m Burned Area Product
Stage 3 Global Validation



Locations of 558 Landsat two-date image pairs interpreted into burned, unburned, and unmapped classes

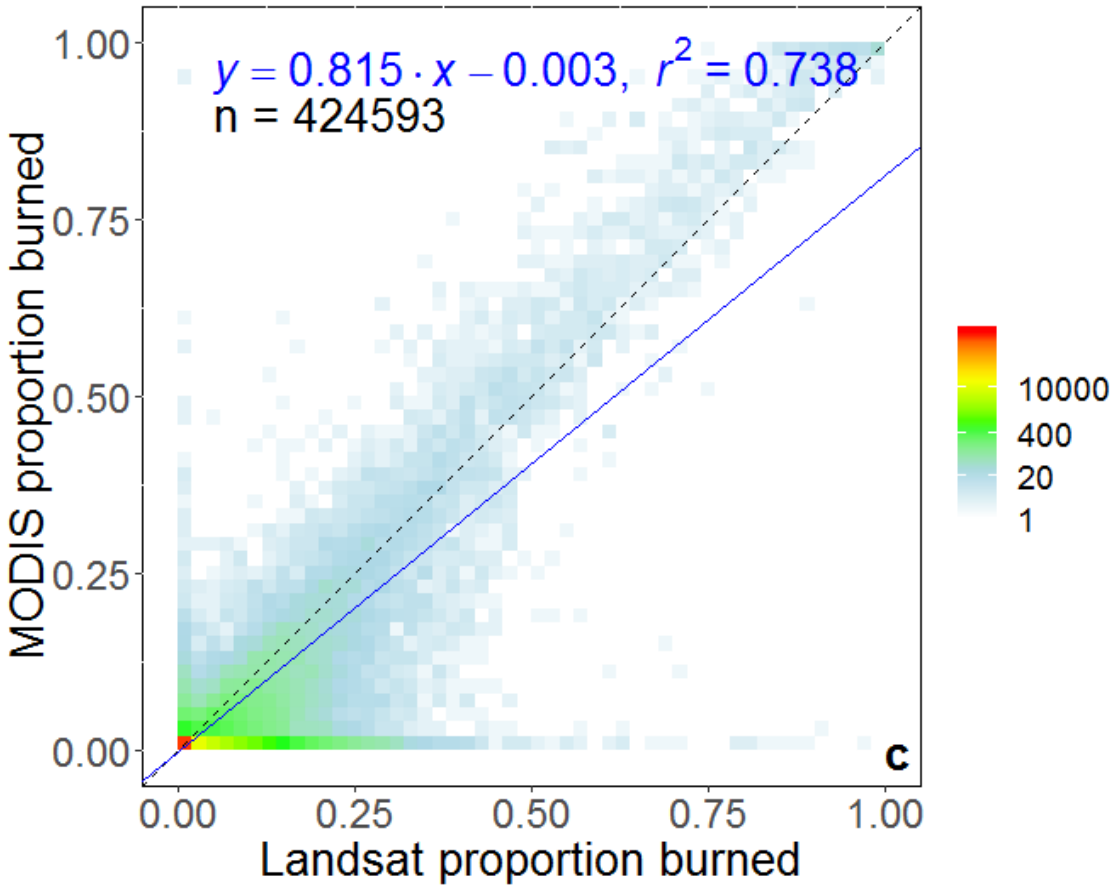
Boschetti, Roy, Giglio, Huang, Humber, Zubkova

Gobal Validation of the Collection 6 MODIS Burned Area Product

RSE, 2019, In Review.

MODIS Collection 6 500 m Burned Area Product Stage 3 Global Validation

Regression slope 0.815, intercept -0.003 (r^2 = 0.82)



5km^2 cells

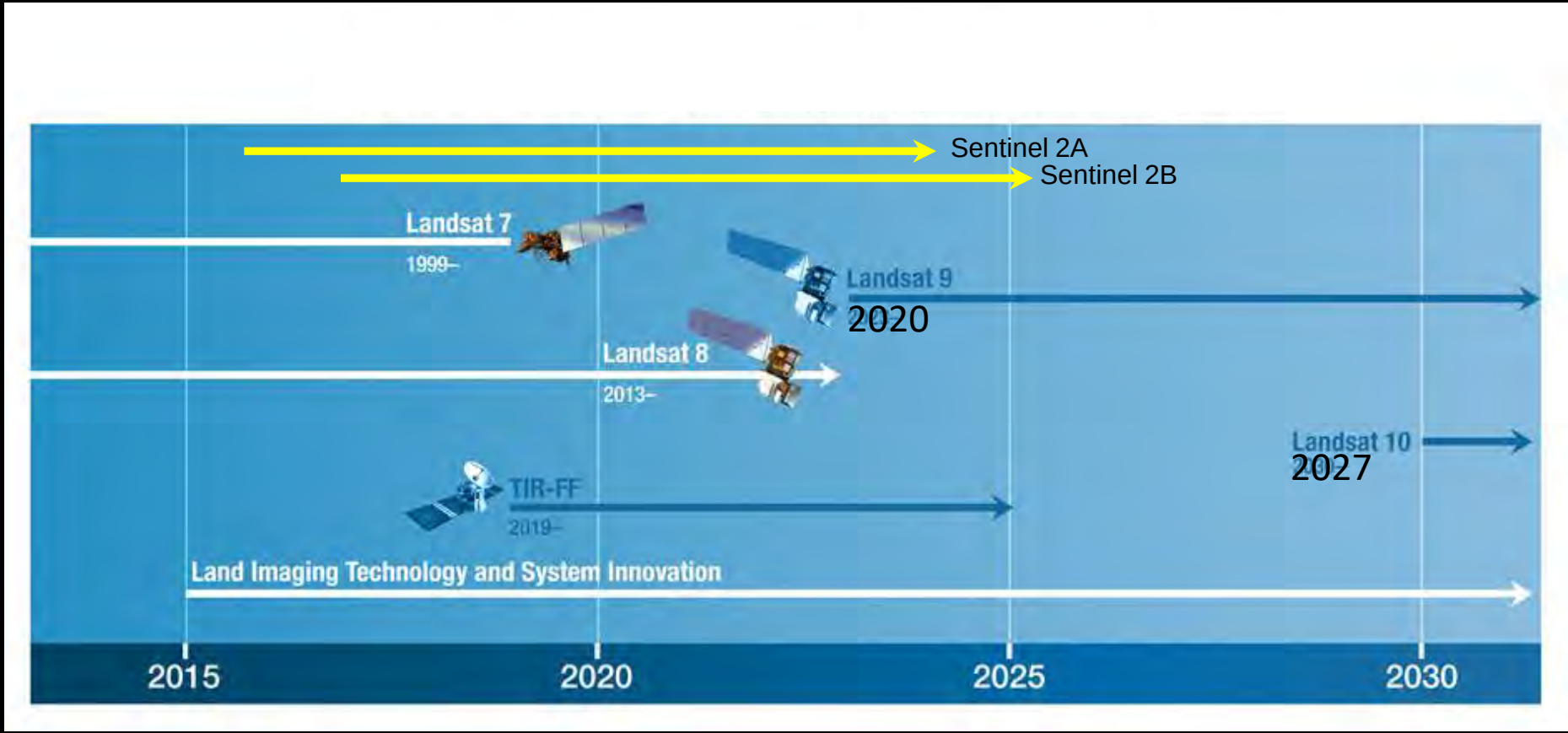
Boschetti, Roy, Giglio, Huang, Humber, Zubkova

Gobal Validation of the Collection 6 MODIS Burned Area Product

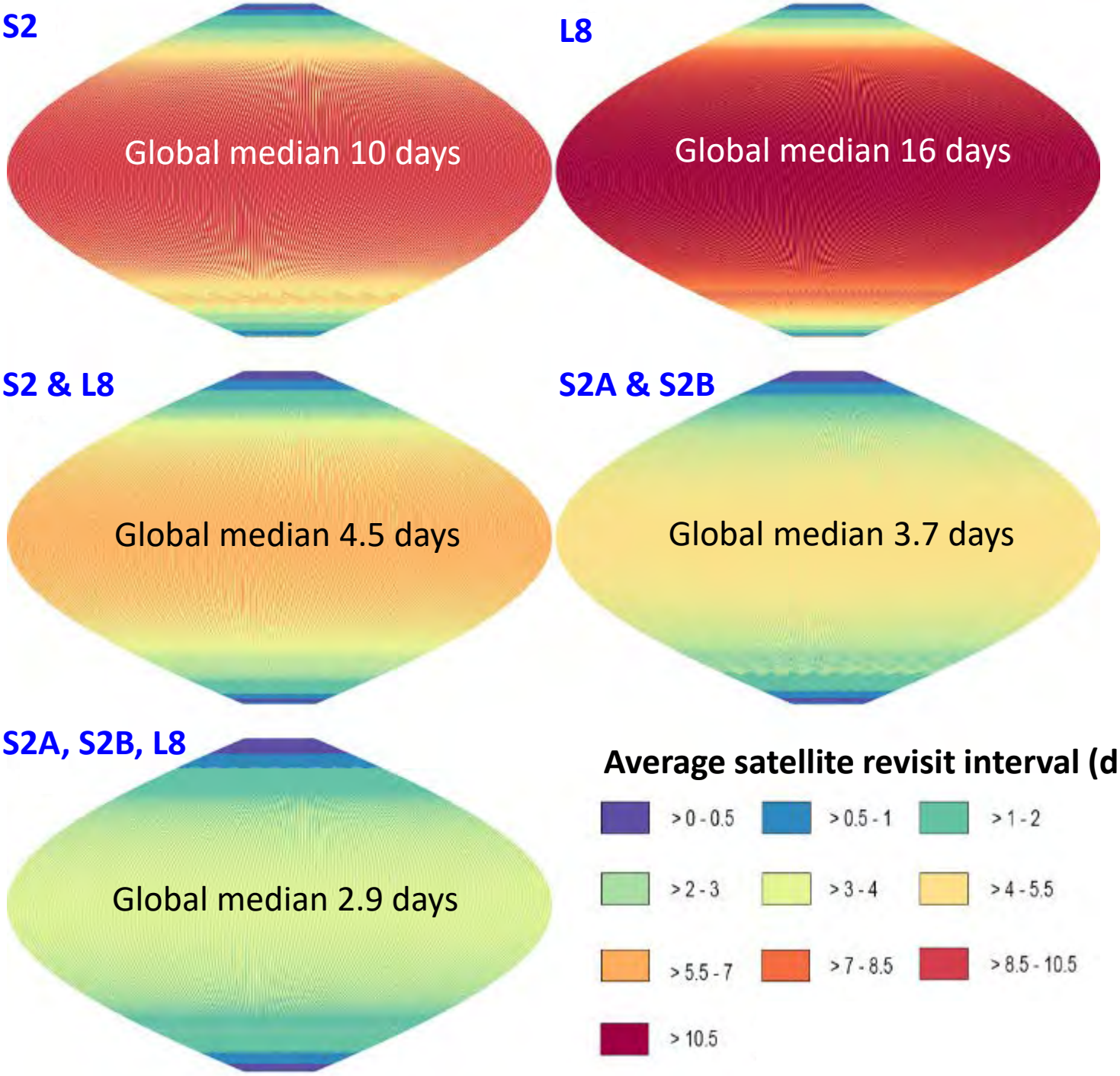
RSE, 2019, In Review.

New Global moderate resolution era

Landsat 8, 9, 10



ESA Sentinel 2A & 2B

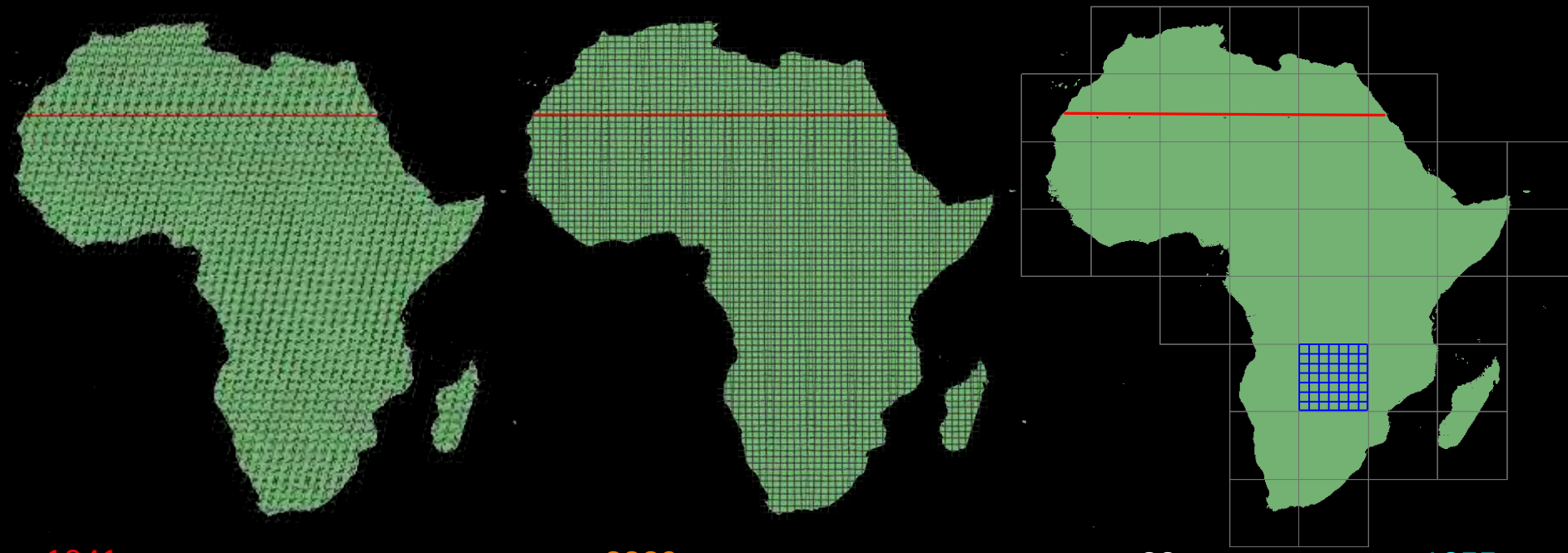


Li, J. and Roy, D.P. 2017

A global analysis of Sentinel-2A, Sentinel-2B and Landsat-8 data revisit intervals and implications for terrestrial monitoring,

Remote Sensing, 9, 902.

Planned Production - all of Africa, including Madagascar, south of the Tropic of Cancer (23.44° N) for 2017 / 2018 / 2019 process on NASA funded AWS



1041
Landsat-8 Collection 1
WRS-2 path/rows (UTM)

2829
Sentinel-2
L1C tiles (UTM)

33
MODIS
Tiles (sinusoidal)

1255
WELD
tiles

Harmonized Landsat Sentinel-2

Home | Algorithms | Products Description | Test Sites | Data | QA | Documents | News

Sentinel-2

True color
Surface
reflectance

FILO
Composite

7 S2 L1C tiles

5295 x 5295 30m pixels

Sentinel-2

True color
Surface
NBAR

FILO
Composite

7 S2 L1C tiles

5295 x 5295 30m pixels

NBAR c-factor method

$$NBAR_\lambda (\theta_{nadir} , \theta_{fixed}) = \mathbf{c} \ \rho_\lambda (\theta_{obs} \ \phi_{obs} , \theta_{sun} \ \phi_{sun})$$

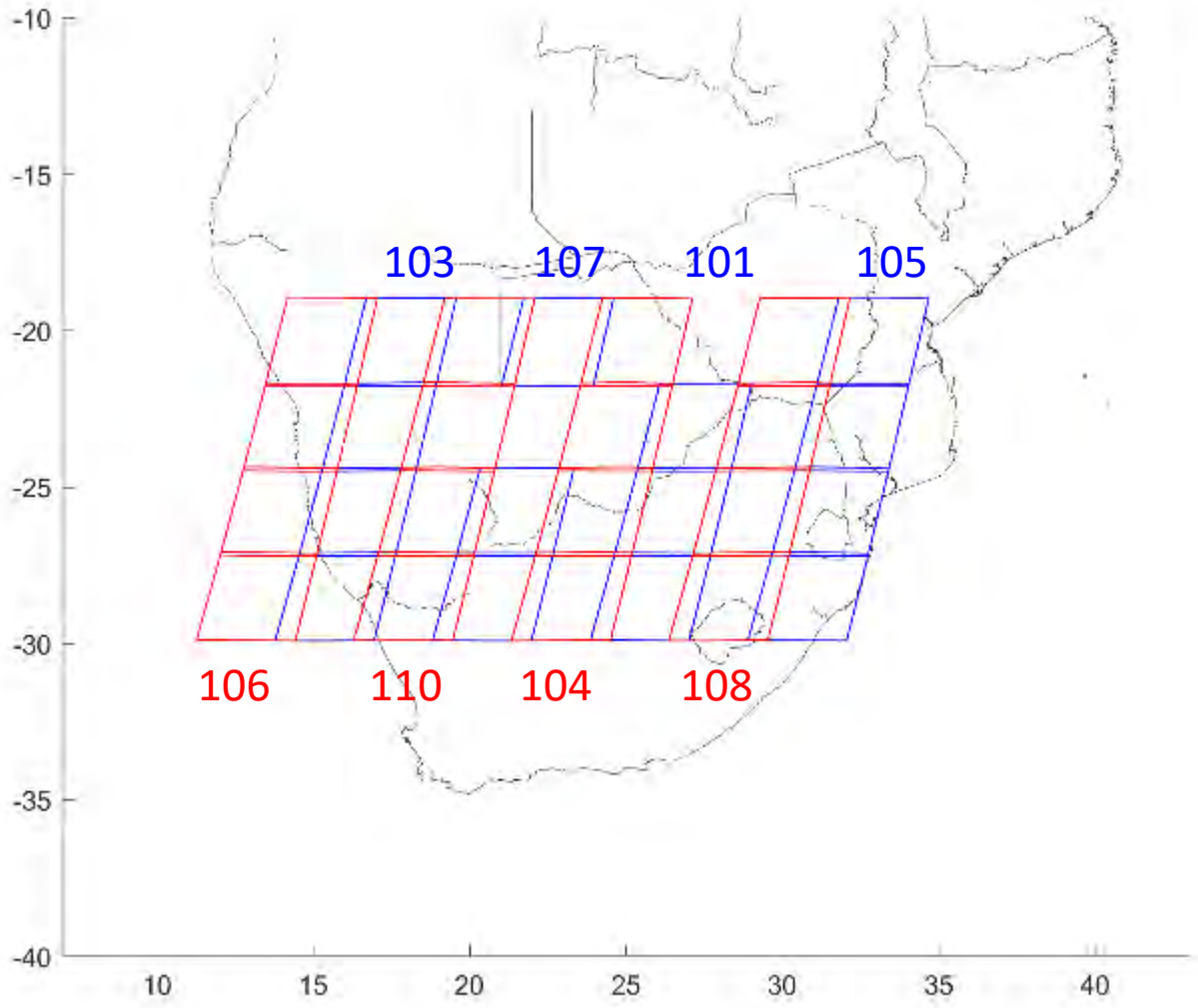
$$\mathbf{c} = \frac{\hat{\rho}_\lambda (\theta_{nadir} , \theta_{fixed})}{\hat{\rho}_\lambda (\theta_{obs} \ \phi_{obs} , \theta_{sun} \ \phi_{sun})}$$

$\hat{\rho}_\lambda$ computed from fixed global average MODIS BRDF/Albedo product (MCD43) spectral BRDF model parameters

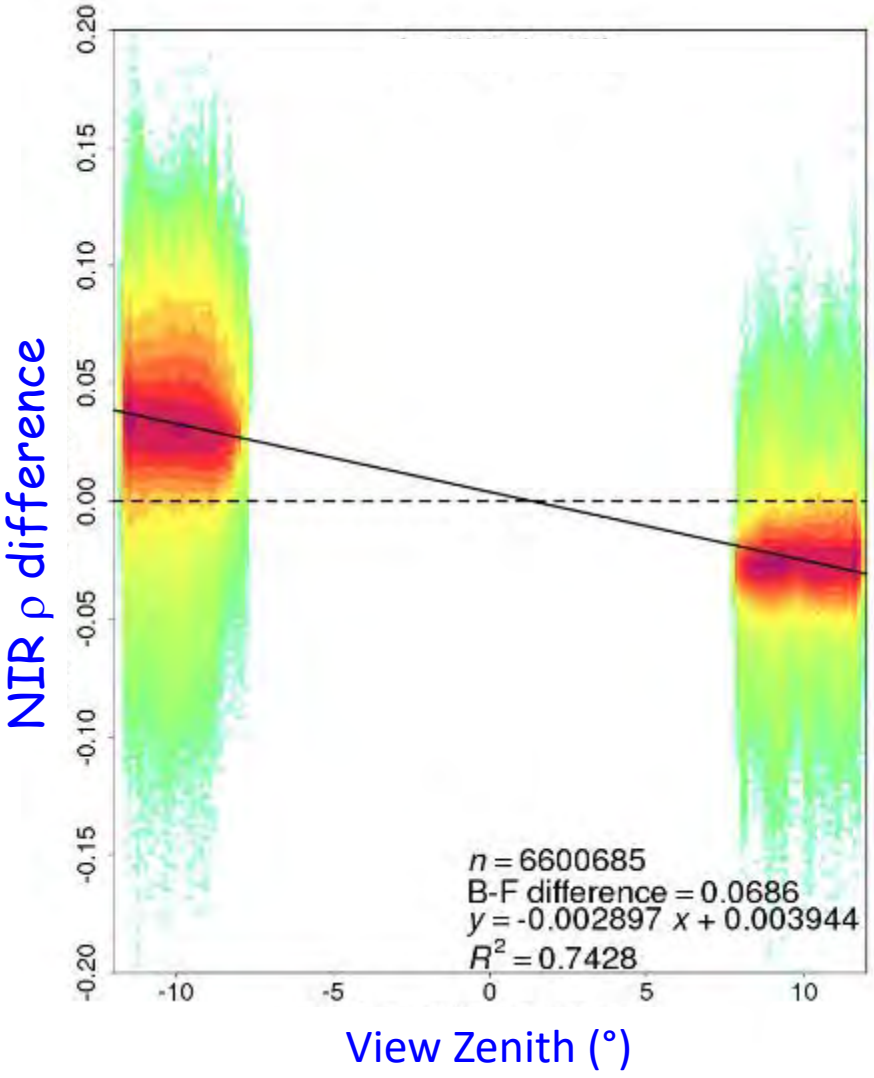
Roy, D.P., Zhang, H. K., Ju, J., Gomez-Dans, J. L., Lewis, P.E., Schaaf C.B., Sun, Q., Li, J., Huang, H., Kovalskyy, V., 2016, A general method to normalize Landsat reflectance data to nadir BRDF adjusted reflectance, Remote Sensing of Environment, 176, 255-271.

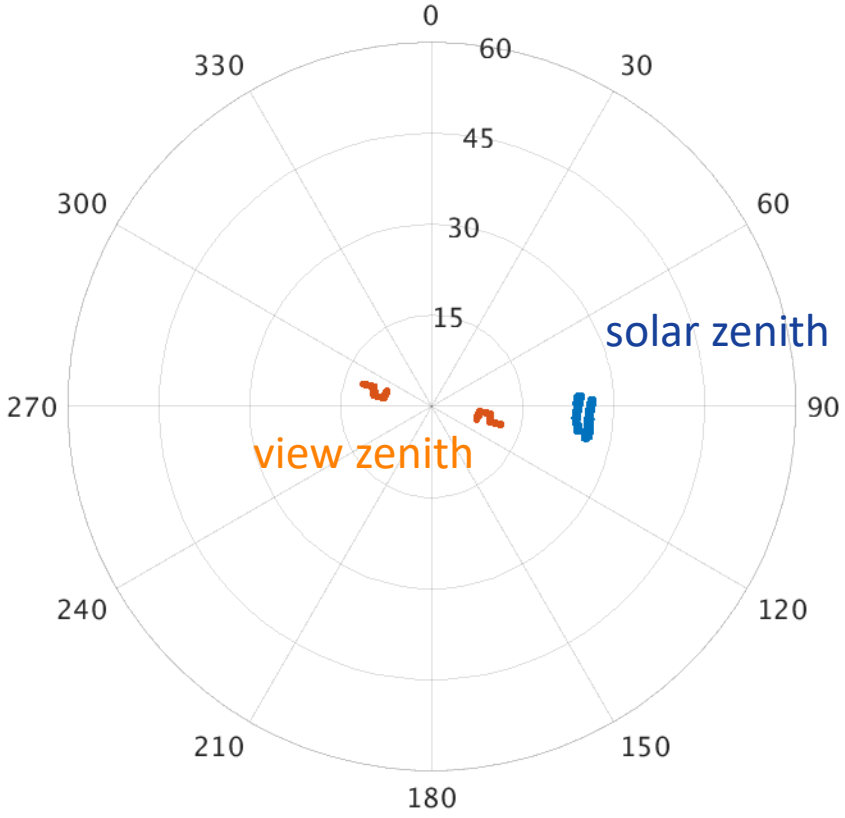
Roy, D.P, Li, J., Zhang, H.K., Yan, L., Huang, H., 2017, Examination of Sentinel-2A multi-spectral instrument (MSI) reflectance anisotropy and the suitability of a general method to normalize MSI reflectance to nadir BRDF adjusted reflectance, Remote Sensing of Environment. 199, 25-38.

Sentinel-2A 10 days 2016

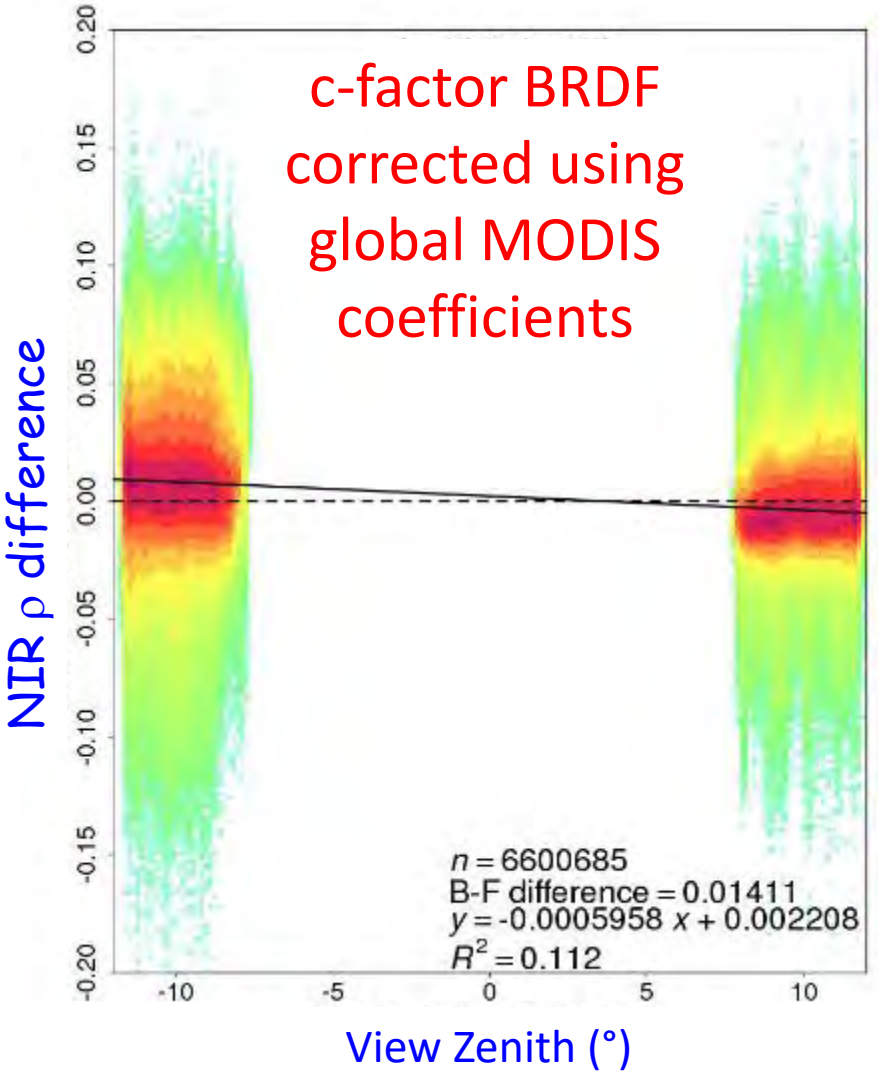


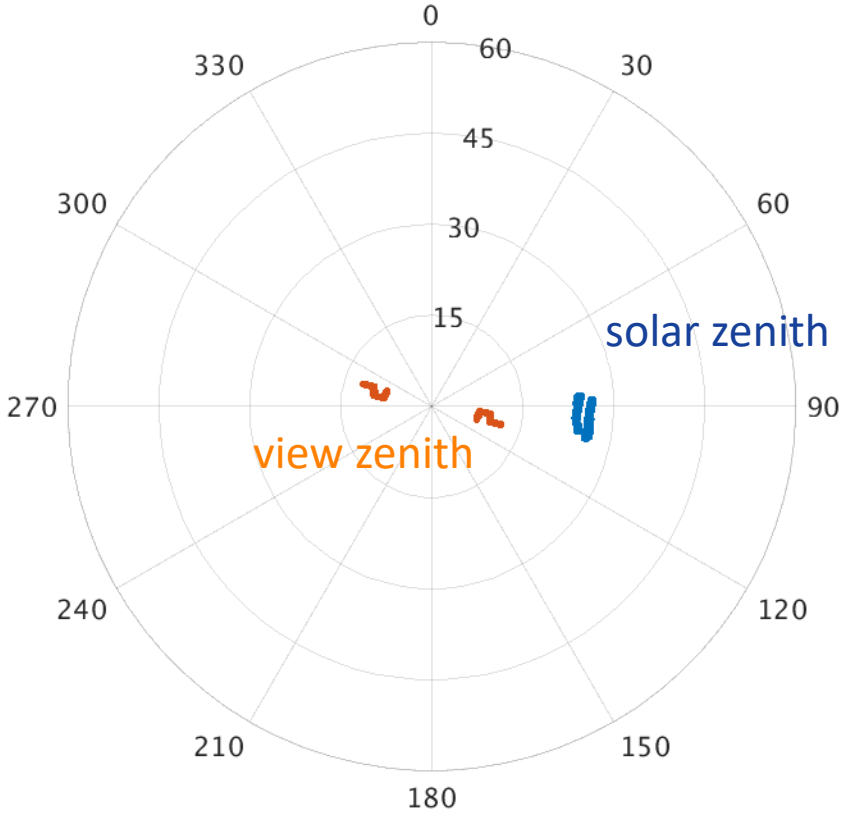
Sentinel-2A 10 days January 2016
(Solar Principal Plane)
Swath overlap NIR ρ difference V view zenith





Sentinel-2A 10 days January 2016
Swath overlap NIR ρ difference V view zenith

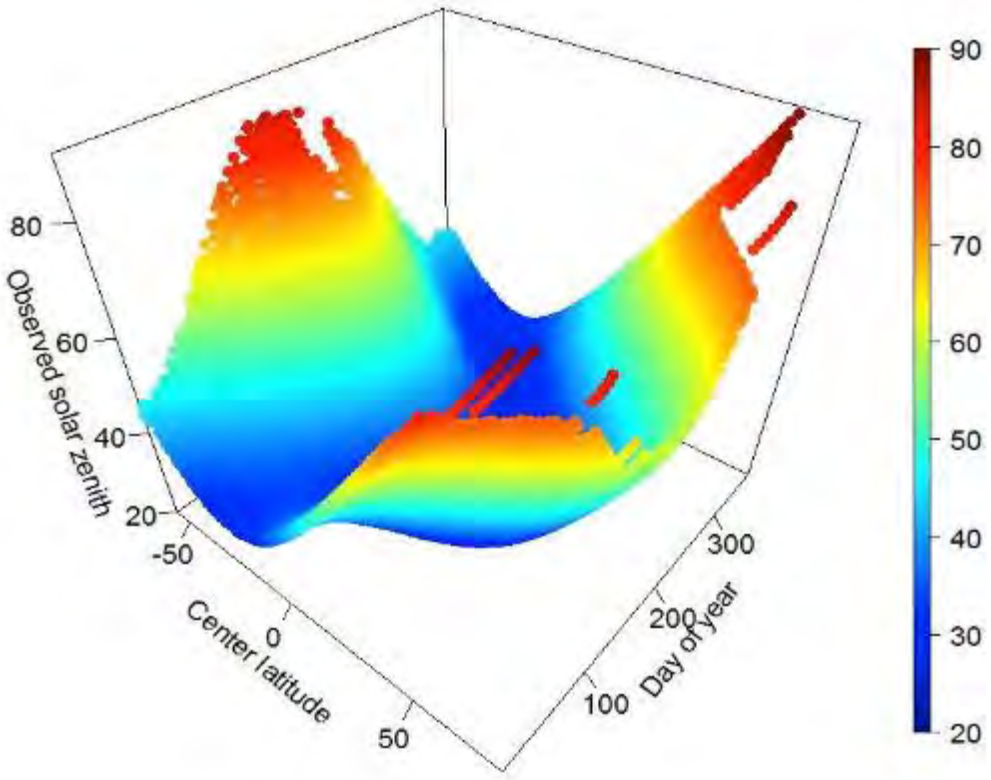




Radiance/reflectance measured by a sensor also changes with the sun's position

(Susan Ustin)

12 months of global Landsat solar zenith (θ_s) plotted as a function of scene center latitude & day of year



$22.14º <= \theta_s <= 89.71º$

θ_s mean = 43.23º

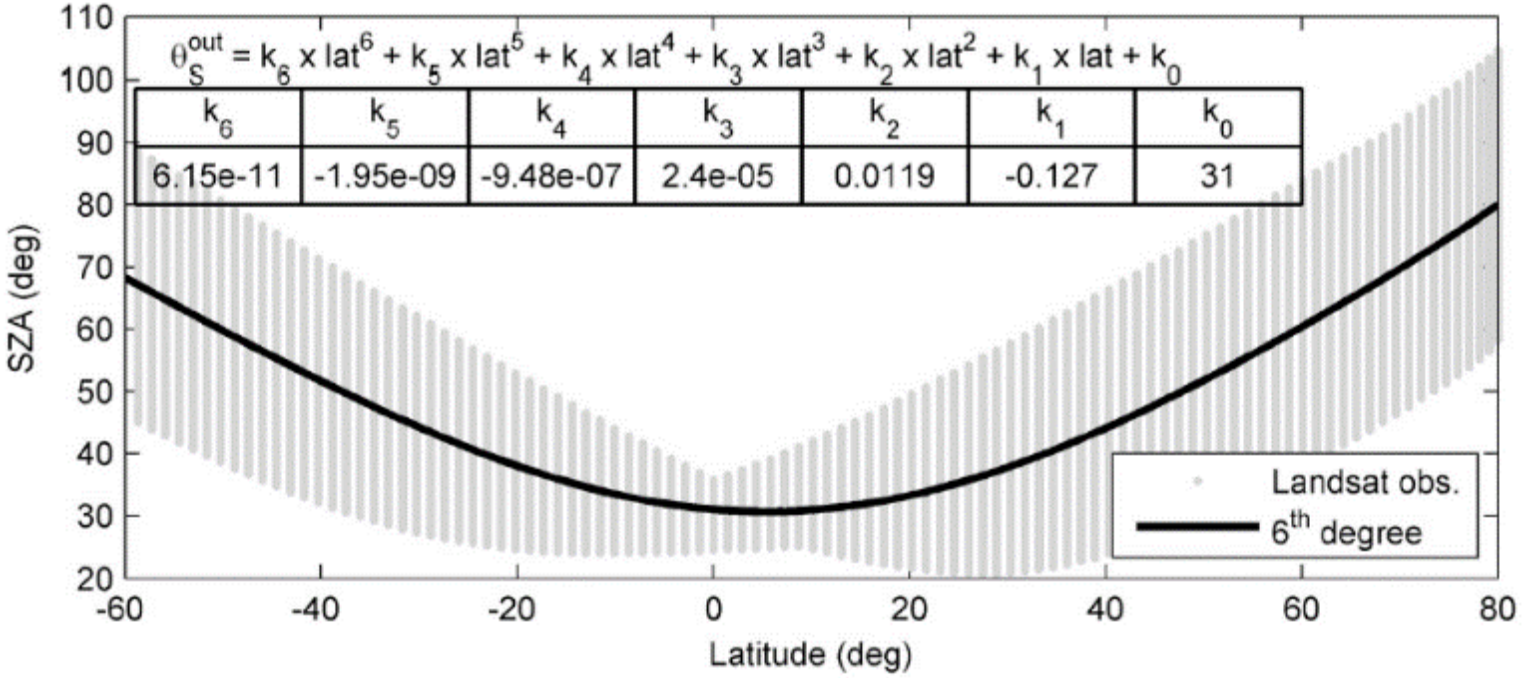
Zhang, H. K., Roy, D.P., Kovalskyy, V., 2016, Optimal solar geometry definition for global long term Landsat time series bi-directional reflectance normalization, *IEEE Transactions on Geoscience and Remote Sensing*. 54(3), 1410-1418.

HLS V1.4 modelled solar zenith

function of latitude only

Claverie, M., Ju, J., Masek, J. G., Dungan, J. L., Vermote, E. F., Roger, J. C., ... & Justice, C. (2018). The Harmonized Landsat and Sentinel-2 surface reflectance data set. *Remote Sensing of Environment*, *219*, 145-161.

Derived using a six degree polynomial function of latitude:



Li modelled solar zenith

function of latitude & day of year

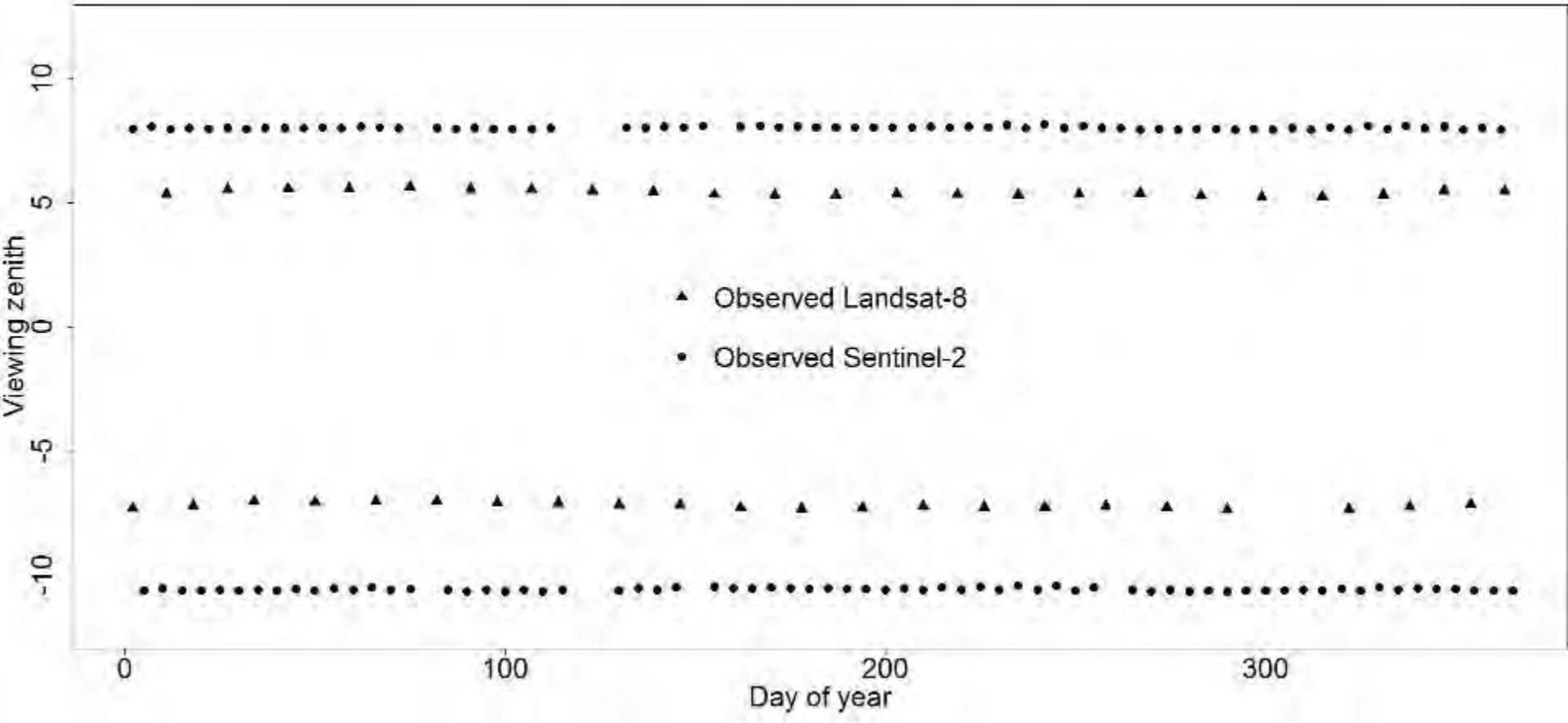
Li, Z., Zhang, H.K., Roy, D.P., 2019, Investigation of Sentinel-2 bidirectional reflectance hot-spot sensing conditions. *IEEE Transactions on Geoscience and Remote Sensing*. DOI: 10.1109/TGRS.2018.2885967

Derived using sensor overpass time model (& astronomical model):

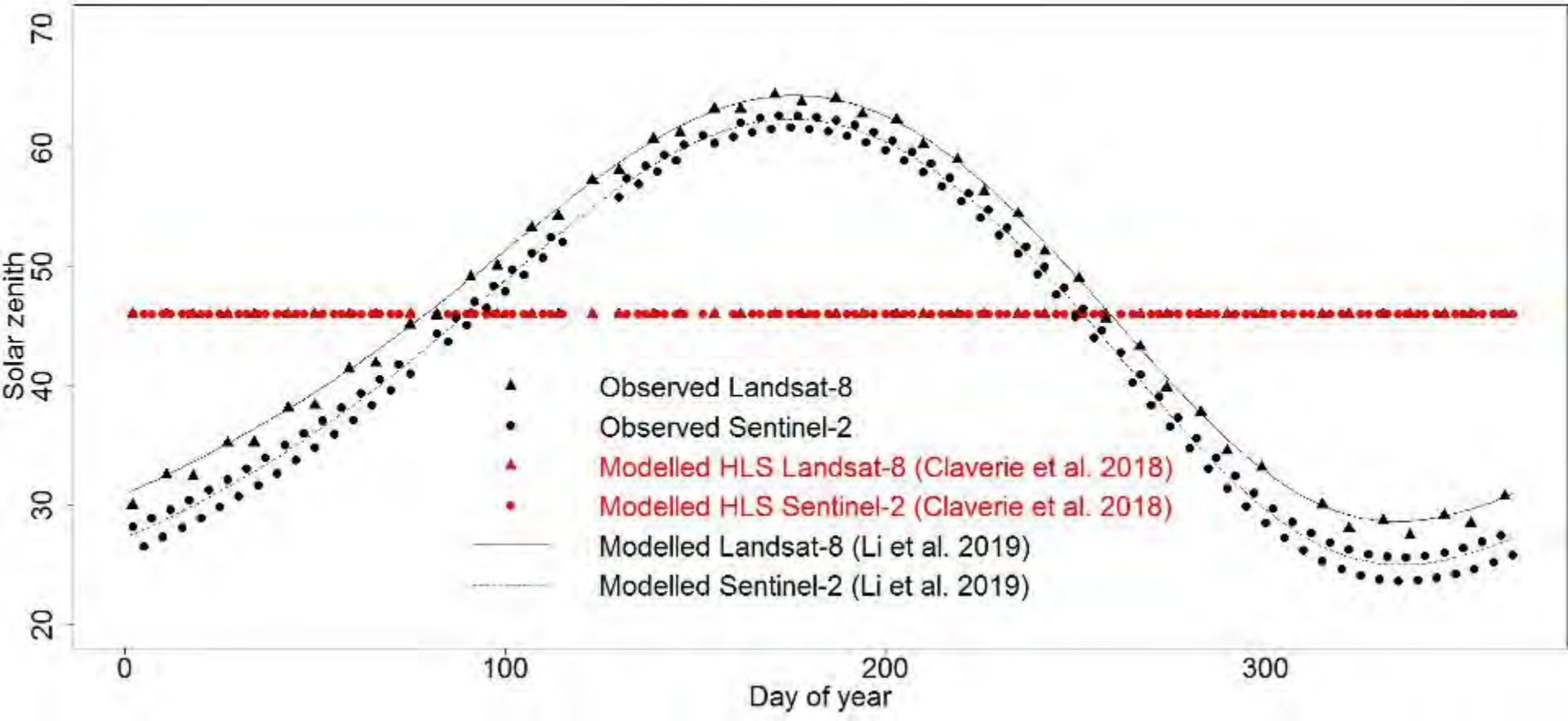
$$\text{local\_time}_{\text{nadir}} = \begin{cases} 10.5 - \dfrac{\arcsin\left(\dfrac{\tan(\varphi_{\text{nadir}})}{\tan(i)}\right)}{15}, & \text{in the descending orbit} \\ 22.5 + \dfrac{\arcsin\left(\dfrac{\tan(\varphi_{\text{nadir}})}{\tan(i)}\right)}{15}, & \text{in the ascending orbit} \end{cases} \quad (4)$$

where 10.5 (10:30 am) is the Sentinel-2 Local Time at Descending Node (for Landsat 10:11 am), φ_{nadir} is the nadir latitude, i is the satellite inclination angle (Sentinel-2 98.62°; Landsat-8 98.2°)

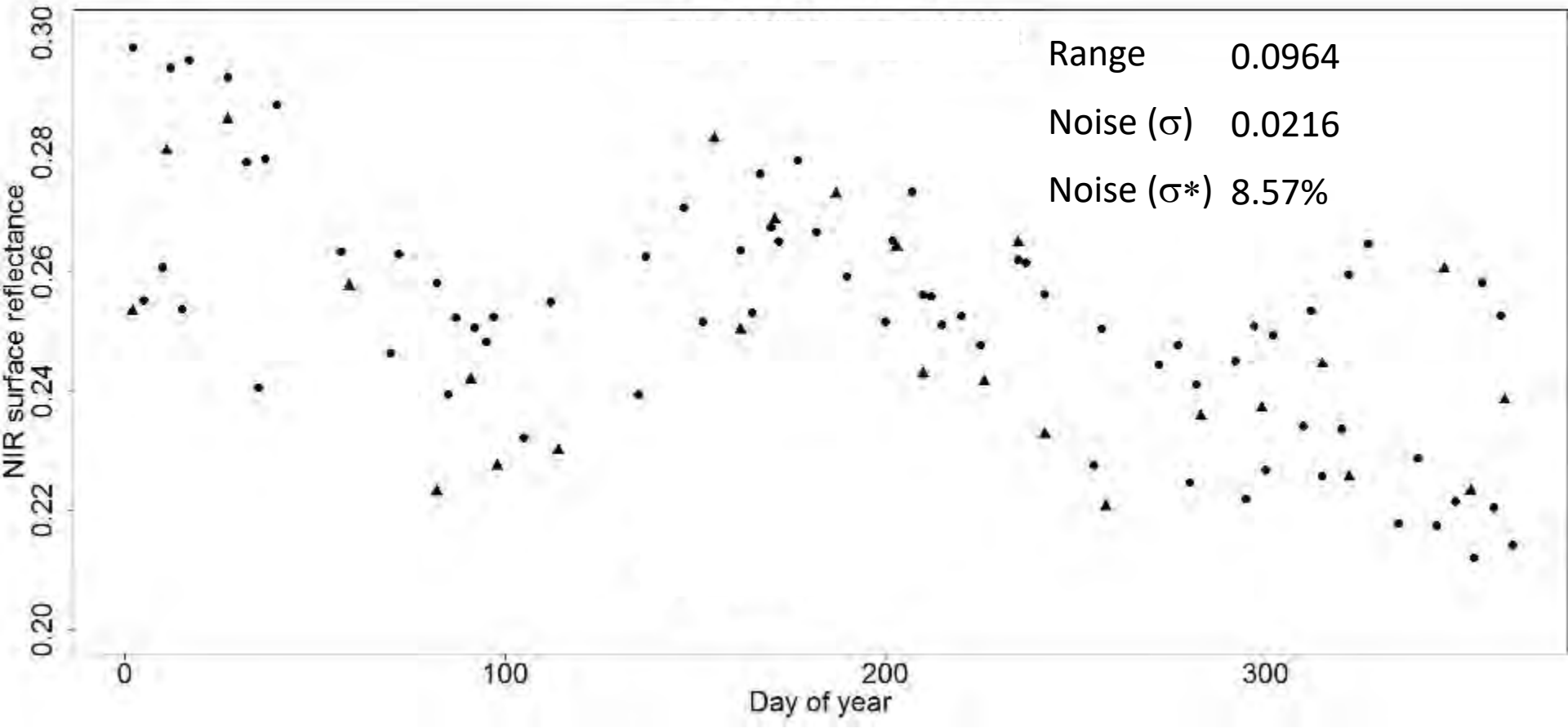
A year of view zenith angles
(for a single pixel in South Africa)



A year of solar zenith angles
(for a single pixel in South Africa)

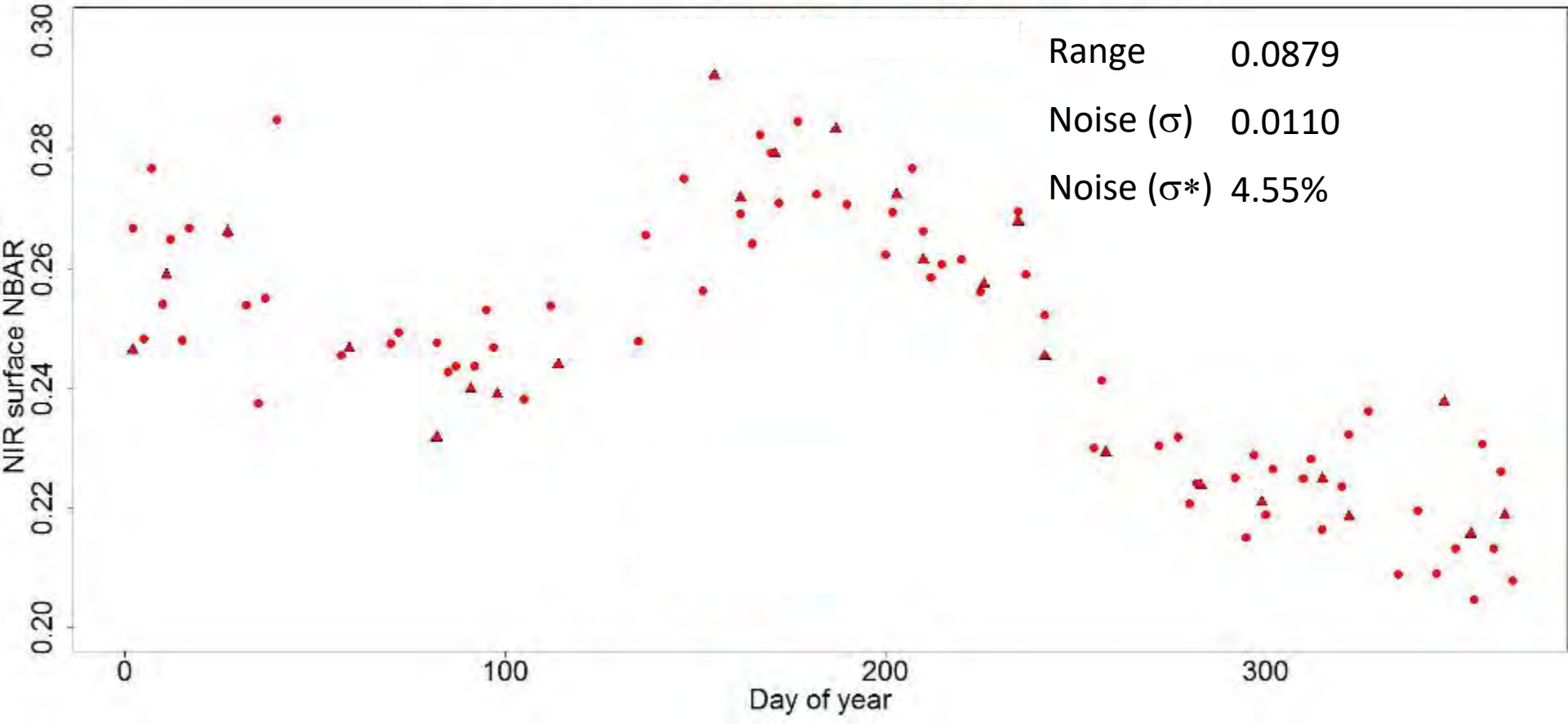


NIR reflectance
(for a single pixel in South Africa)



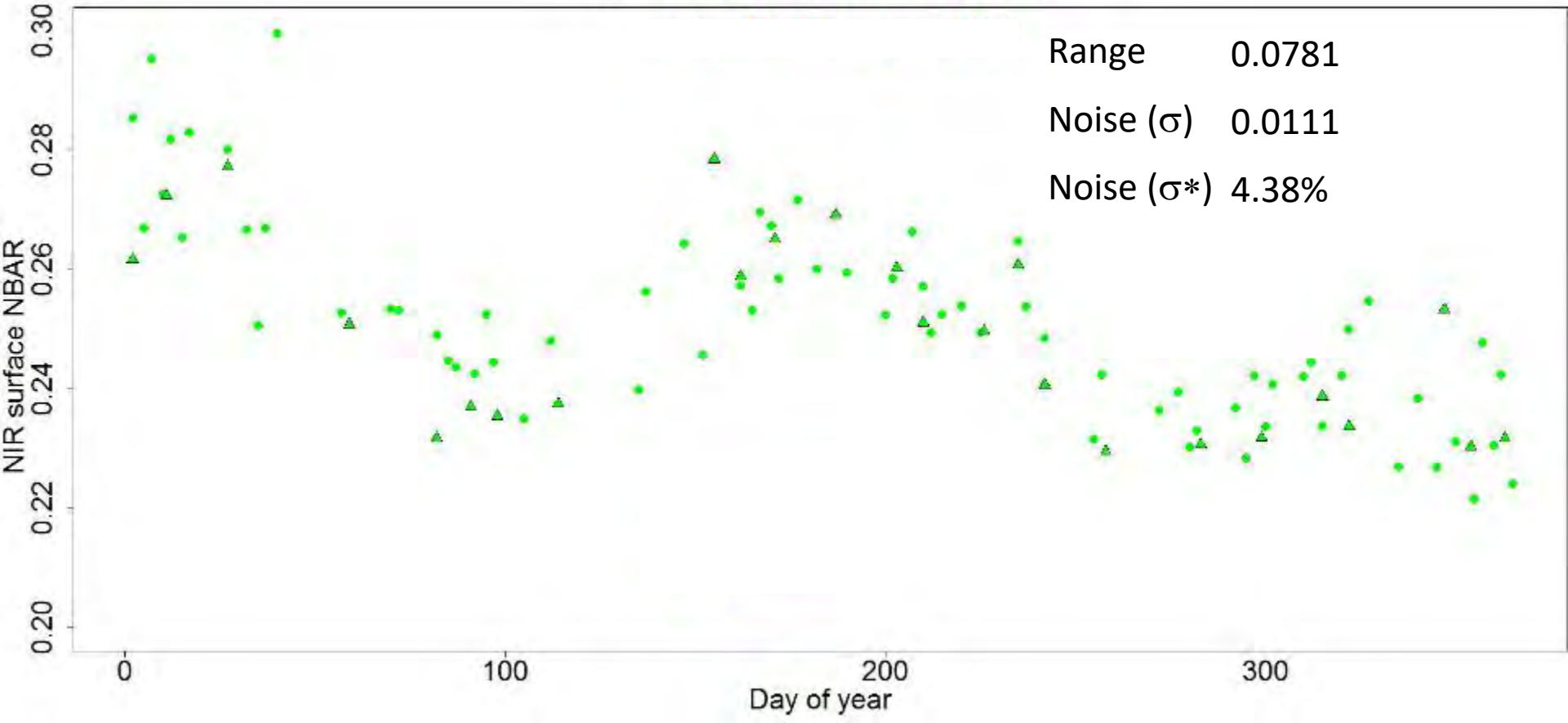
NIR NBAR - fixed HLS 1.4 solar zenith

(for a single pixel in South Africa)



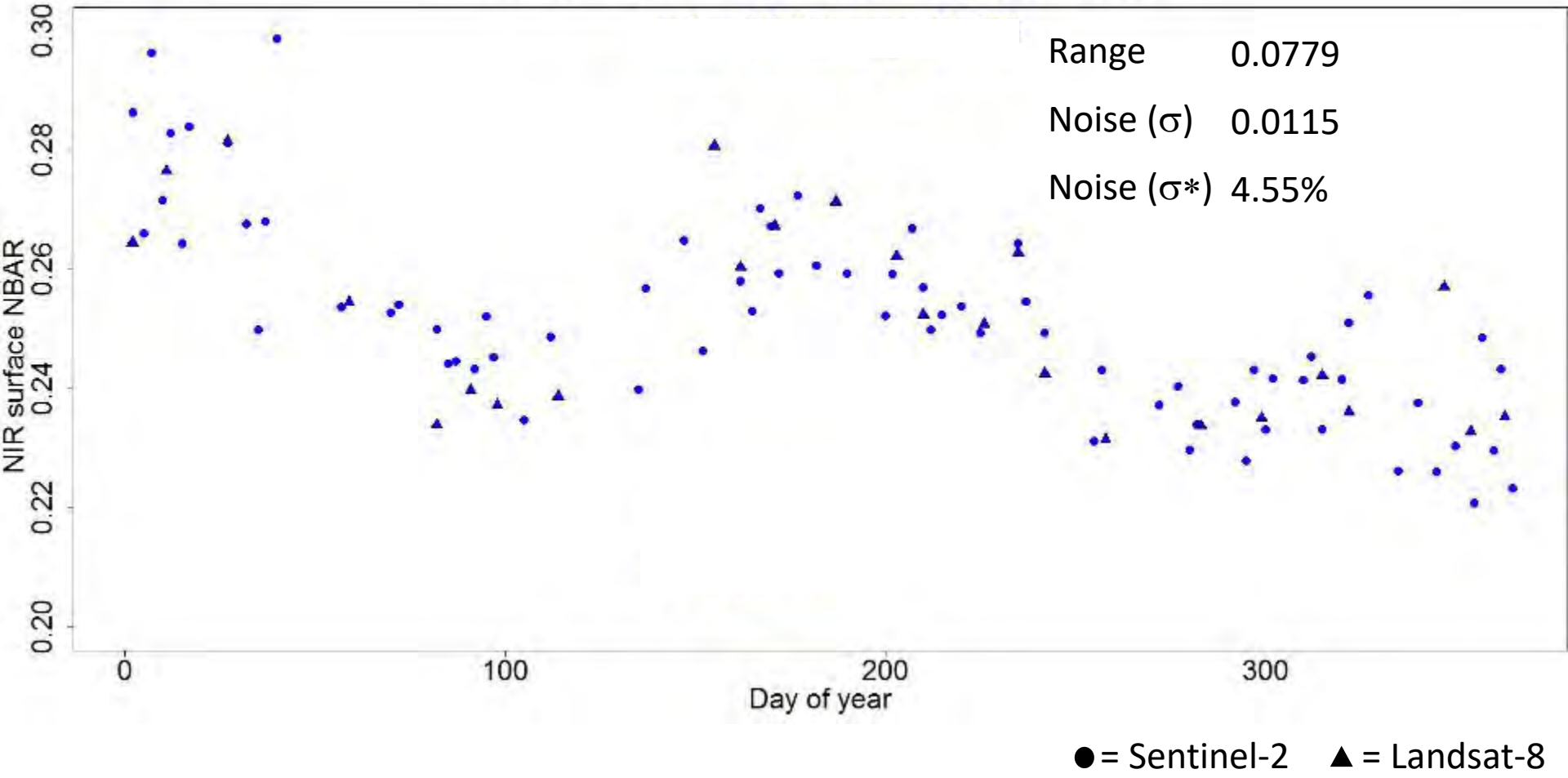
NIR NBAR – observed solar zenith

(for a single pixel in South Africa)

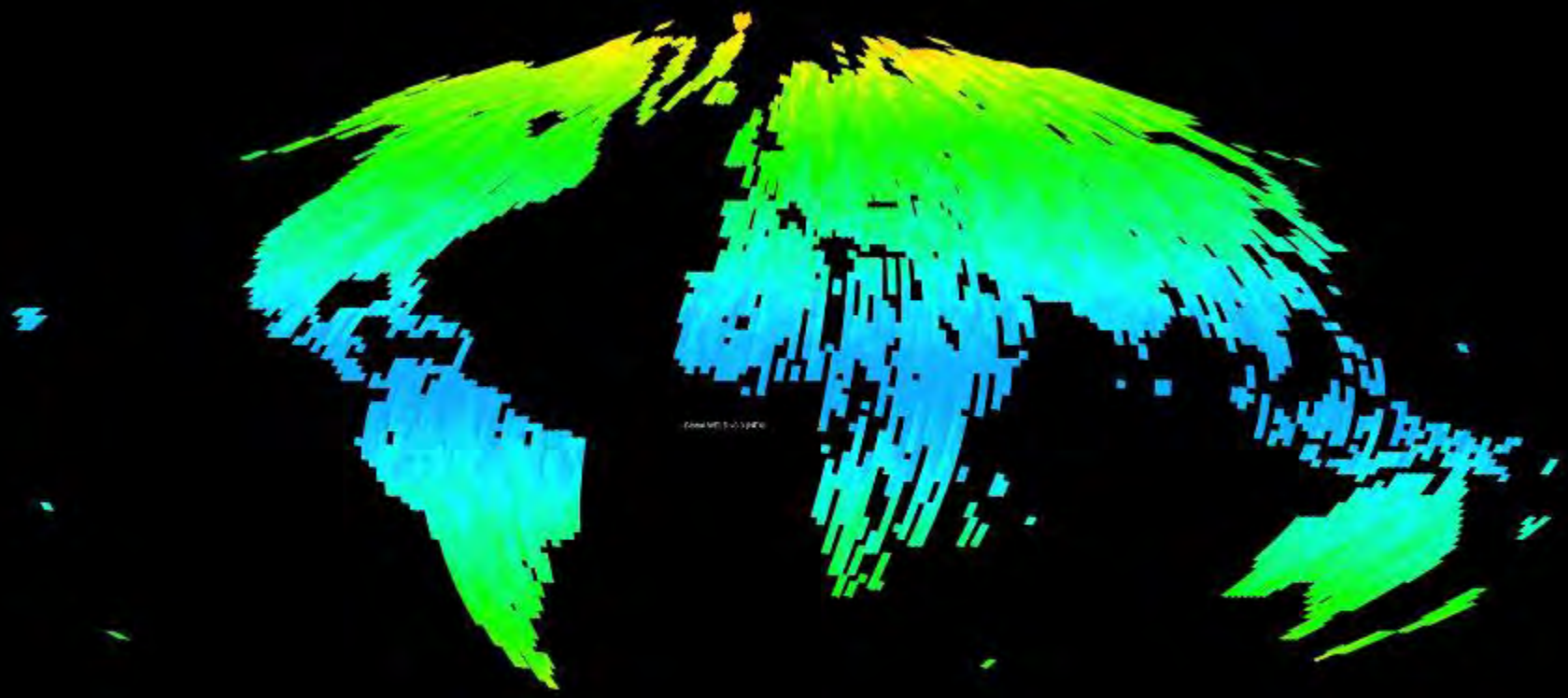


NIR NBAR – local modelled solar zenith

(for a single pixel in South Africa)



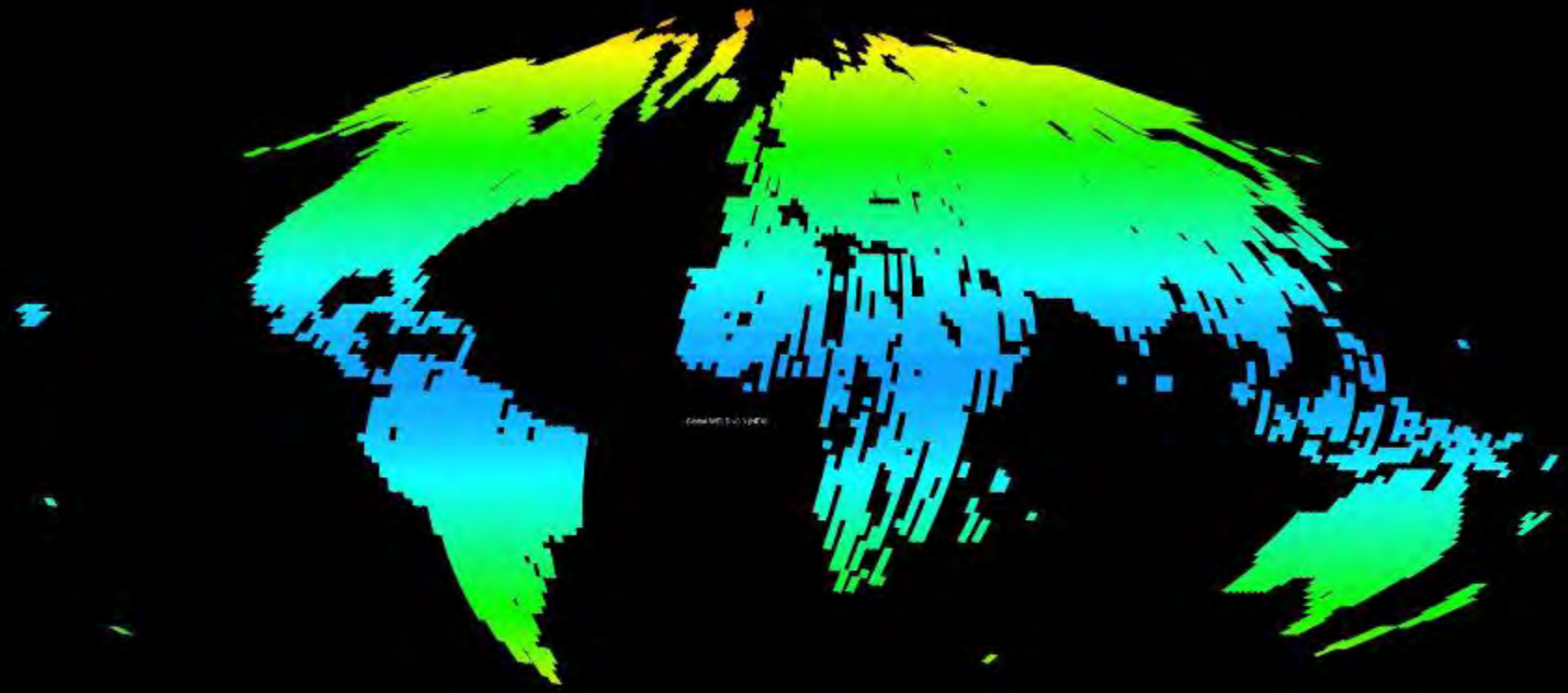
WELD Landsat 5 & 7 observed Solar Zenith



Global WELD NEX Version 3.0 September 2009 30m product
from 15,058 L1T scenes (7,328 Landsat 5 & 7,730 Landsat 7)

Sinusoidal Equal Area Projection

WELD Landsat 5 & 7 modeled Solar Zenith used to derive WELD NBAR



Global WELD NEX Version 3.0 September 2009 30m product
from 15,058 L1T scenes (7,328 Landsat 5 & 7,730 Landsat 7)

Sinusoidal Equal Area Projection

Sentinel-2 Landsat-8 Pre-Processing

- Global WELD processing framework
  - Tiling into MODIS sinusoidal grid
  - Sentinel-2A to Landsat-8 registration
  - Sentinel-2A to Sentinel-2A registration

- Atmospheric correction (LaSRC)

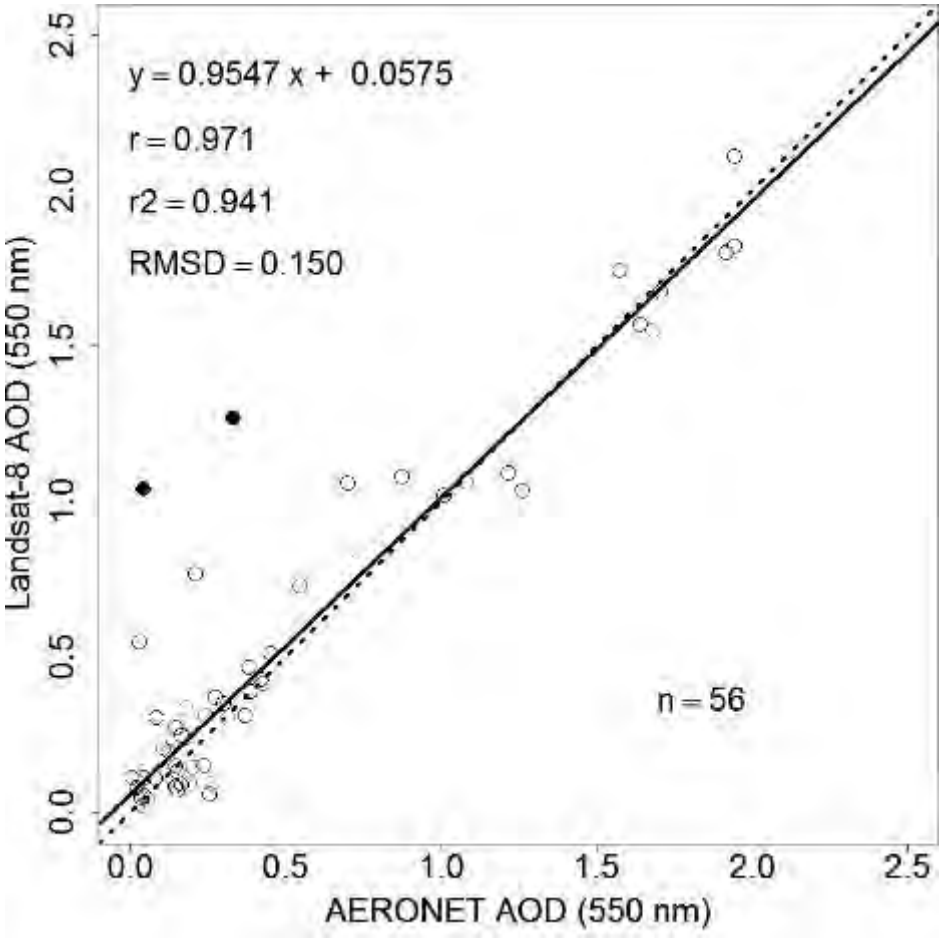
- Nadir BRDF-adjusted reflectance (NBAR) (MODIS c-factor)

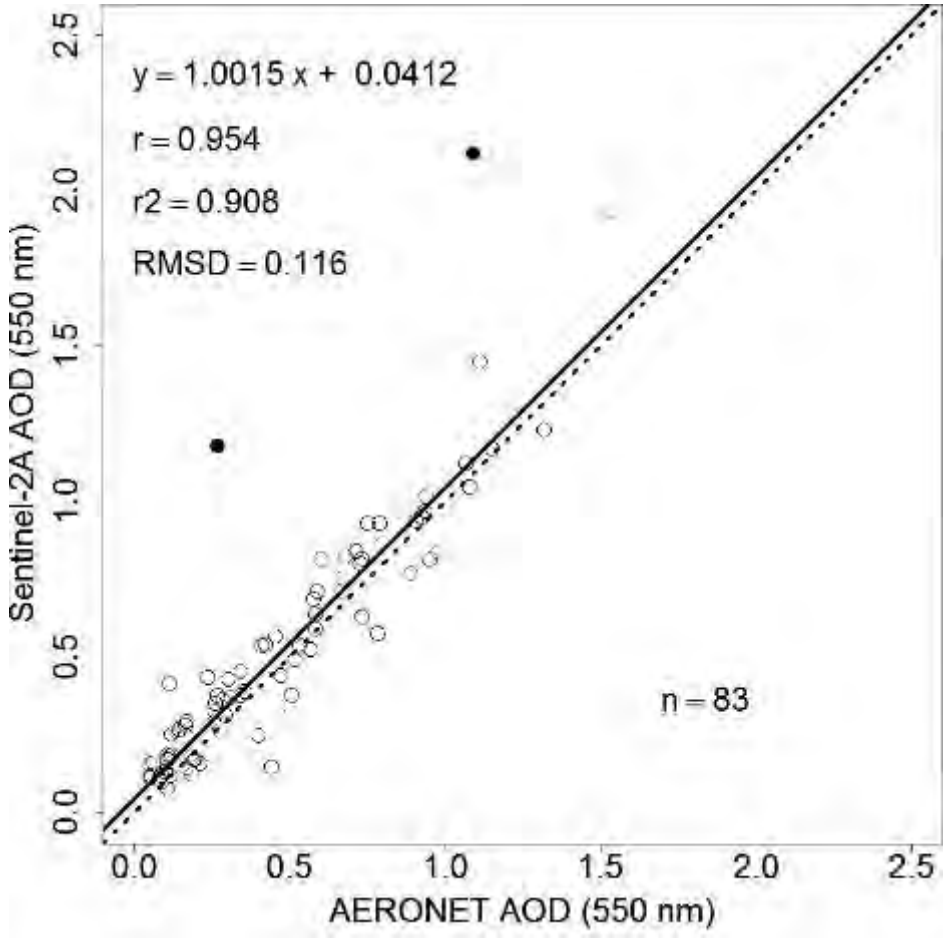
- Masking
    - cloud (Landsat 8 Collection 1 & Sen2Cor masks)
    - no masking of shadow

Evaluation of Landsat-8 and Sentinel-2A aerosol optical depth retrievals across Chinese cities and implications for medium spatial resolution urban aerosol monitoring, Li, Z., Roy, D.P., Zhang, H.K., Vermote, E.F., Huang, H., 2019, Remote Sensing. 11(2), 122.

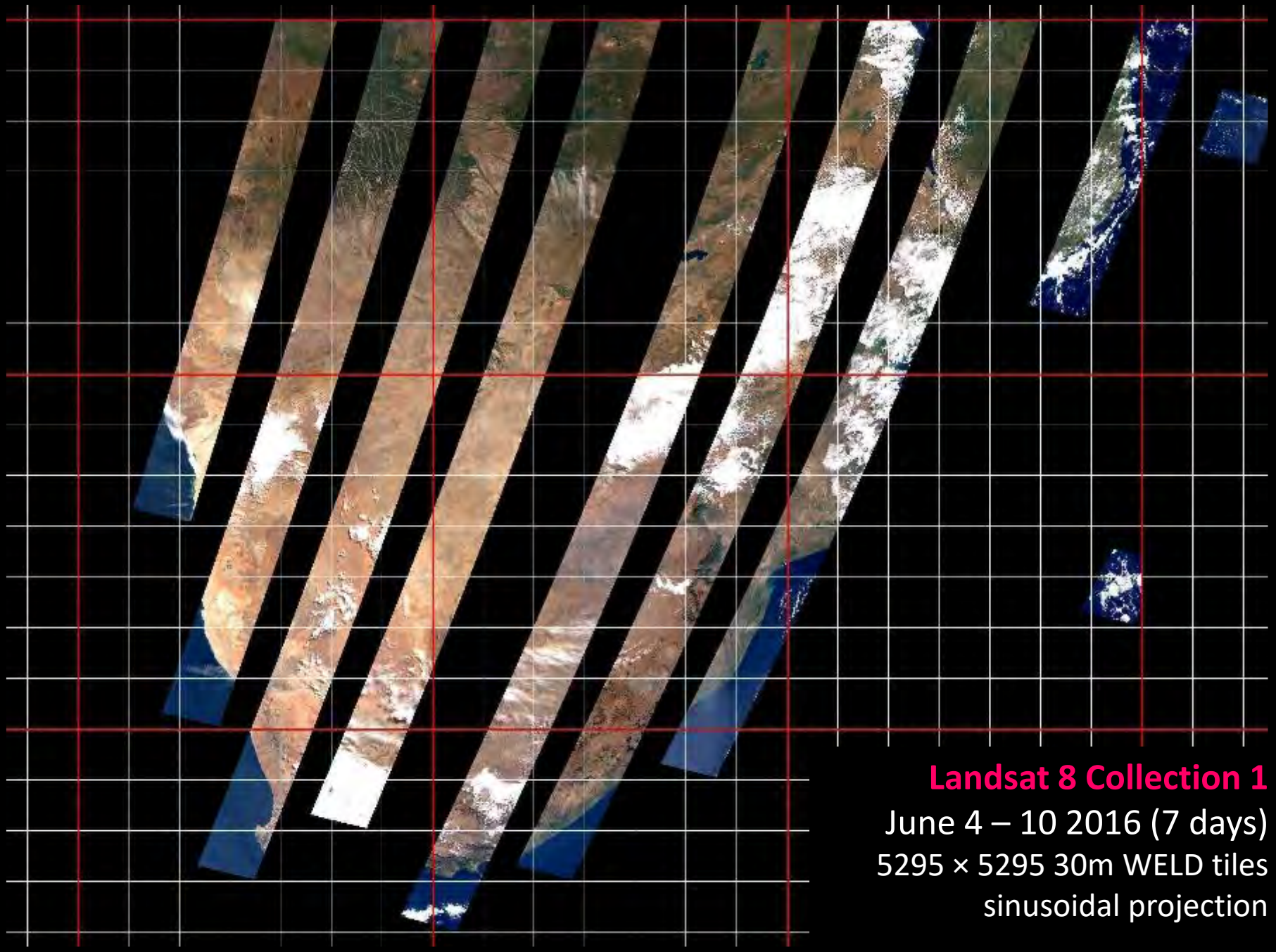
V3.5.5 LaSRC AOD retrieval

All urban AERONET sites in China,
+/- 10 minute overpass, Level 2 AERONET





Southern Africa



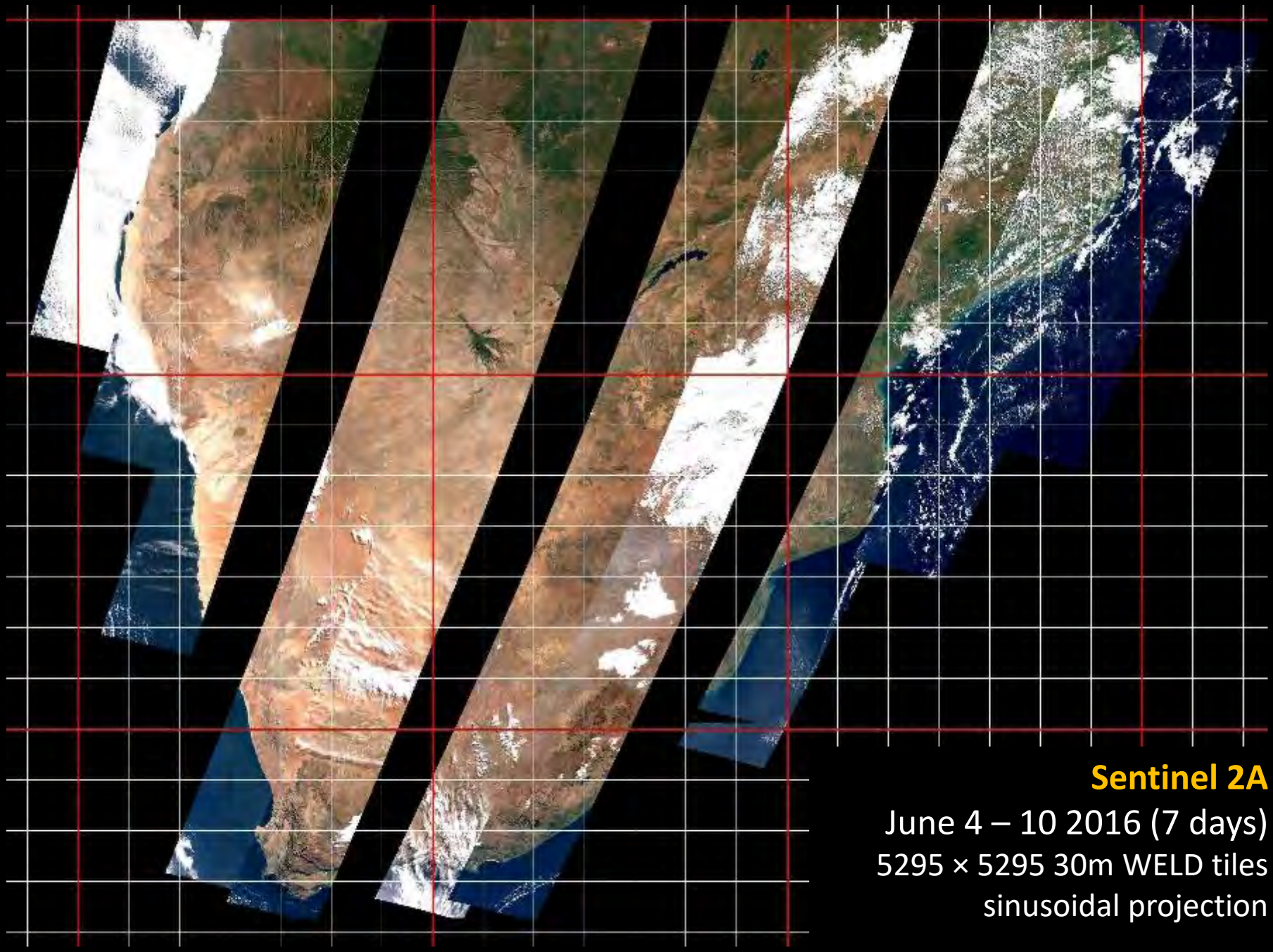
Landsat 8 Collection 1

June 4 – 10 2016 (7 days)

5295 × 5295 30m WELD tiles

sinusoidal projection

Southern Africa

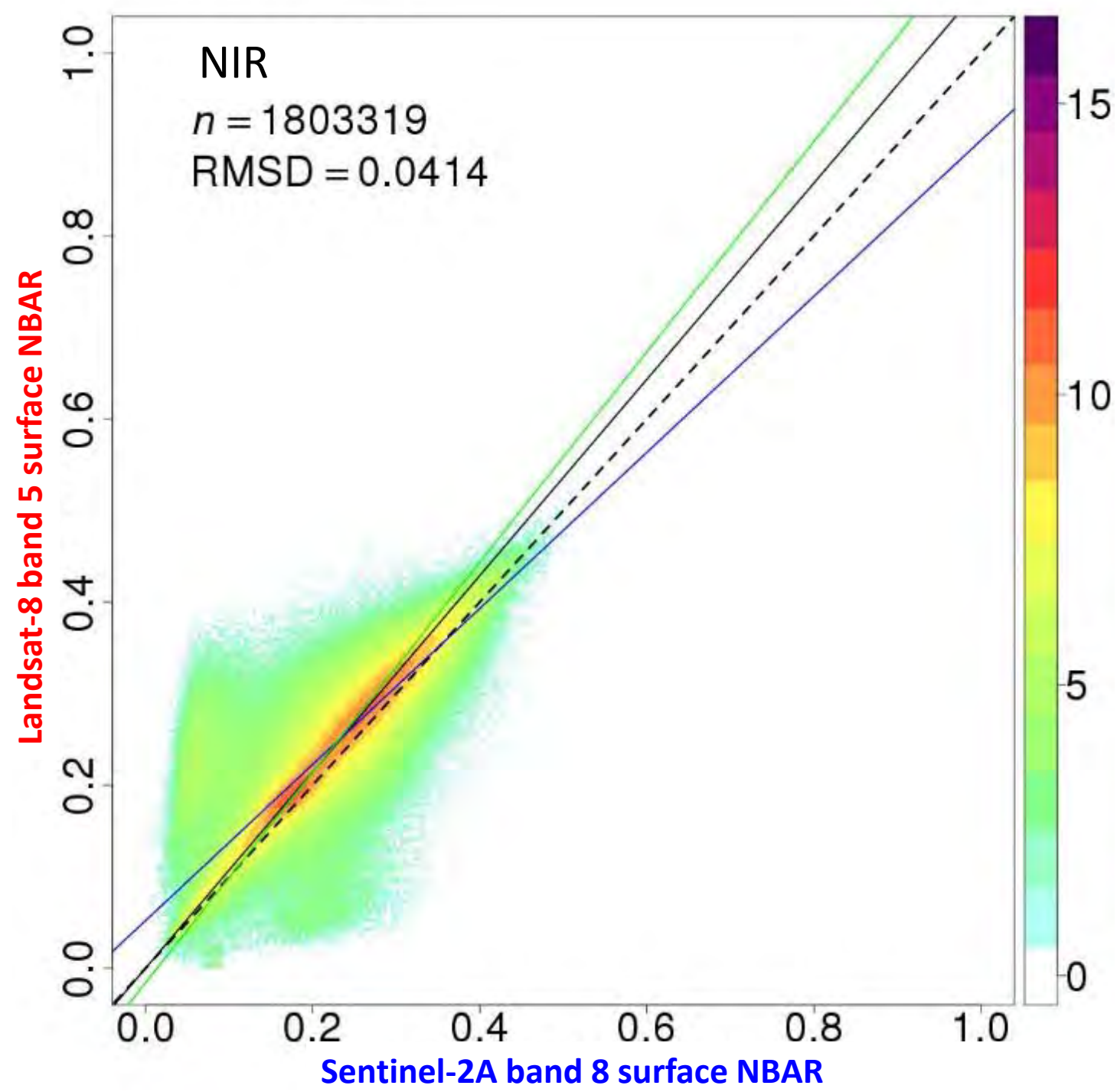


Sentinel 2A

June 4 – 10 2016 (7 days)

5295 × 5295 30m WELD tiles

sinusoidal projection

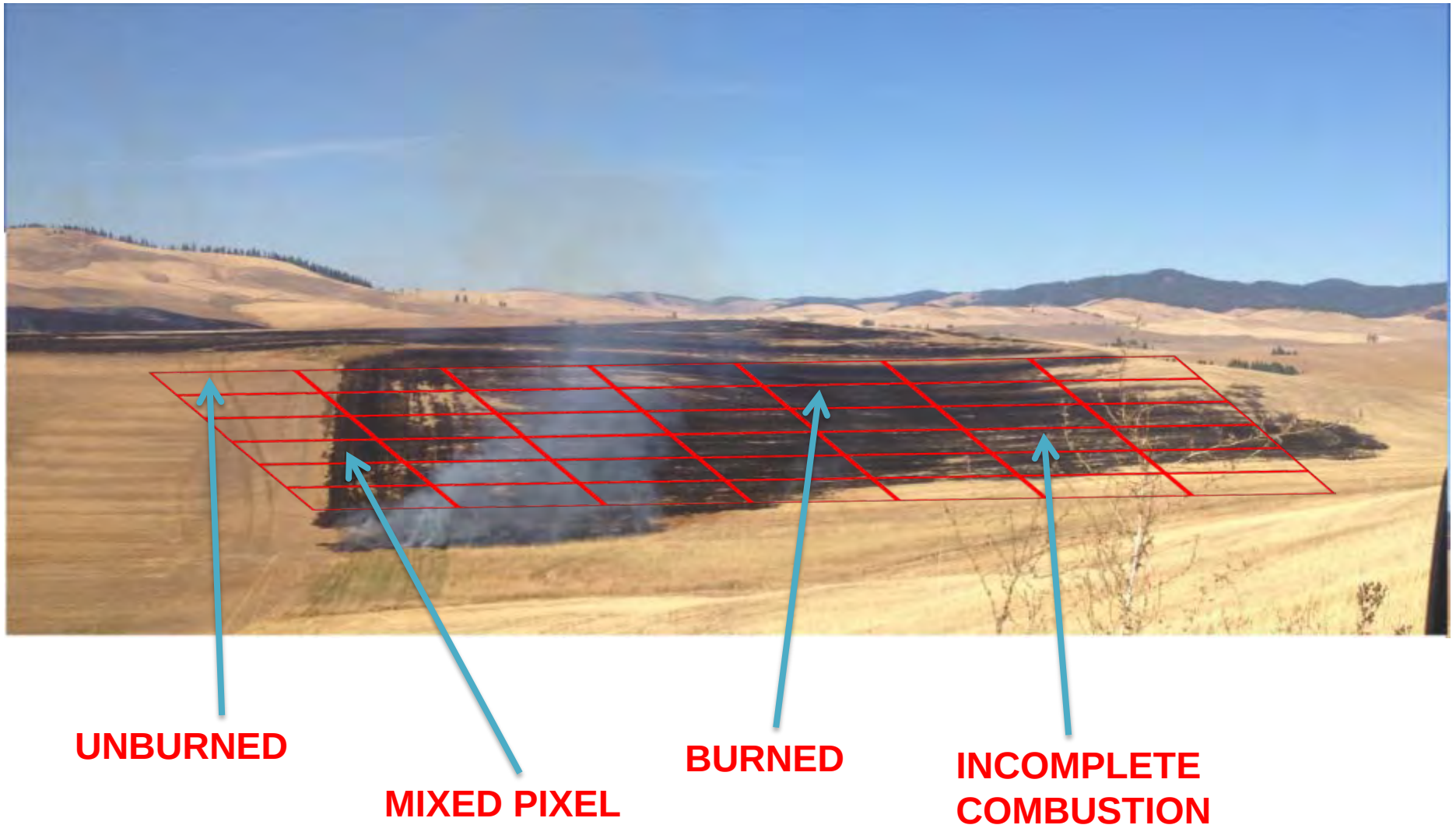


Apply **Landsat-8** **Sentinel-2A** band statistical calibration

Zhang, Roy, Yan, Li, Huang, Vermote, Skakun, Roger, 2018, RSE,

Characterization of Sentinel-2A and Landsat-8 top of atmosphere, surface, nadir BRDF adjusted reflectance and NDVI differences

To first order the change in reflectance due to burning is dependent on the fraction of area burned *f* and combustion completeness *cc*



Landsat 8

Kafue
National park,
Zambia

Day 155 2016

false color surface
NBAR

2000 x 2000 30m pixels

Sentinel 2A

Kafue
National park,
Zambia

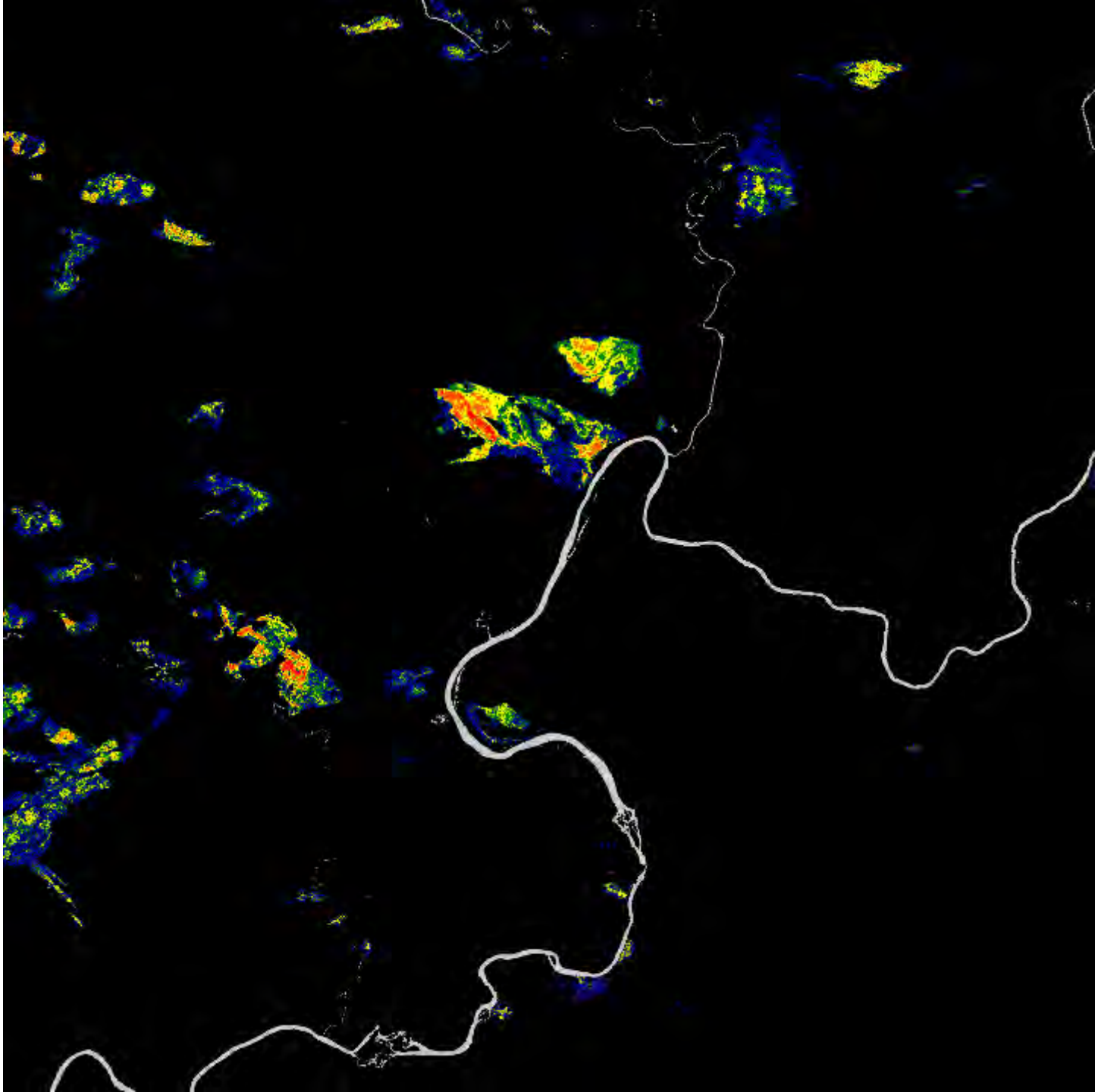
Day 164 2016

false color surface
NBAR

2000 x 2000 30m pixels

f x cc

day 155 -> 164



2000 x 2000 30m pixels

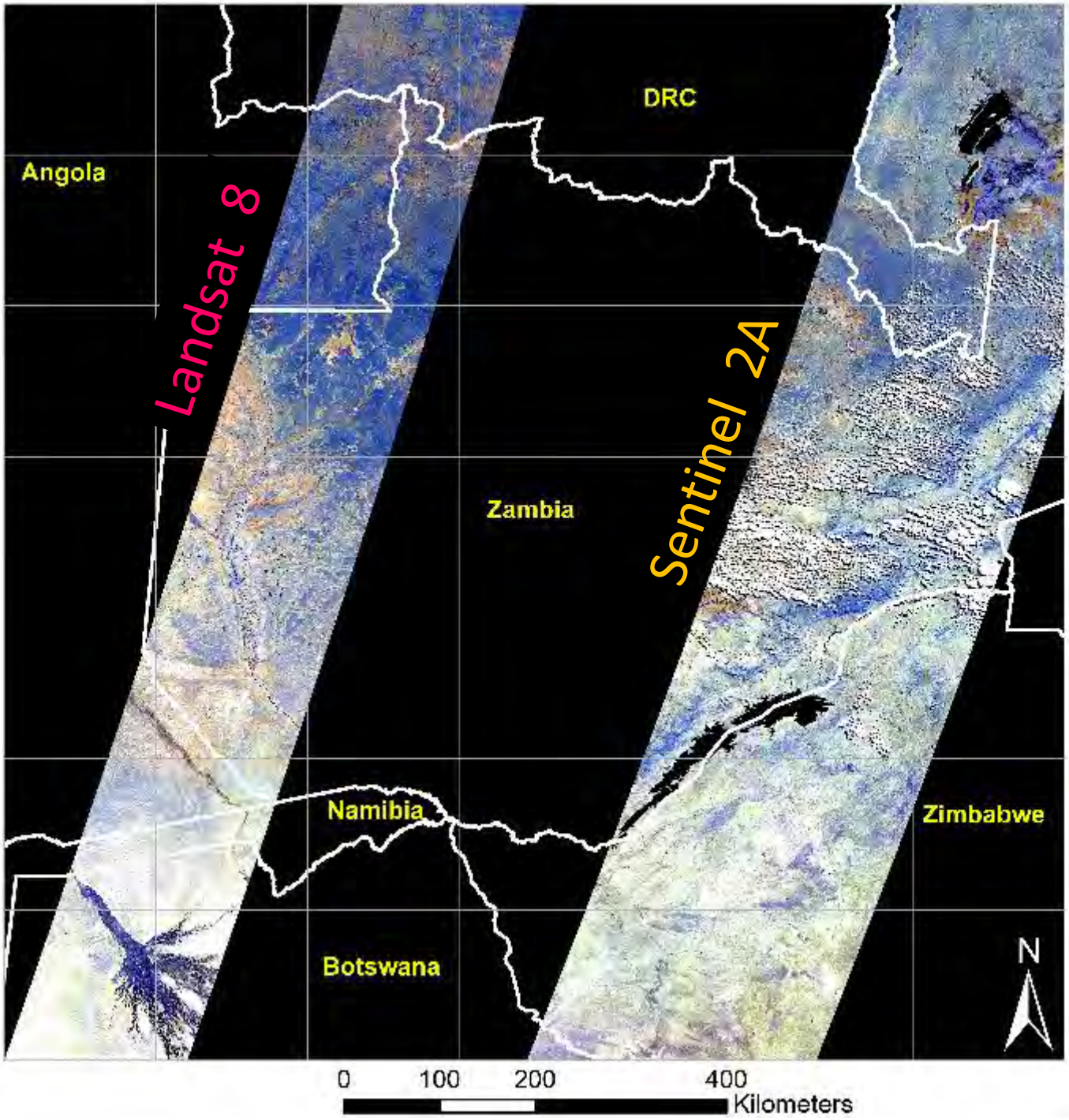
Example results

July 19th 2016

~2200 nm
1600 nm
865 nm

MODIS tile h20v10

7 x 7 WELD tiles

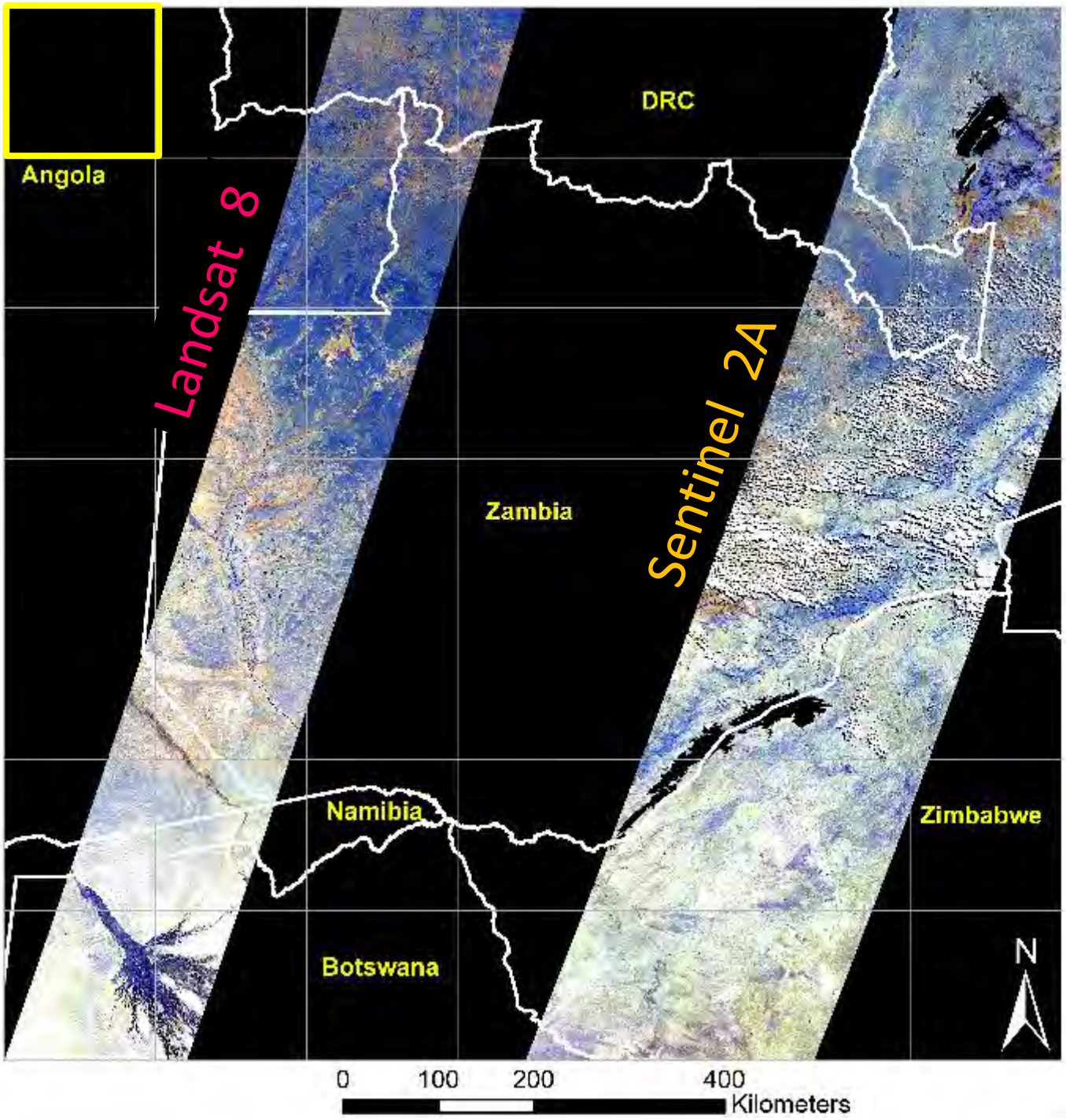


July 19th 2016

~2200 nm
1600 nm
865 nm

MODIS tile h20v10

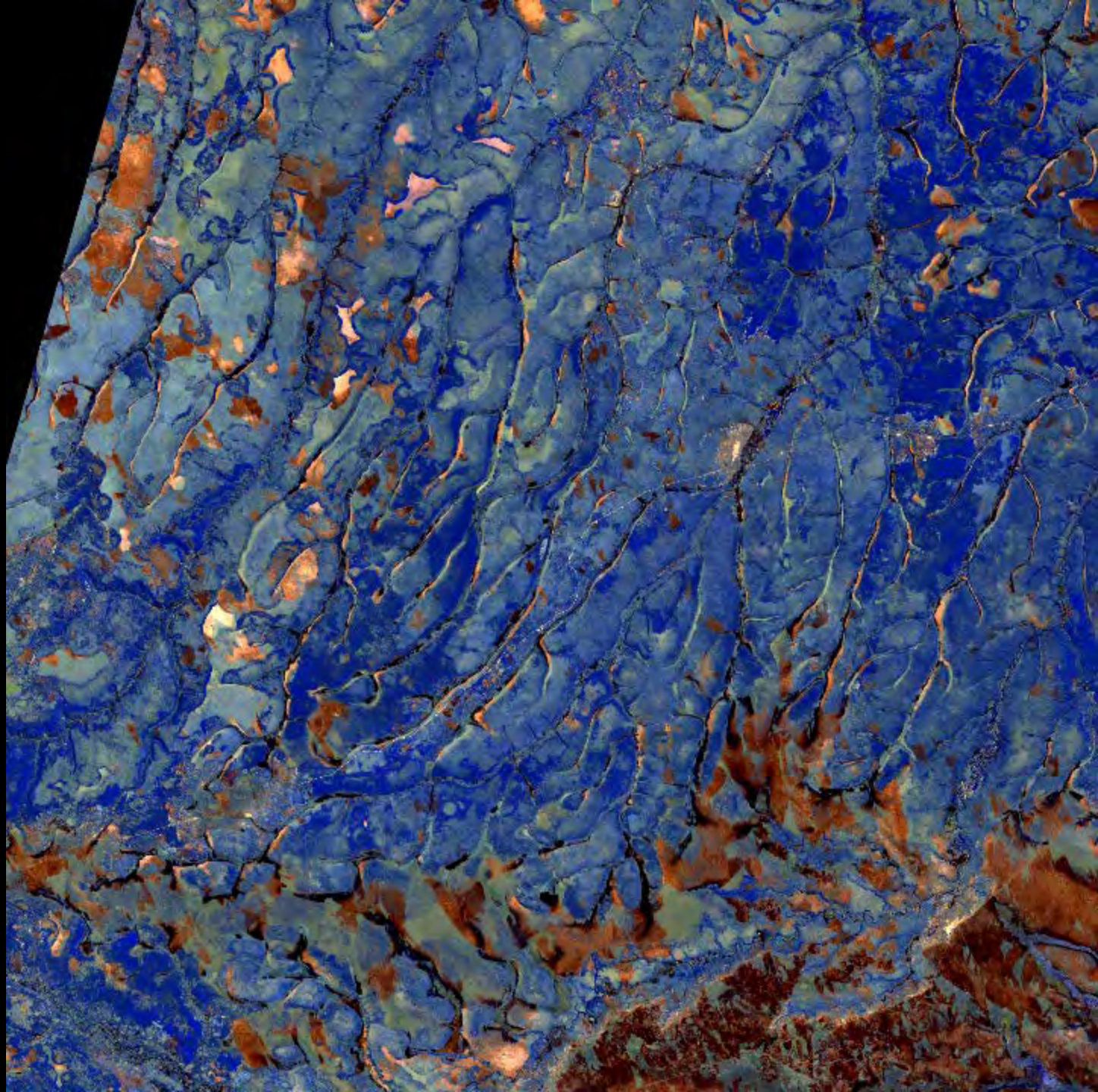
7 x 7 WELD tiles



Landsat 8

Day 183 2016
July 1st

2200 nm
1600 nm
865 nm



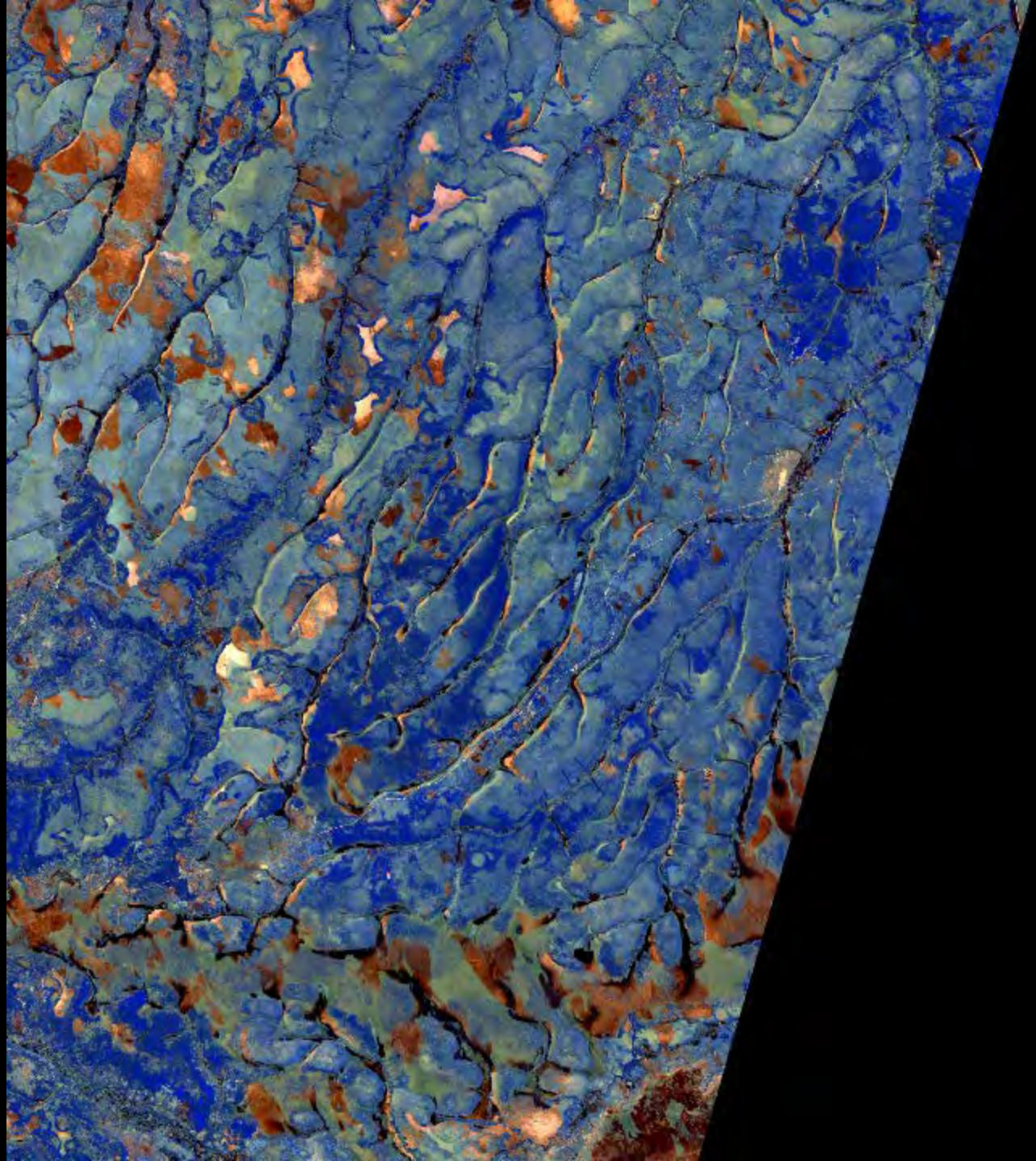
Angola,
Lunda Sul
Province

159 x 159 km
5295 x 5295 30m pixels

Sentinel 2A

Day 183 2016
July 1st

2190 nm
1610 nm
865 nm



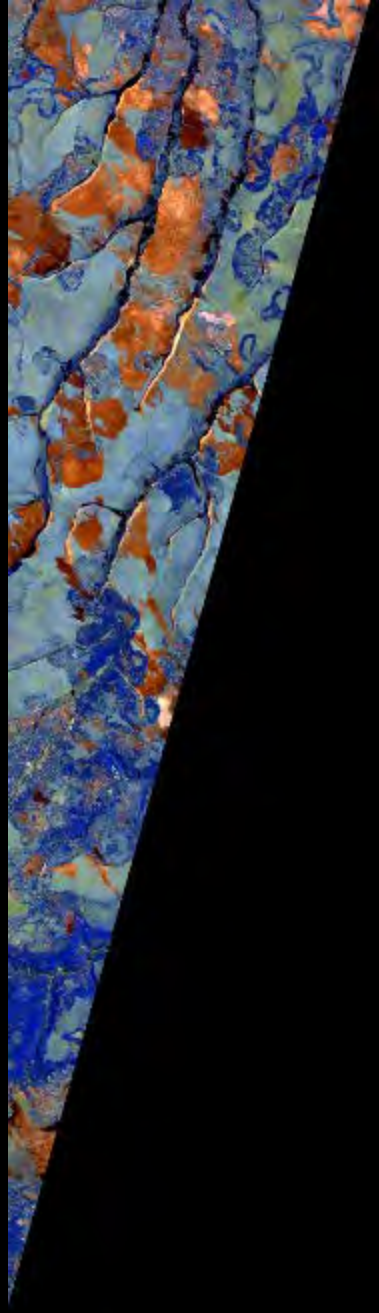
Angola,
Lunda Sul
Province

159 x 159 km
5295 x 5295 30m pixels

Landsat 8

Day 190 2016
July 8th

2200 nm
1600 nm
865 nm



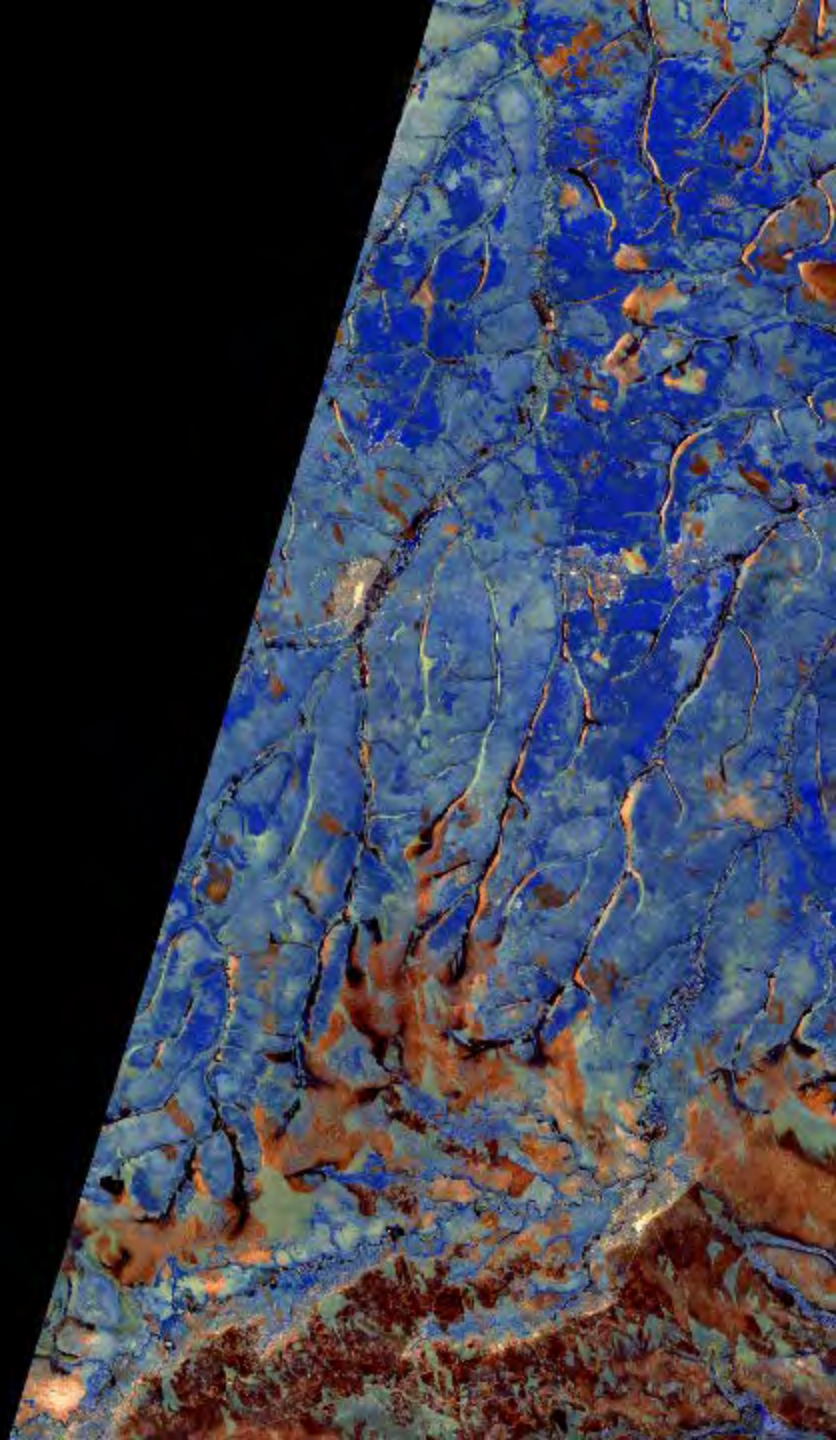
Angola,
Lunda Sul
Province

159 x 159 km
5295 x 5295 30m pixels

Sentinel 2A

Day 190 2016
July 8th

2190 nm
1610 nm
865 nm



Angola,
Lunda Sul
Province

159 x 159 km
5295 x 5295 30m pixels

Landsat 8

Day 192 2016
July 10th

2200 nm
1600 nm
865 nm

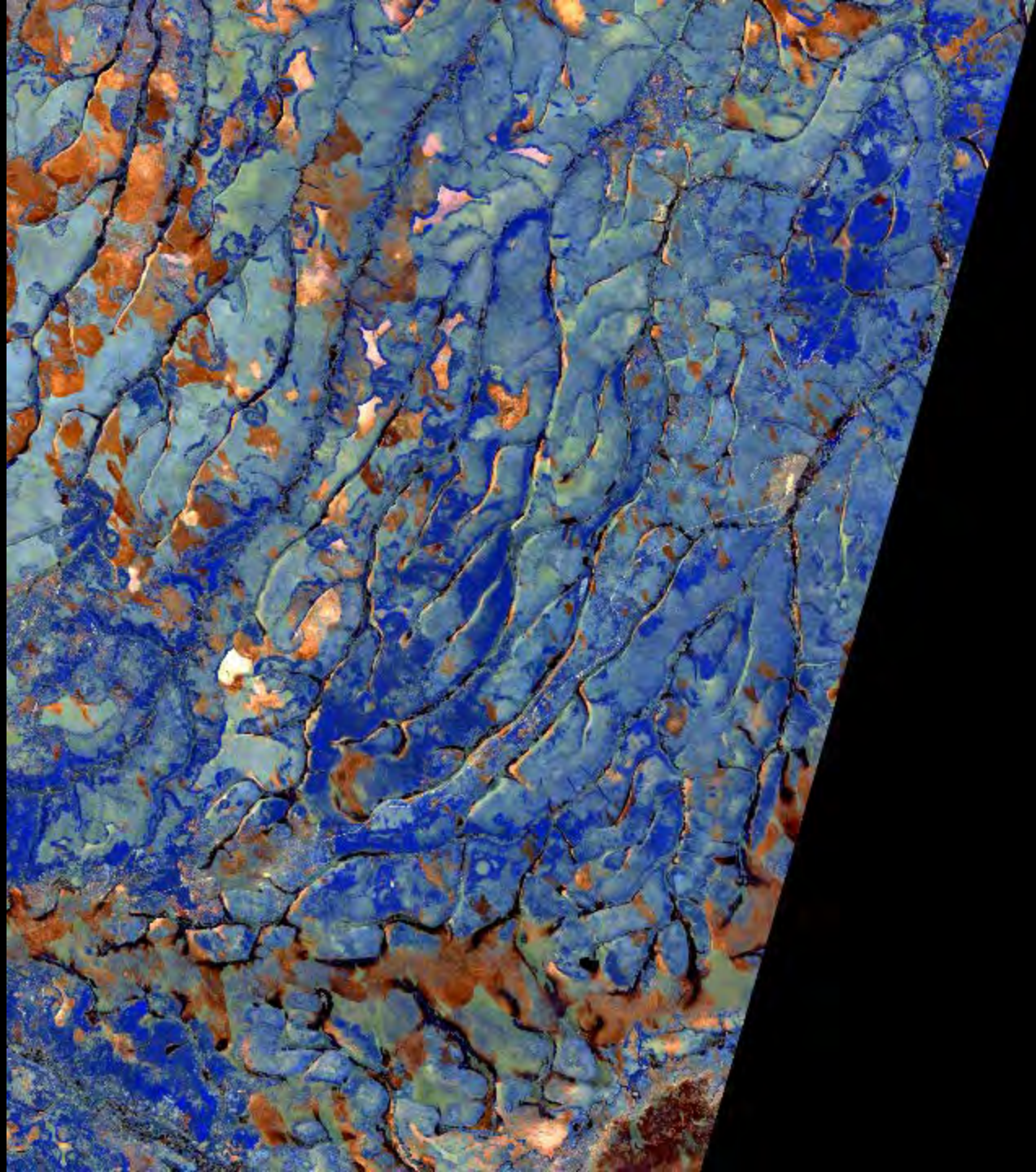
Angola,
Lunda Sul
Province

159 x 159 km
5295 x 5295 30m pixels

Sentinel 2A

Day 193 2016
July 11th

2190 nm
1610 nm
865 nm



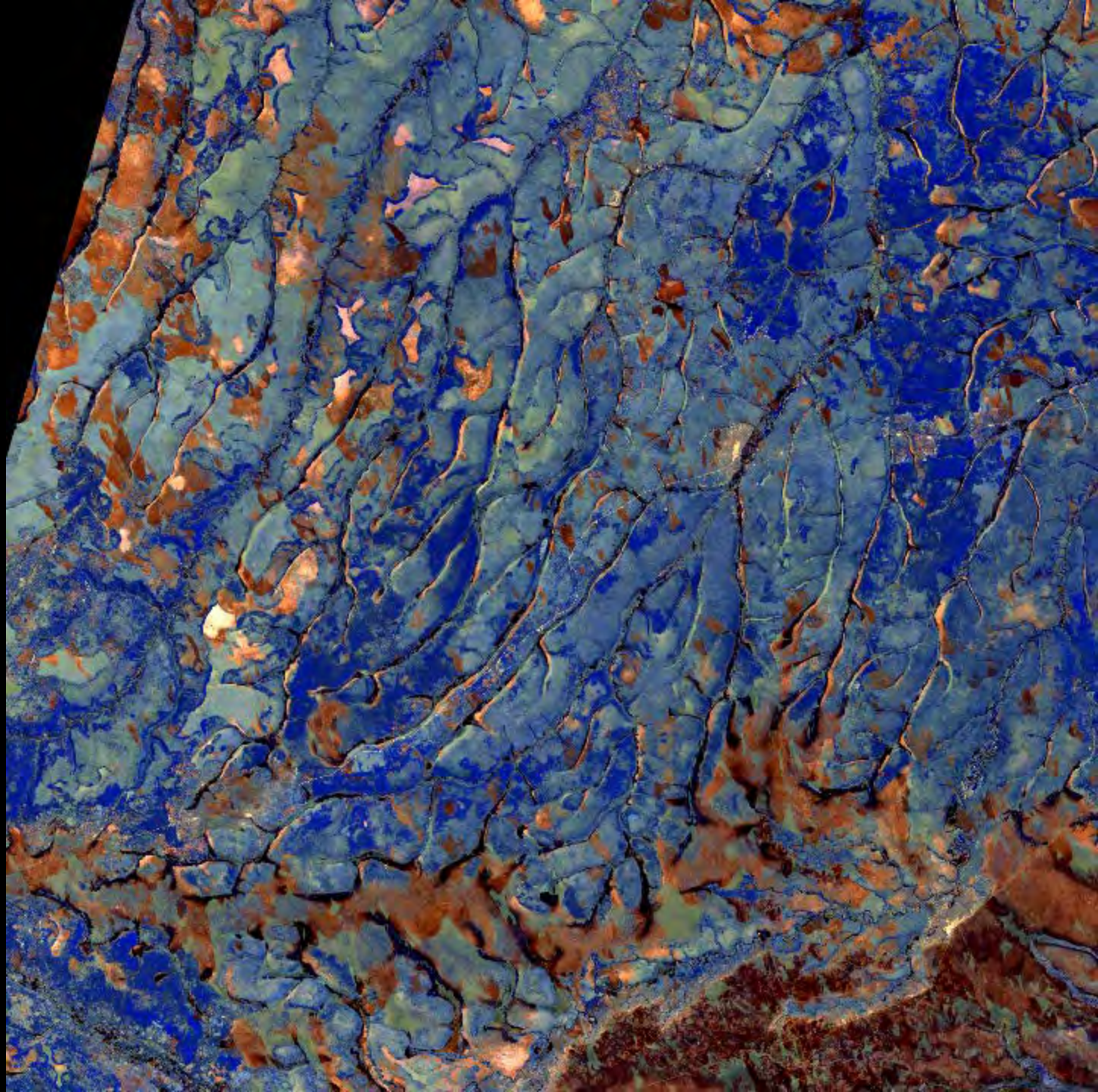
Angola,
Lunda Sul
Province

159 x 159 km
5295 x 5295 30m pixels

Landsat 8

Day 199 2016
July 17th

2200 nm
1600 nm
865 nm



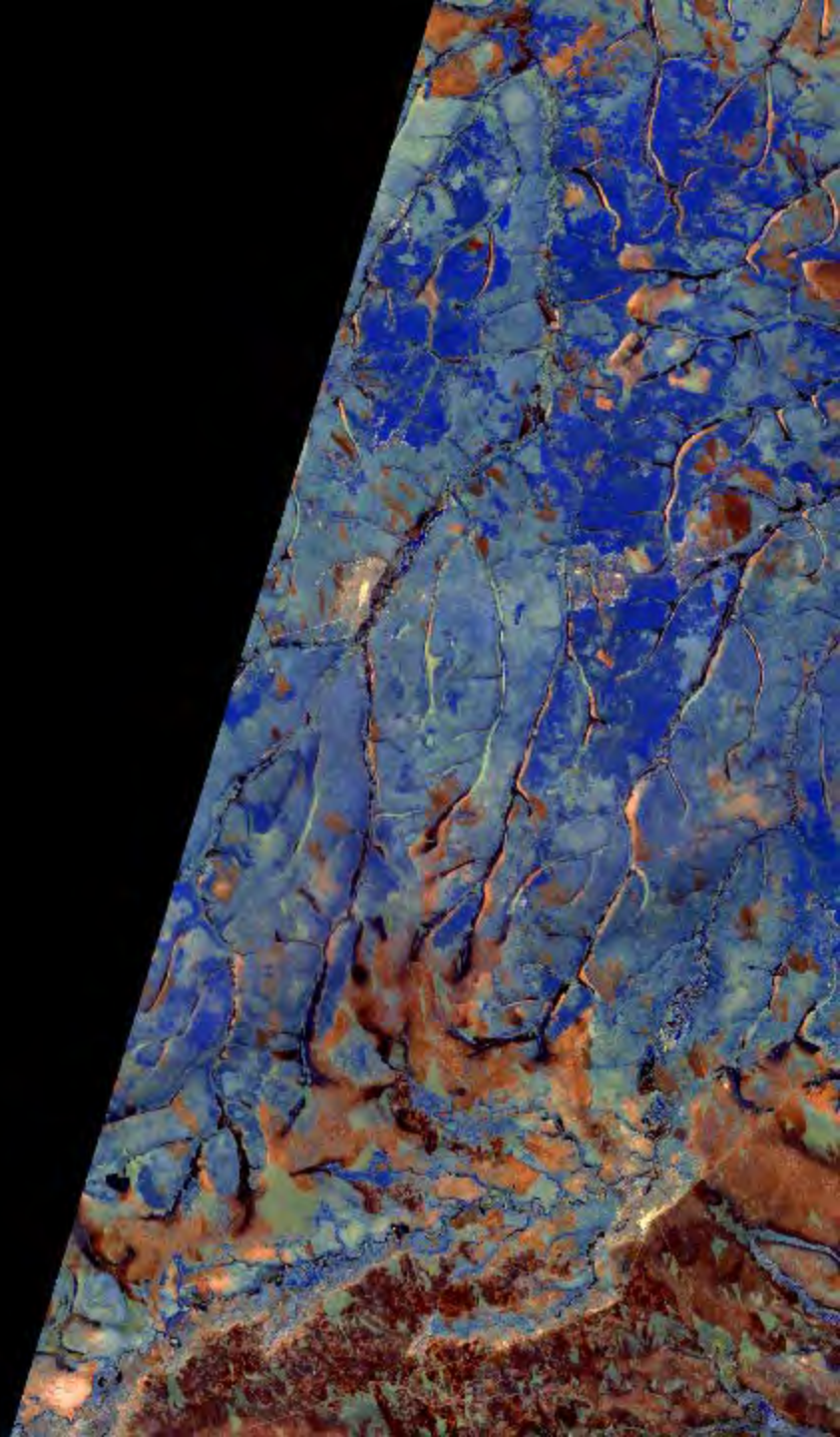
Angola,
Lunda Sul
Province

159 x 159 km
5295 x 5295 30m pixels

Sentinel 2A

Day 200 2016
July 18th

2190 nm
1610 nm
865 nm



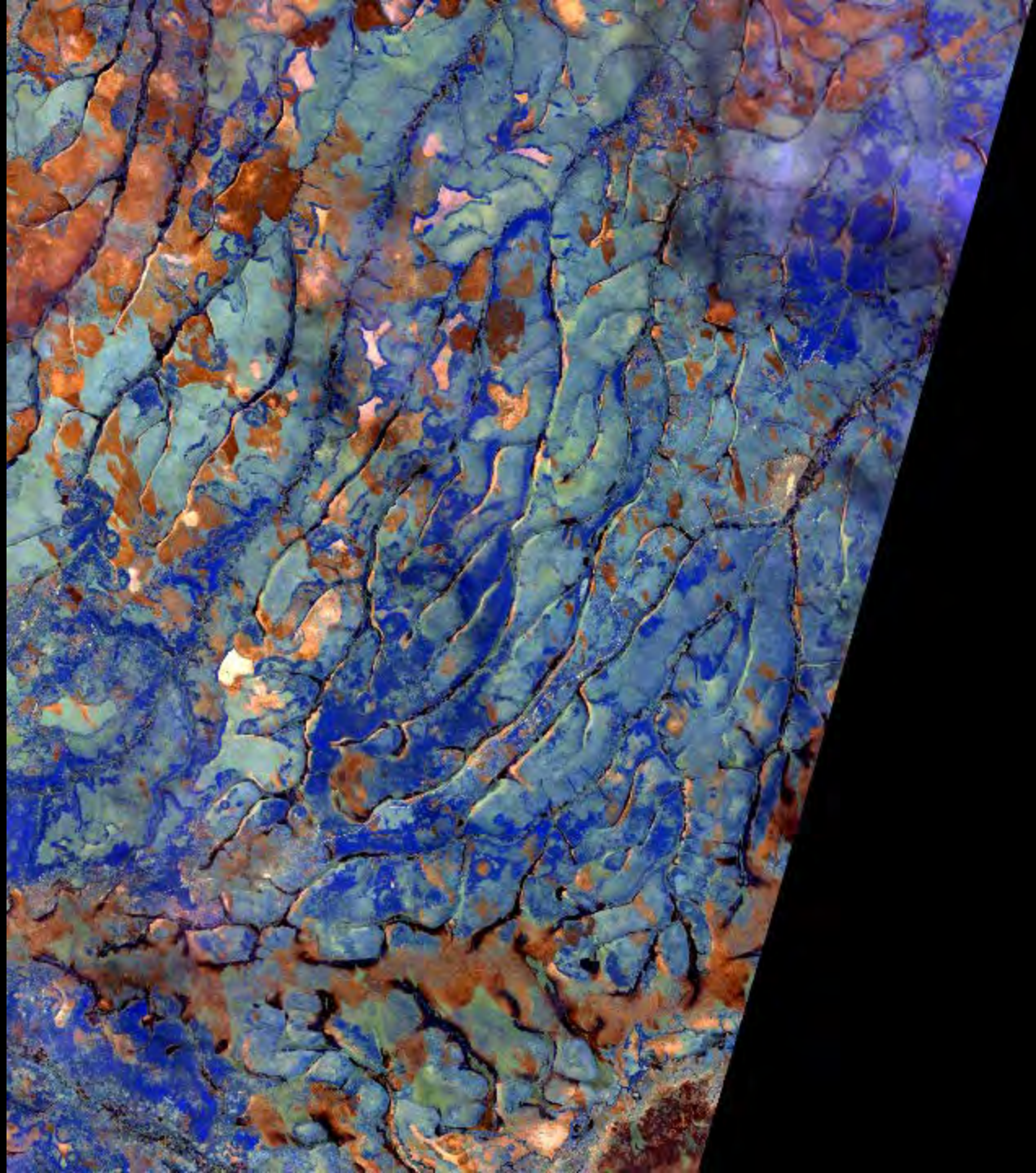
Angola,
Lunda Sul
Province

159 x 159 km
5295 x 5295 30m pixels

Sentinel 2A

Day 203 2016
July 21st

2190 nm
1610 nm
865 nm



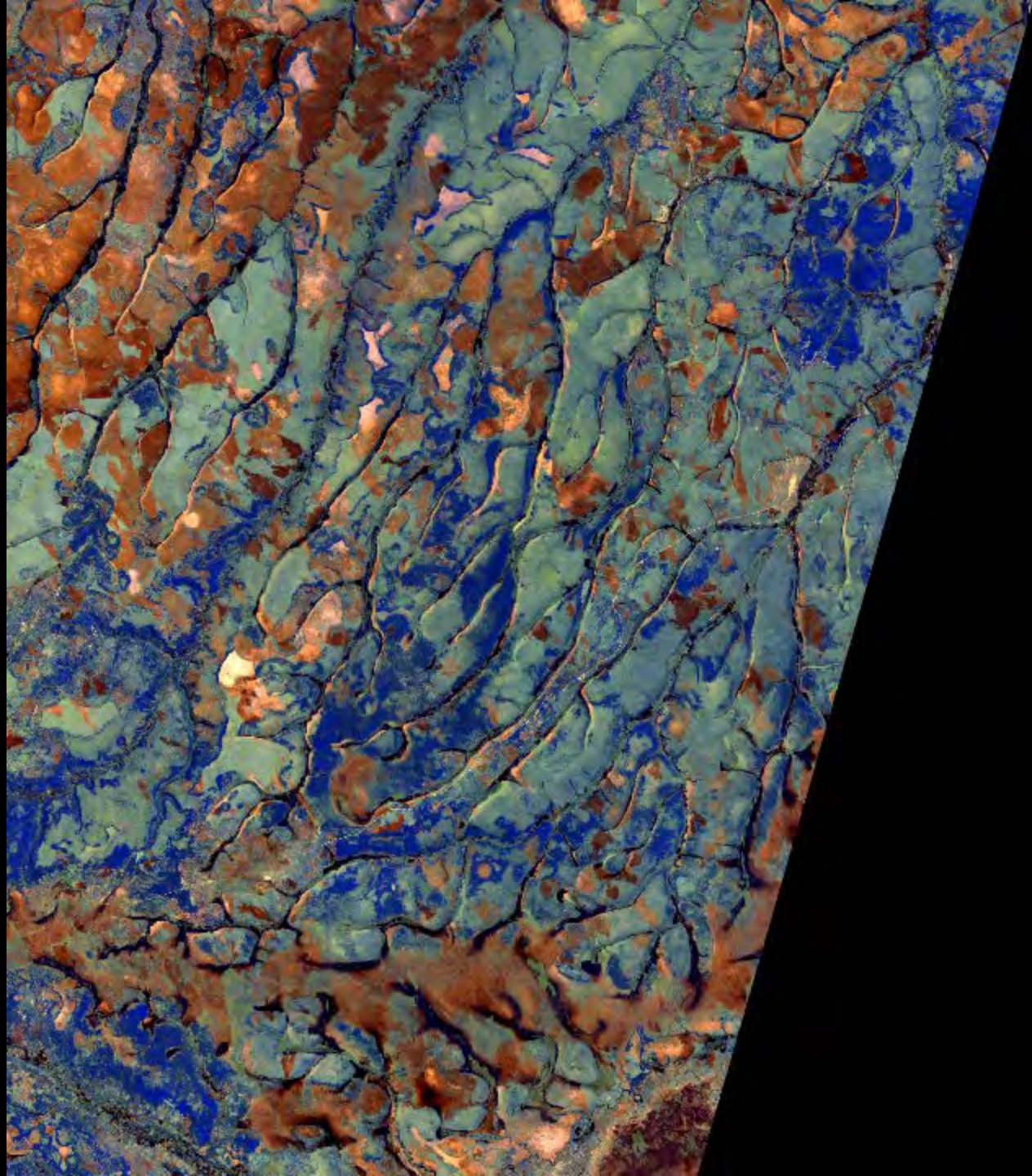
Angola,
Lunda Sul
Province

159 x 159 km
5295 x 5295 30m pixels

Sentinel 2A

Day 213 2016
July 31st

2190 nm
1610 nm
865 nm



Angola,
Lunda Sul
Province

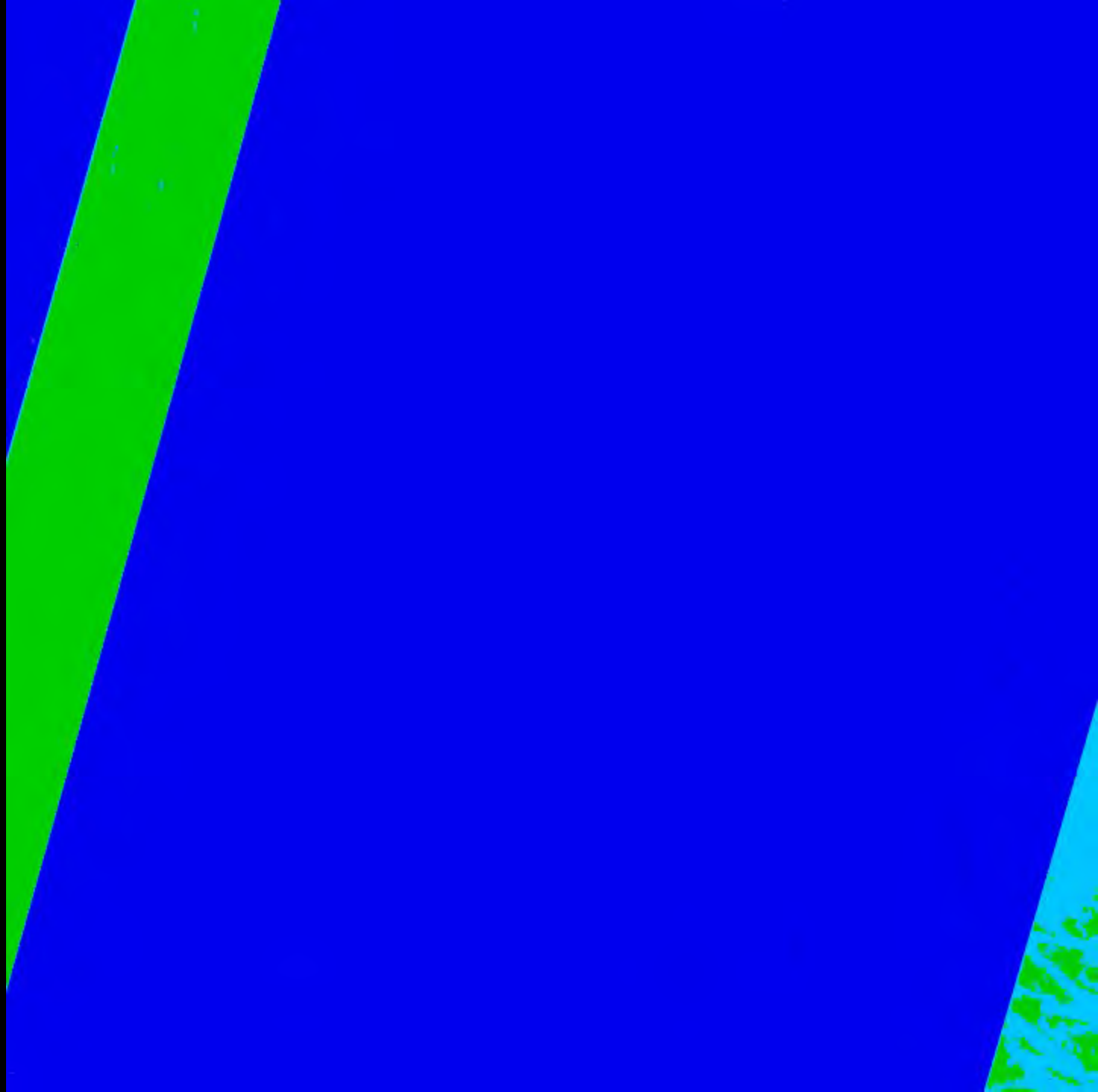
159 x 159 km
5295 x 5295 30m pixels

Number of cloud-free observations
July 2016
Landsat 8

median 2
3
4
5
6
≥7

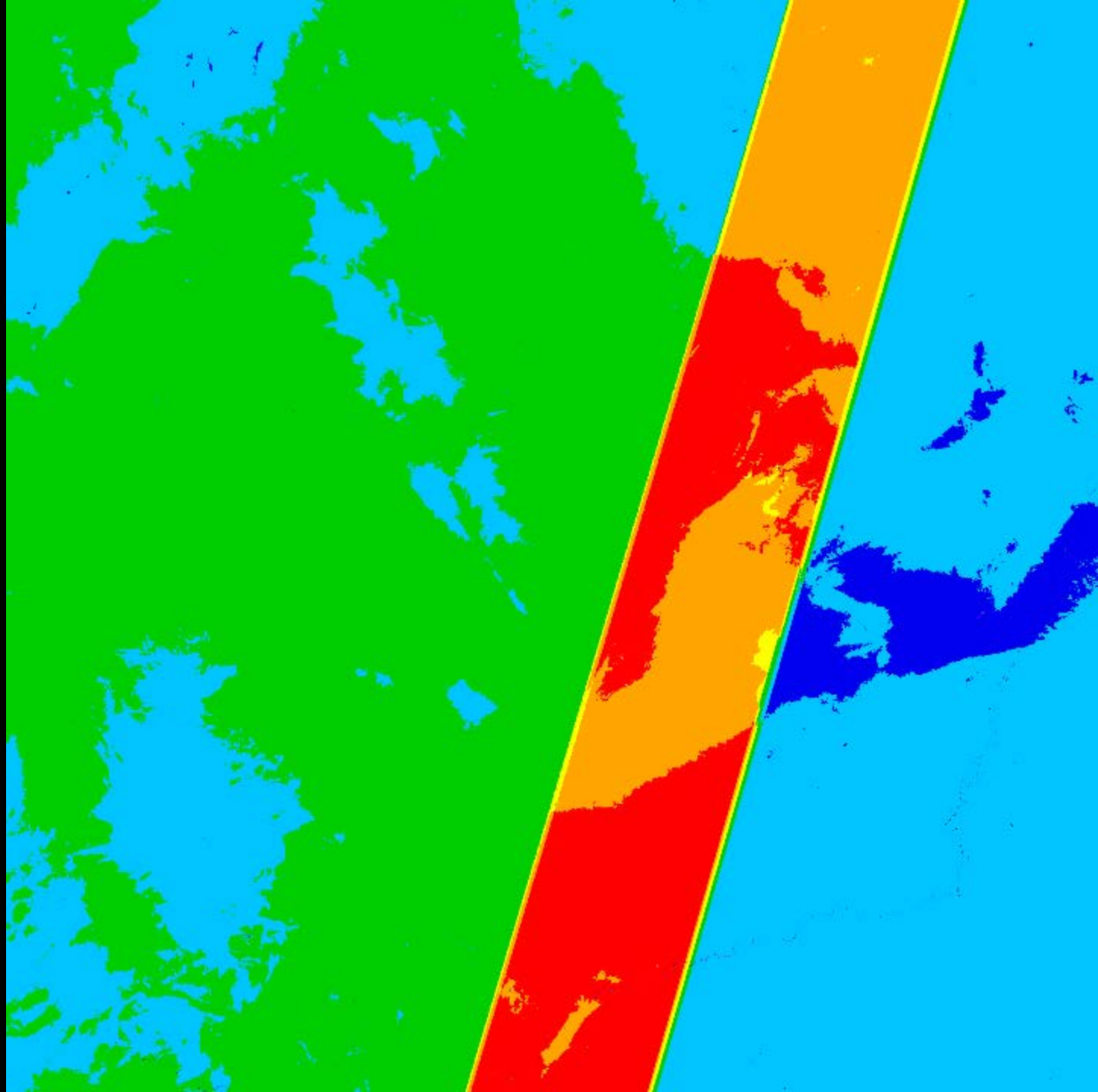
Angola,
Lunda Sul
Province

159 x 159 km
5295 x 5295 30m pixels



Number of cloud-free observations
July 2016
Sentinel-2A

2
3
median 4
5
6
≥7

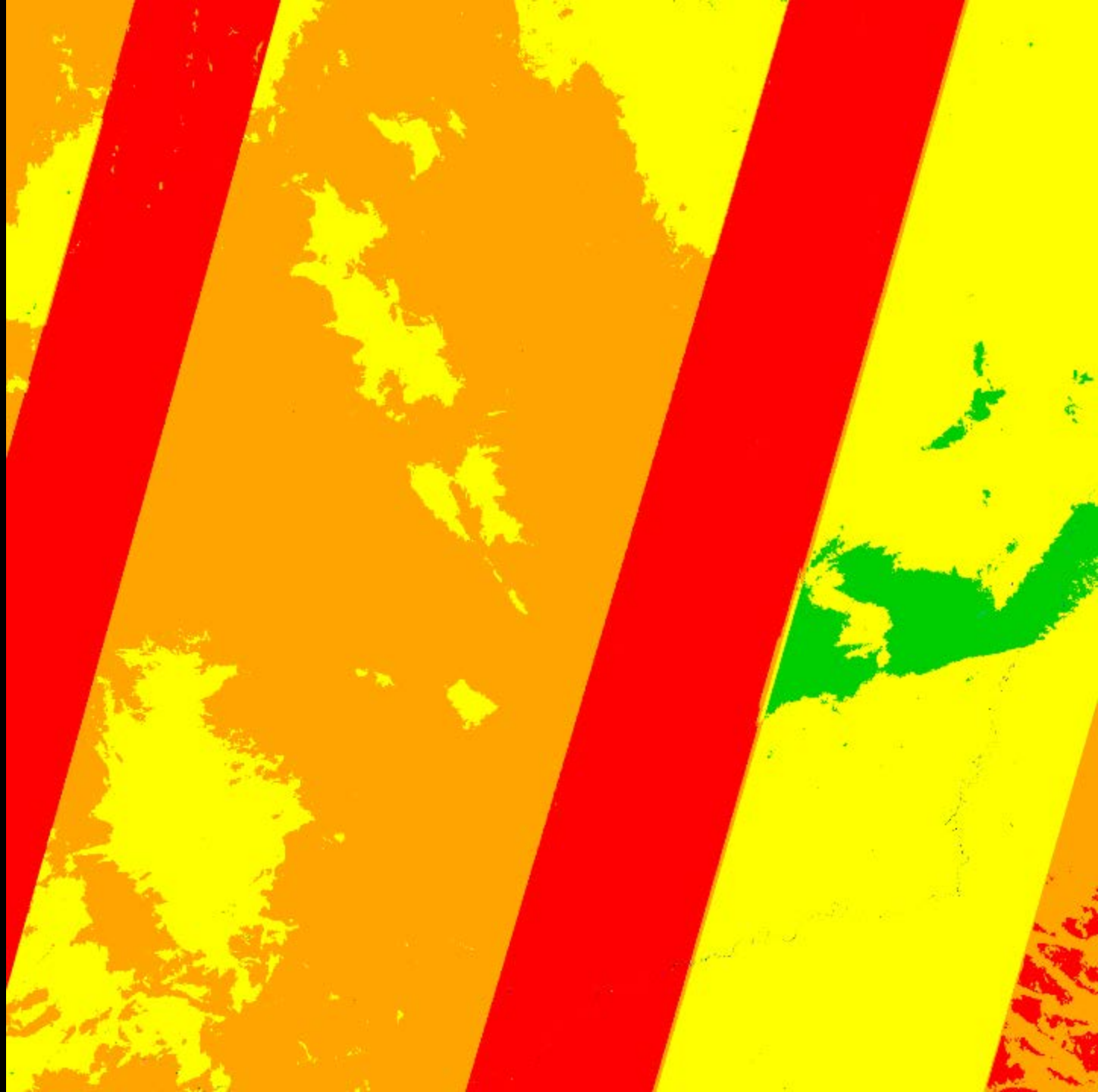


Angola,
Lunda Sul
Province

159 x 159 km
5295 x 5295 30m pixels

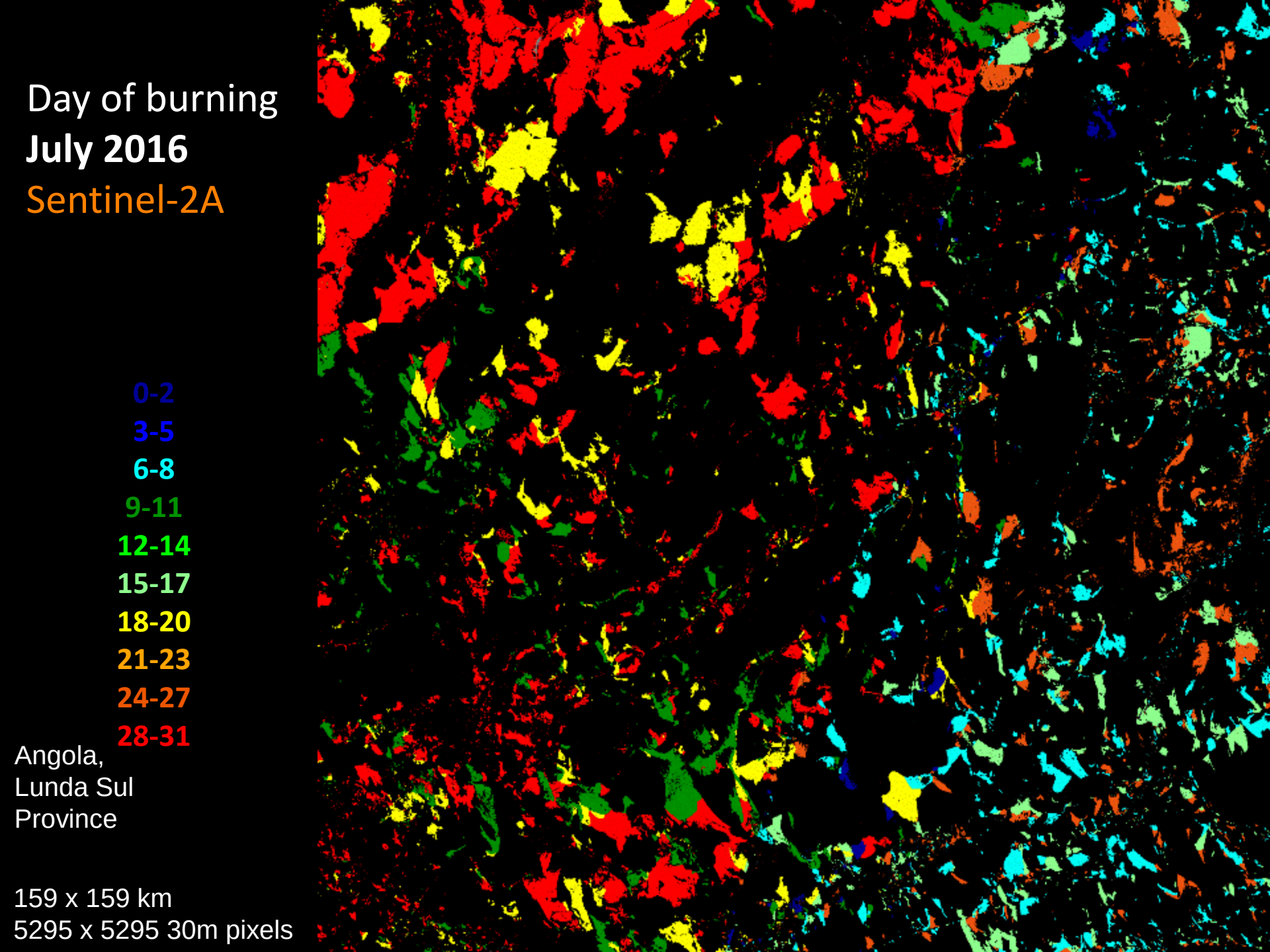
Number of cloud-free observations
July 2016
Landsat-8
Sentinel-2A

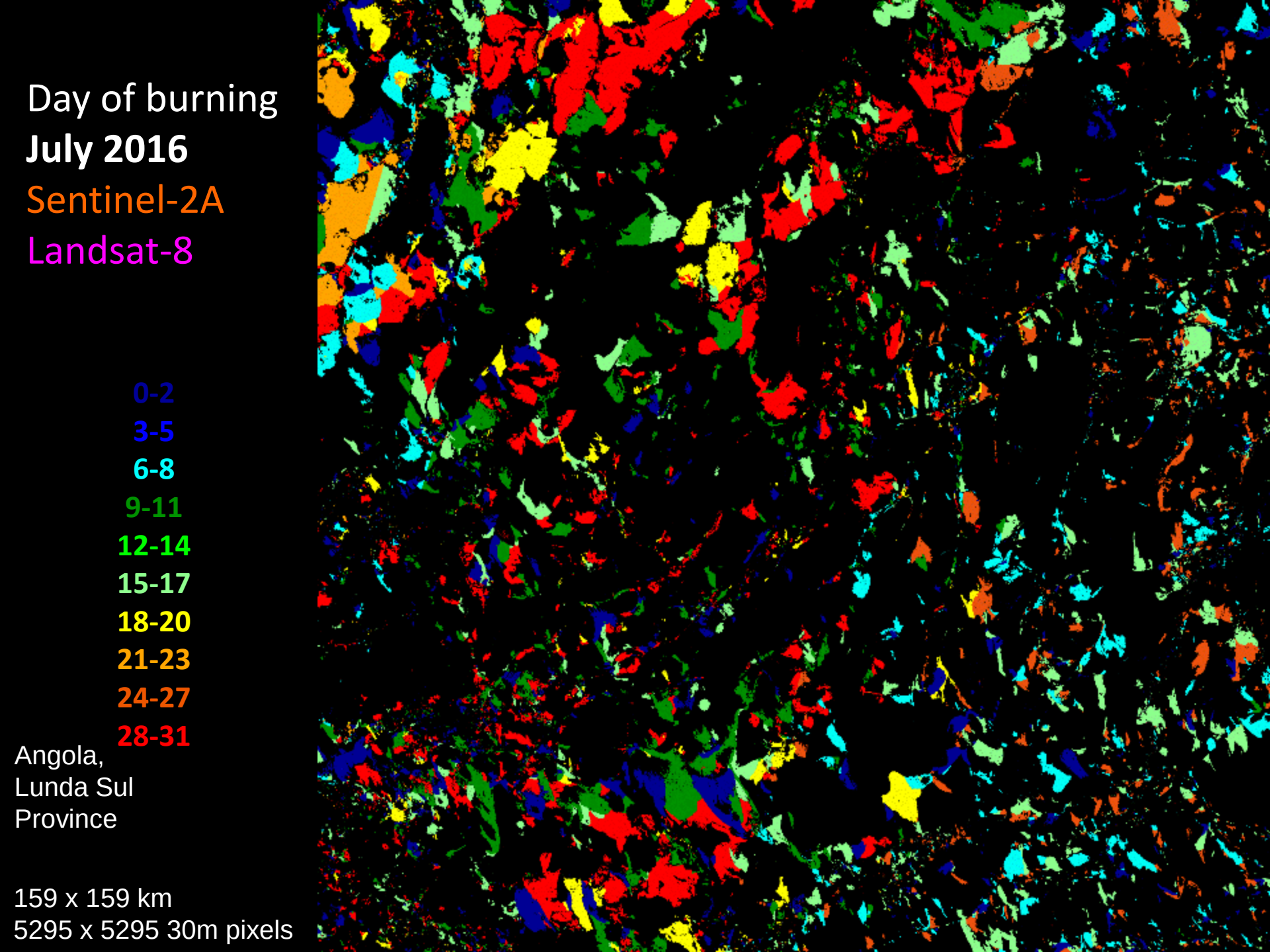
2
3
4
5
median 6
≥7



Angola,
Lunda Sul
Province

159 x 159 km
5295 x 5295 30m pixels

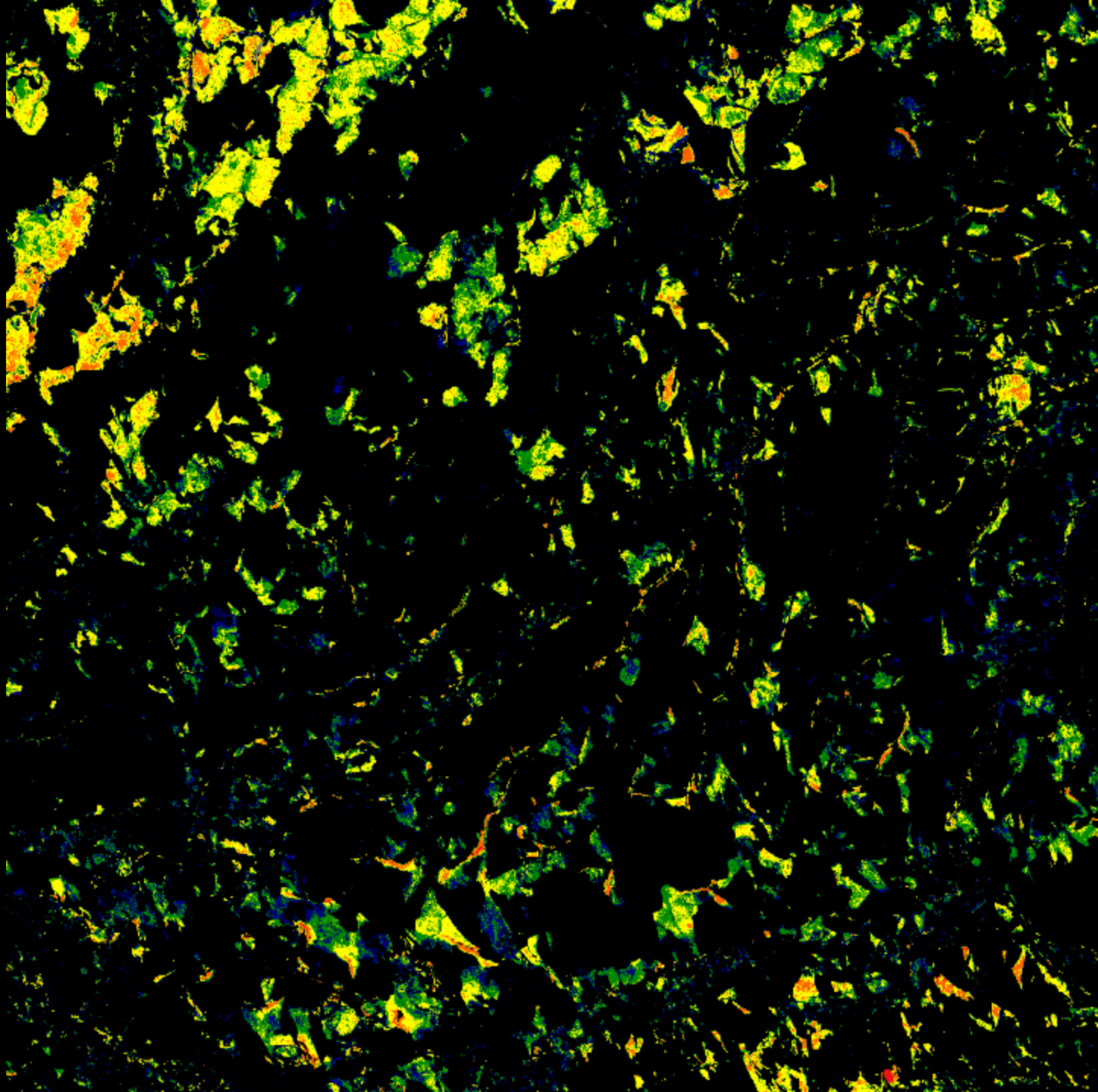

Day of burning
July 2016
Sentinel-2A
0-2
3-5
6-8
9-11
12-14
15-17
18-20
21-23
24-27
28-31
Angola,
Lunda Sul
Province
159 x 159 km
5295 x 5295 30m pixels


Day of burning
July 2016
Sentinel-2A
Landsat-8
0-2
3-5
6-8
9-11
12-14
15-17
18-20
21-23
24-27
28-31
Angola,
Lunda Sul
Province
159 x 159 km
5295 x 5295 30m pixels

f x cc

July 2016

Sentinel-2A



0.2 ≤ f.cc < 0.4

0.4 ≤ f.cc < 0.6

0.6 ≤ f.cc < 0.8

0.8 ≤ f.cc < 0.9

0.9 ≤ f.cc ≤ 1.0

Angola,
Lunda Sul
Province

159 x 159 km
5295 x 5295 30m pixels

f x cc

July 2016

Sentinel-2A

Landsat-8

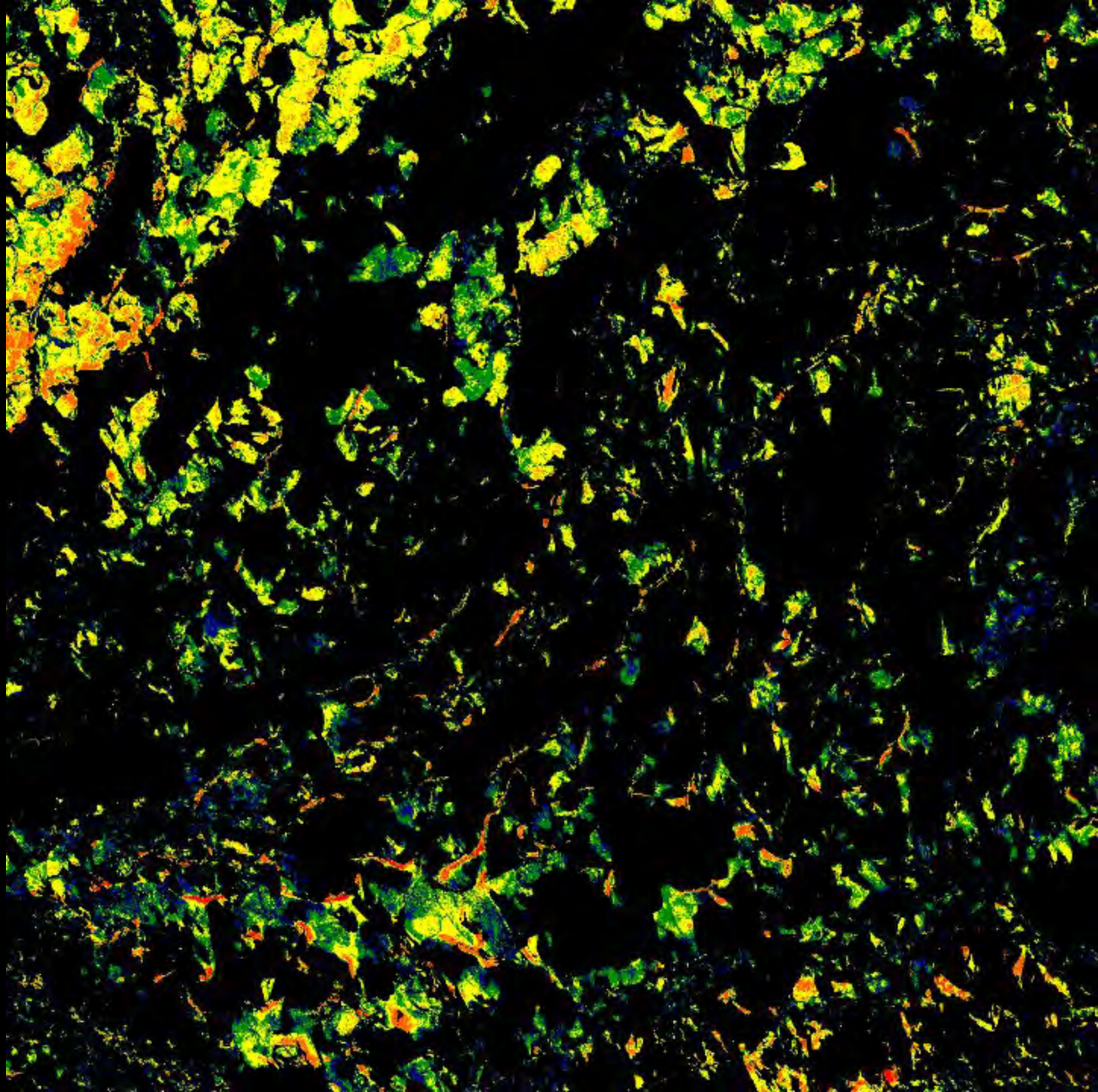
$0.2 \leq f.cc < 0.4$

$0.4 \leq f.cc < 0.6$

$0.6 \leq f.cc < 0.8$

$0.8 \leq f.cc < 0.9$

$0.9 \leq f.cc \leq 1.0$

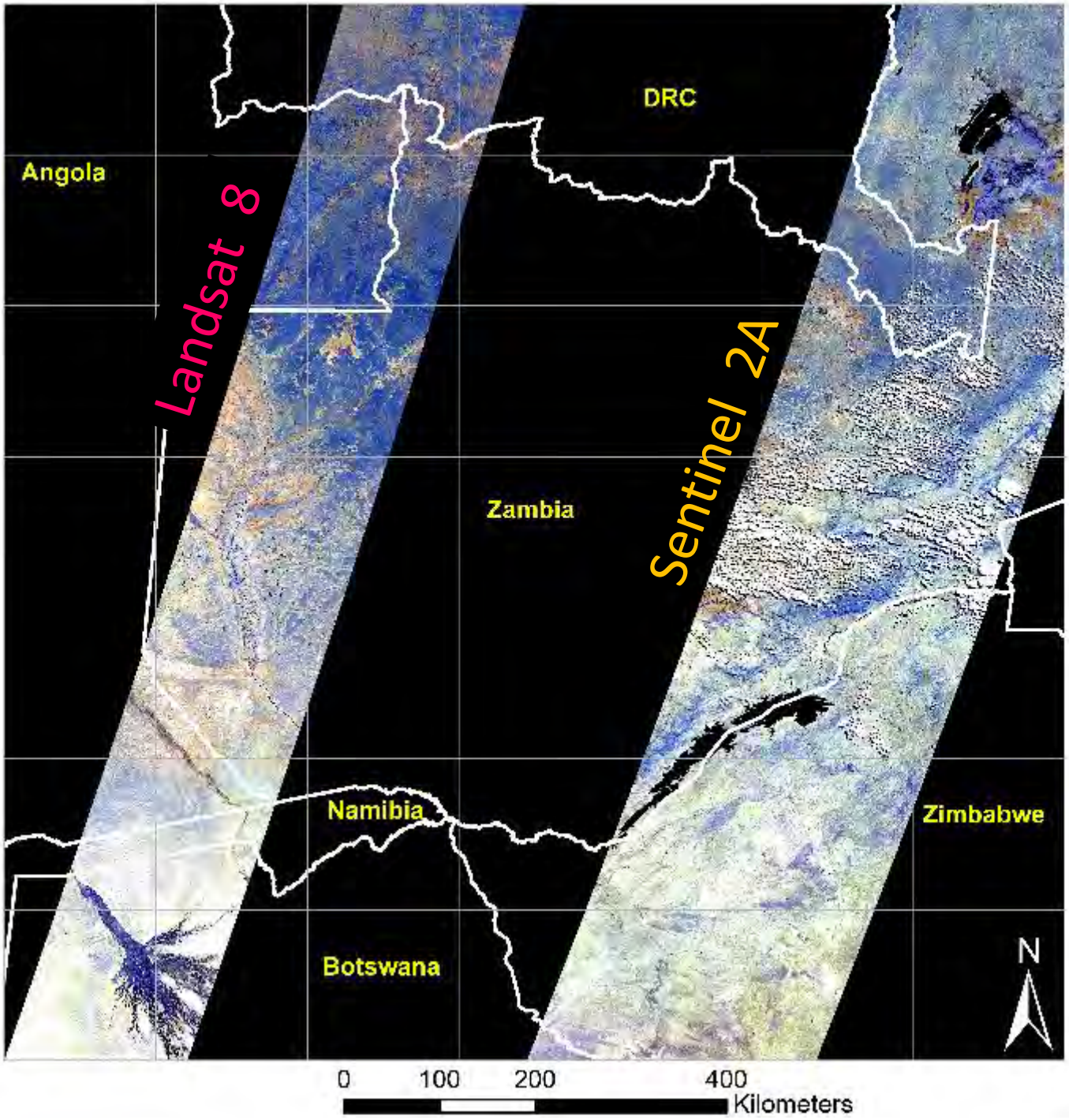


Angola,
Lunda Sul
Province

159 x 159 km
5295 x 5295 30m pixels

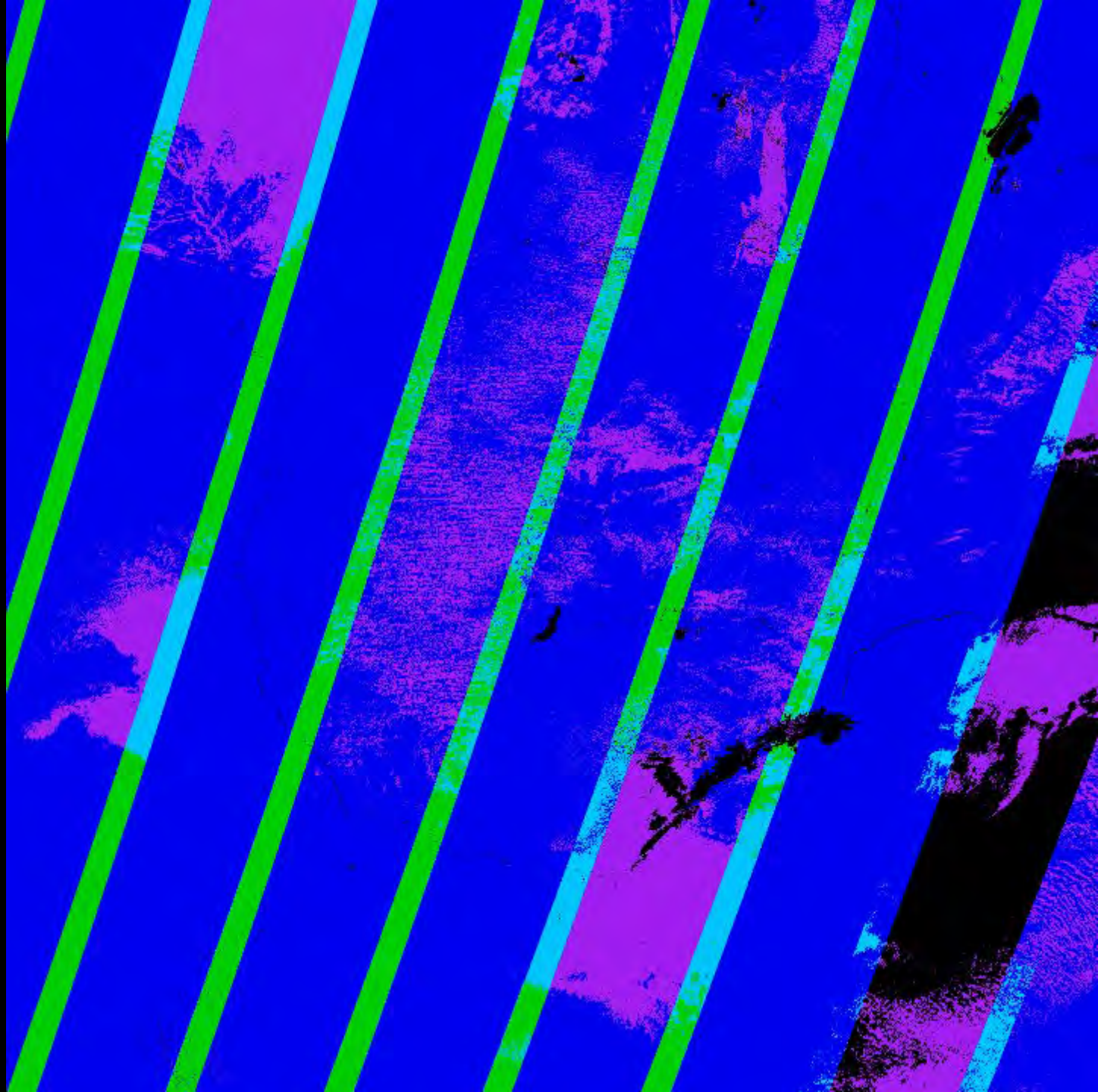
MODIS tile h20v10

7 x 7 WELD tiles



Number of cloud-free observations July 2016

Landsat 8

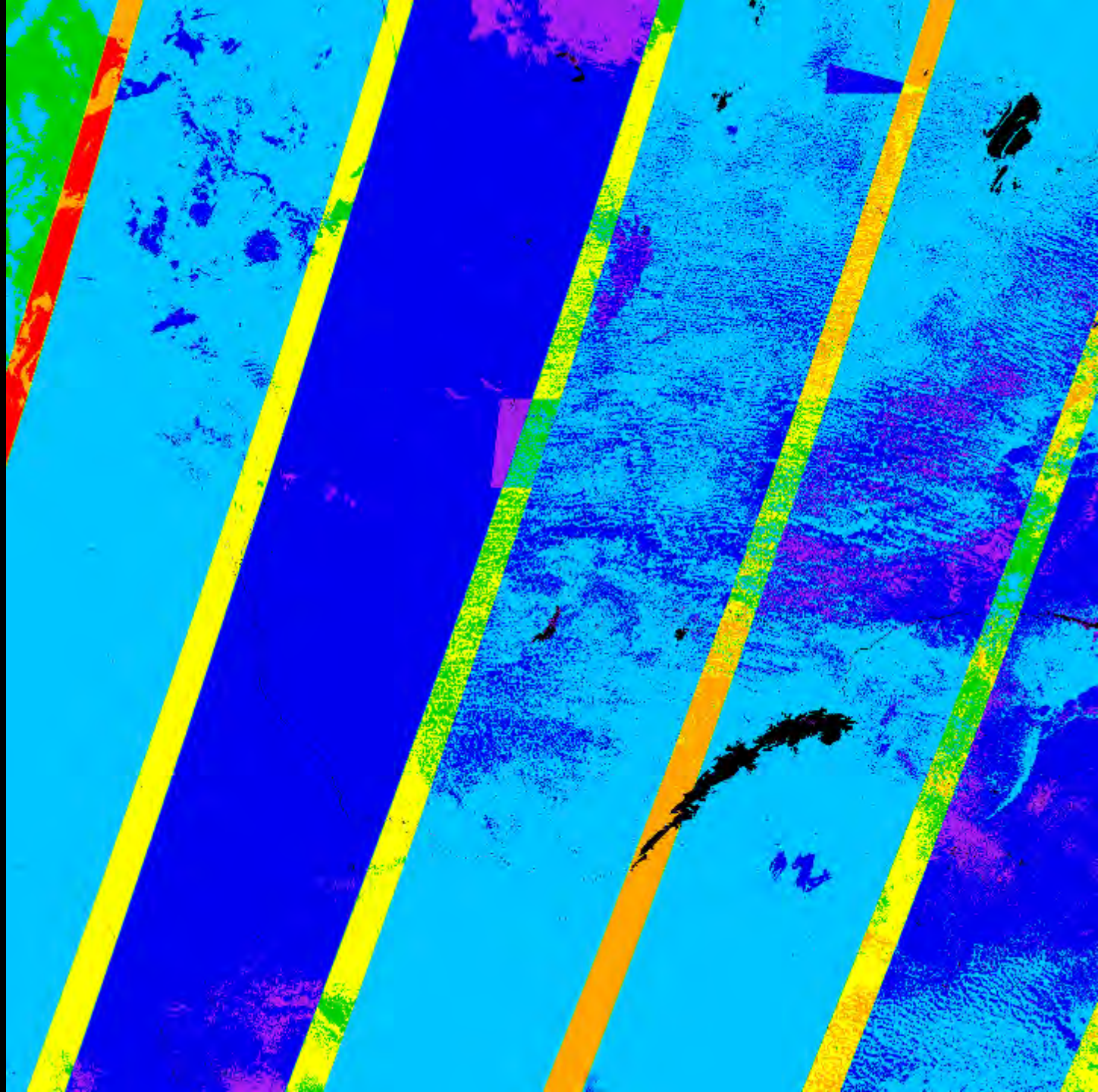


1112 x 1112 km

MODIS tile h20v10

Number of cloud-free observations July 2016

Sentinel-2A



1
2
median 3
4
5
6
≥7

1112 x 1112 km

MODIS tile h20v10

Number of cloud-free observations July 2016

Landsat 8

Sentinel-2A

1

2

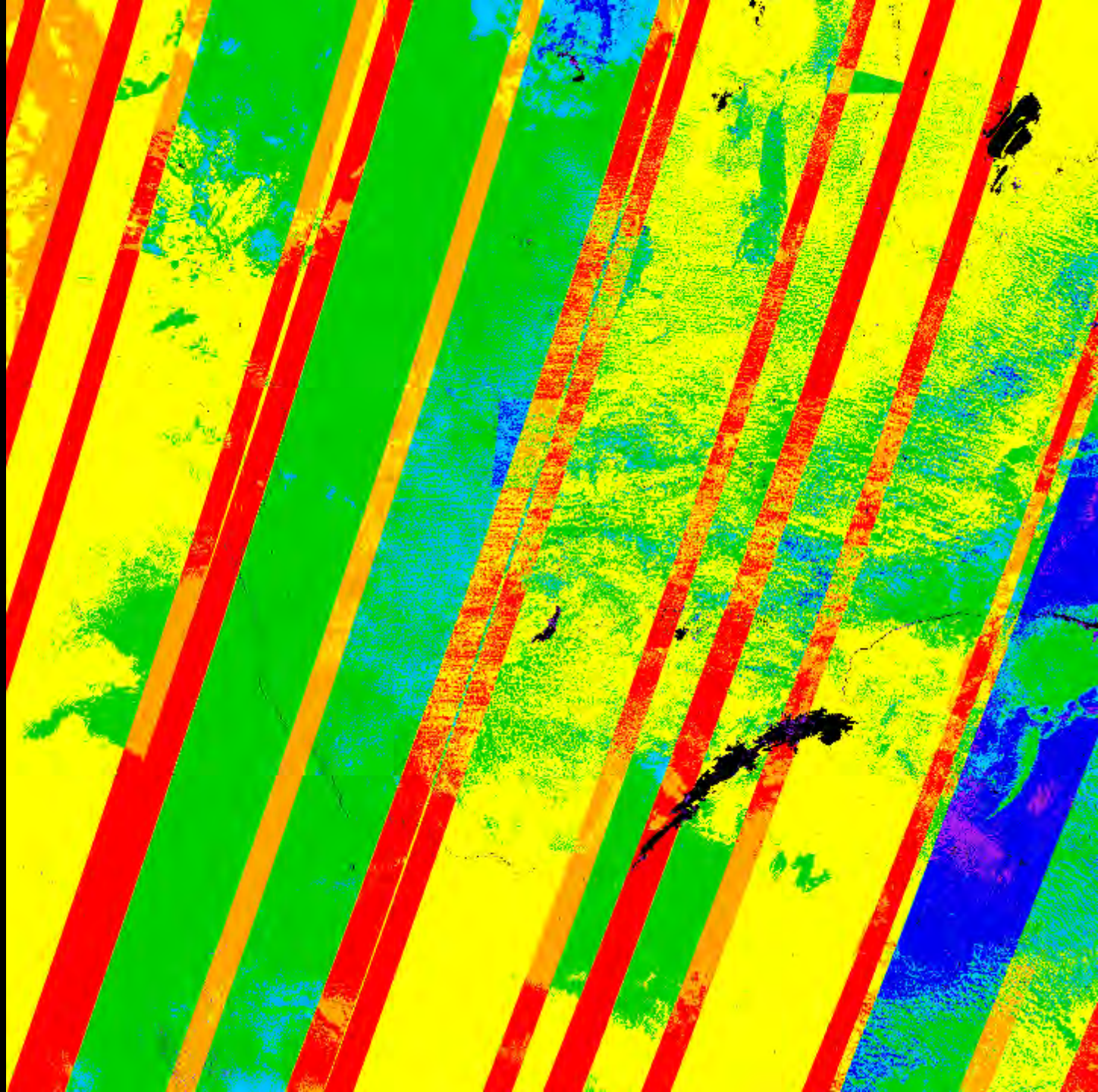
3

4

median 5

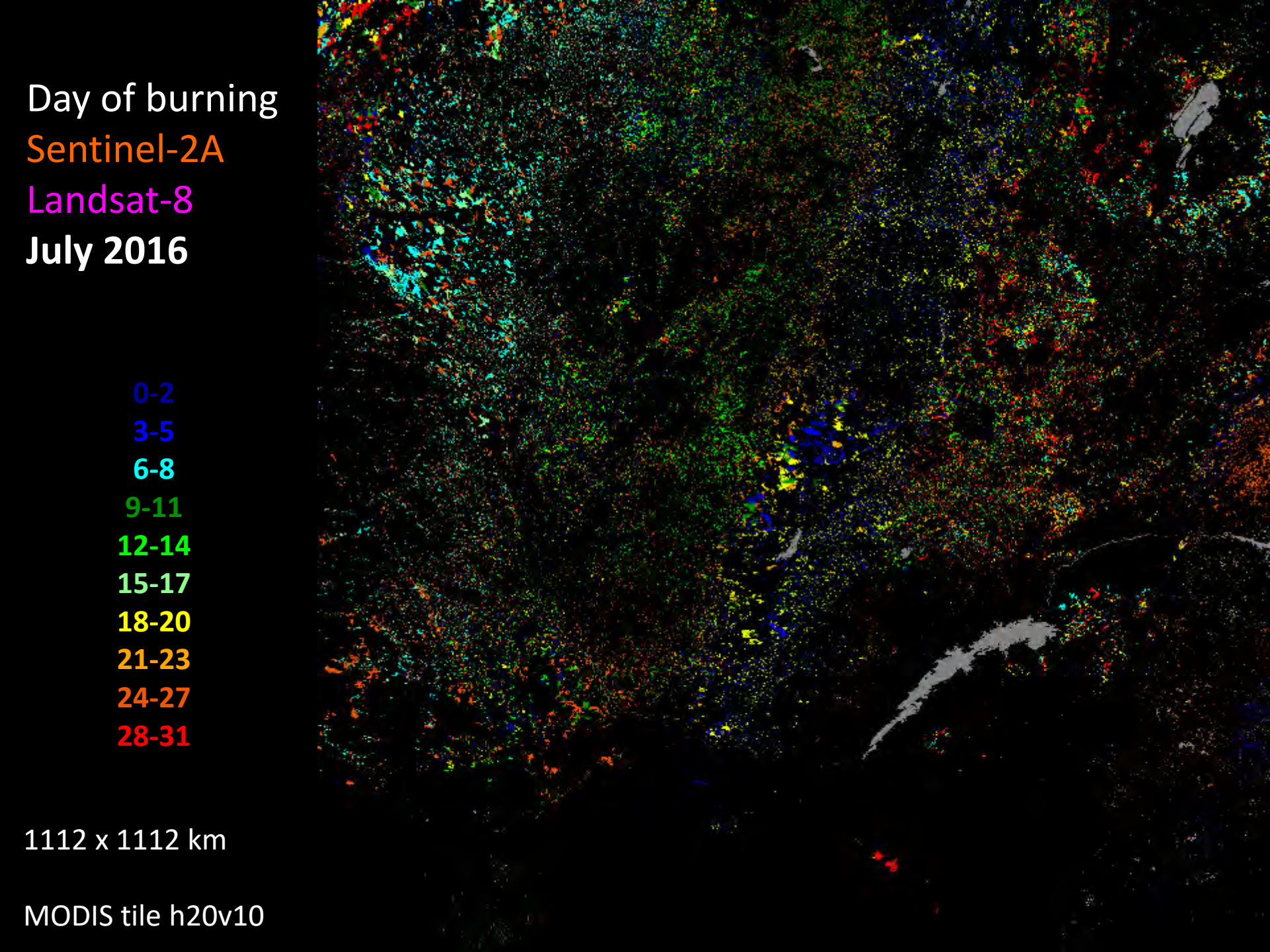
6

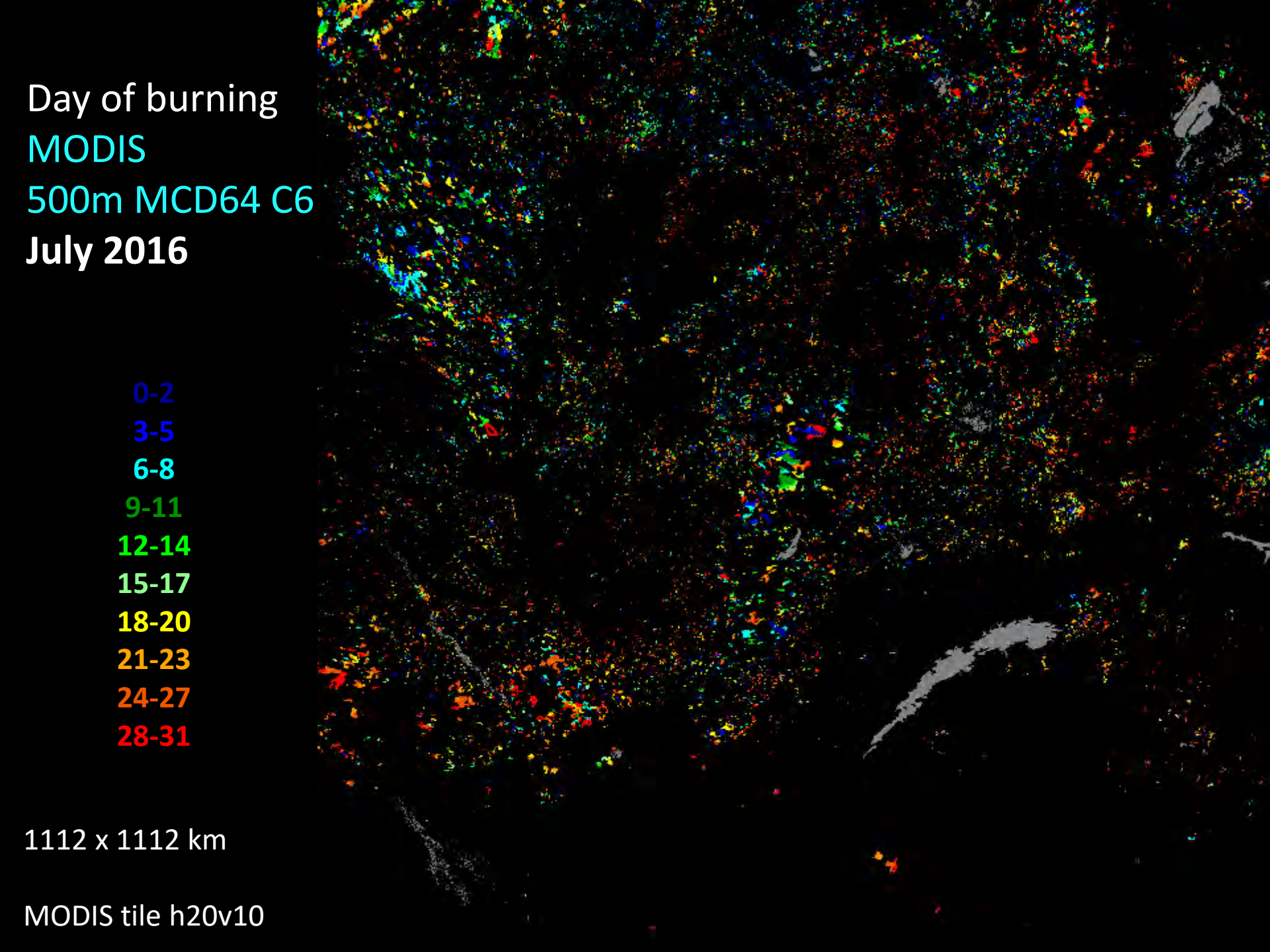
≥7



1112 x 1112 km

MODIS tile h20v10


Day of burning
Sentinel-2A
Landsat-8
July 2016
0-2
3-5
6-8
9-11
12-14
15-17
18-20
21-23
24-27
28-31
1112 x 1112 km
MODIS tile h20v10


Day of burning
MODIS
500m MCD64 C6
July 2016
0-2
3-5
6-8
9-11
12-14
15-17
18-20
21-23
24-27
28-31
1112 x 1112 km
MODIS tile h20v10

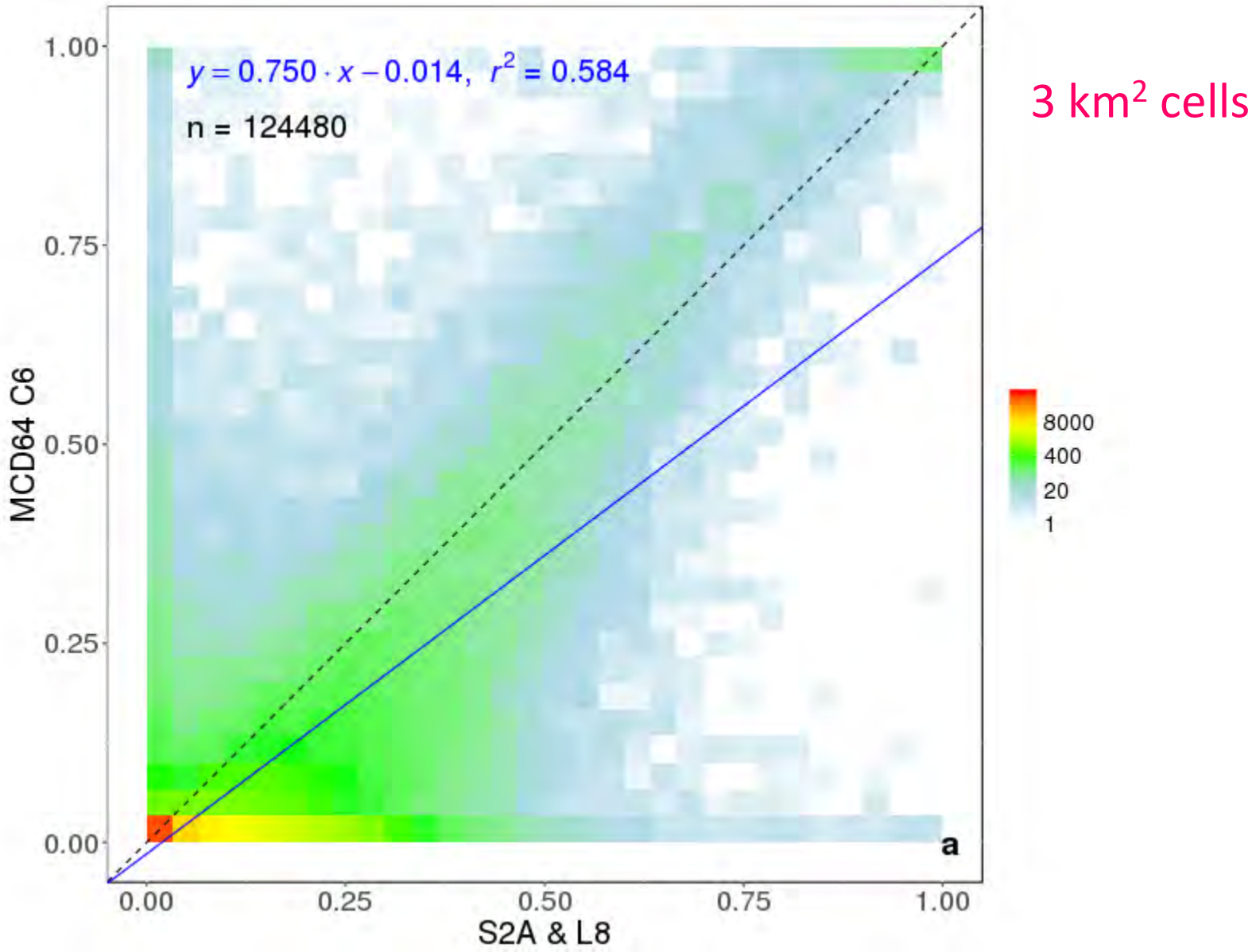
Confusion matrix for July 2016 results

		MODIS MCD64 C6 (assumed to be truth)			Row total km^2
		Burned km^2	**Unburned** km^2	**Unmapped** km^2	
Landsat-8/ Sentinel-2A	**Burned** km^2	3,9871 (**3.2%**)	72,428 (5.9%)	154 (<0.1%)	112,454 (**9.1%**)
	Unburned km^2	25,283 (2.0%)	1,086,069 (**87.8%**)	2,620 (0.2%)	1,113,972 (90.1%)
	Unmapped km^2	15 (<0.01%)	2,430 (0.2%)	7,561 (**0.6%**)	10,006 (0.8%)
Column total [km^2		65,170 (**5.3%**)	1,160,926 (93.9%)	10,336 (0.8%)	1,236,433 (100.0%)

Omission Error (0-1) = 0.64; Commission Error (0-1) = 0.39; Relative Bias [%] = - 41.9%

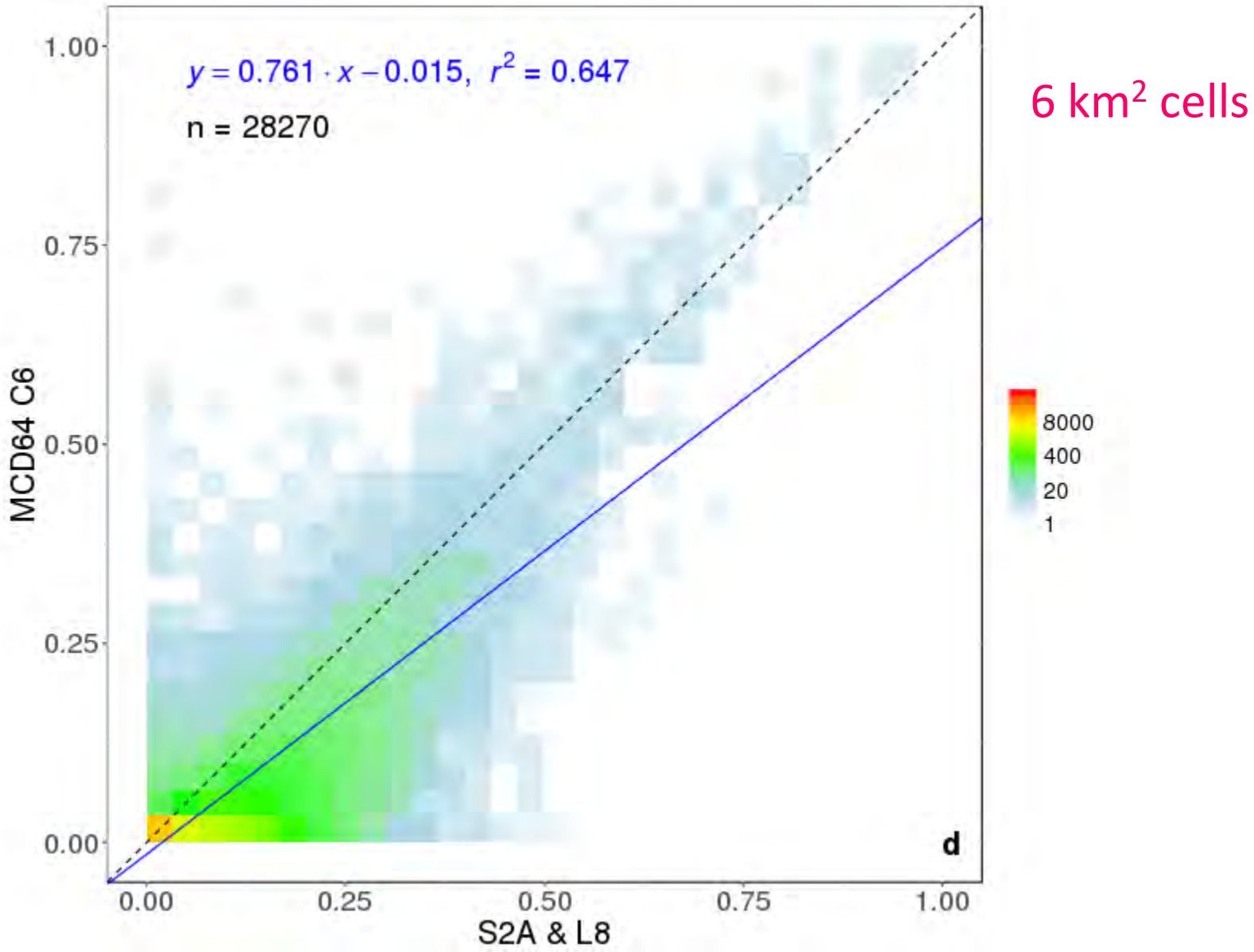
User's Accuracy (0-1) = 0.61; Producer's Accuracy (0-1) = 0.36; Overall Accuracy (0-1) = 0.91

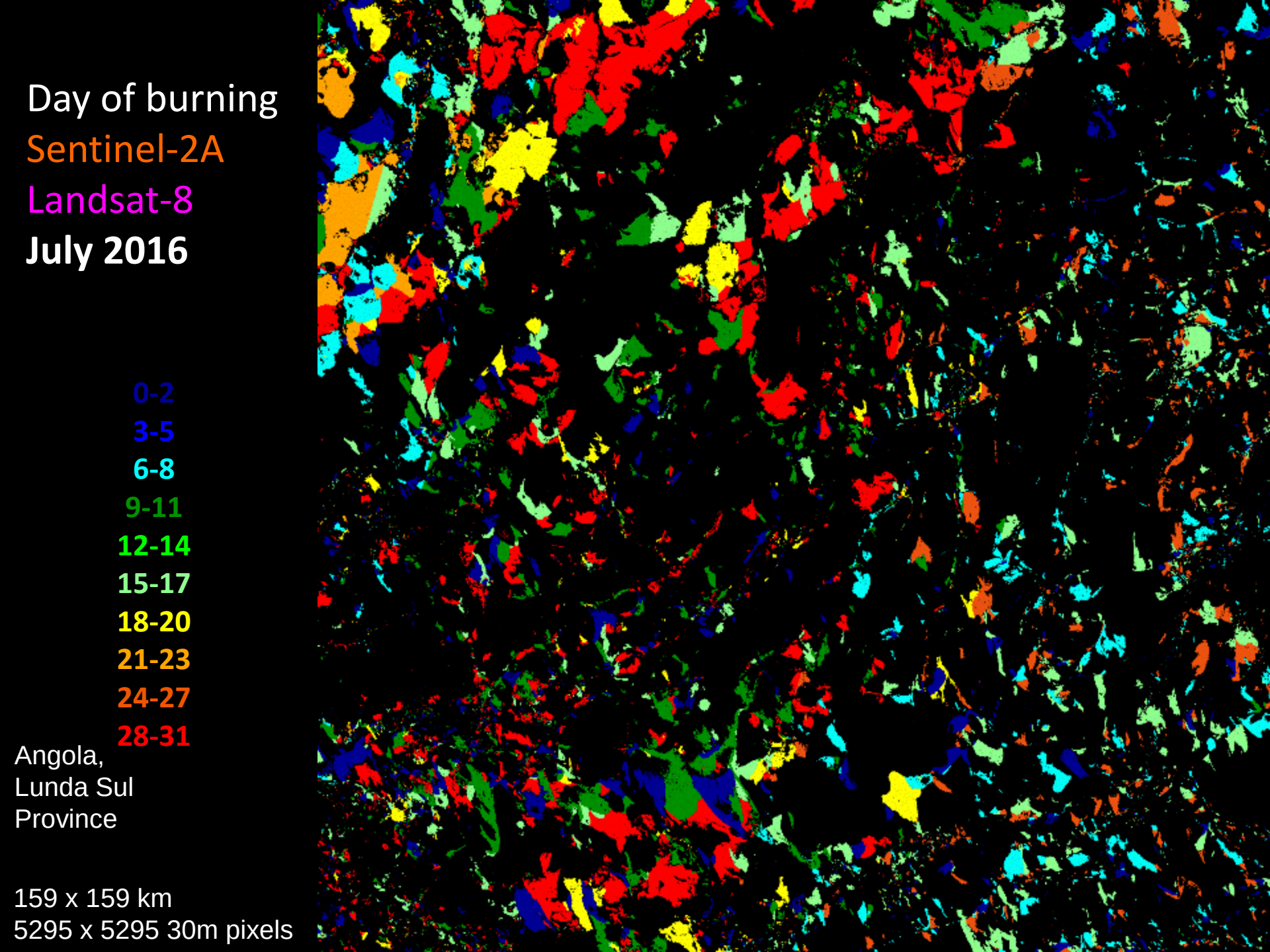
Comparison of July 2016 burned proportions mapped by MODIS and Landsat-8 & Sentinel-2



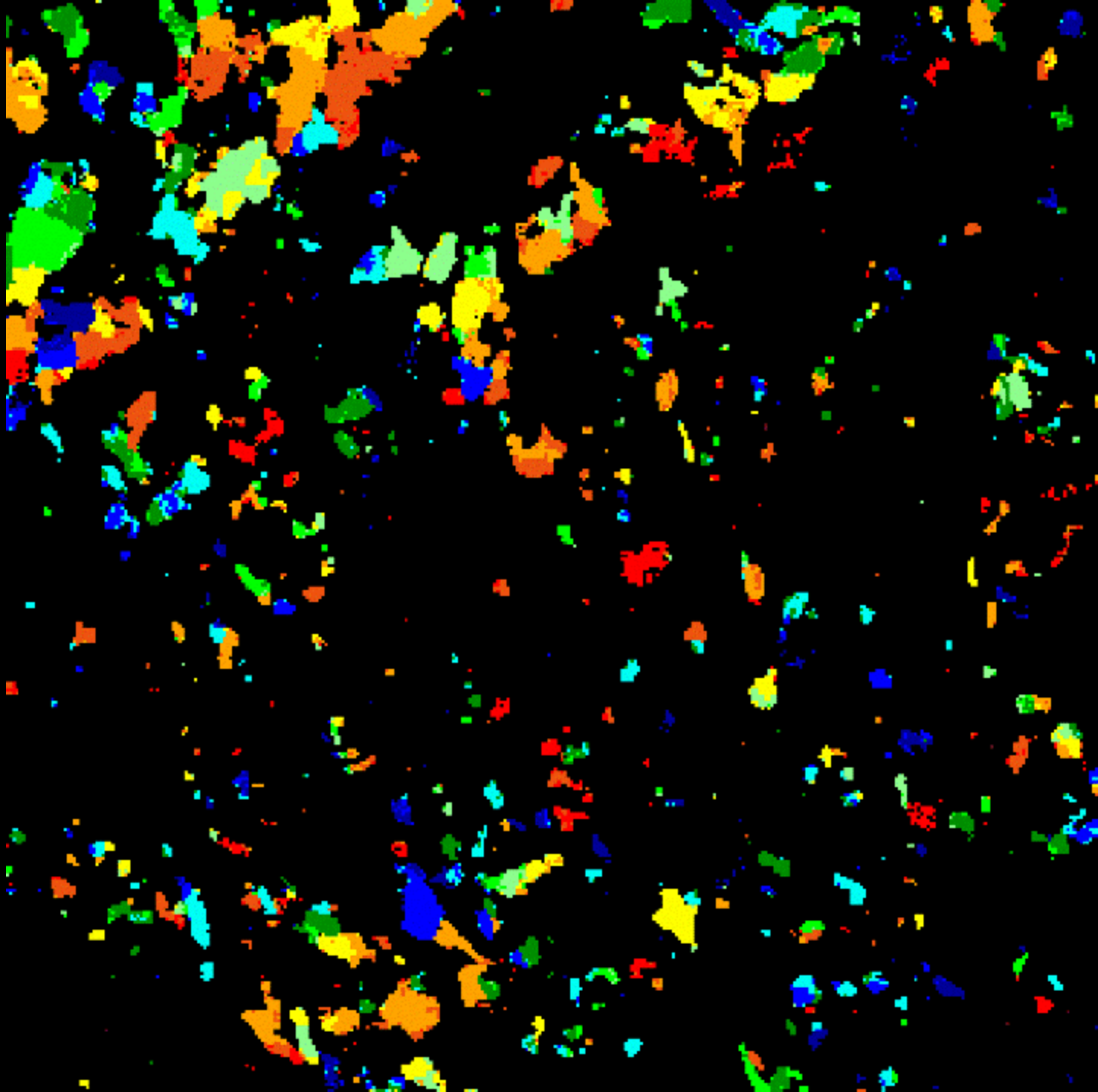
3 km^2 cells

Comparison of July 2016 burned proportions mapped by MODIS and Landsat-8 & Sentinel-2




Day of burning
Sentinel-2A
Landsat-8
July 2016
0-2
3-5
6-8
9-11
12-14
15-17
18-20
21-23
24-27
28-31
Angola,
Lunda Sul
Province
159 x 159 km
5295 x 5295 30m pixels

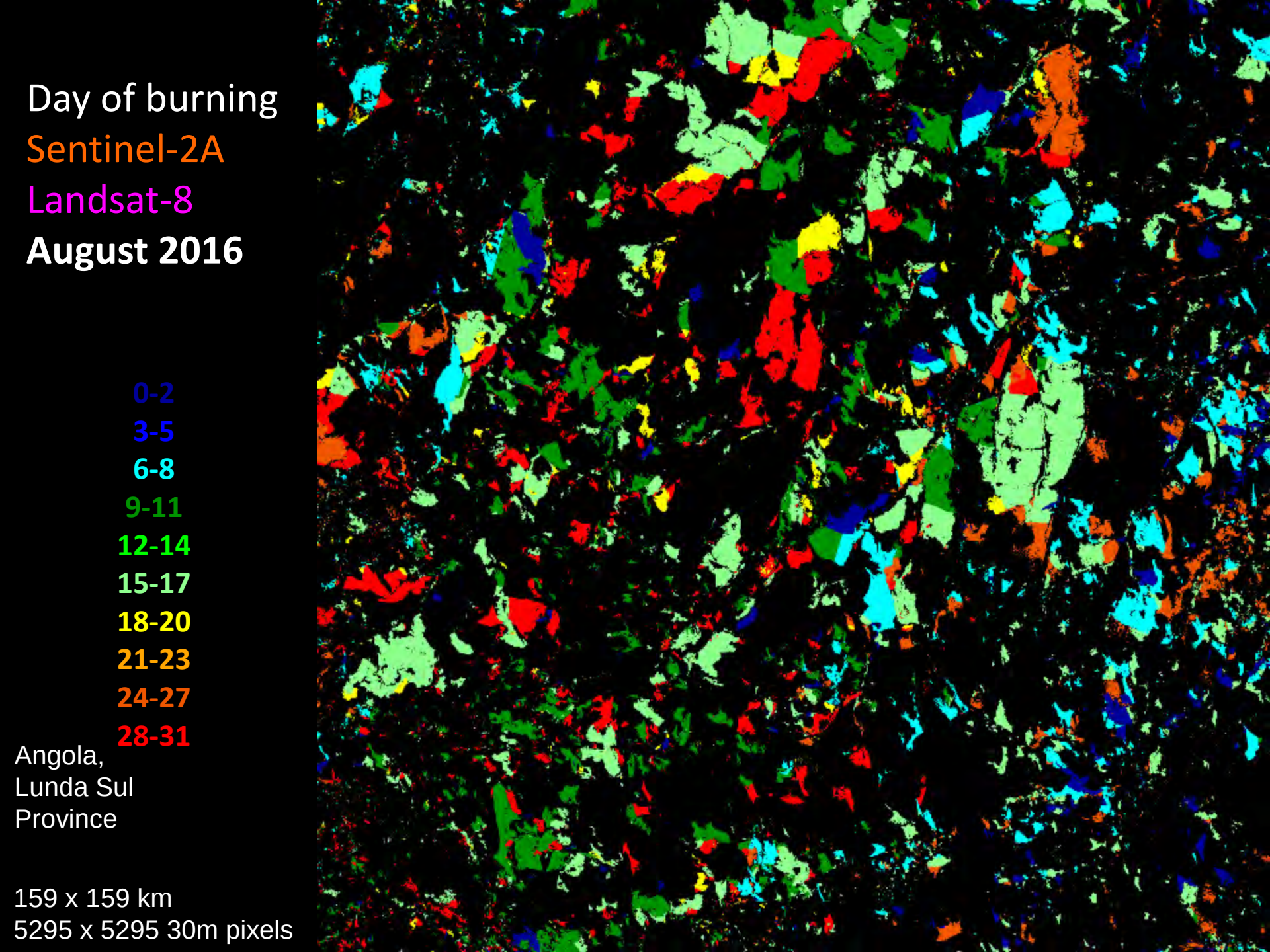
Day of burning
MODIS
500m MCD64
July 2016

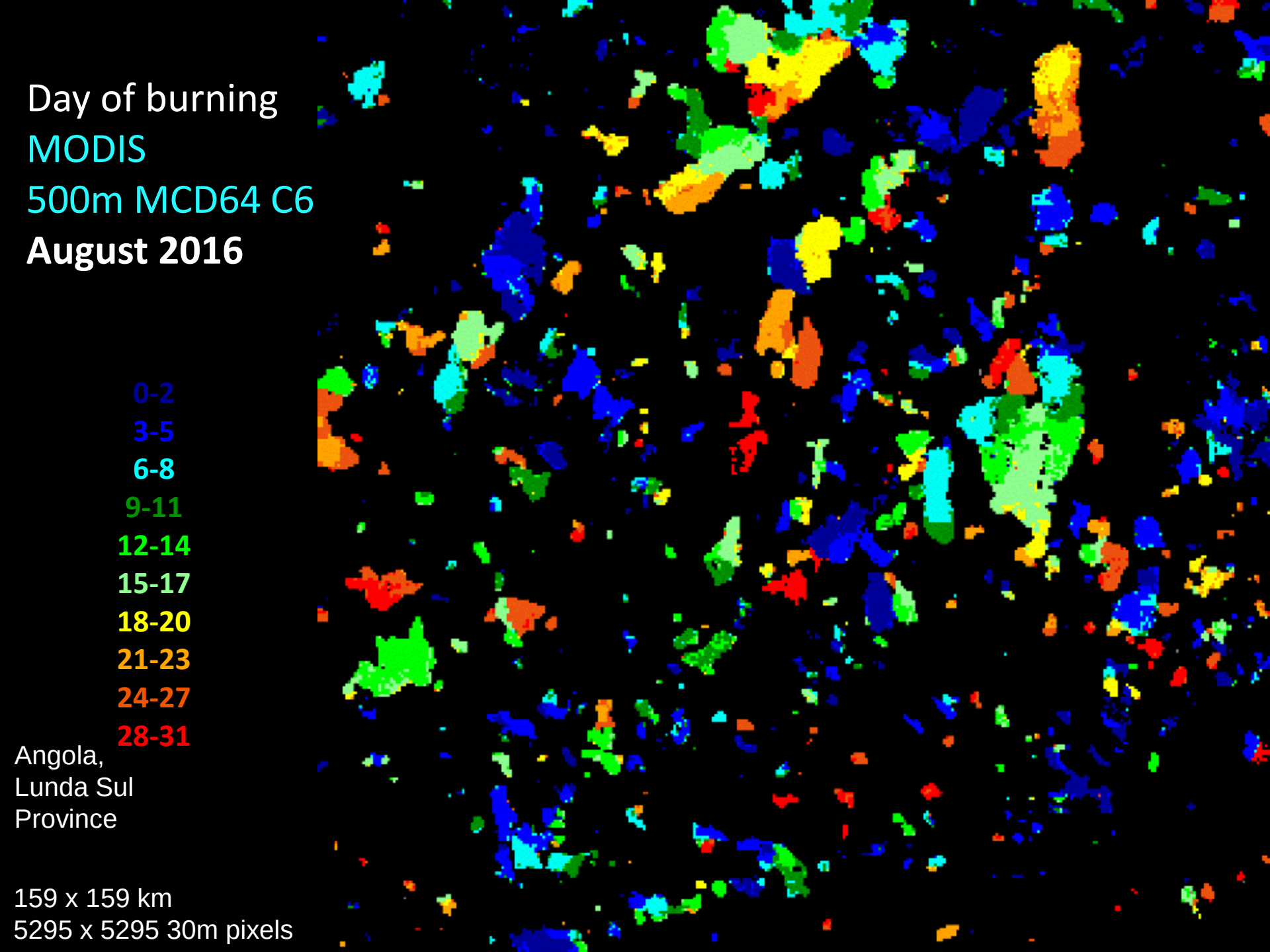


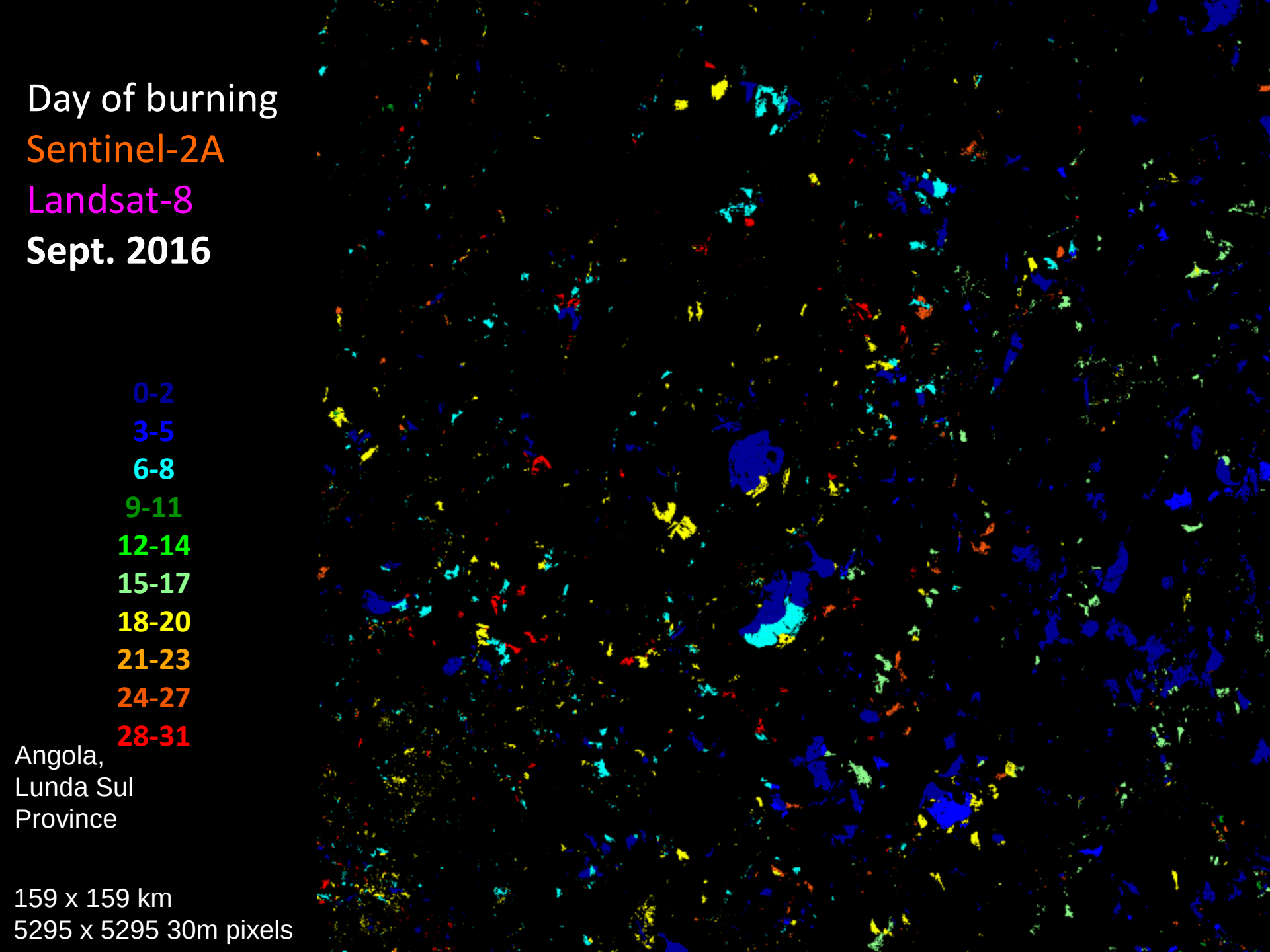
0-2
3-5
6-8
9-11
12-14
15-17
18-20
21-23
24-27
28-31

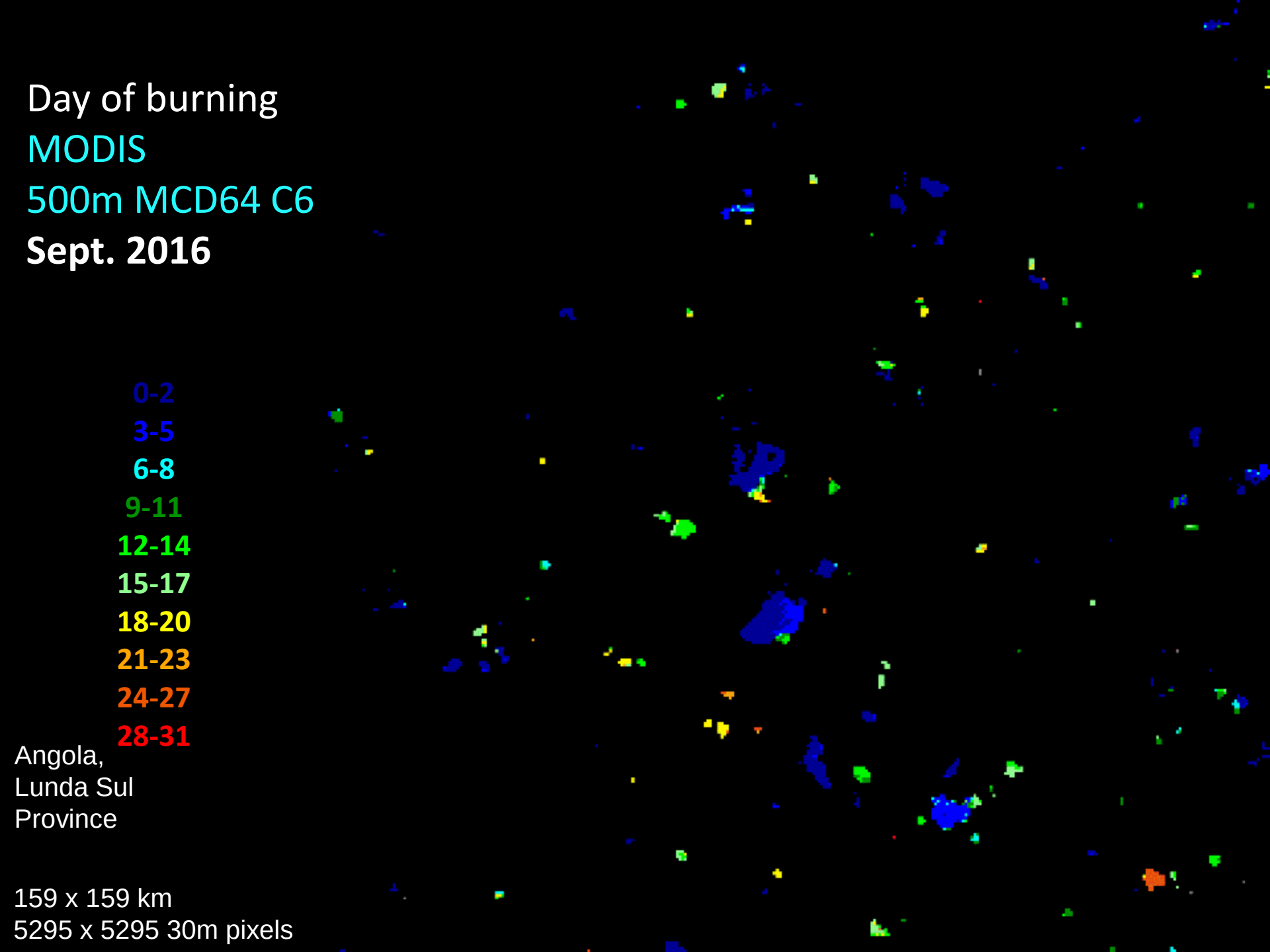
Angola,
Lunda Sul
Province

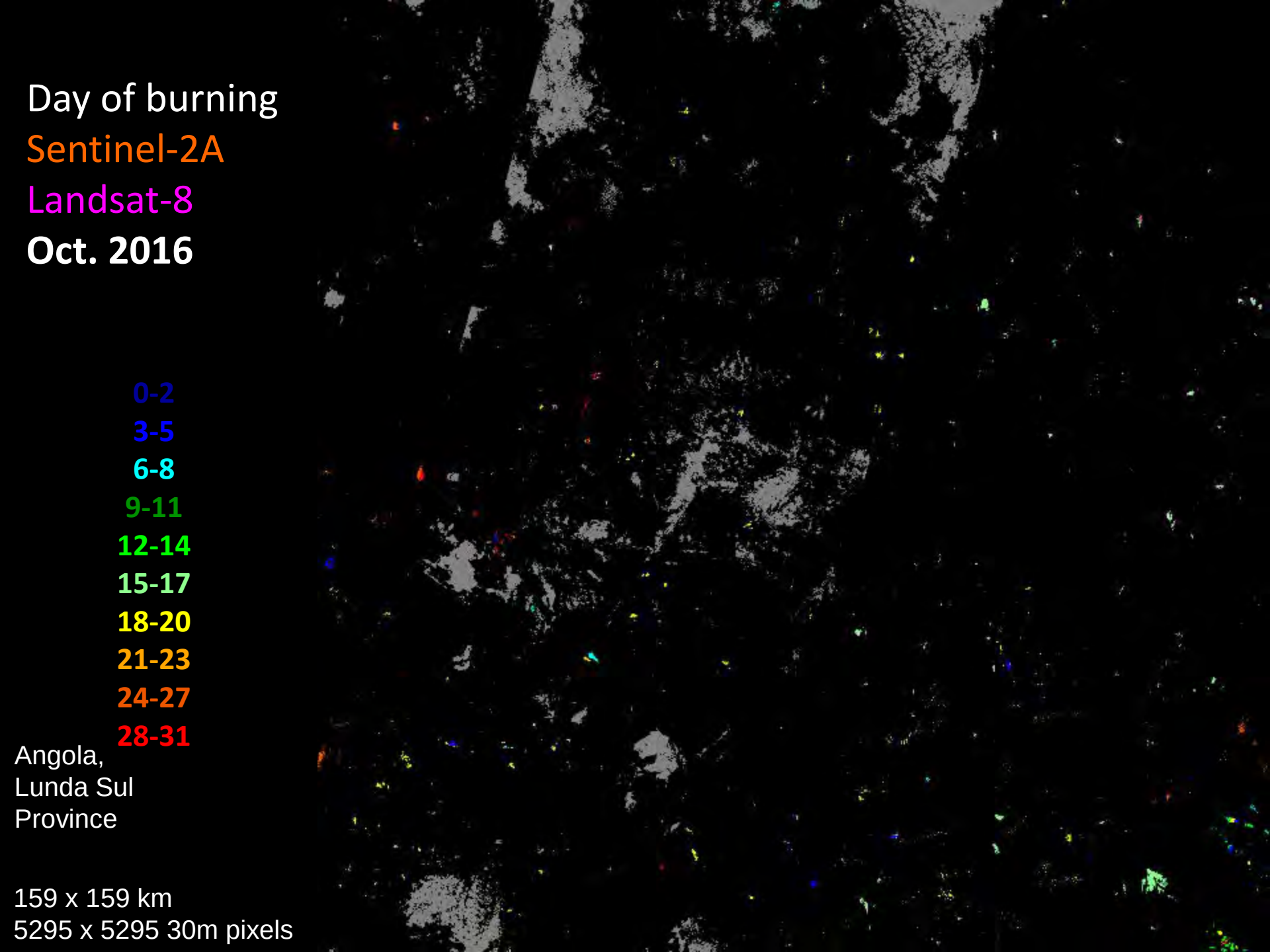
159 x 159 km
5295 x 5295 30m pixels

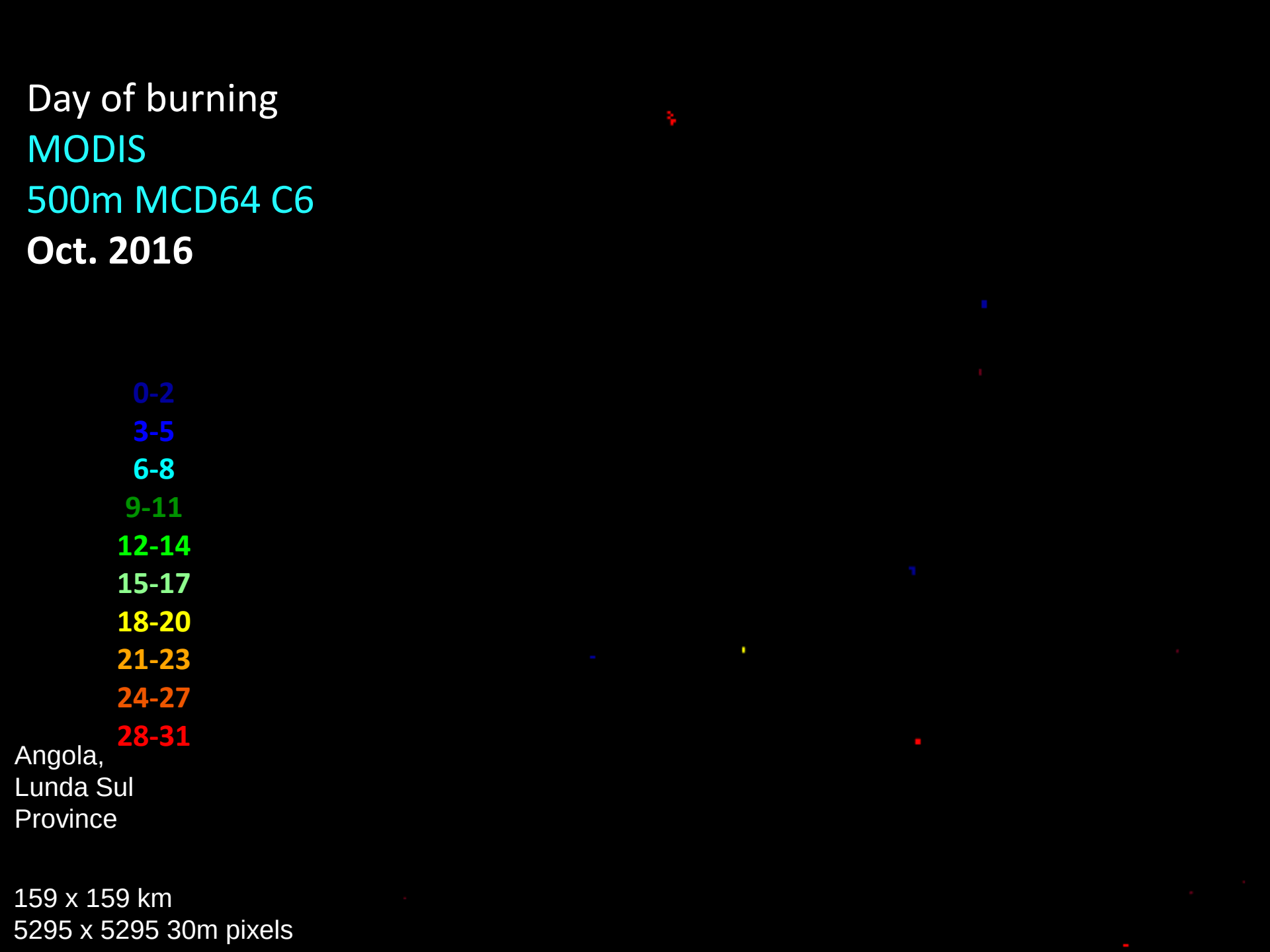

Day of burning
Sentinel-2A
Landsat-8
August 2016
0-2
3-5
6-8
9-11
12-14
15-17
18-20
21-23
24-27
28-31
Angola,
Lunda Sul
Province
159 x 159 km
5295 x 5295 30m pixels

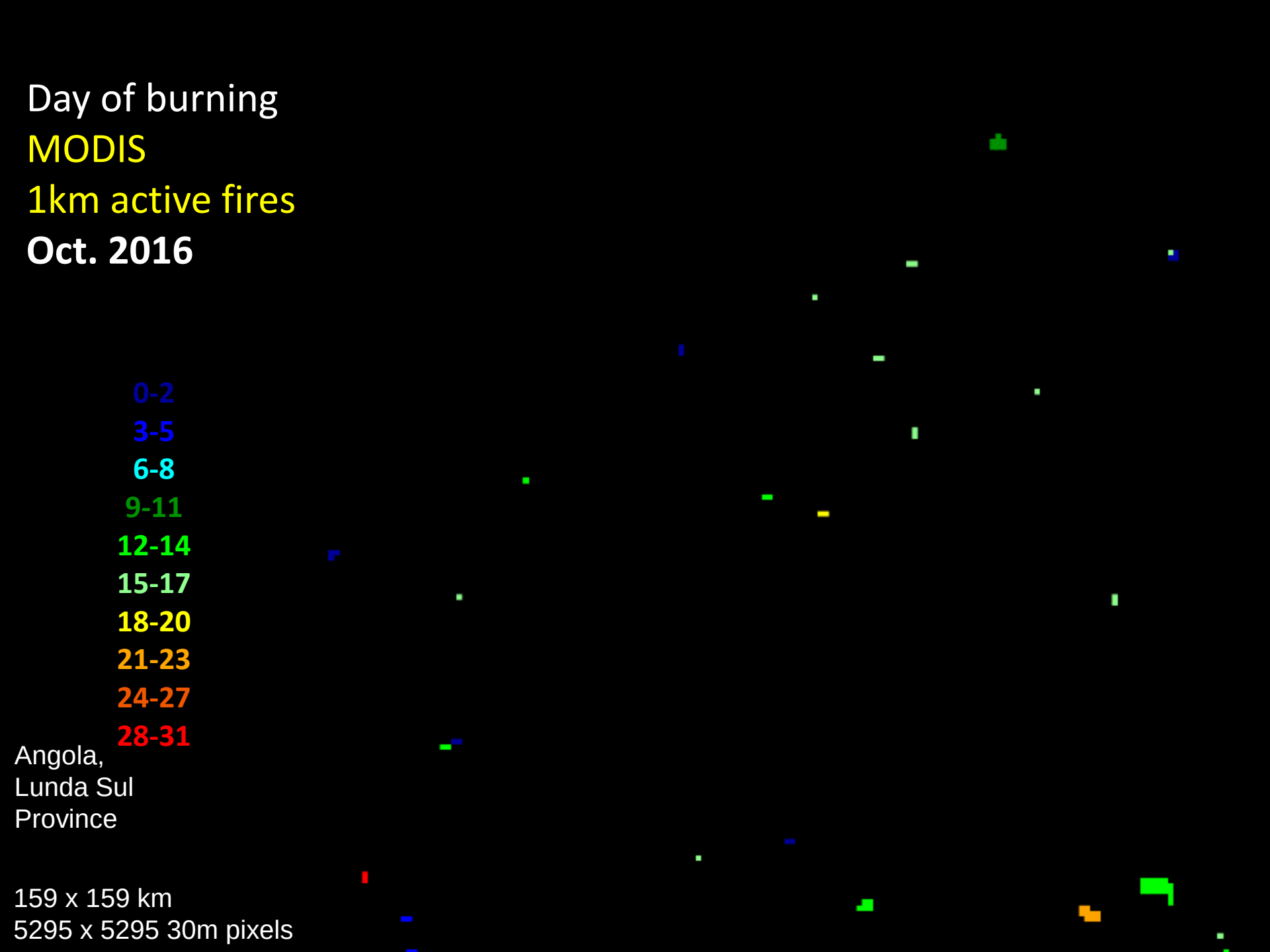

Day of burning
MODIS
500m MCD64 C6
August 2016
0-2
3-5
6-8
9-11
12-14
15-17
18-20
21-23
24-27
28-31
Angola,
Lunda Sul
Province
159 x 159 km
5295 x 5295 30m pixels

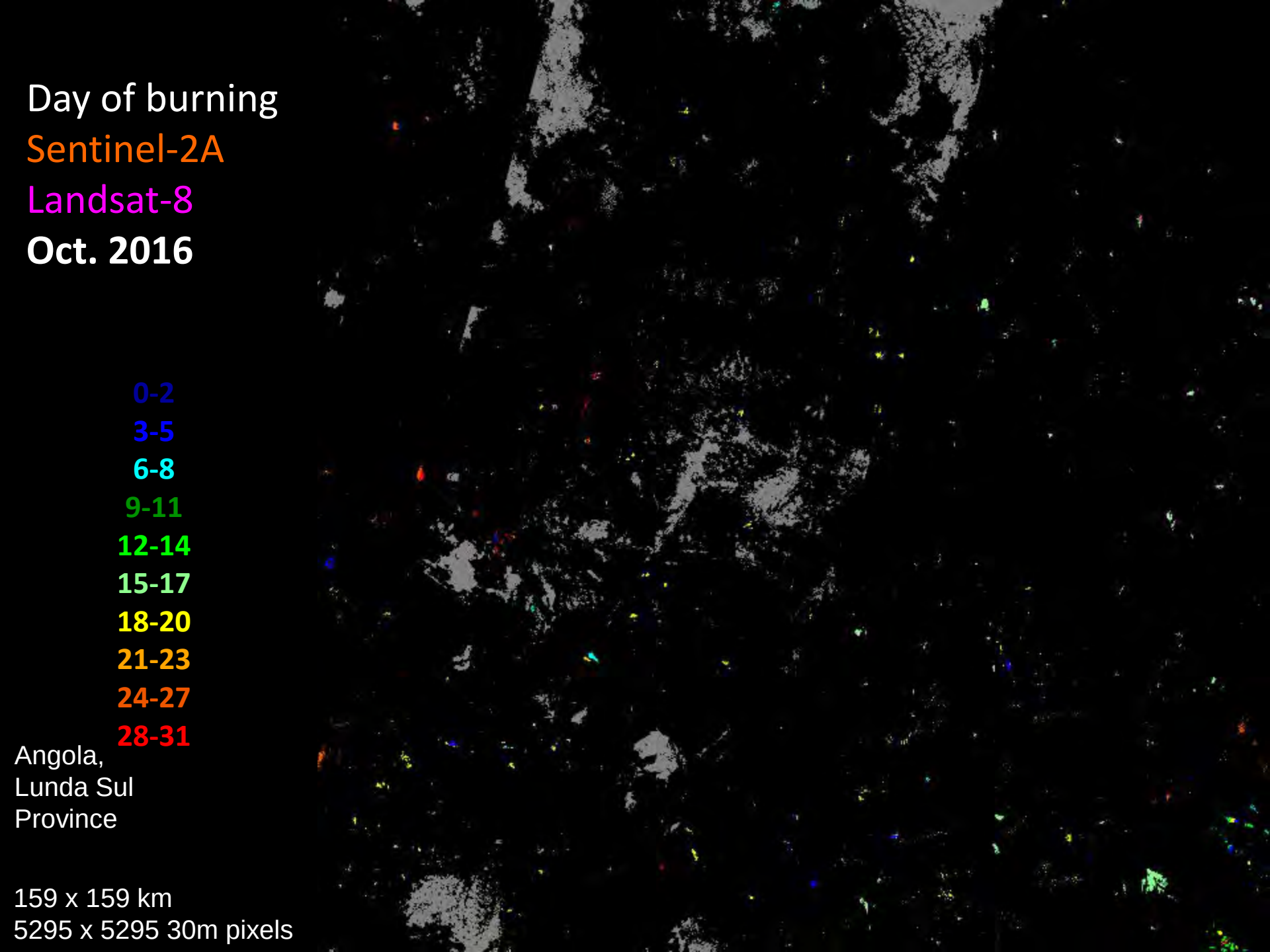

Day of burning
Sentinel-2A
Landsat-8
Sept. 2016
0-2
3-5
6-8
9-11
12-14
15-17
18-20
21-23
24-27
28-31
Angola,
Lunda Sul
Province
159 x 159 km
5295 x 5295 30m pixels


Day of burning
MODIS
500m MCD64 C6
Sept. 2016
0-2
3-5
6-8
9-11
12-14
15-17
18-20
21-23
24-27
28-31
Angola,
Lunda Sul
Province
159 x 159 km
5295 x 5295 30m pixels

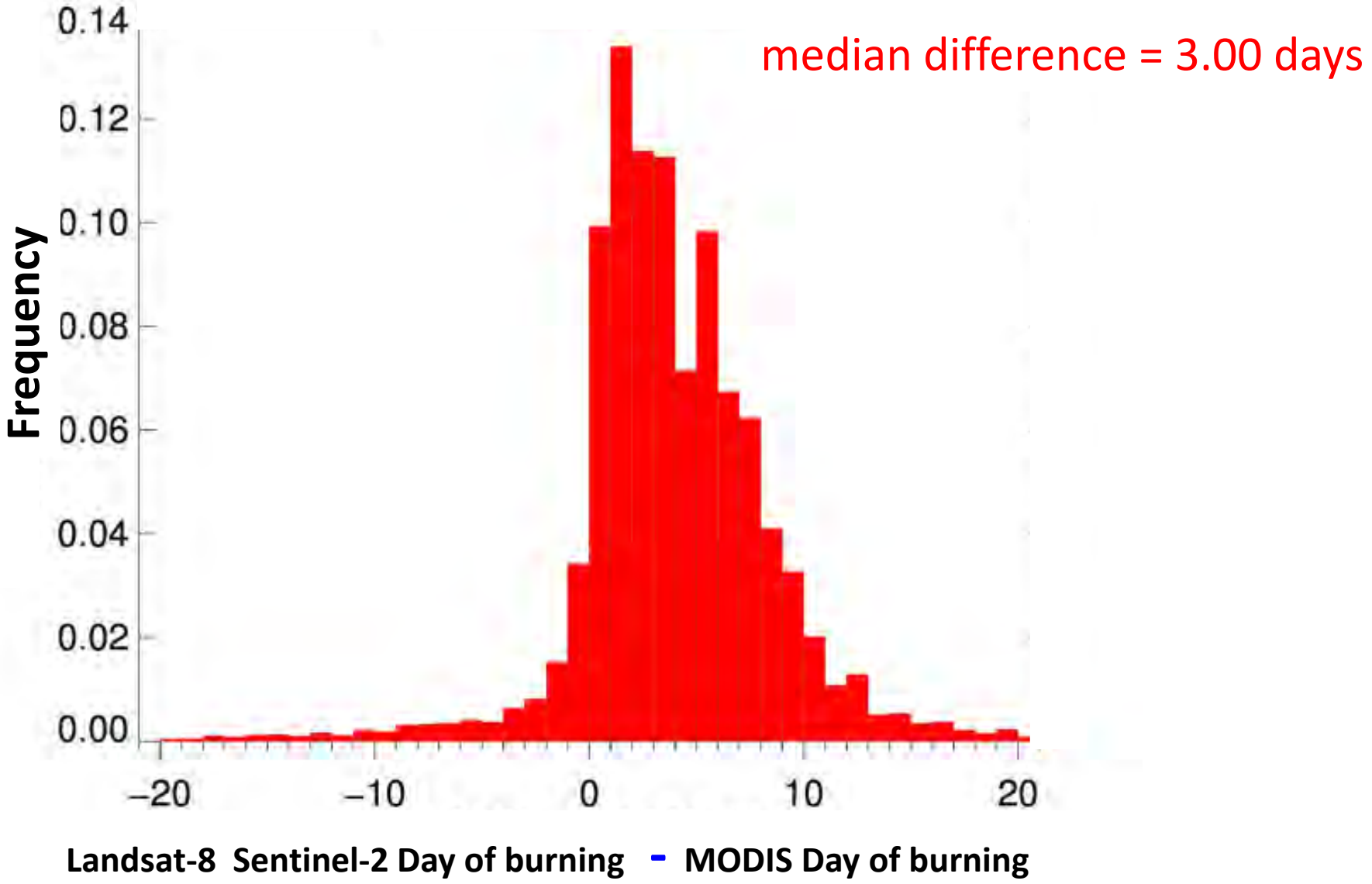

Day of burning
Sentinel-2A
Landsat-8
Oct. 2016
0-2
3-5
6-8
9-11
12-14
15-17
18-20
21-23
24-27
28-31
Angola,
Lunda Sul
Province
159 x 159 km
5295 x 5295 30m pixels


Day of burning
MODIS
500m MCD64 C6
Oct. 2016
0-2
3-5
6-8
9-11
12-14
15-17
18-20
21-23
24-27
28-31
Angola,
Lunda Sul
Province
159 x 159 km
5295 x 5295 30m pixels

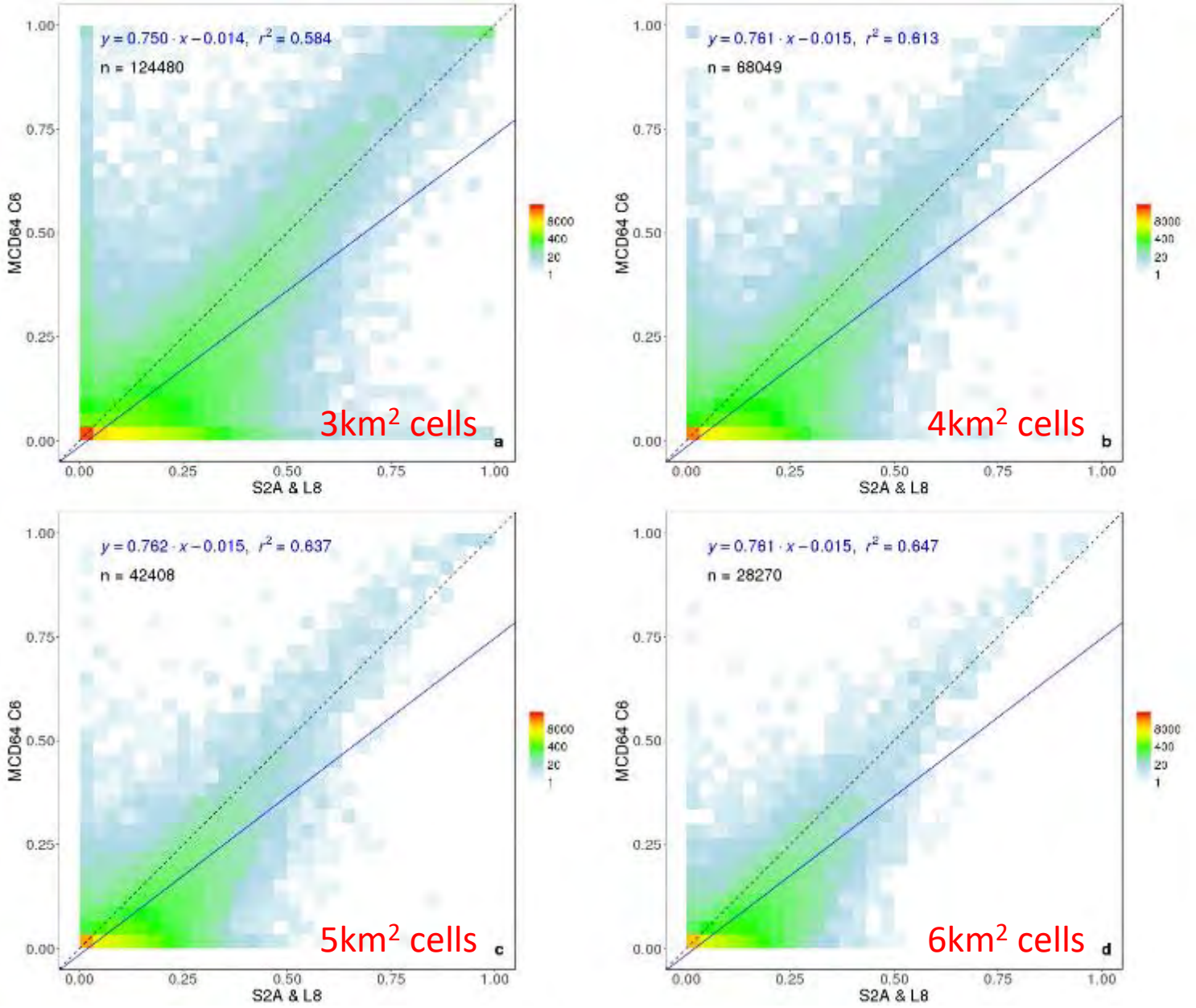

Day of burning
MODIS
1km active fires
Oct. 2016
0-2
3-5
6-8
9-11
12-14
15-17
18-20
21-23
24-27
28-31
Angola,
Lunda Sul
Province
159 x 159 km
5295 x 5295 30m pixels


Day of burning
Sentinel-2A
Landsat-8
Oct. 2016
0-2
3-5
6-8
9-11
12-14
15-17
18-20
21-23
24-27
28-31
Angola,
Lunda Sul
Province
159 x 159 km
5295 x 5295 30m pixels

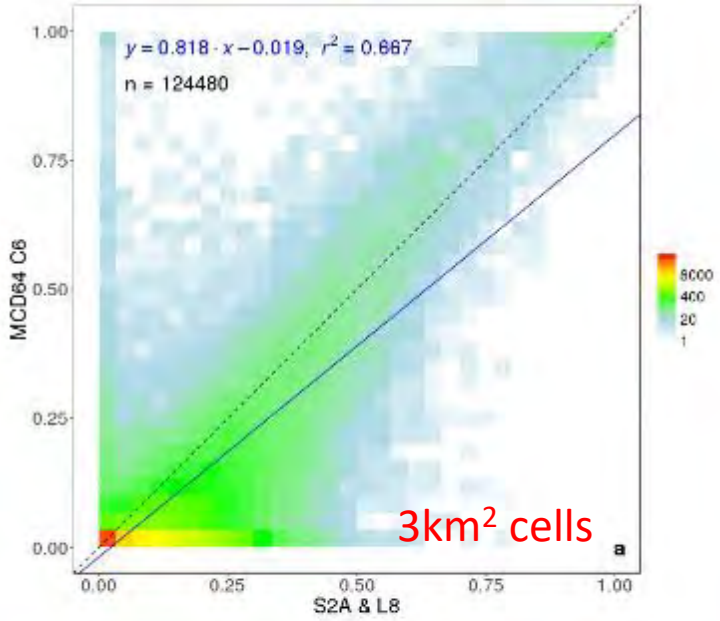
July temporal product reporting difference (days)

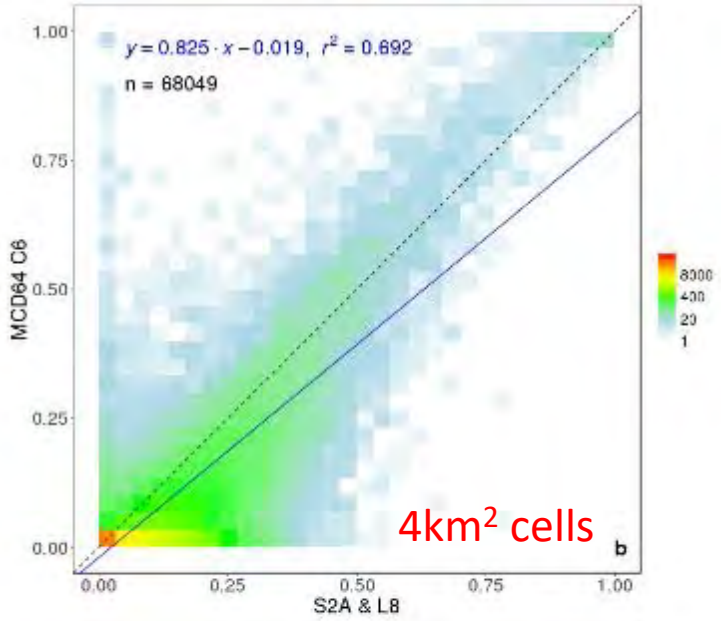


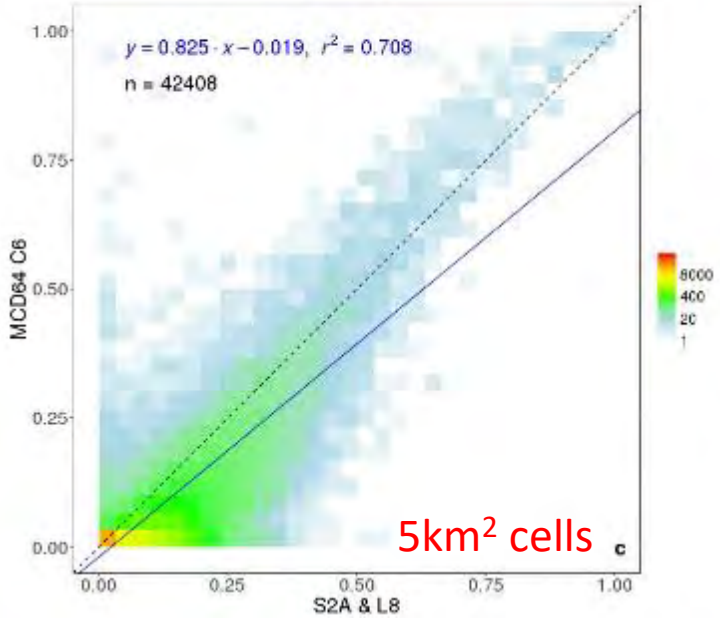
Comparison of July 2016 burned proportions mapped by MODIS and Landsat-8 & Sentinel-2

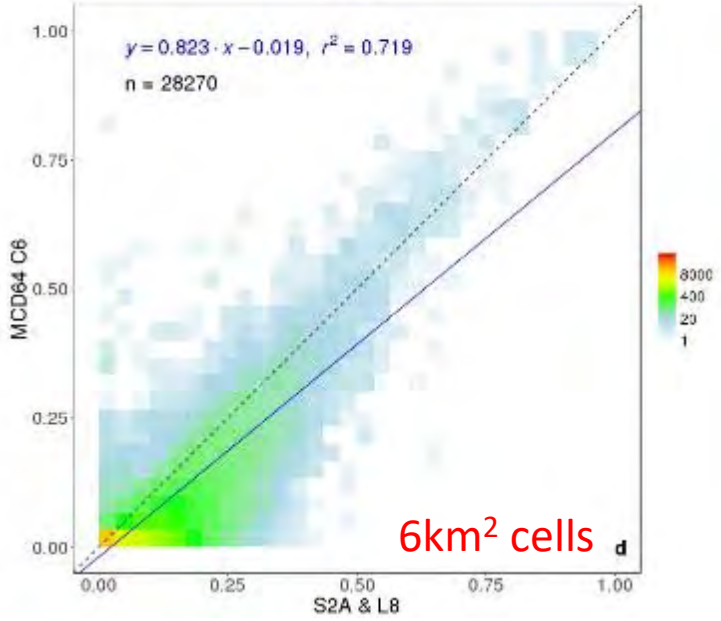


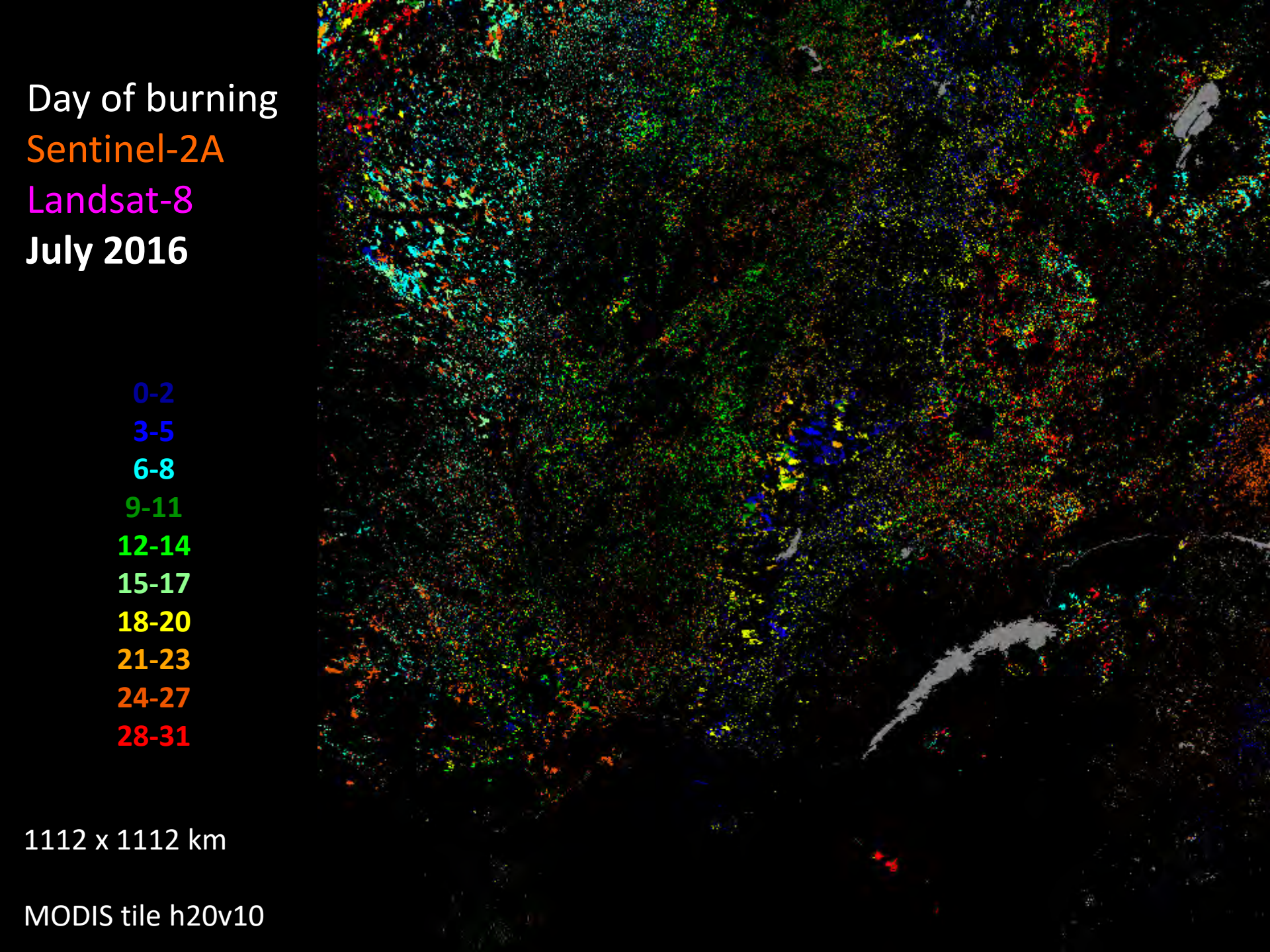
Comparison of July 2016 burned proportions mapped by MODIS and Landsat-8 & Sentinel-2 with 3-day adjustment

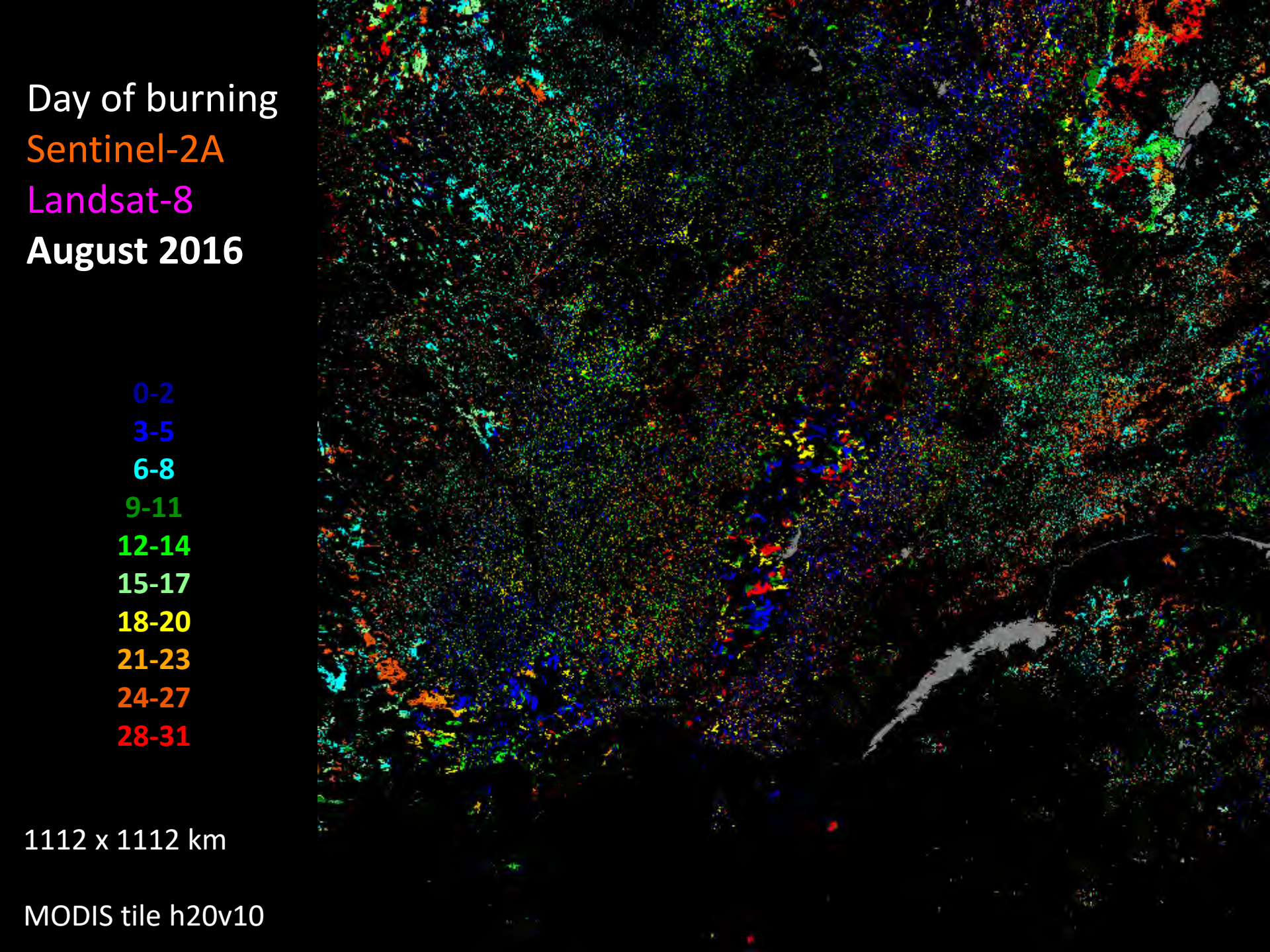


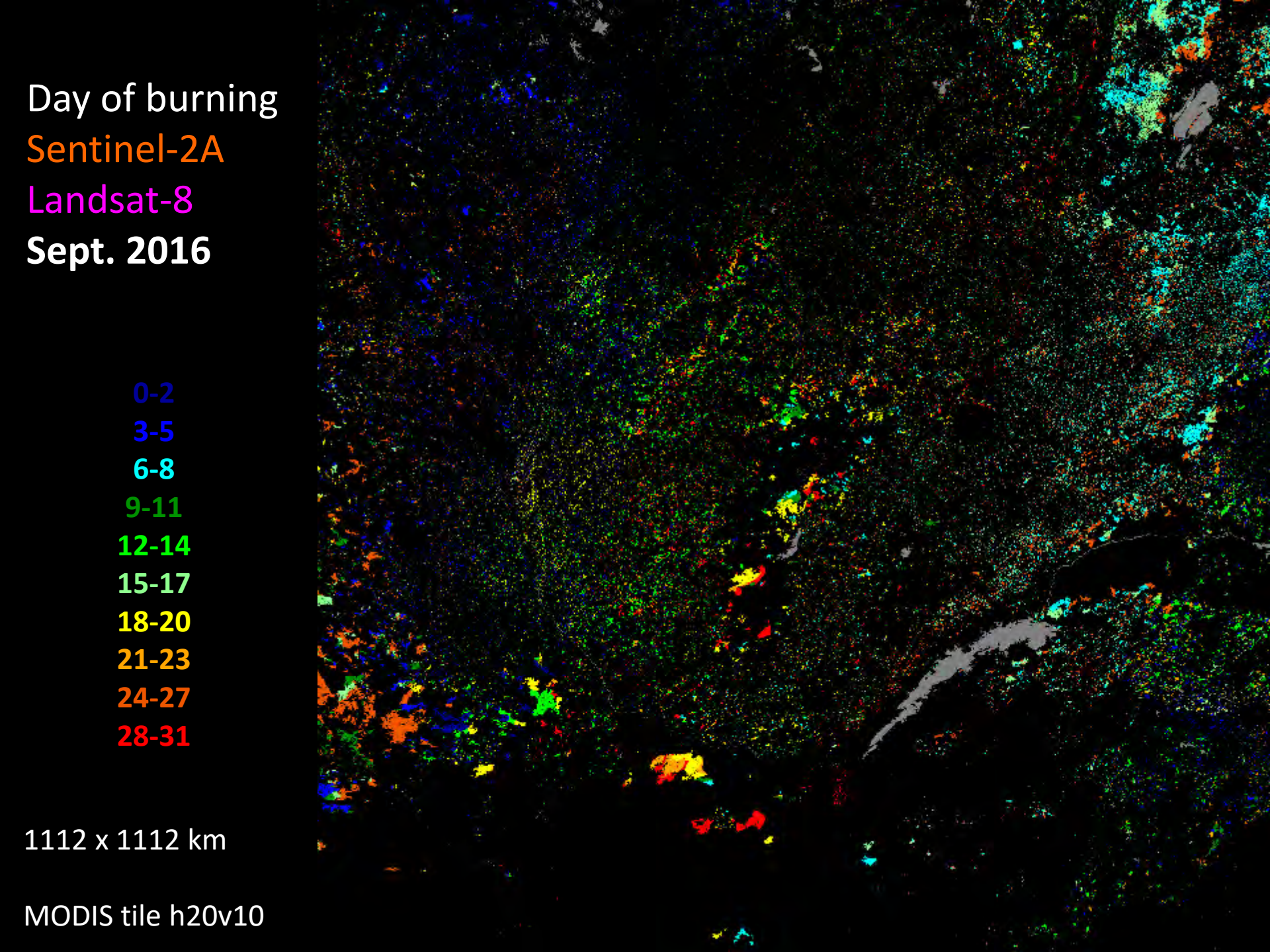


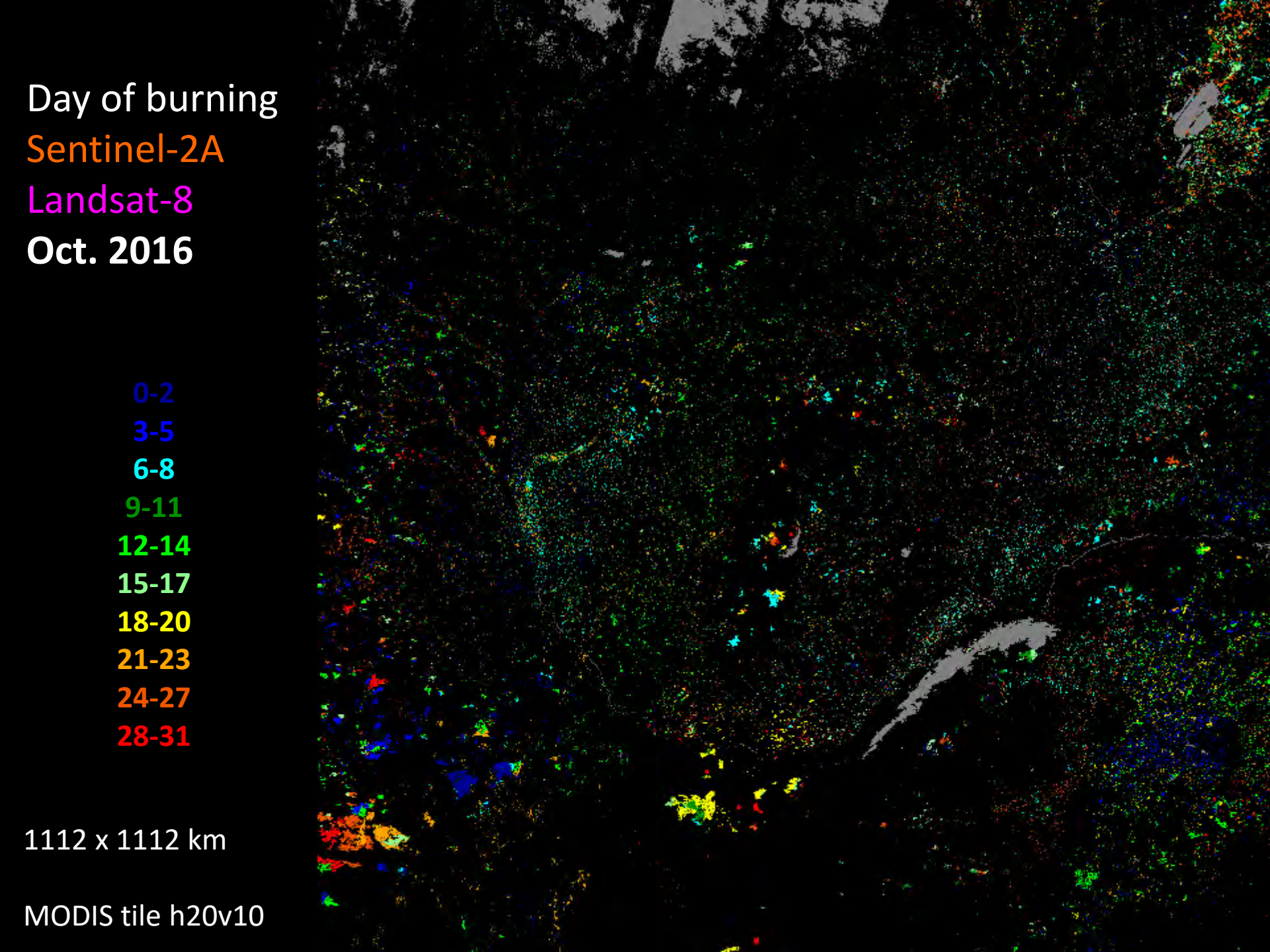


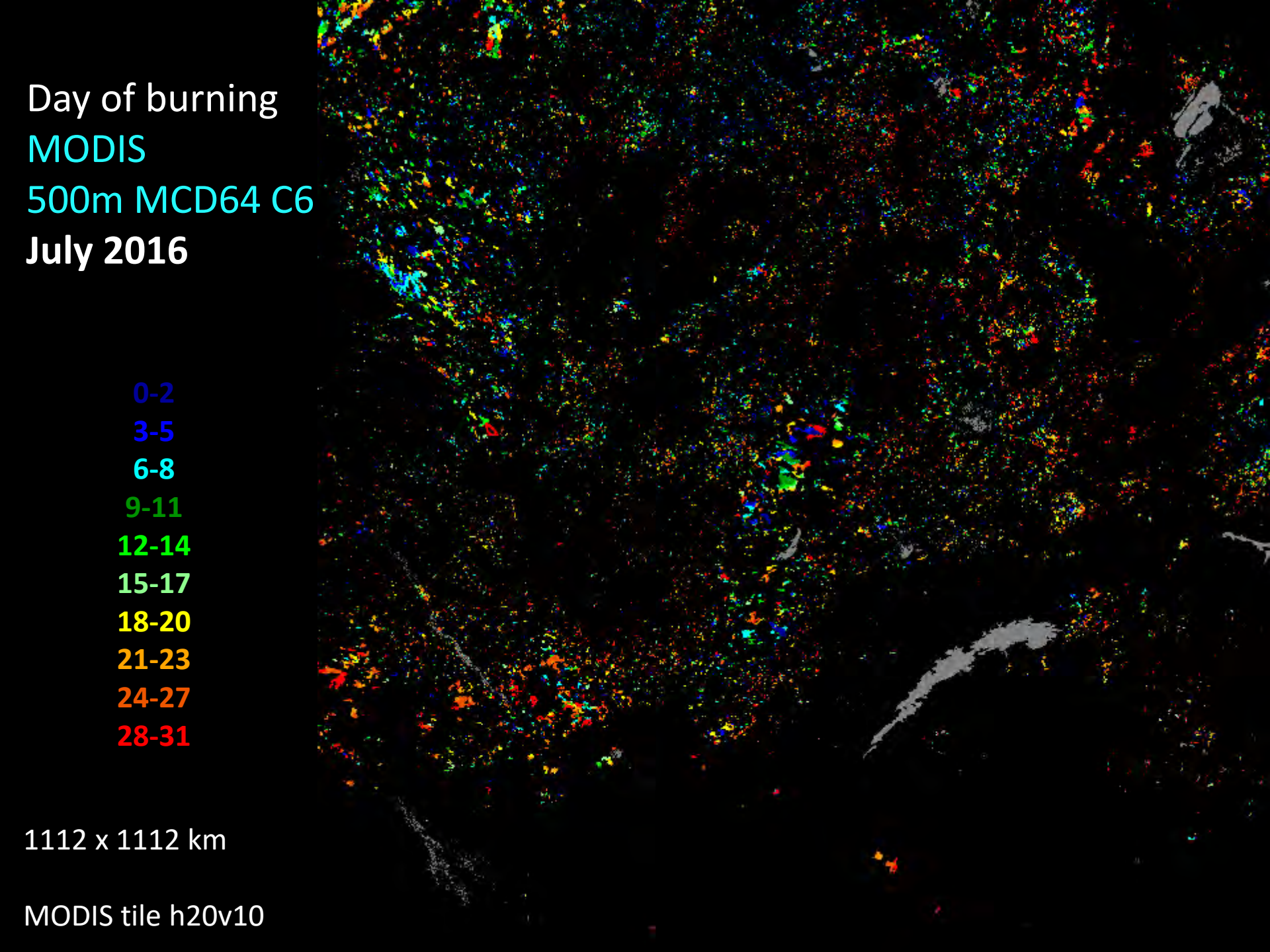


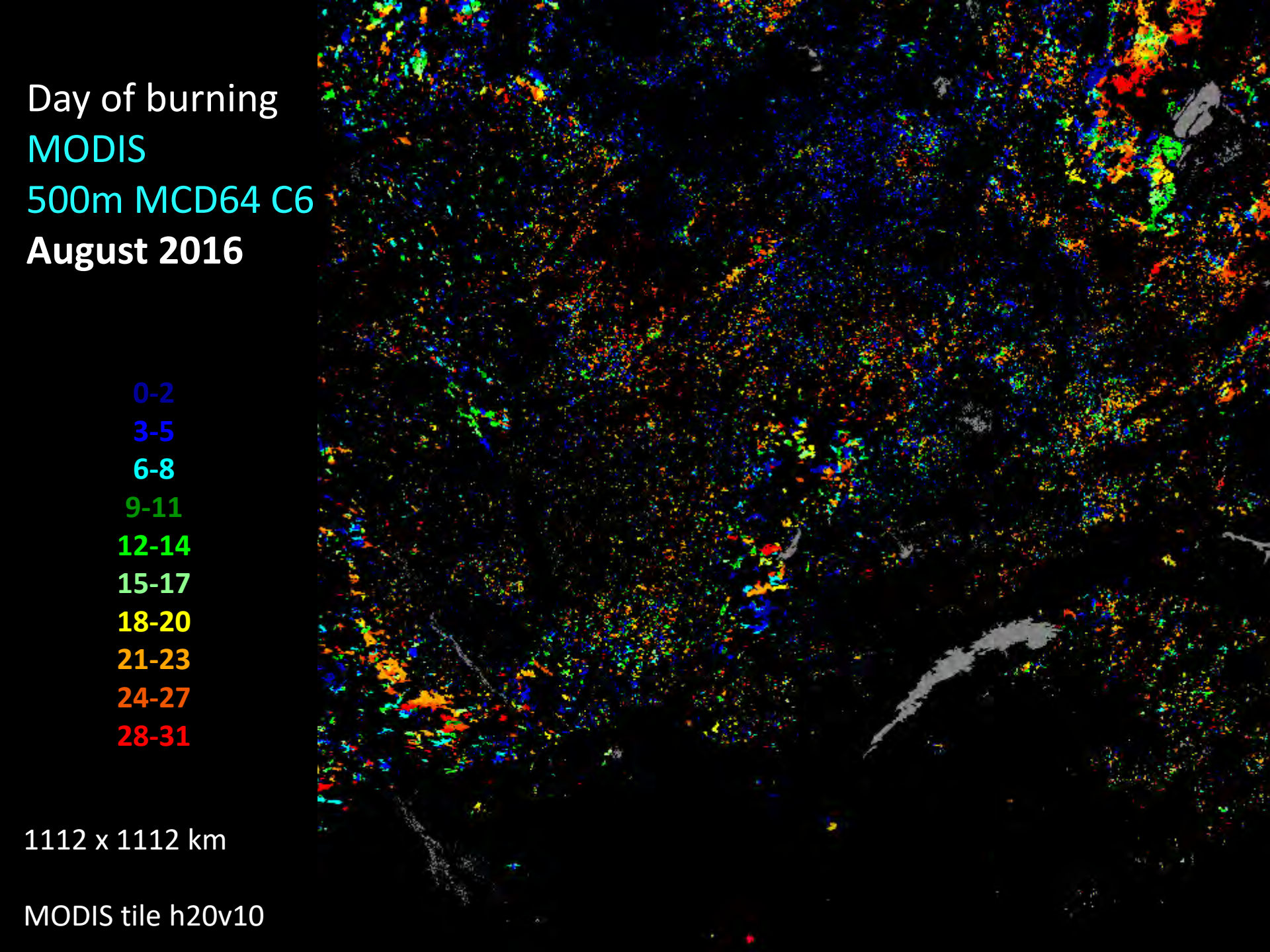

Day of burning
Sentinel-2A
Landsat-8
July 2016
0-2
3-5
6-8
9-11
12-14
15-17
18-20
21-23
24-27
28-31
1112 x 1112 km
MODIS tile h20v10

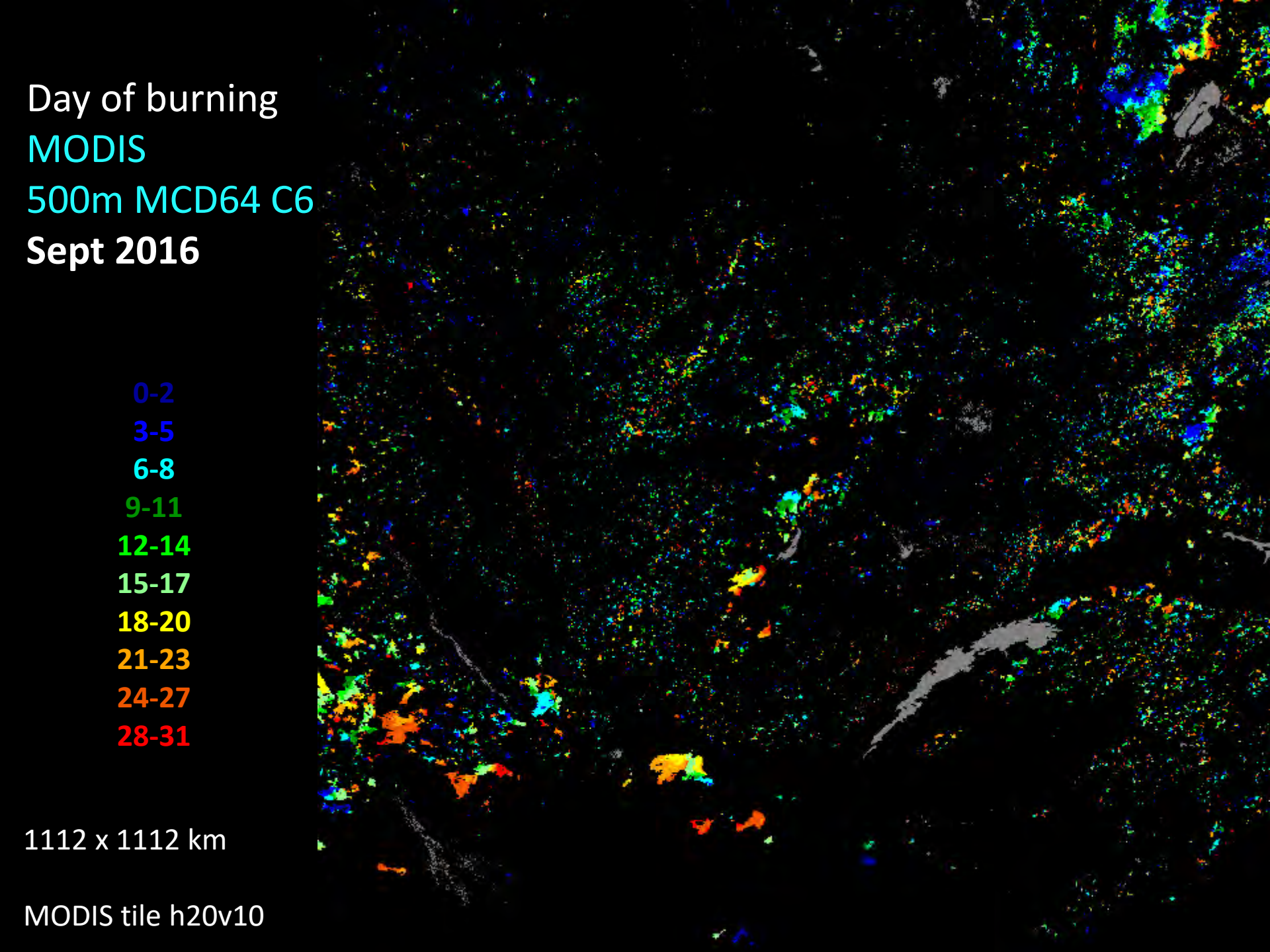

Day of burning
Sentinel-2A
Landsat-8
August 2016
0-2
3-5
6-8
9-11
12-14
15-17
18-20
21-23
24-27
28-31
1112 x 1112 km
MODIS tile h20v10

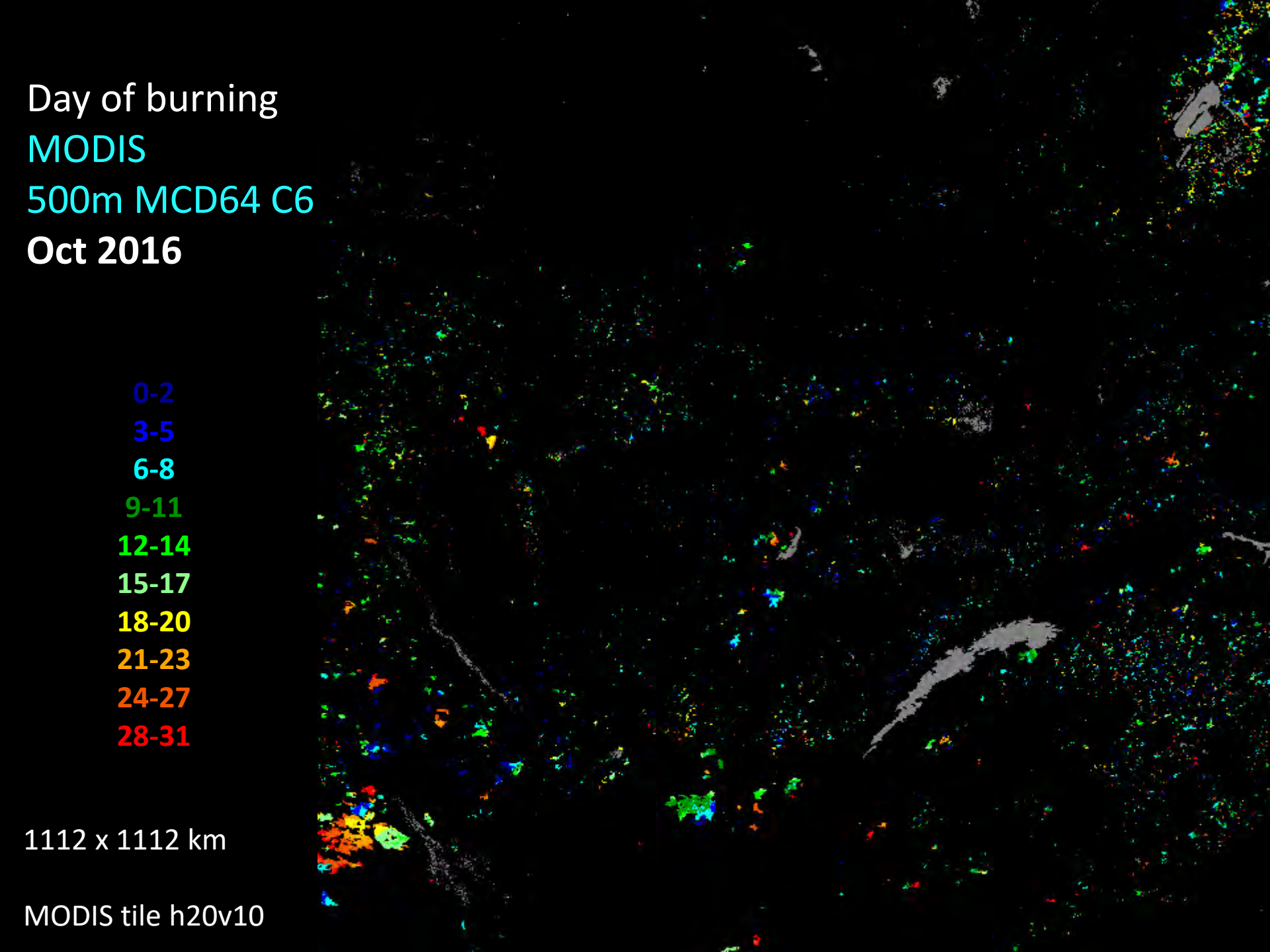

Day of burning
Sentinel-2A
Landsat-8
Sept. 2016
0-2
3-5
6-8
9-11
12-14
15-17
18-20
21-23
24-27
28-31
1112 x 1112 km
MODIS tile h20v10


Day of burning
Sentinel-2A
Landsat-8
Oct. 2016
0-2
3-5
6-8
9-11
12-14
15-17
18-20
21-23
24-27
28-31
1112 x 1112 km
MODIS tile h20v10


Day of burning
MODIS
500m MCD64 C6
July 2016
0-2
3-5
6-8
9-11
12-14
15-17
18-20
21-23
24-27
28-31
1112 x 1112 km
MODIS tile h20v10


Day of burning
MODIS
500m MCD64 C6
August 2016
0-2
3-5
6-8
9-11
12-14
15-17
18-20
21-23
24-27
28-31
1112 x 1112 km
MODIS tile h20v10

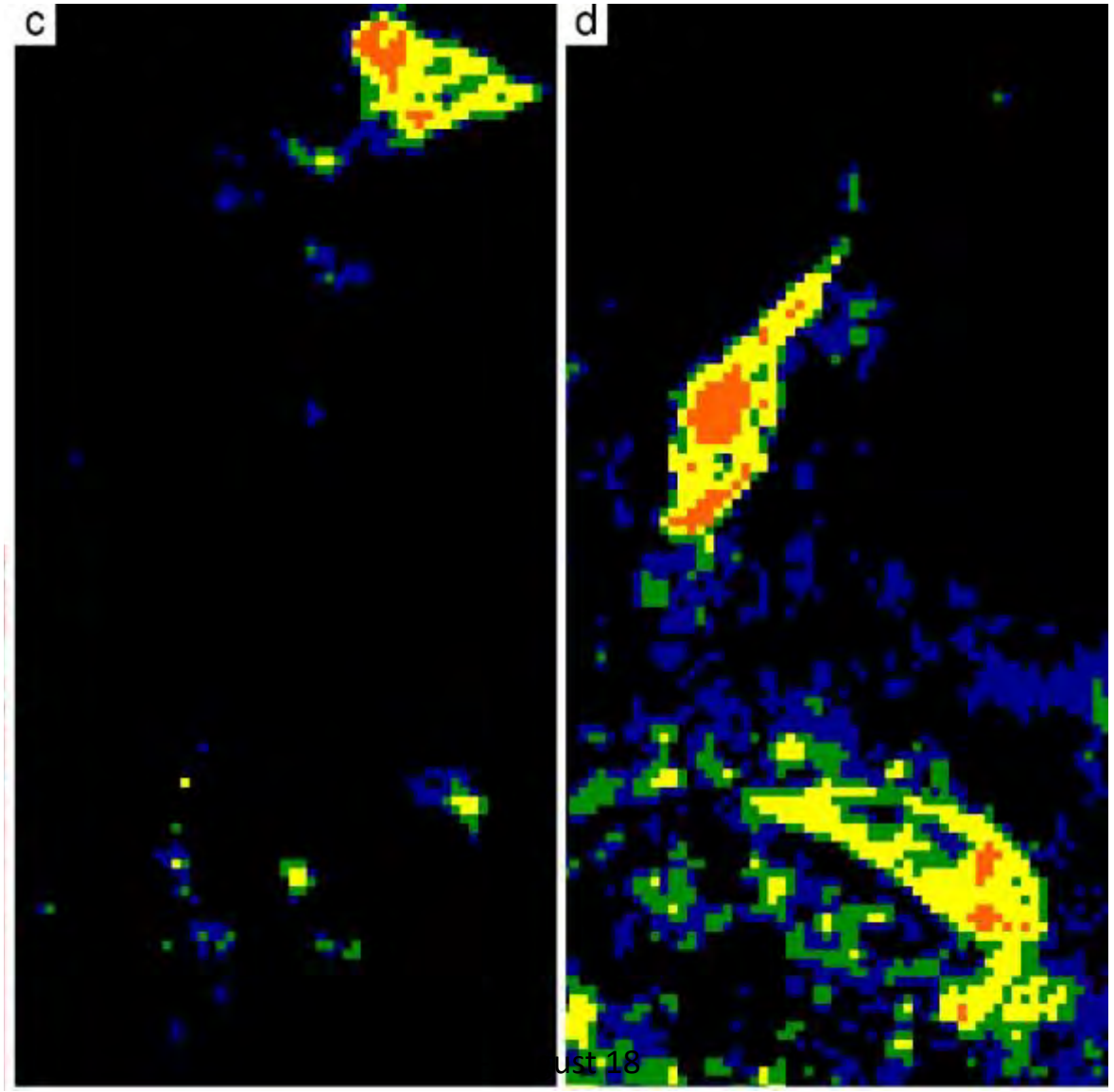

Day of burning
MODIS
500m MCD64 C6
Sept 2016
0-2
3-5
6-8
9-11
12-14
15-17
18-20
21-23
24-27
28-31
1112 x 1112 km
MODIS tile h20v10


Day of burning
MODIS
500m MCD64 C6
Oct 2016
0-2
3-5
6-8
9-11
12-14
15-17
18-20
21-23
24-27
28-31
1112 x 1112 km
MODIS tile h20v10

Validation

Sentinel-2A
Landsat-8
30 m

0.2 ≤ f.cc < 0.4
0.4 ≤ f.cc < 0.6
0.6 ≤ f.cc < 0.8
0.8 ≤ f.cc < 0.9
0.9 ≤ f.cc ≤ 1.0



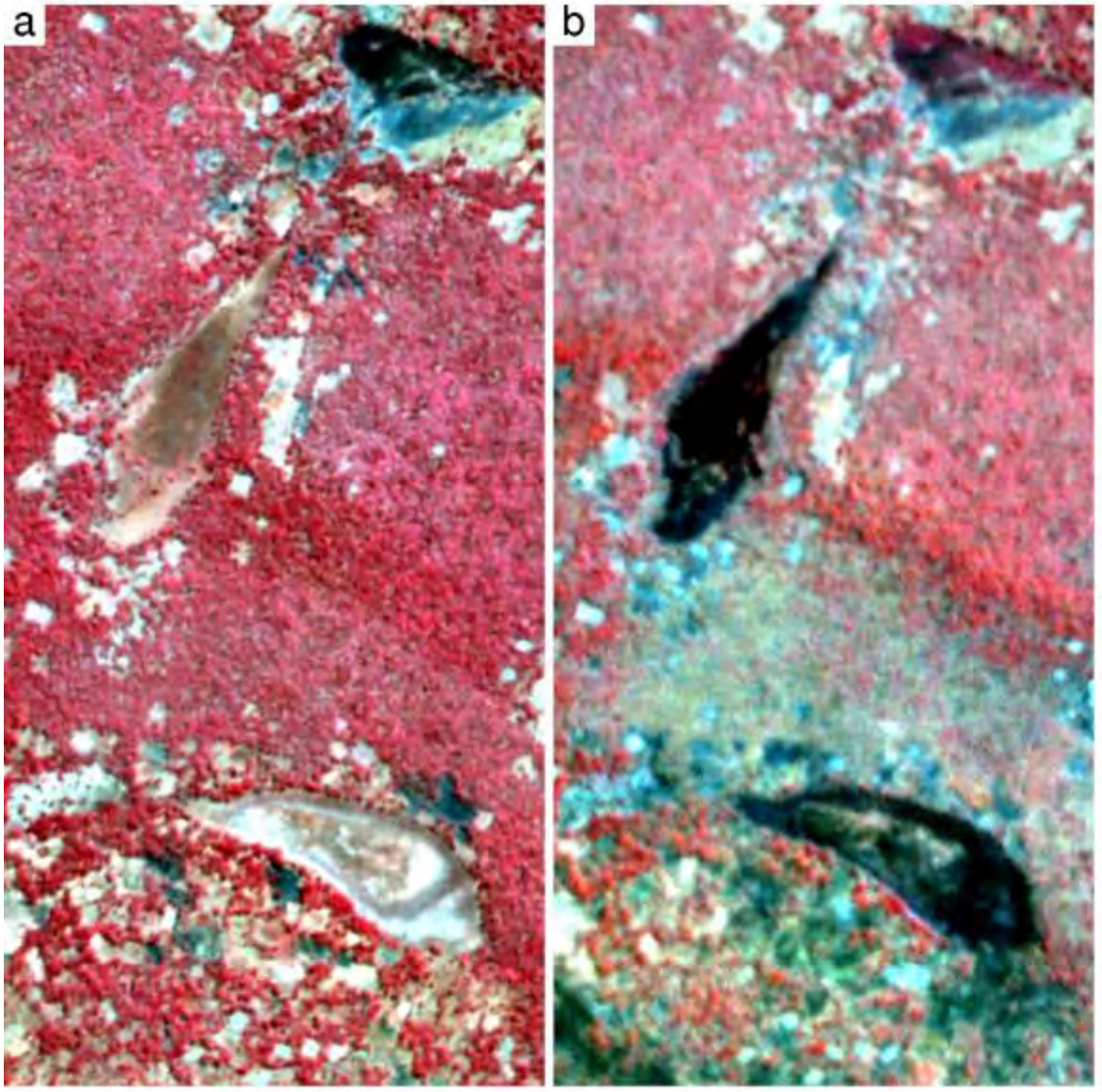
Zambia

1.8 km × 3.6 km

60 × 120 30 m pixels

July18 August 18

3 m false color
(0.82, 0.63, 0.54 µm)



Zambia

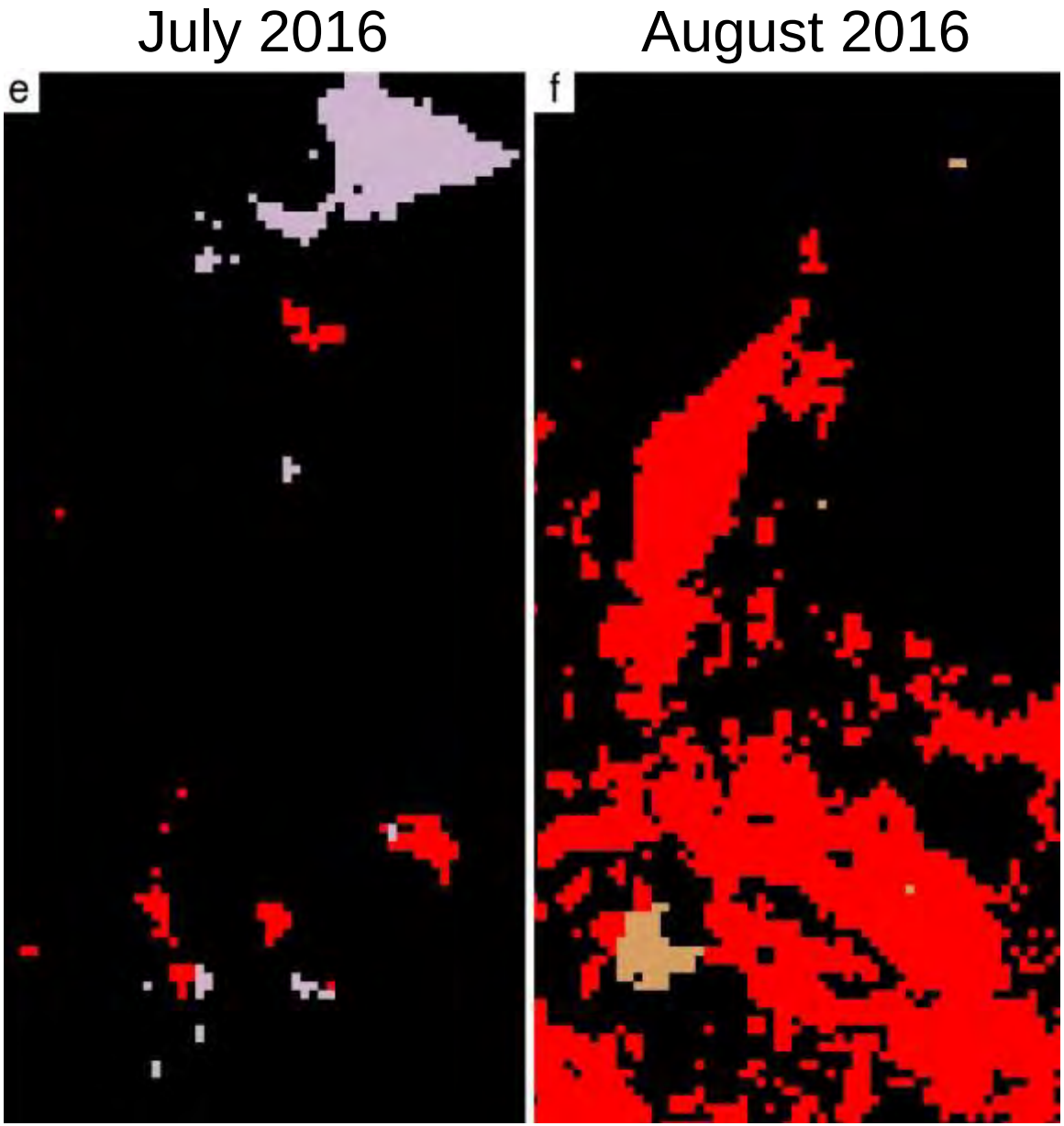
1.8 km × 3.6 km

600 × 1200 3 m pixels

Sentinel-2A
Landsat-8
30 m

Mapped:

- < July 18
- July 18 - August 18
- > August 18



Zambia

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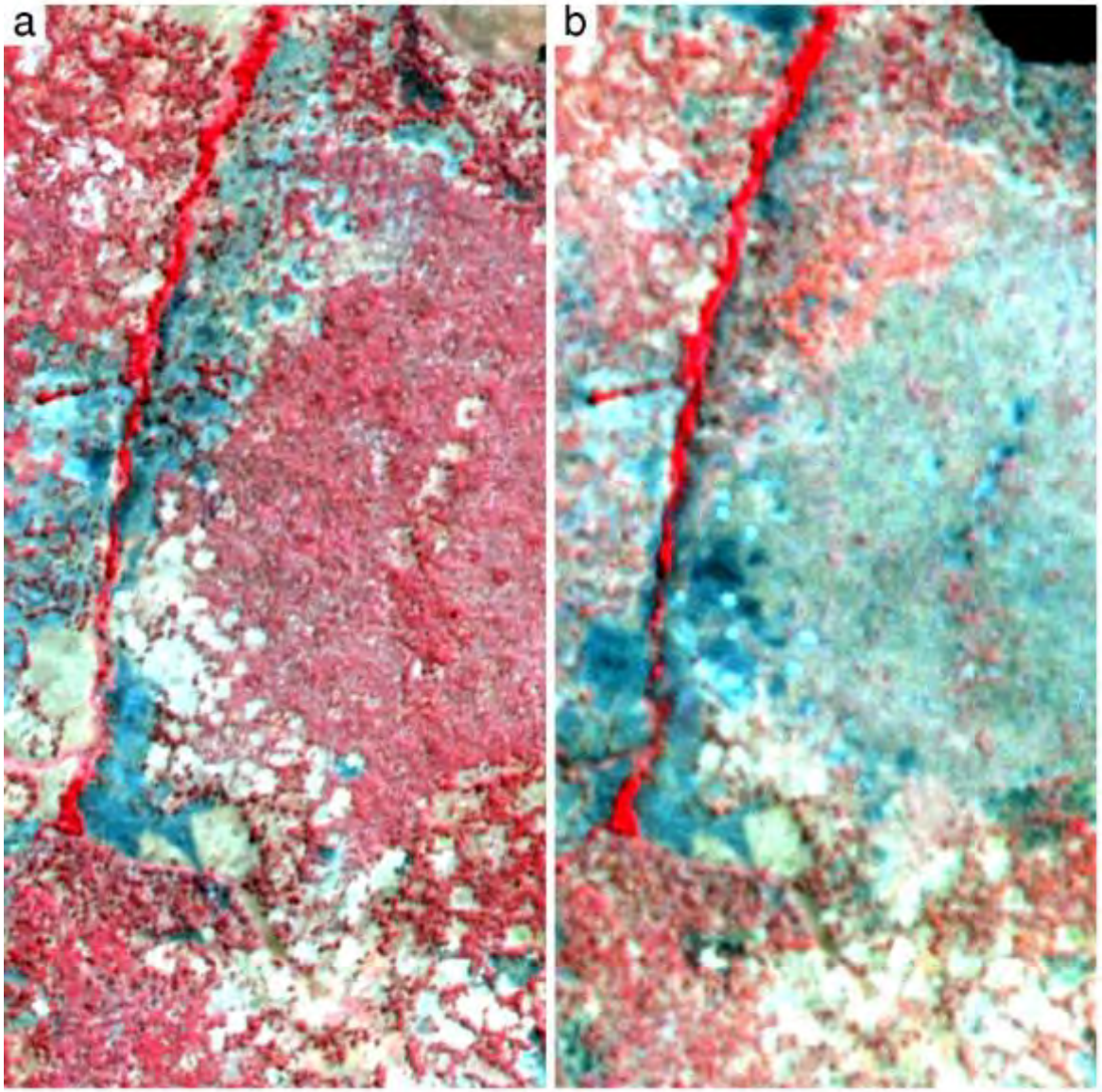
July18 August 18

3 m false color
(0.82, 0.63, 0.54 µm)



Zambia

1.8 km × 3.6 km

600 × 1200 3 m pixels

Sentinel-2A
Landsat-8
30 m

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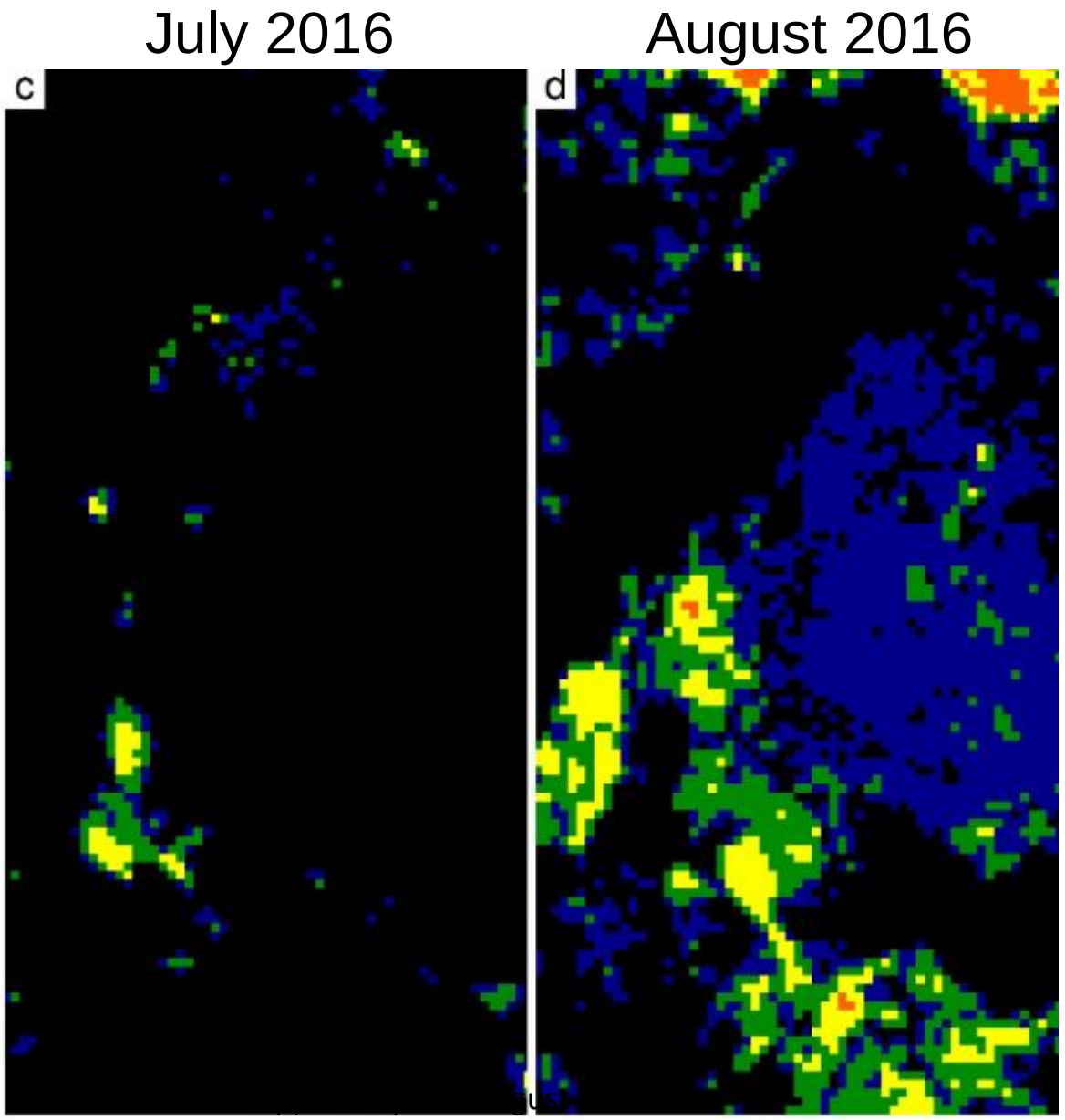


Zambia

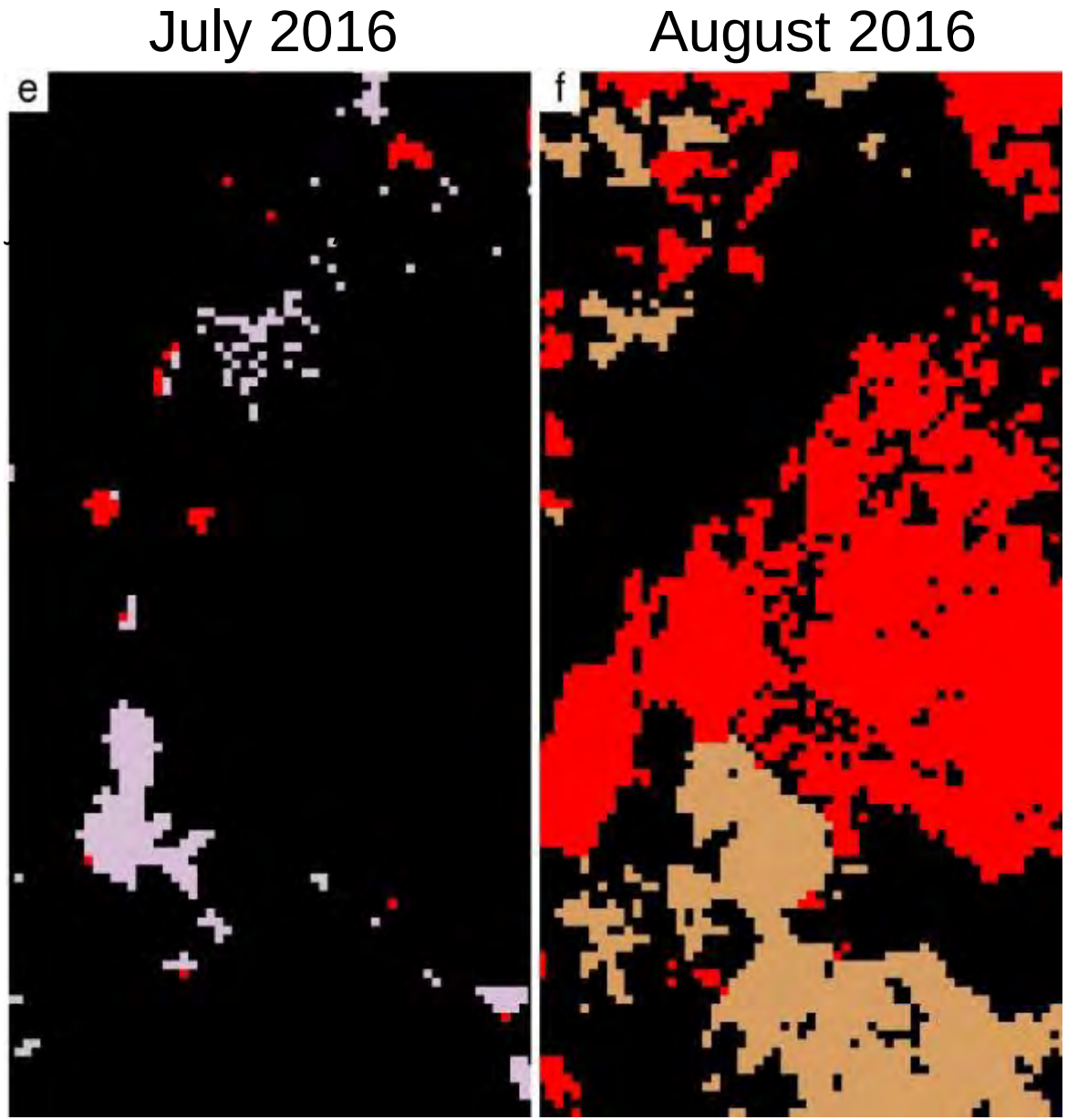
1.8 km × 3.6 km

60 × 120 30 m pixels

Sentinel-2A
Landsat-8
30 m

Mapped:

- < July 18
- July 18 - August 18
- > August 18



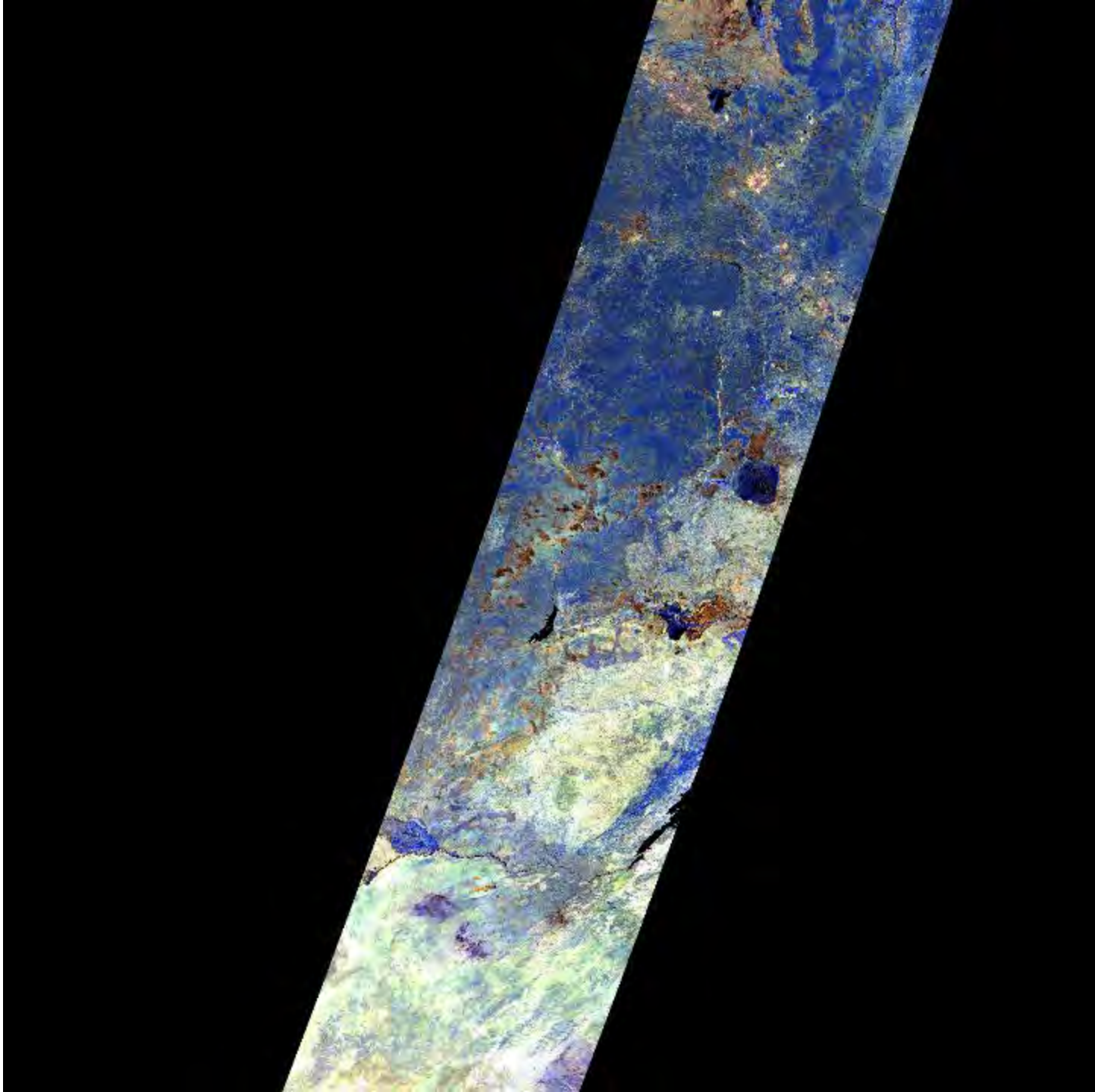
Zambia

1.8 km × 3.6 km

60 × 120 30 m pixels

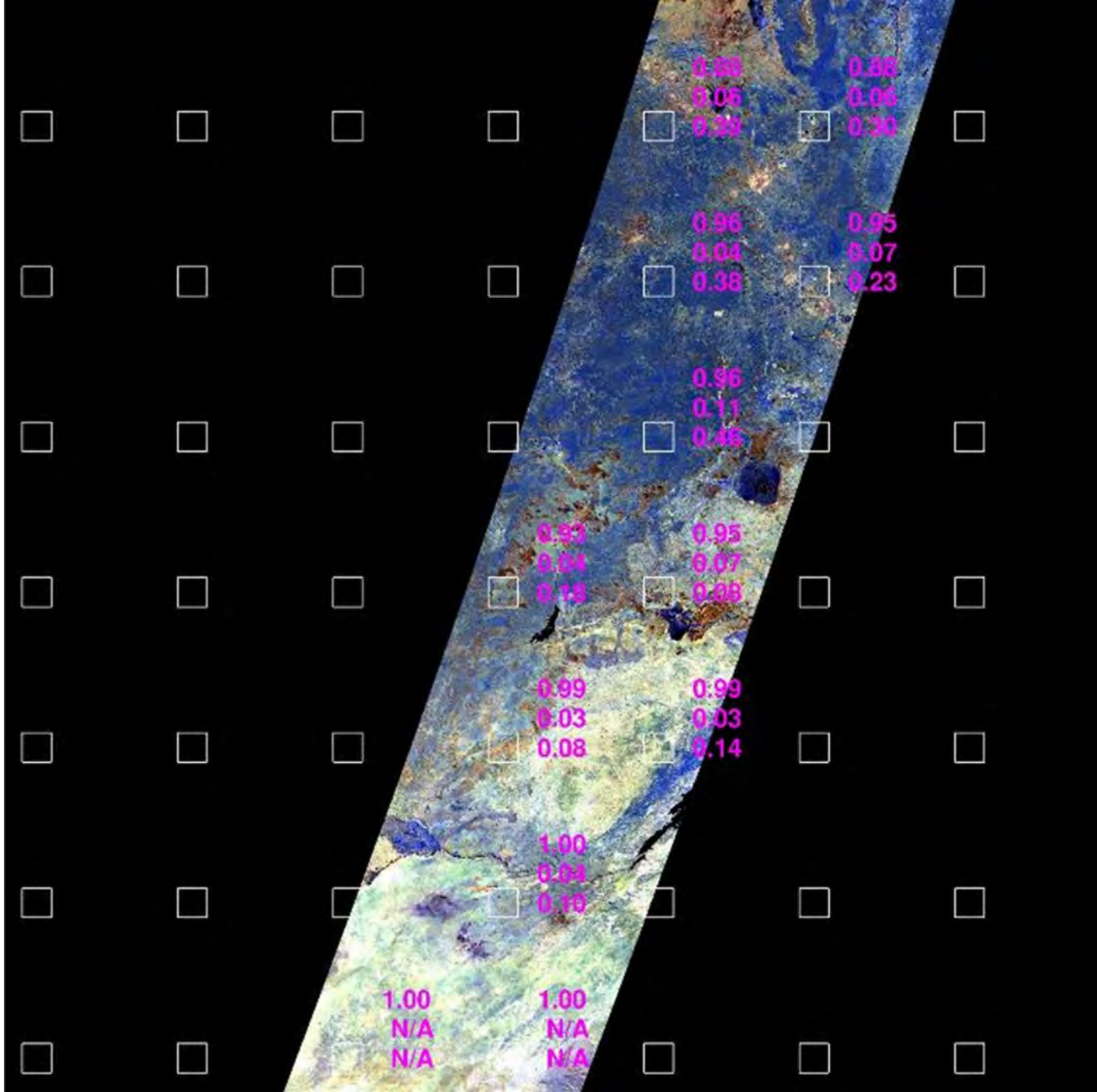
Sentinel-2A false color

surface NBAR
July 2nd 2016
swath



1112 x 1112 km

MODIS tile h20v10



overall accuracy
commission error
the omission error

1112 x 1112 km

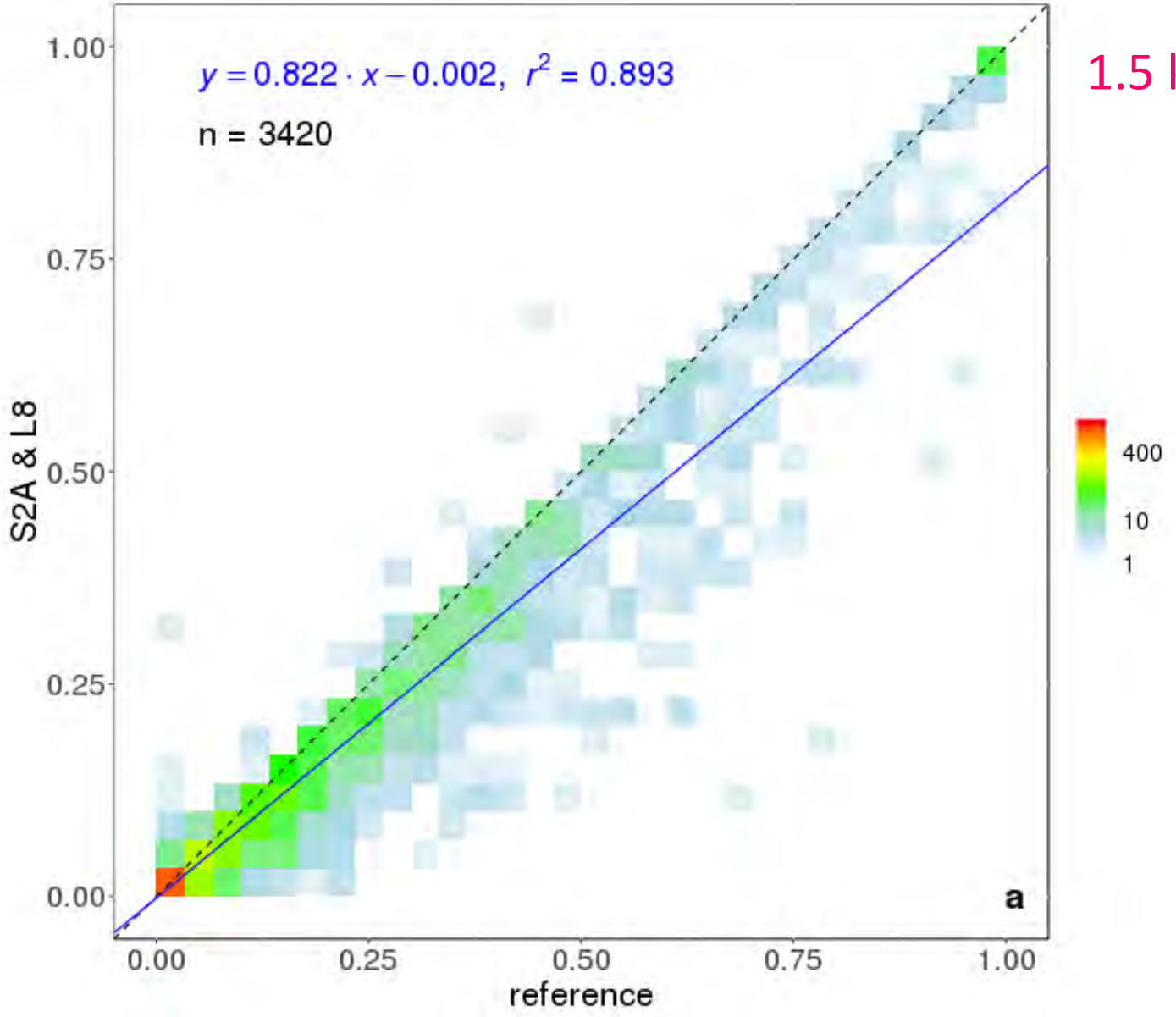
MODIS tile h20v10

		Landsat-8/Sentinel-2A			
		Burned [km^2]	**Unburned** [km^2]	**Unmapped** [km^2]	Row total [km^2]
Reference	**Burned** [km^2]	1203.94 (**11.13%**)	378.03 (3.50%)	0.00 (<0.01%)	1581.97 (14.63%)
	Unburned [km^2]	73.39 (0.01%)	9152.43 (**84.68%**)	0.05 (<0.01%)	9225.87 (84.69%)
	Unmapped [km^2]	0.00 (0.00%)	0.01 (<0.01%)	0.00 (**0.00%**)	0.01 (<0.01%)
	Column total [km^2]	1277.33 (11.14%)	9530.47 (88.18%)	0.05 (<0.01%)	10807.80

Omission Error (0-1) = 0.24 **Commission Error (0-1) = 0.06** Relative Bias [%] = -0.19

User's Accuracy (0-1) = 0.94 Producer's Accuracy (0-1) = 0.76 Overall Accuracy (0-1) = 0.96

Comparison of July 2016 burned proportions mapped by reference and Landsat-8 & Sentinel-2



1.5 km^2 cells

Validate cc in field with international collaborators ?

SAFNet GOFC-GOLD Global Observation of Forest and Land Cover Dynamics South African National Parks INTERNATIONAL START SECRETARIAT

10th Southern African Fire Network (SAFNet) Meeting

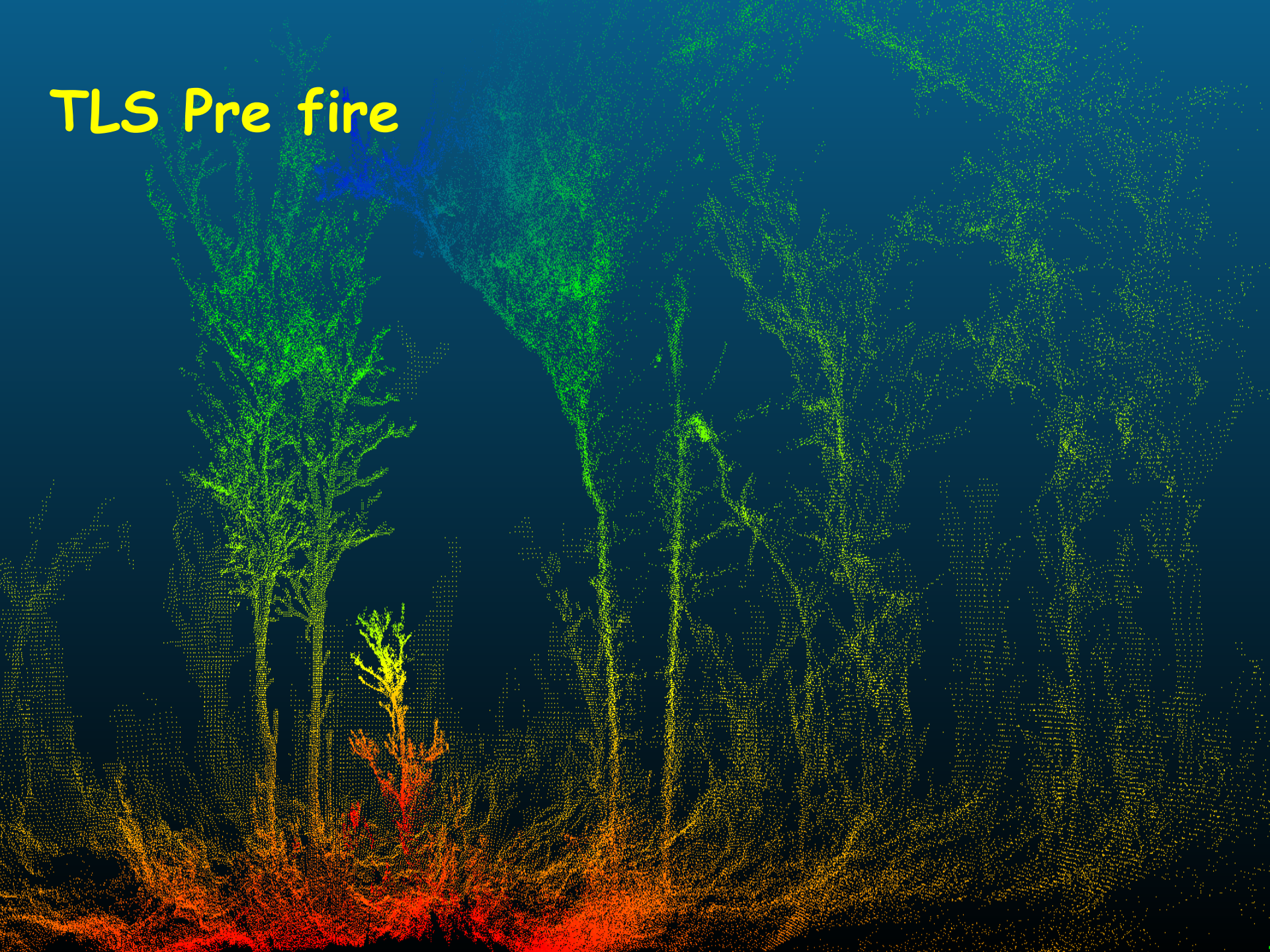
17th - 19th April 2018

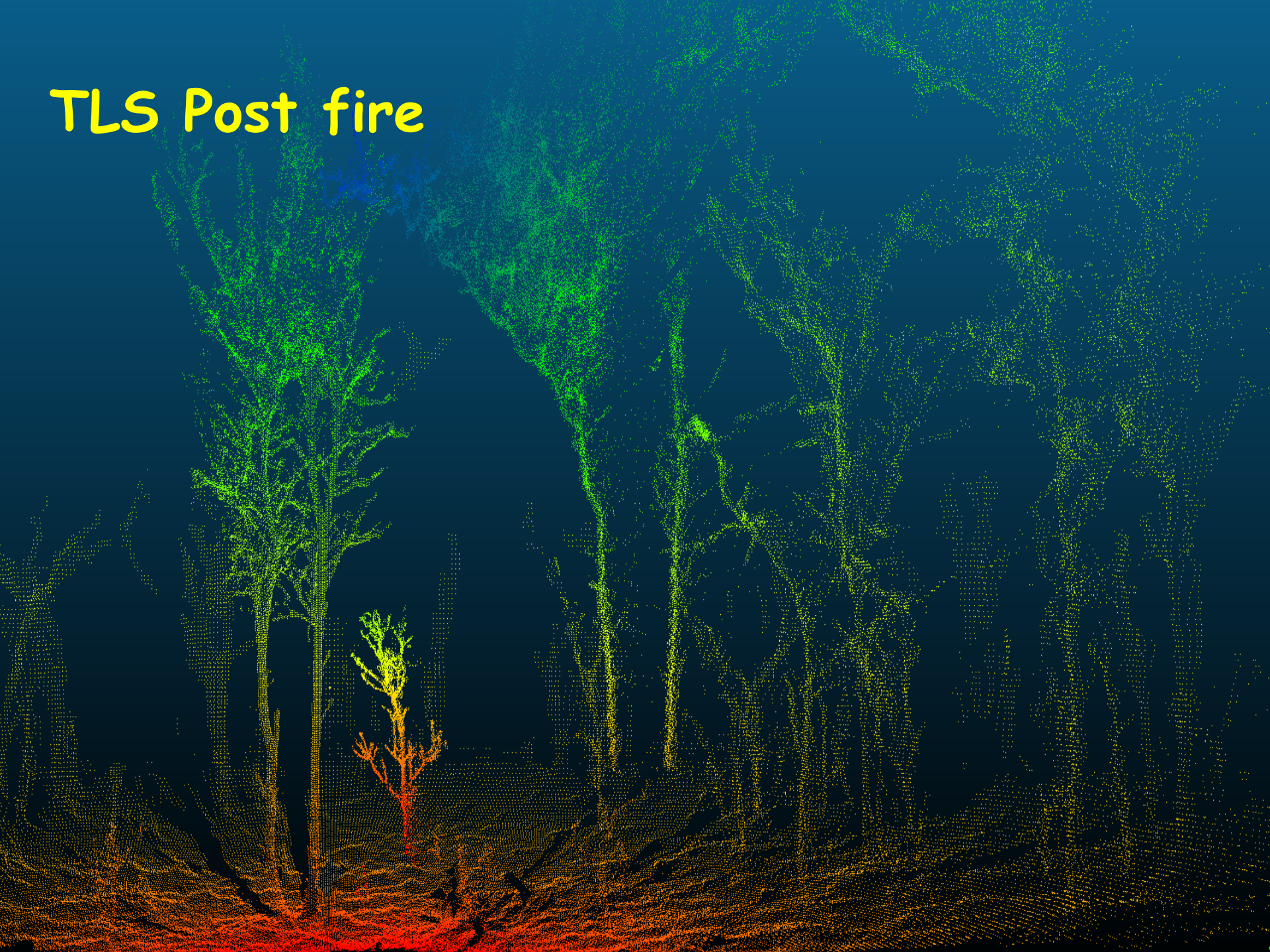
Venue: Kruger National Park, Skukuza, South Africa

Collaborative fire information, resource sharing, training and research in support of Integrated Fire Management in Southern African countries

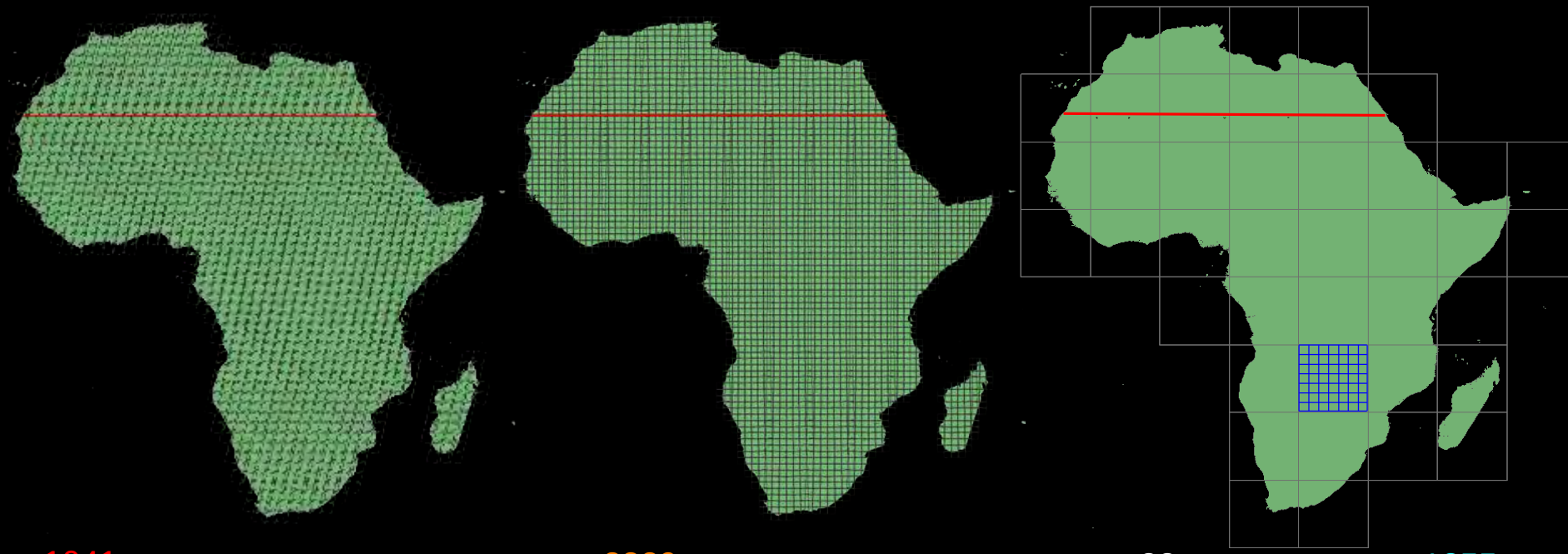
Too green to burn !

Kruger National Park, South Africa, October 2018 – drier !


TLS Pre fire


TLS Post fire

Planned Production - all of Africa, including Madagascar, south of the Tropic of Cancer (23.44° N) for 2017 / 2018 / 2019 process on NASA funded AWS



1041
Landsat-8 Collection 1
WRS-2 path/rows (UTM)

2829
Sentinel-2
L1C tiles (UTM)

33
MODIS
Tiles (sinusoidal)

1255
WELD
tiles

Summary

- New moderate resolution data will provide global burned area mapping capability
  - Exciting
  - Improved reporting of small and spatially fragmented burned areas
  - Need S2A and L8 for reliable burned area mapping, L8 alone insufficient
  - S2A, S2B & L8 will be optimal
- Major R&D effort on Sentinel-2 and Landsat-8 pre-processing
  - will use HLS V1.5 this Fall (improved cloud mask, correct c-factor implementation)
- Automated burned area algorithm protoyped
  - applied to NBAR surface reflectance gridded WELD tile time series
  - only 2 parameters
  - map 30m burned area + sub-pixel fraction (f) x combustion completeness (cc)
  - *Remote Sensing of Environment*, paper currently in review (round 3 !)
- Planned production
  - all of Africa, including Madagascar, south of the Tropic of Cancer
  - 2017 (S2A & L8), 2018 (S2A, S2B, L8), 2018 (S2A, SB, L8)
- Validation
  - Commercial data (burned area, f) & perhaps *in situ* Terrestrial Laser Scanner (cc)