



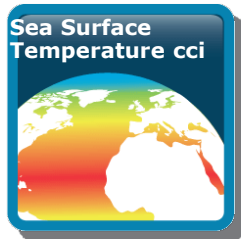
# ESA Fire CCI BA Product Updates

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On behalf of the Fire\_cci consortium

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ESA contribution to GCOS.  
Generation of temporal series of ECV.



## Pixel product:

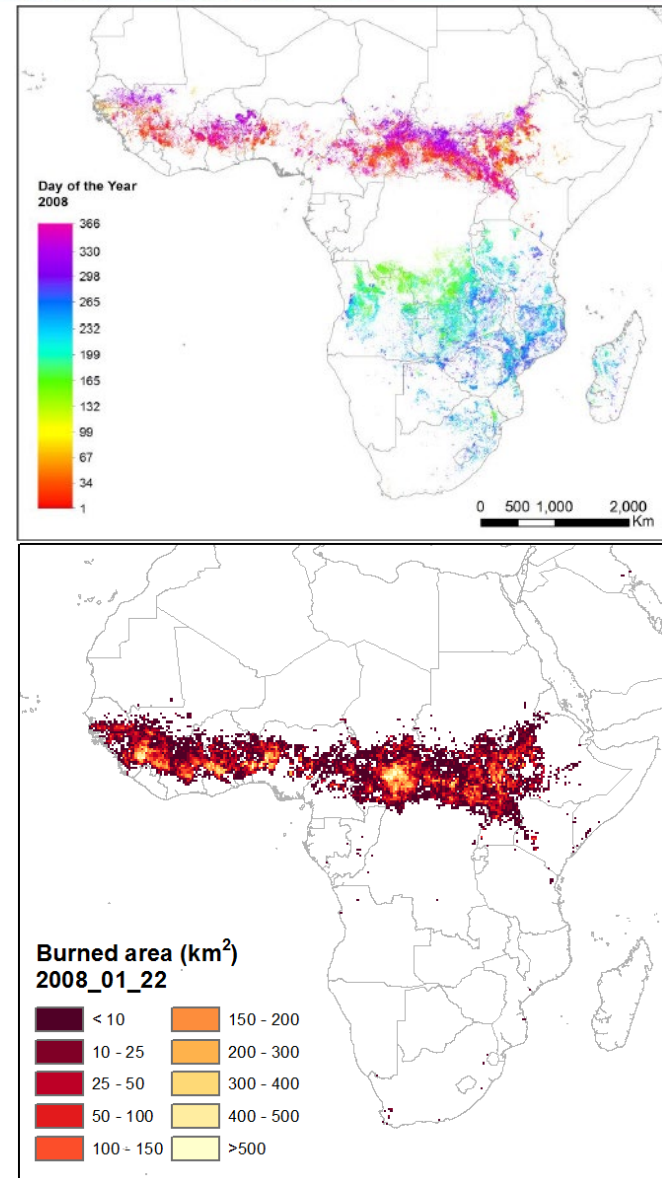
Monthly files, continental tiles, GeoTiff format:

4 Variables: Day of detection (1-366),  
Confidence level (0-100), Burned land  
cover (derived from LC\_cci), Sensor  
detecting.

## Grid product:

15-day global files at 0.25 x 0.25 degree.  
NetCDF format.

23 variables: total burned area, standard  
error, fraction of burnable area, fraction of  
observed area, number of patches and  
burned area of each land cover.





Optic: MERIS, MODIS, LTDR, **OLCI and SLSTR (S-3)**, MSI S-2:

Hybrid algorithms: changes in reflectance, guided by hotspots.

Local-adapted (spatial thresholds).

Two-phase: seeds + growing phase.

Radar: S-1

Changes in backscatter coefficient.

Changes in coherence (interferometry).





Distribution of MODIS Fire\_cci v5.0 (250 m).

Update of the MODIS RNIR algorithm.

Processing of MODIS Fire\_cci v5.1 (250m).

Processing of Sub-Saharan Africa 2016 from S-2 MSI (+ S-1 interferometric SAR over cloudy regions).

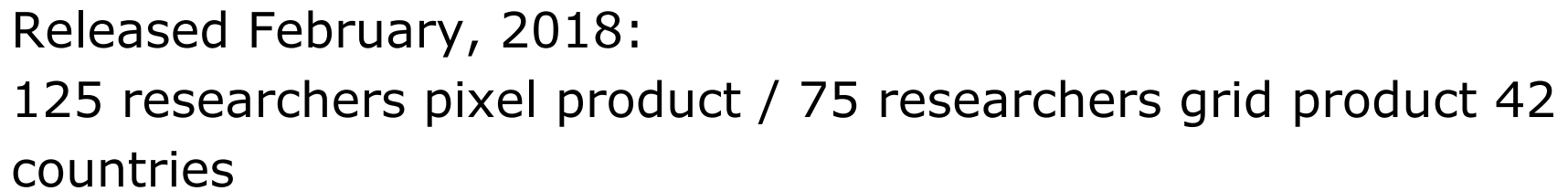
Development of SAR backscatter BA algorithms and application over

Amazon basin v1.0 (also tested worldwide)

Indonesia

Stage 3 validation (2003-2014) for global products.

Stage 2 validation (2016) for small-fire database.

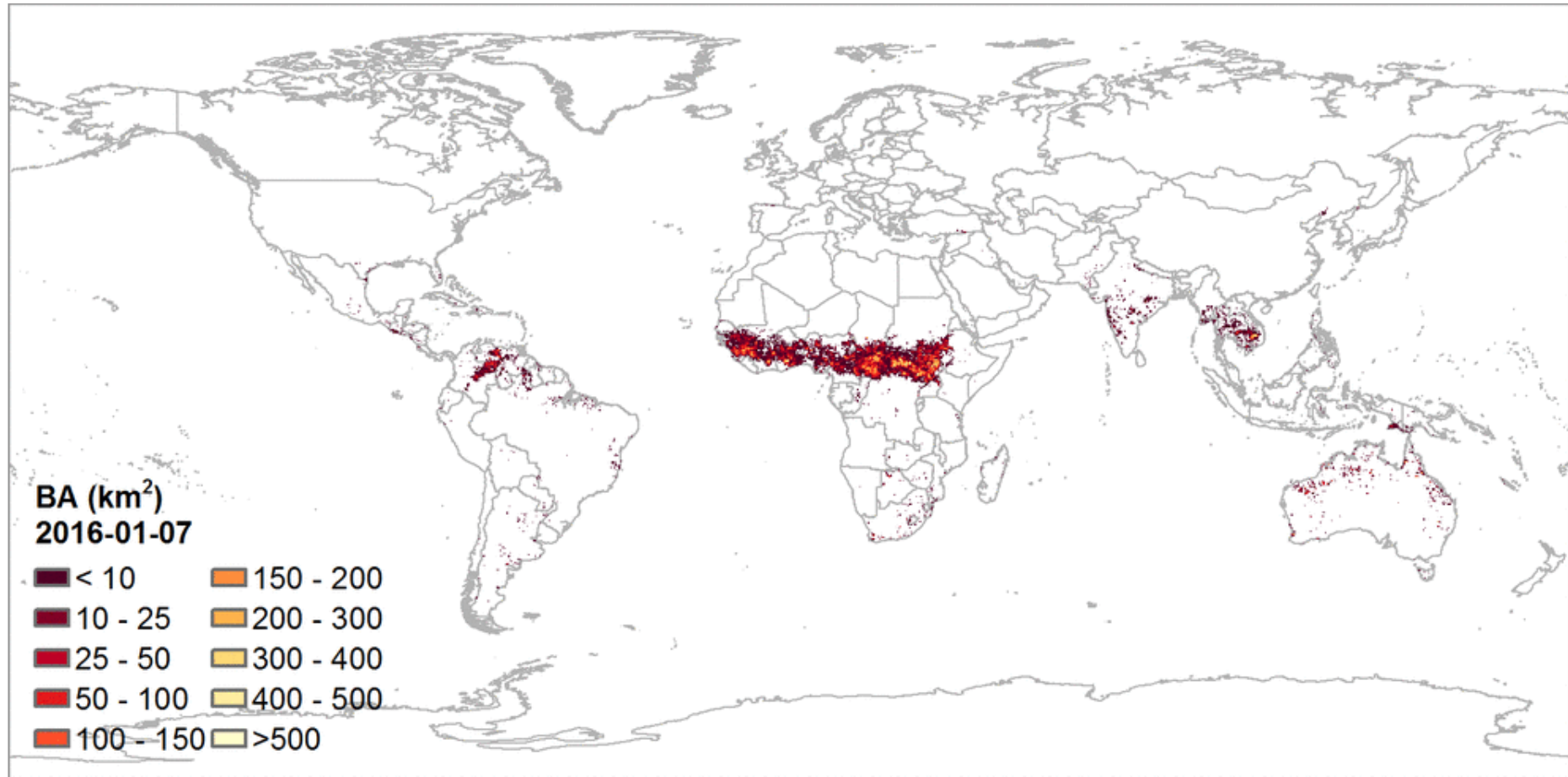




# Sample of MODIS Fire\_cci v5.0 products: Total BA



## 15 day periods

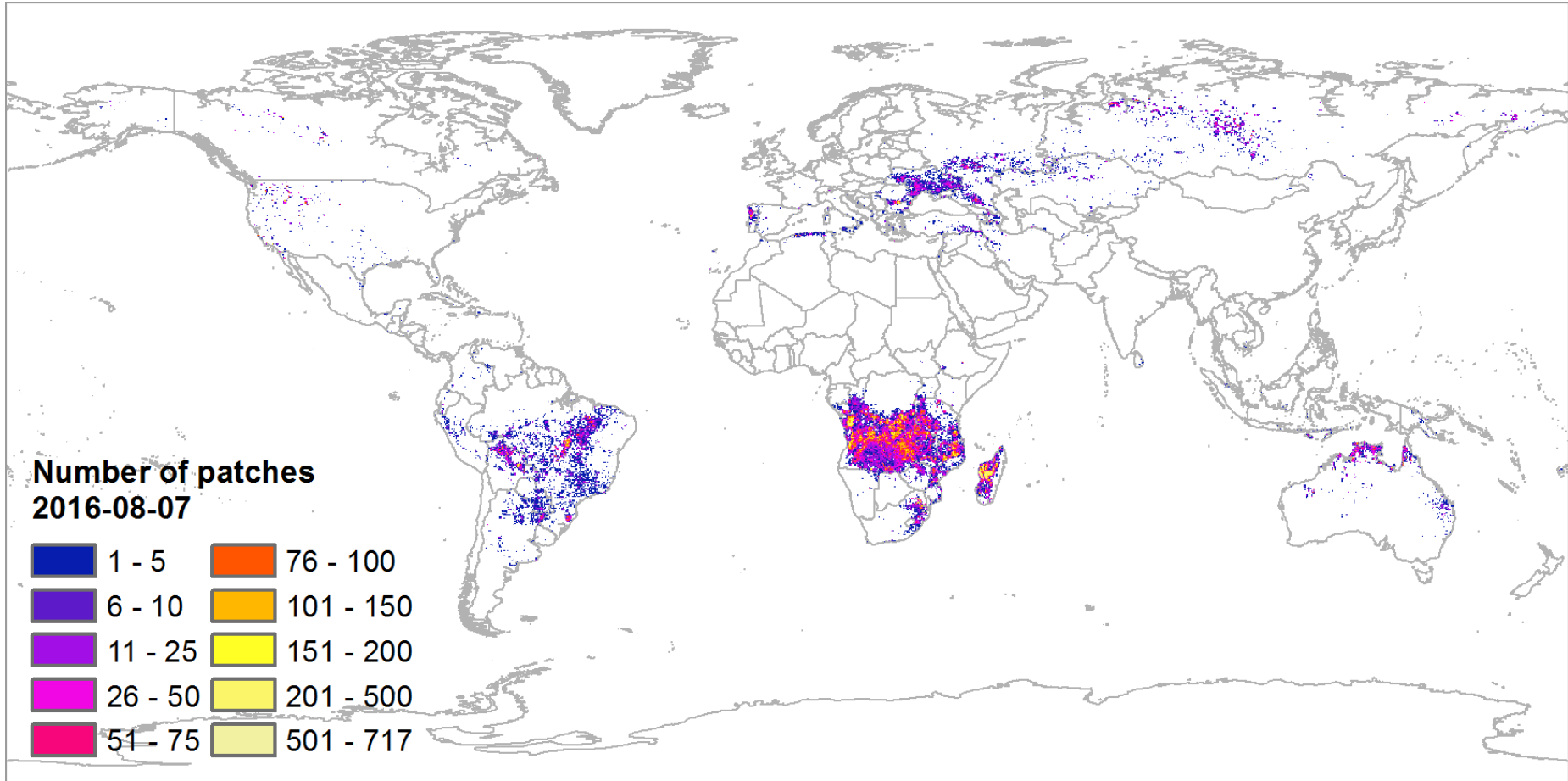




# MODIS Fire\_cci BA v5.0: Number of burned patches



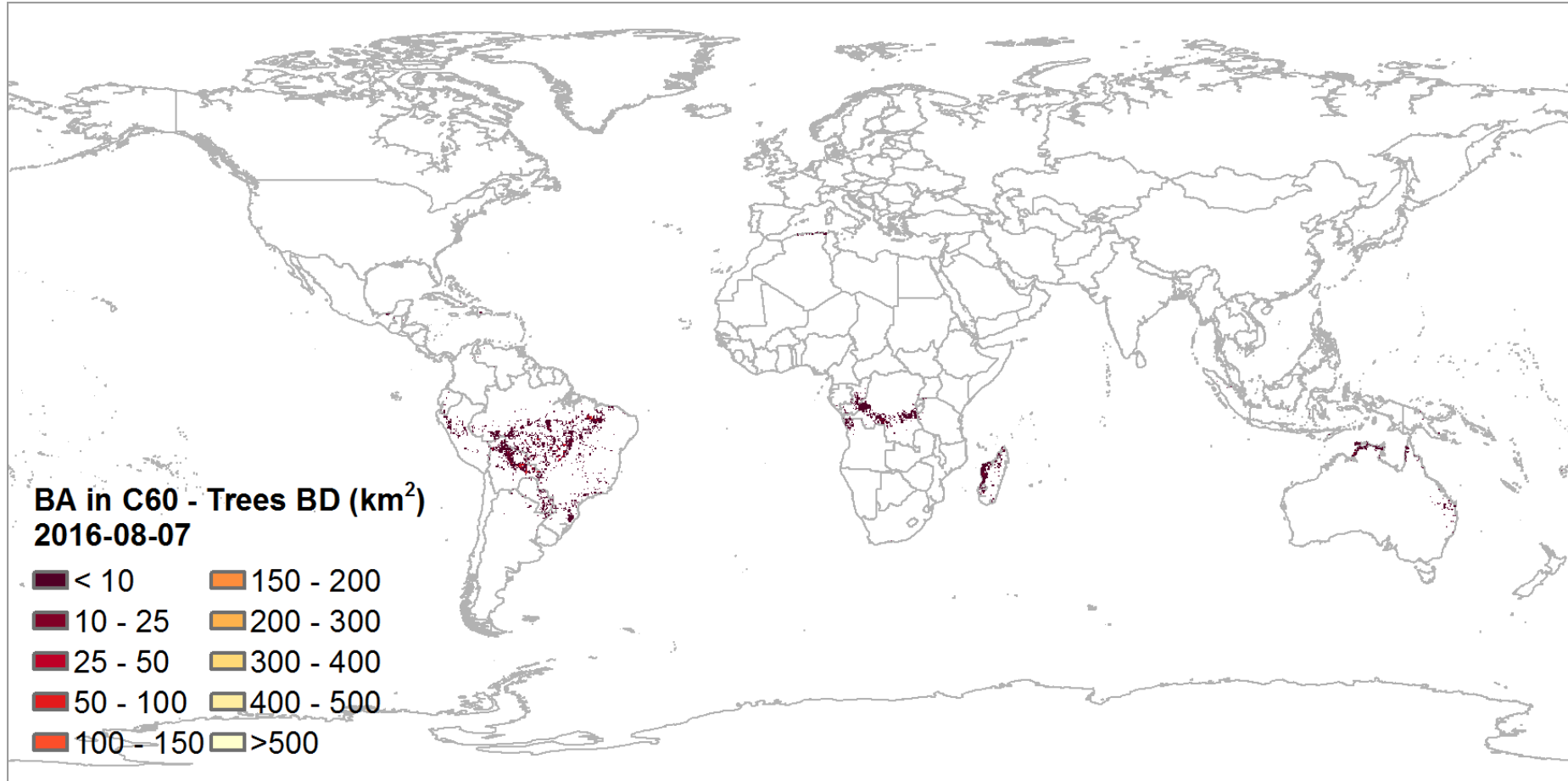
(01-15/07/2016)







(01-15/07/2016)

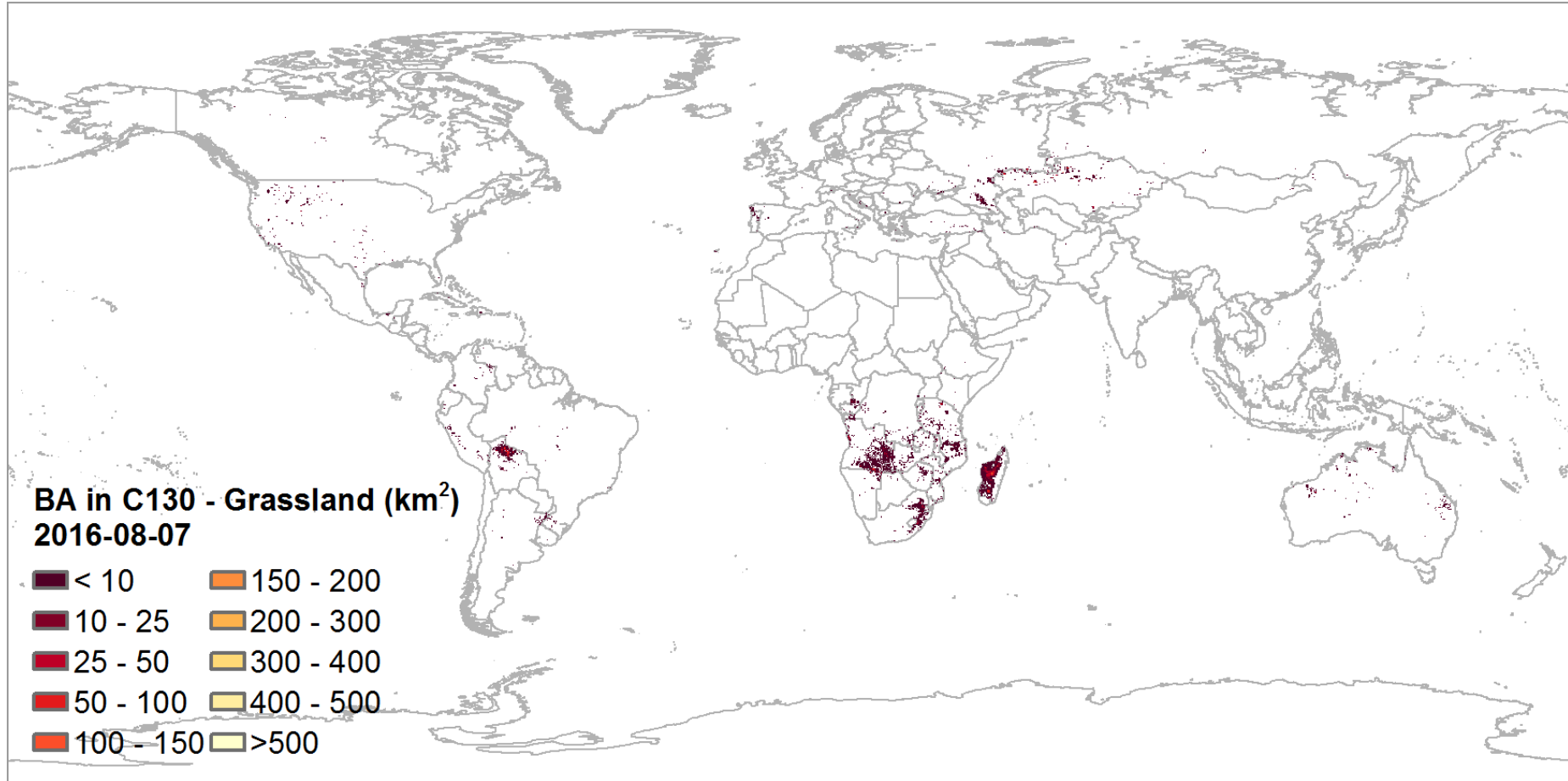




# MODIS Fire\_cci BA v5.0: BA in Grasslands



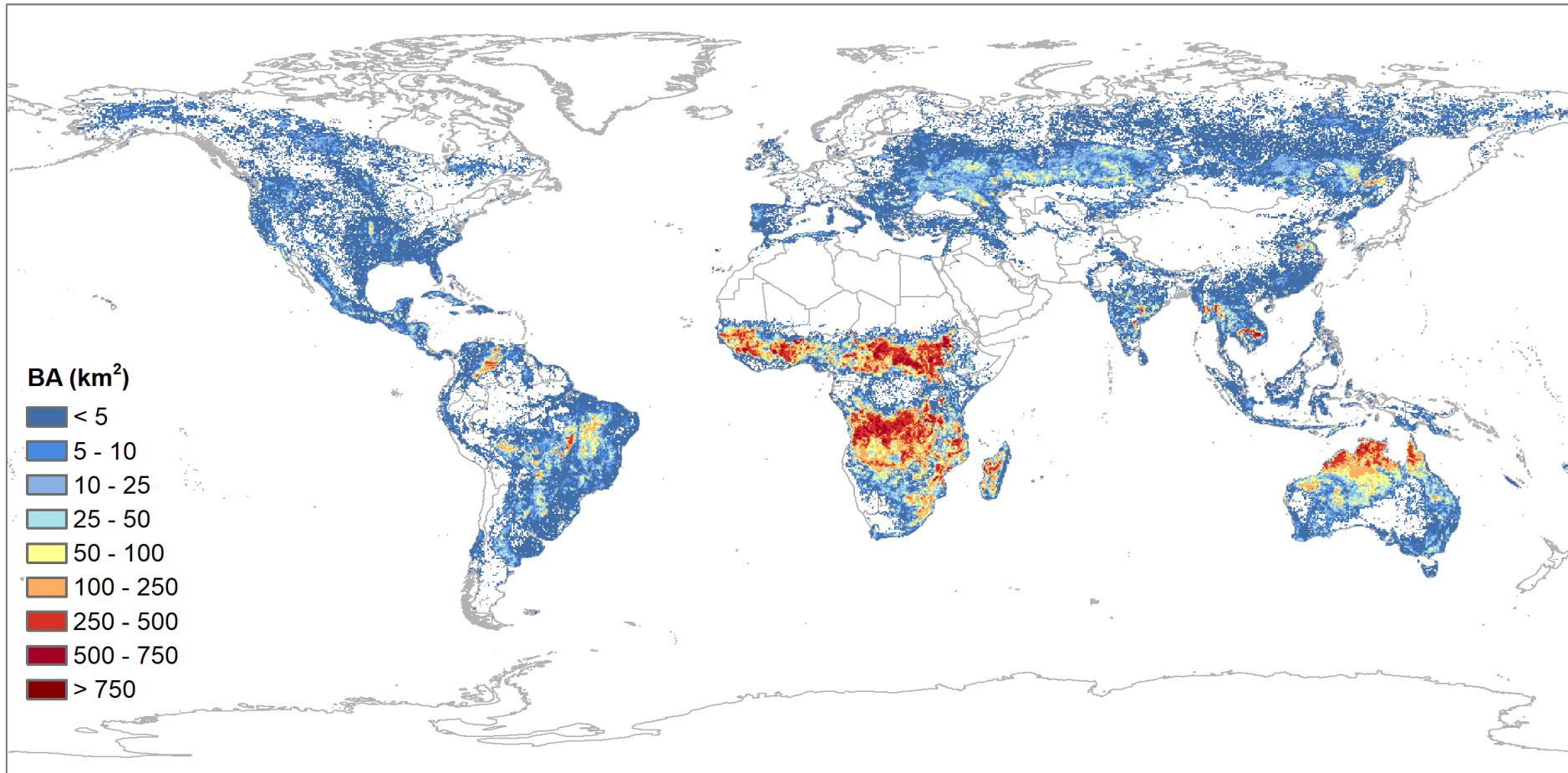
(01-15/07/2016)





# Fire\_cci BA v5.0

## Average burned area



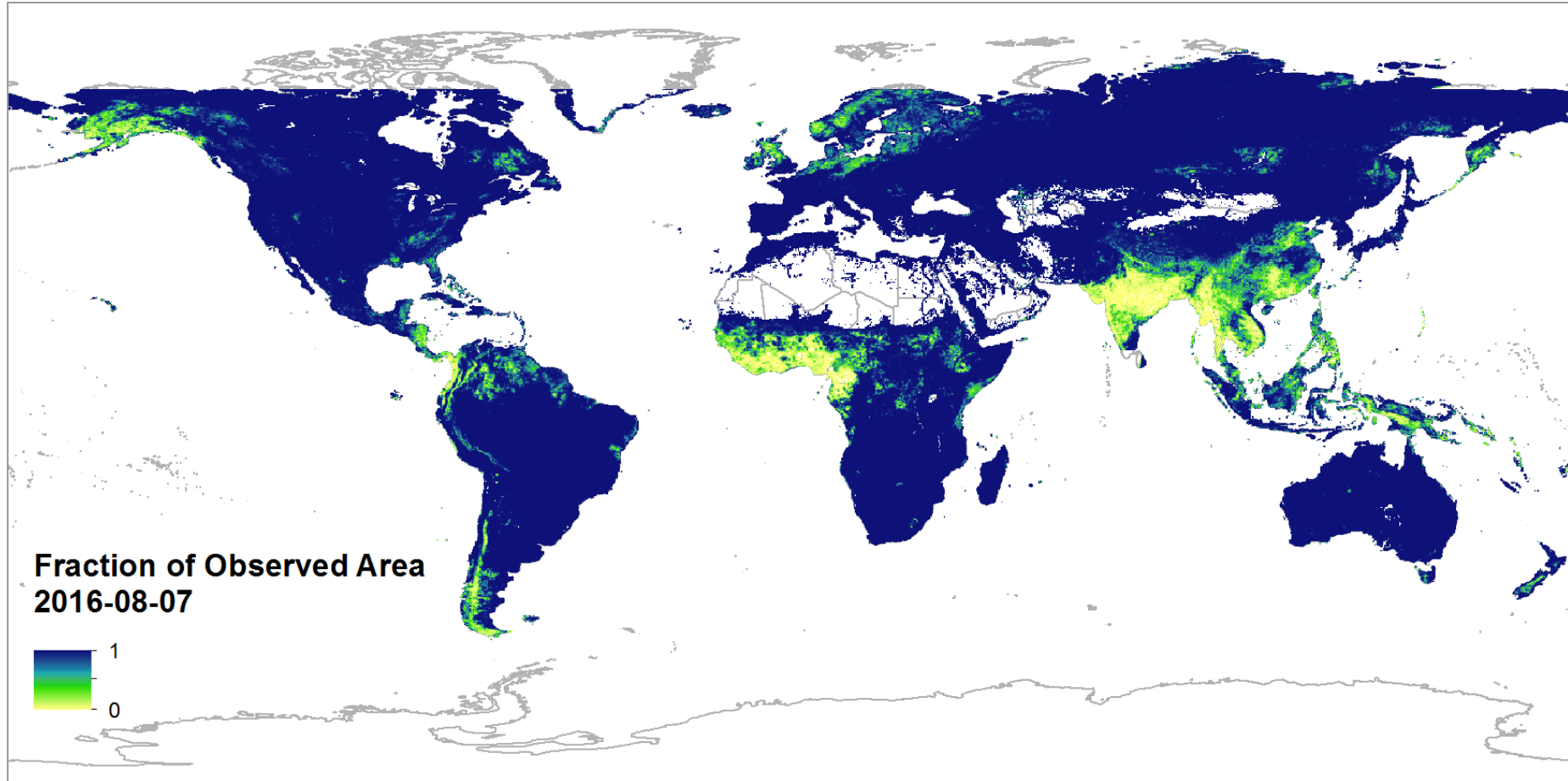
Chuvieco et al., 2018, ESSD



# MODIS Fire\_cci BA v5.0: Fraction of observed area



(01-15/07/2016)





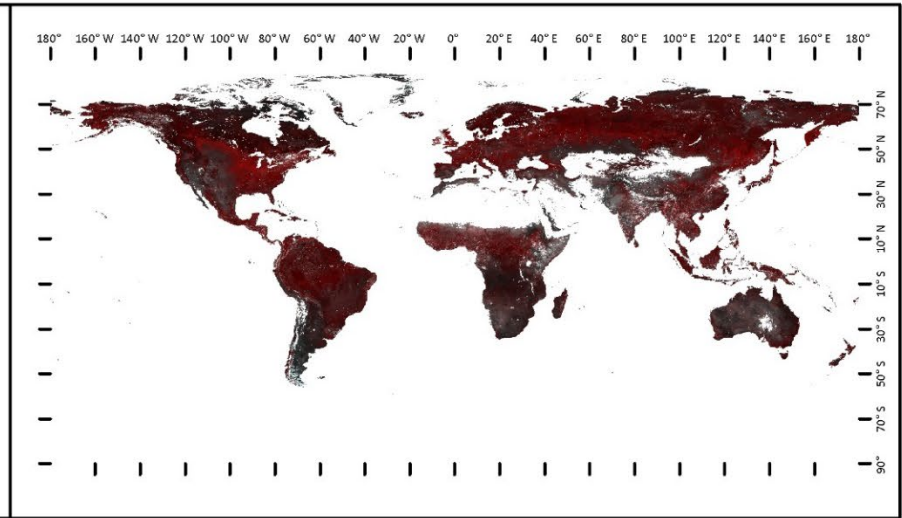
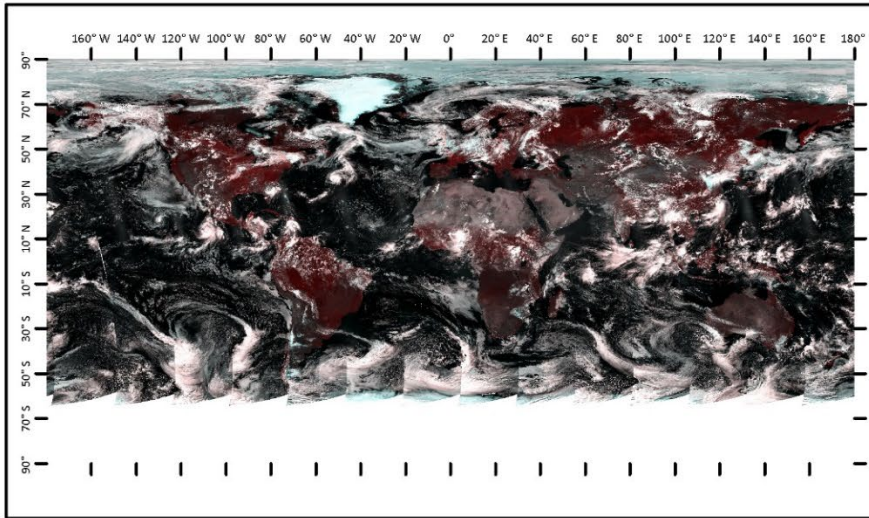


# LTDR BA product

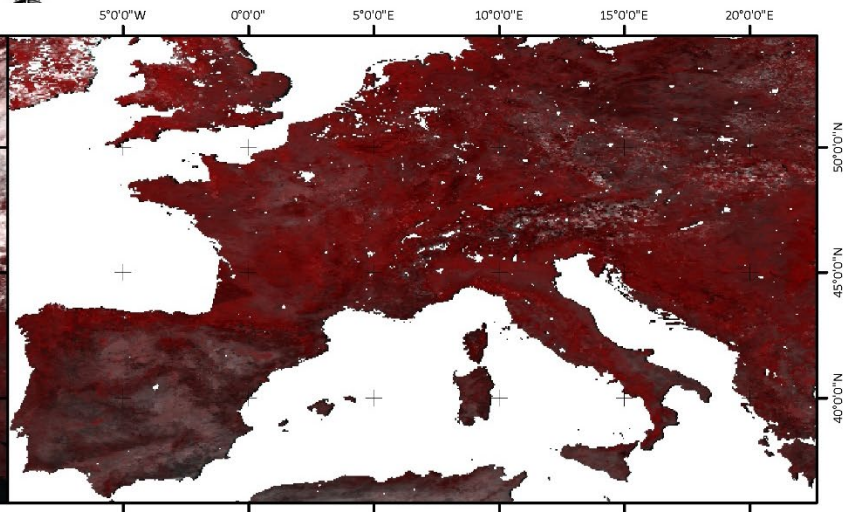
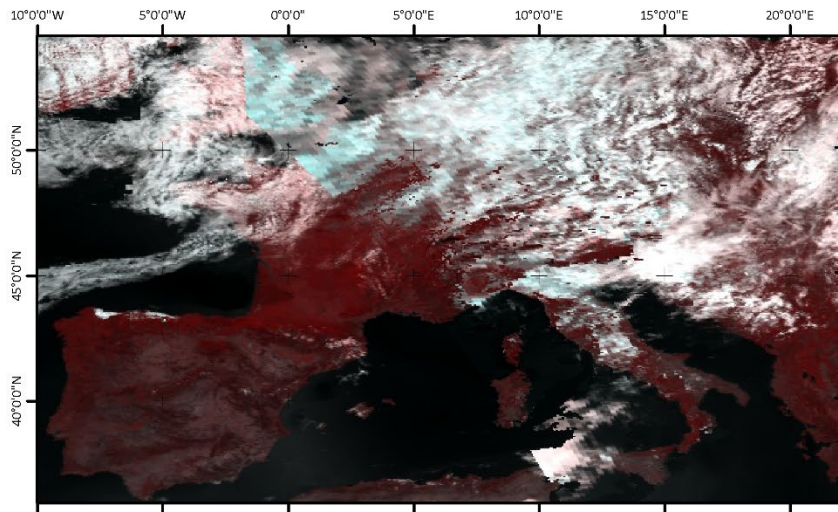


AVH09C1 Year: 2008 Day: 200

Compositing AVH09C1 + Land Cover, Year: 2008, Day: 198 - 213



RGB: NIR RED RED



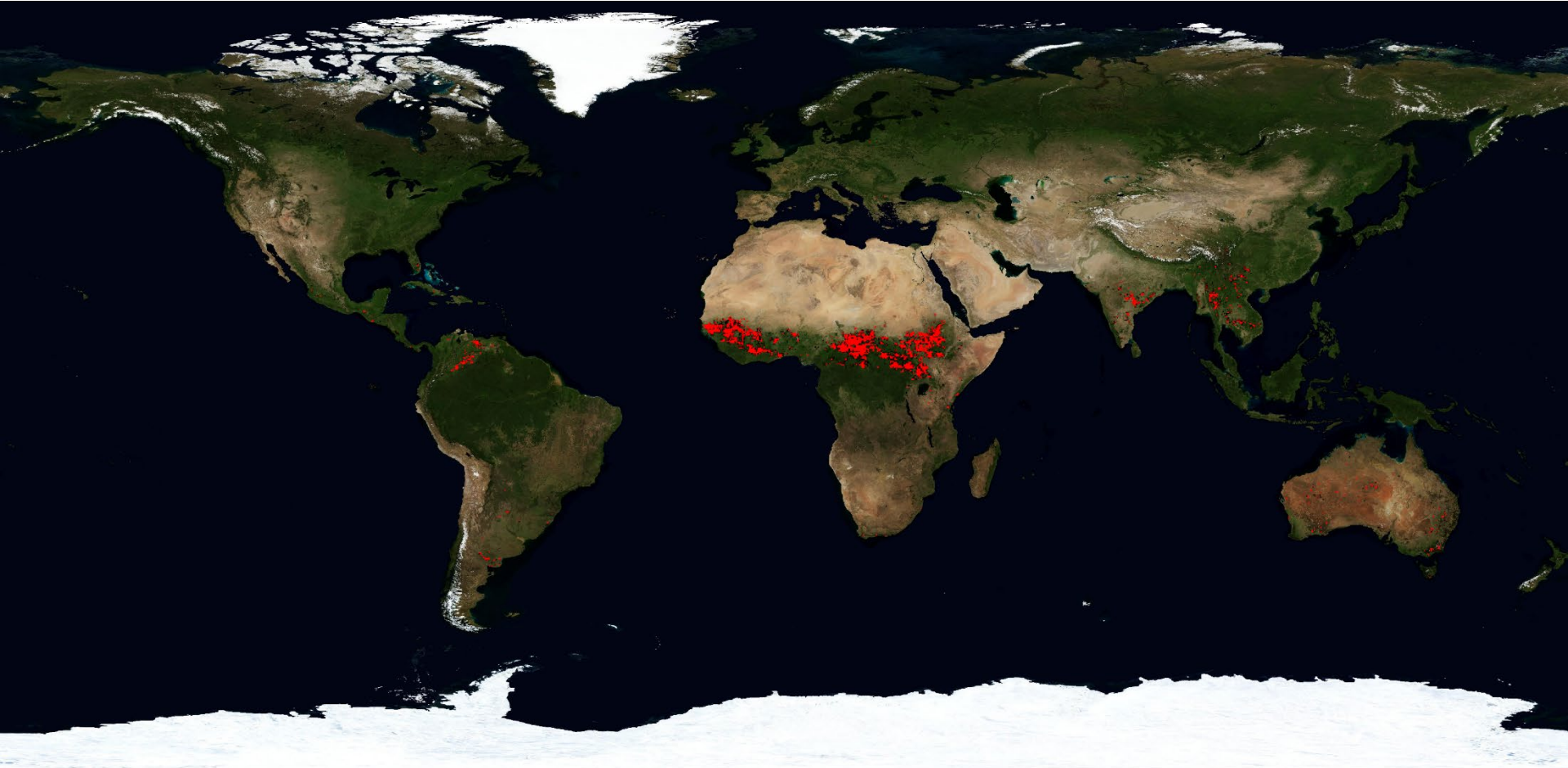




# FireCCILT1 (AVHRR-LTDR Fire\_cci v1)



Sample grid product: Feb 2000





Africa (2016):

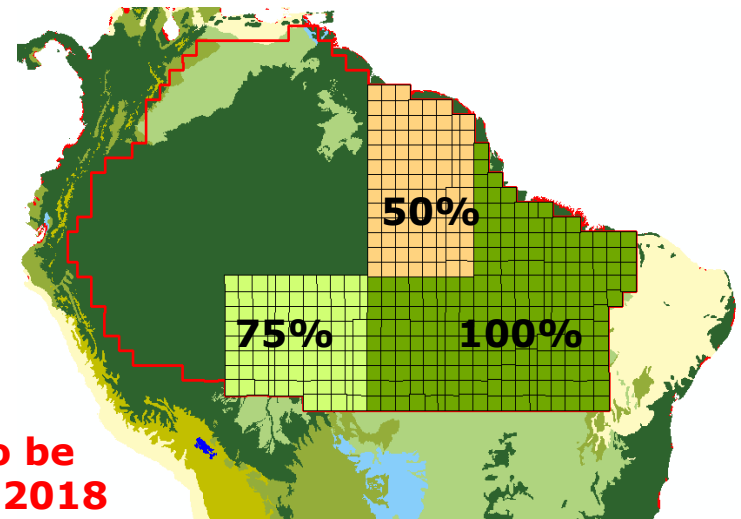
Primary source: Sentinel-2 MSI data: complemented by MODIS HS and S-1 coherence in cloudy regions.

Indonesia (2015-16):

S-1 backscatter pre/post fire season + OBIA

Amazon basin (2017):

S-1 backscatter TS and MODIS/VIIRS HS

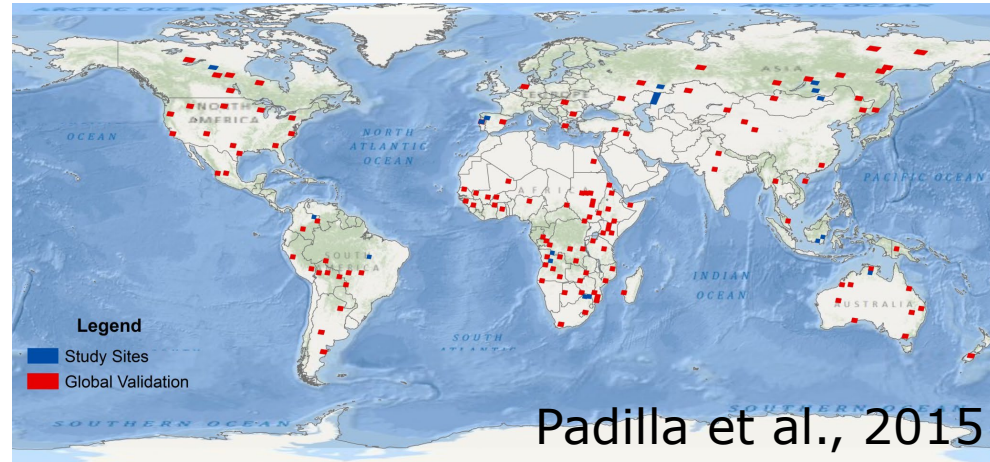


**AWS processing: to be  
completed by Dec. 2018**



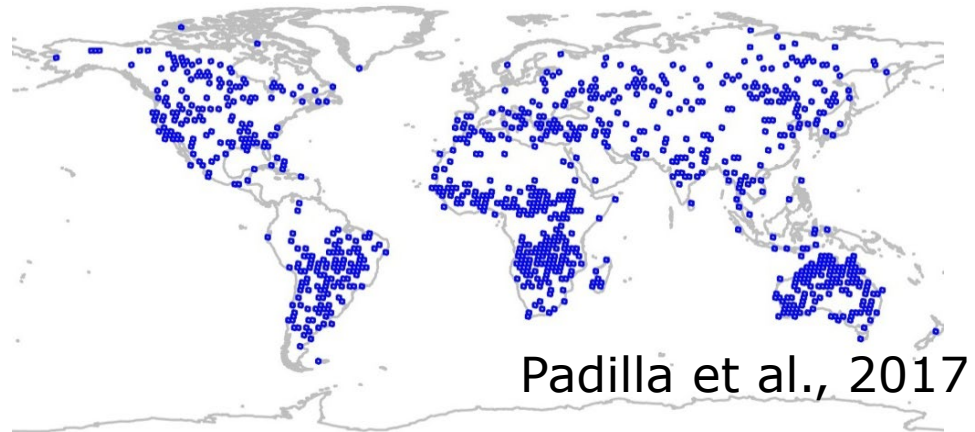
2008:

- 130 sites statistically selected.
- Sampling intensity in each stratum proportional to BA extent



2003-2014

- 1200 sampling units, 100 each year over
- Sampling intensity in each stratum proportional to BA extent
- Minimum 2 units in each stratum







# Validation sample - SFD Amazon



2017:

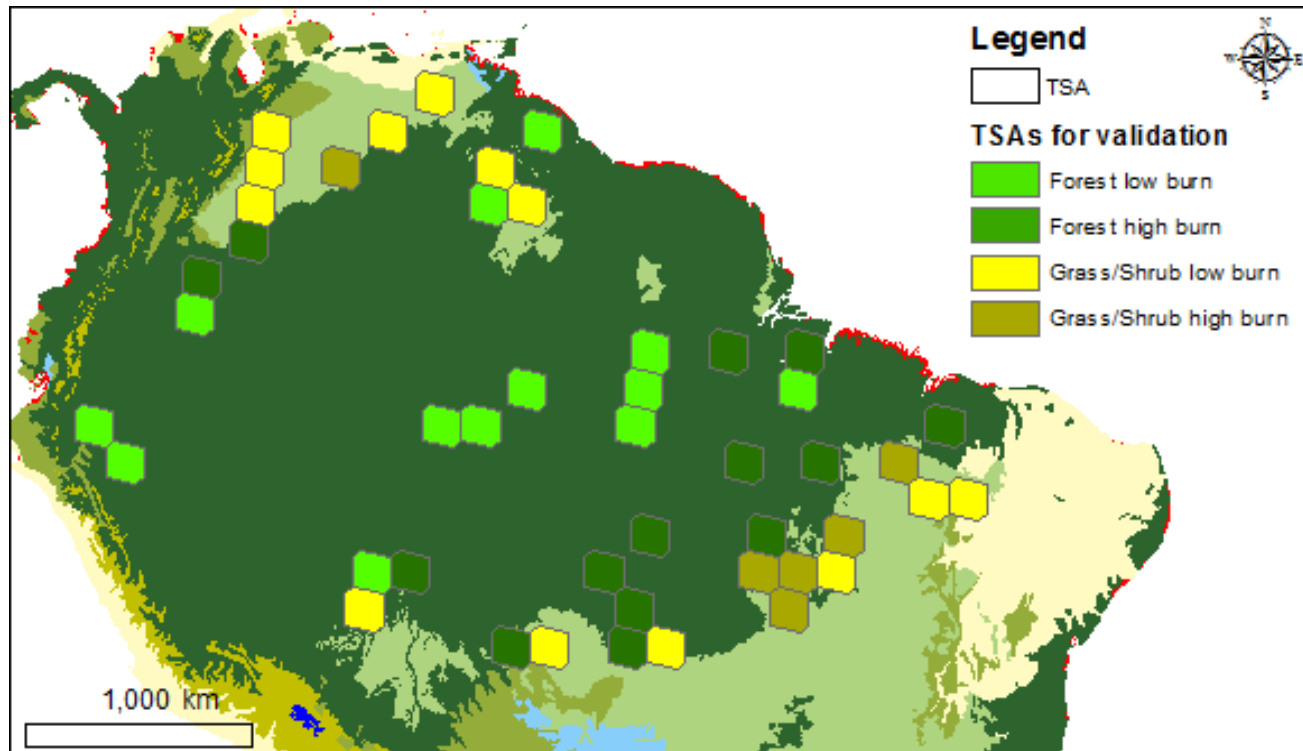
- Amazon LDA (7.8M km<sup>2</sup>)
- 46 TSA
- Sample allocation

$$n = \frac{(\sum W_i S_i)^2}{[s(\hat{0})]^2 + (1/N) \sum W_i S_i^2} \approx \left( \frac{\sum W_i S_i}{s(\hat{0})} \right)^2$$

Olofsson et al. 2014

$$n_h \propto N_h \sqrt{BA_h}$$

Padilla et al. 2017

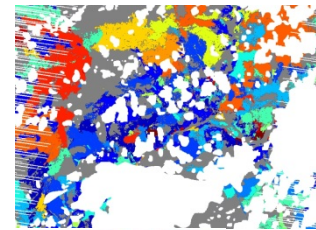




# Updates on validation

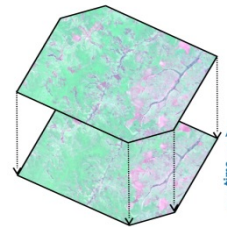
Observations available along long time series (~115 days)

Less amount of observed errors are expected in long (in time) units than in short units

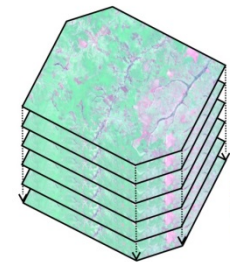


- time ->

unburned  
no-data

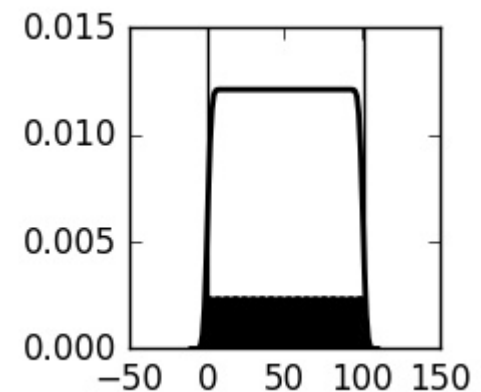
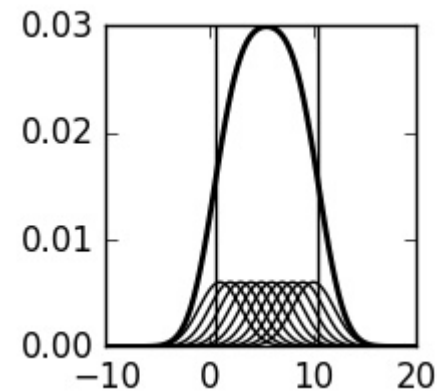
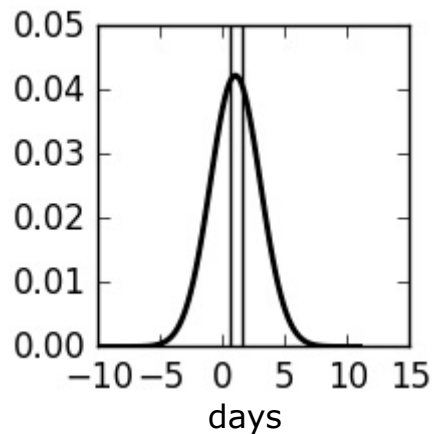


short unit



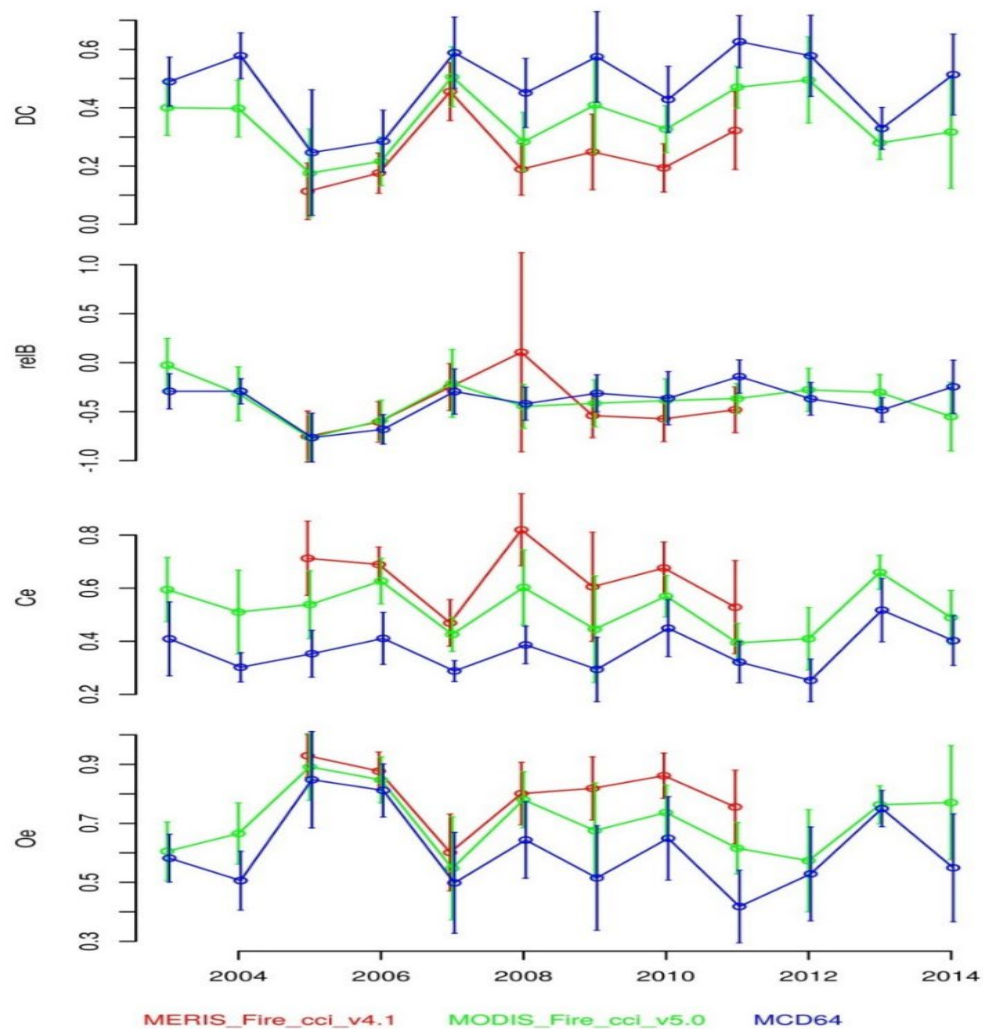
long unit

pdf of BA detection time





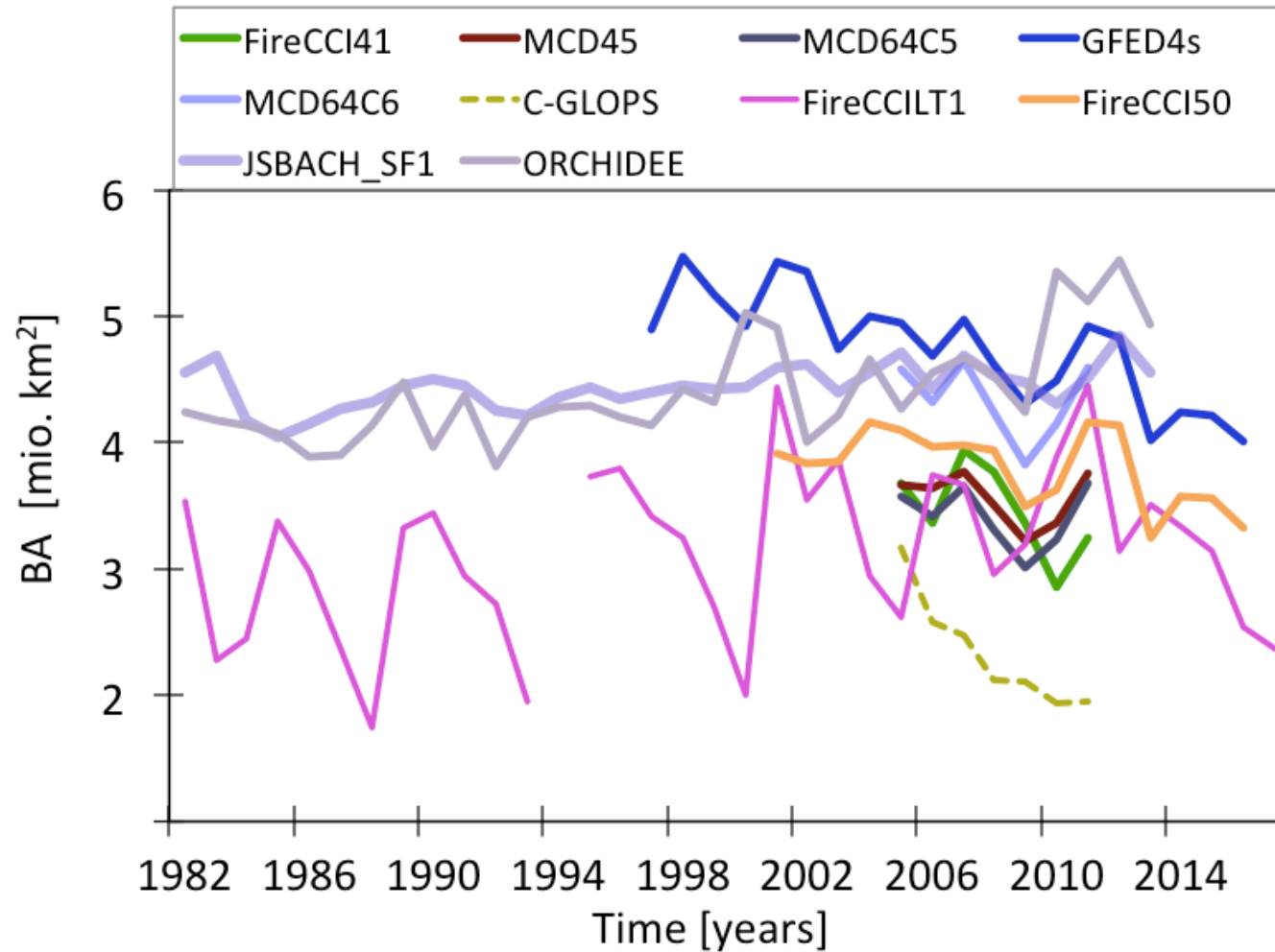
# Validation results: global algorithms







# Intercomparison of annual global BA time series



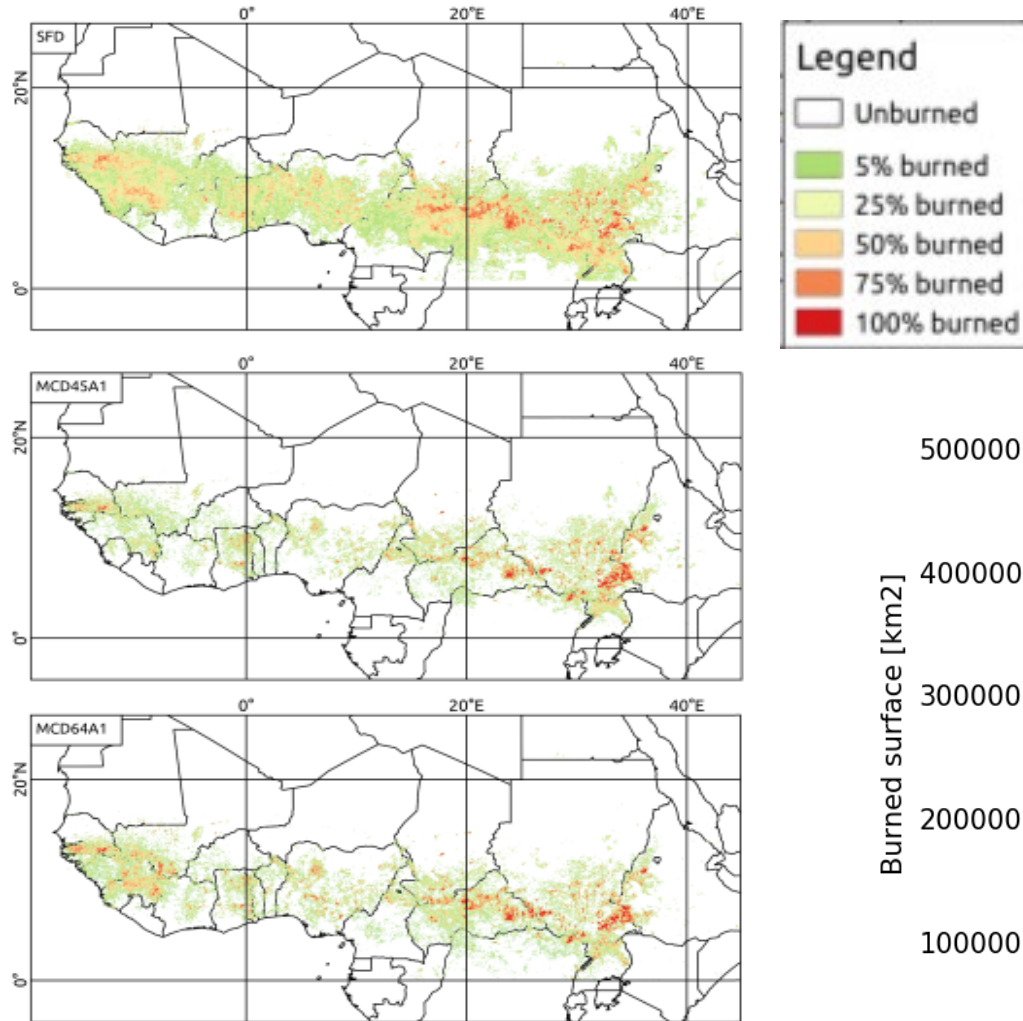
Correlation FireCCILT1 with other satellite BA products low.  
e.g.  $R^2$  with GFED4s (1997-2015) is 0.02!

FireCCILT1 has strong inter-annual variability:  
f(observational gaps)?

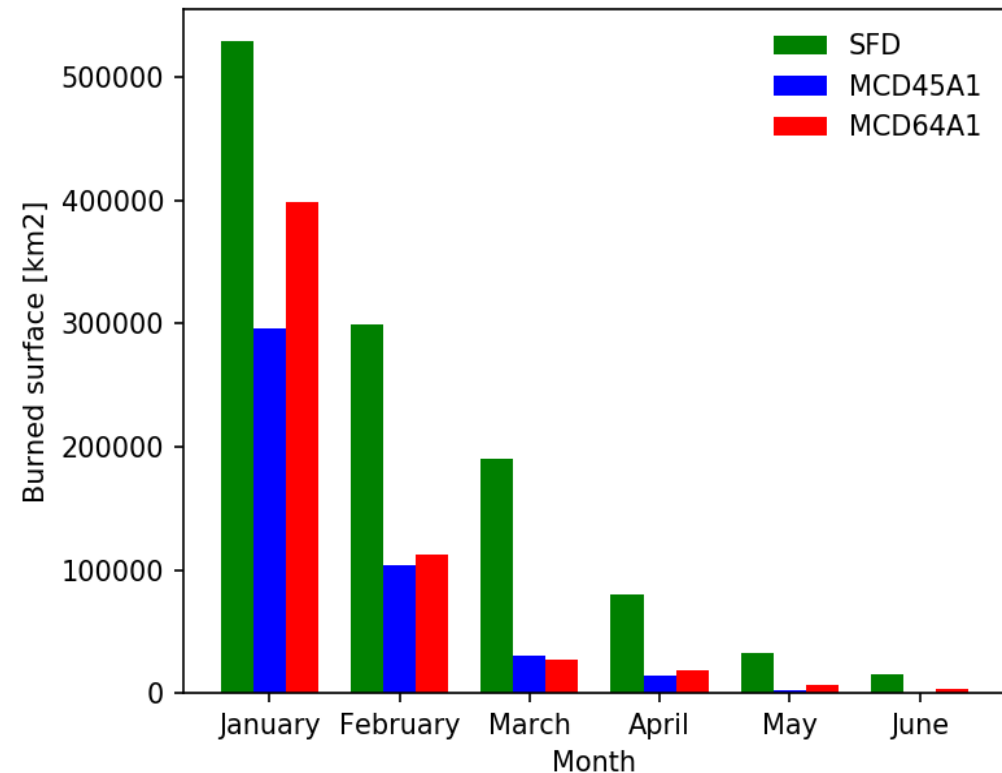
Low inter-annual variability in FireMIP models



# BA detected by S2-MSI is much higher than current global products



Total burned surface in the first half of 2016



Roteta et al., 2018, RSE

ESA UNCLASSIFIED - For Official Use



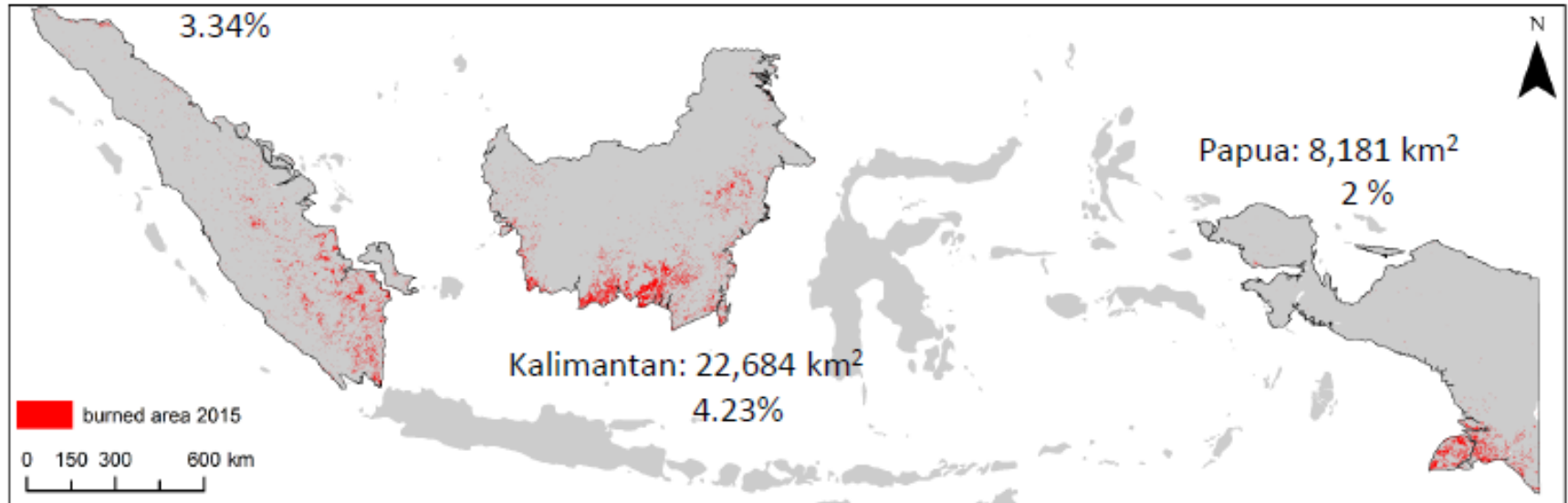
European Space Agency



# SFD S-1: Indonesia 2015

Sumatra: 15,181 km<sup>2</sup>

3.34%



Papua: 8,181 km<sup>2</sup>

2 %

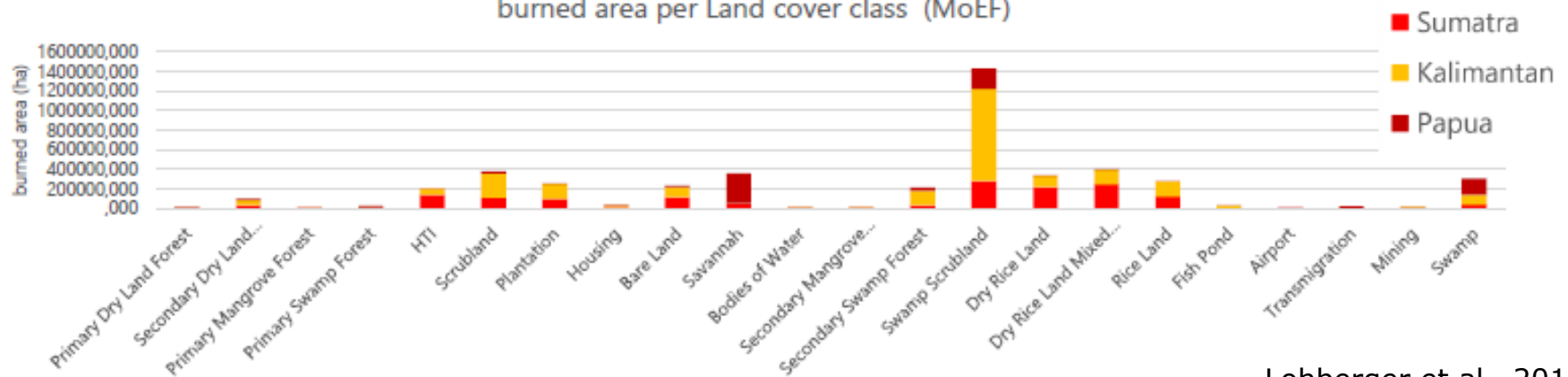
Kalimantan: 22,684 km<sup>2</sup>

4.23%

burned area 2015

0 150 300 600 km

burned area per Land cover class (MoEF)



Lohberger et al., 2017

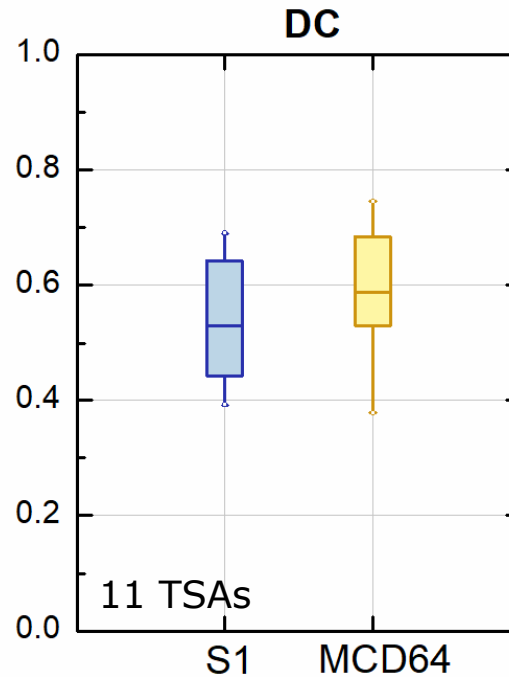
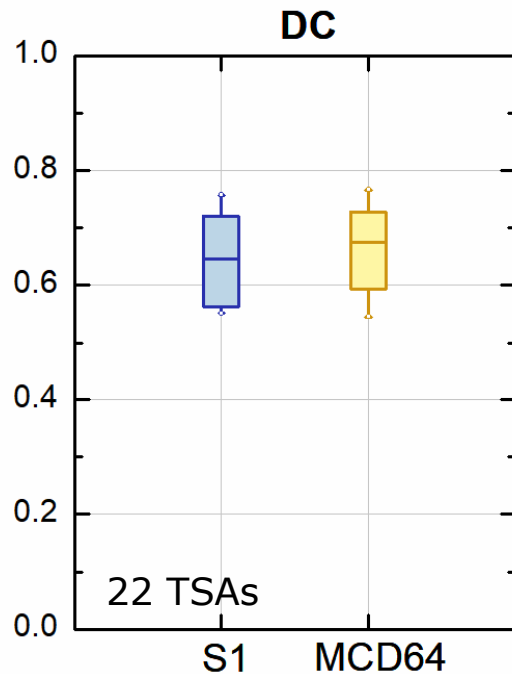




# Validation results: SFD Amazon



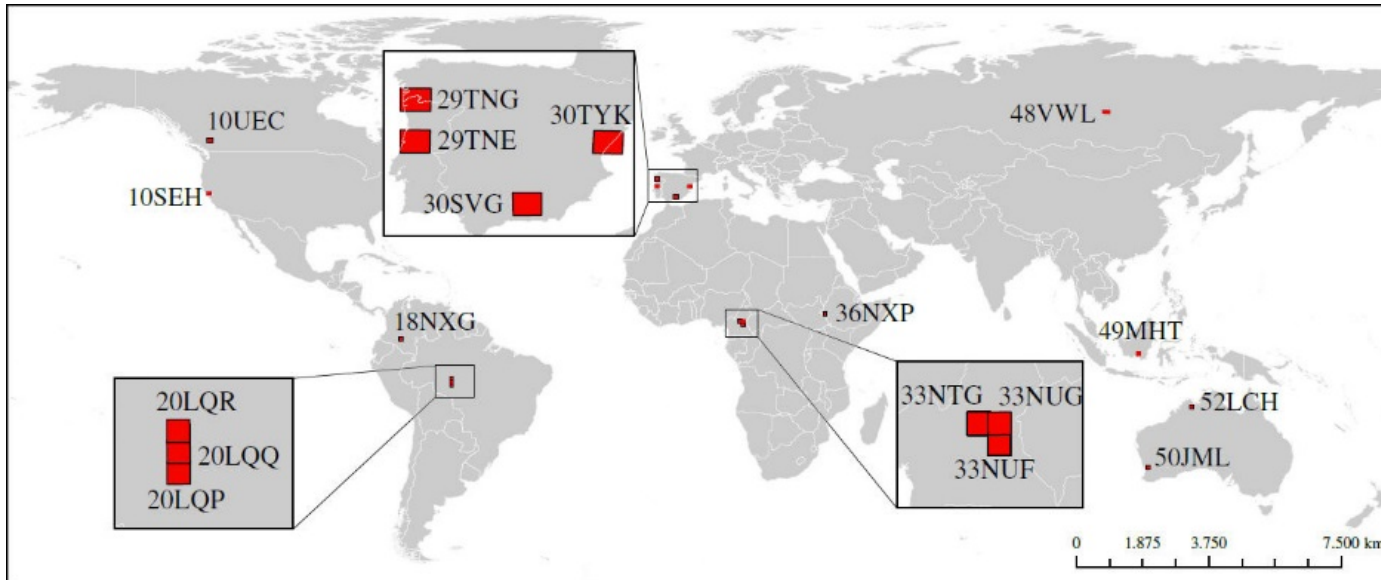
| Class                       | Sentinel-1 product |             |       |             | MCD64 product |      |       |             |
|-----------------------------|--------------------|-------------|-------|-------------|---------------|------|-------|-------------|
|                             | CE                 | OE          | relB  | DC          | CE            | OE   | relB  | DC          |
| <b>Total</b>                | <b>0.37</b>        | <b>0.36</b> | 0.01  | <b>0.63</b> | 0.16          | 0.45 | -0.34 | <b>0.66</b> |
| <b>Forest high burn</b>     | 0.59               | 0.19        | 0.97  | 0.54        | 0.42          | 0.62 | -0.34 | 0.46        |
| <b>Forest low burn</b>      | 0.63               | 0.19        | 1.21  | 0.50        | 0.13          | 0.54 | -0.47 | 0.60        |
| <b>Grasslands high burn</b> | 0.18               | 0.28        | -0.12 | 0.77        | 0.11          | 0.33 | -0.24 | 0.77        |
| <b>Grasslands low burn</b>  | 0.59               | 0.19        | 0.97  | 0.54        | 0.22          | 0.69 | -0.60 | 0.44        |



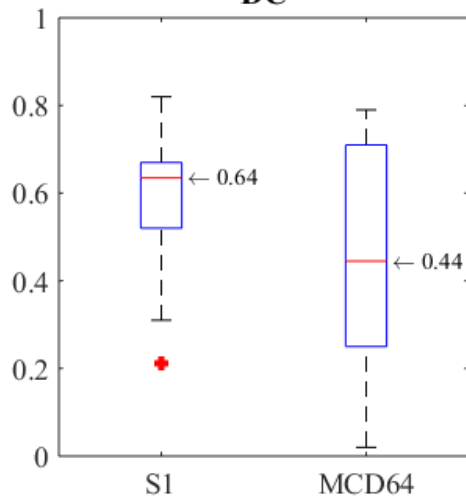
Fernandez-Carrillo et al., 2018



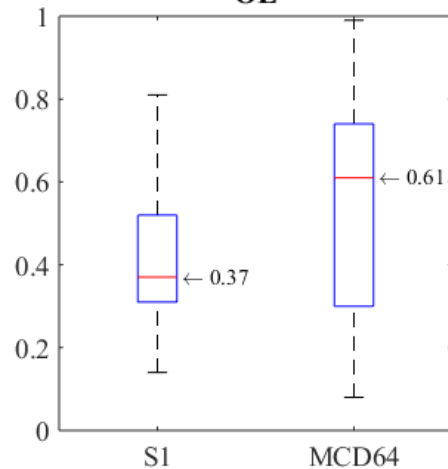
# S1 backscatter algorithm: global application



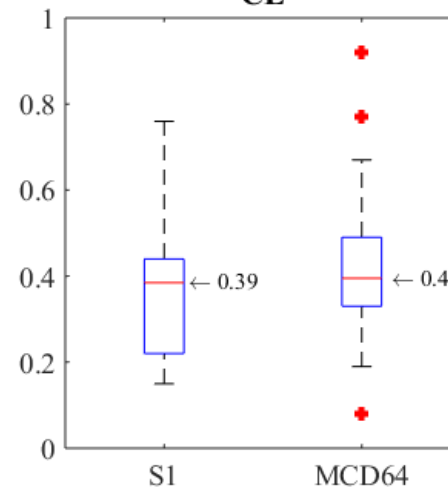
DC



OE

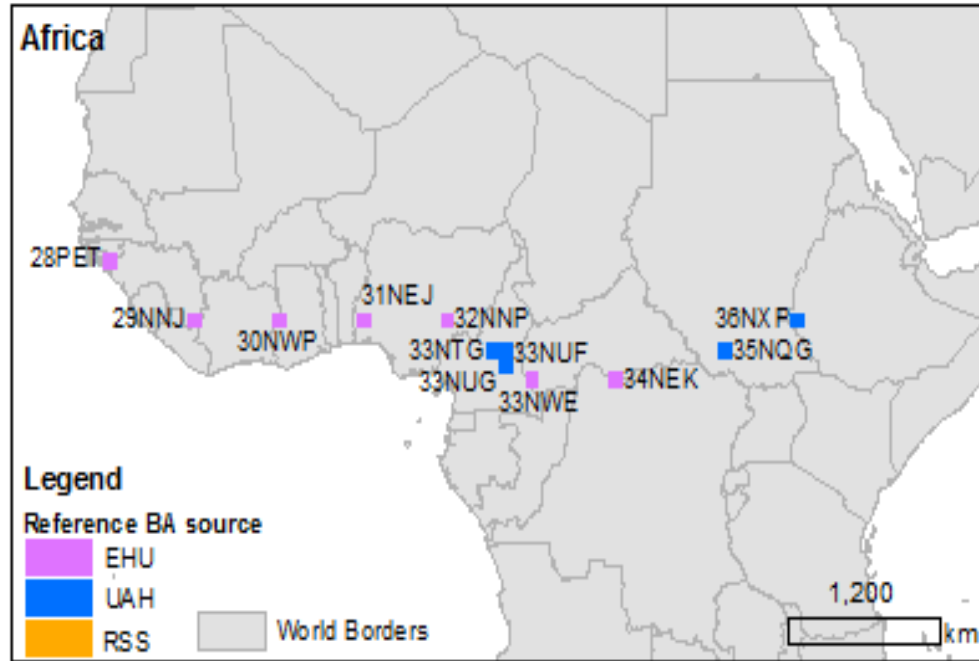


CE





# SFD algorithm inter-comparison



| Algorithm | Land cover | OE   | CE   | DC   | LU/LC (%) |
|-----------|------------|------|------|------|-----------|
| UAH       | Crops      | 0.62 | 0.35 | 0.48 | 16        |
|           | Grasslands | 0.71 | 0.49 | 0.37 | 2         |
|           | Shrubs     | 0.62 | 0.40 | 0.47 | 23        |
|           | Forests    | 0.54 | 0.35 | 0.54 | 58        |
|           | Others     | 0.49 | 0.41 | 0.55 | 1         |
| EHU       | Crops      | 0.15 | 0.14 | 0.86 | 23        |
|           | Grasslands | 0.24 | 0.51 | 0.60 | 2         |
|           | Shrubs     | 0.44 | 0.45 | 0.55 | 18        |
|           | Forests    | 0.29 | 0.13 | 0.79 | 55        |
|           | Others     | 0.29 | 0.04 | 0.82 | 1         |
| UL        | Crops      | 1.00 | 0.46 | 0.01 | 21        |
|           | Grasslands | 1.00 | N/A  | N/A  | 2         |
|           | Shrubs     | 0.97 | 0.13 | 0.06 | 19        |
|           | Forests    | 0.98 | 0.10 | 0.05 | 56        |
|           | Others     | N/A  | N/A  | N/A  | 1         |
| RSS       | Crops      | 0.90 | 0.22 | 0.17 | 2         |
|           | Grasslands | 1.00 | N/A  | 0.00 | 1         |
|           | Shrubs     | 0.99 | 0.53 | 0.03 | 15        |
|           | Forests    | 0.99 | 0.44 | 0.03 | 82        |
|           | Others     | 0.87 | 0.05 | 0.23 | 0         |

| Algorithm  | Sensor | # of tiles | # of periods | Test area (M pixels) | OA   | OE   | CE   | DC    |
|------------|--------|------------|--------------|----------------------|------|------|------|-------|
| S1-σ-Ama.  | S1     | 11         | 15           | 85.3                 | 0.90 | 0.60 | 0.37 | 0.49  |
| S2-Af.     | S2     | 11         | 12           | 61.9                 | 0.92 | 0.33 | 0.29 | 0.69* |
| S1-Coh-Af. | S1     | 11         | 12           | 59.8                 | 0.87 | 0.72 | 0.57 | 0.34  |
| S1-σ-Ind.  | S1     | 3          | 3            | 17.7                 | 0.92 | 0.99 | 0.46 | 0.03  |

\* six tiles with reference perimeters derived from Sentinel-2





# Thank you