climate change initiative

→ FIRE

"Global and continental burned area datasets from the ESA FireCCI project"

Emilio Chuvieco, Universidad de Alcalá

On behalf the FireCCI consortium

fire cci

ESA CCI

GITA
UNIVERSIDAD DE ALCALÁ

Land

- biomass cci
- fire cci
- high resolution land cover cci
- lakes cci
- land cover cci
- land surface temperature cci

Atmosphere

- aerosol cci
- cloud cci
- ghg cci
- ozone cci
- water vapour cci

Ocean

- salinity cci
- sst cci
- sea state cci
- sea ice cci
- sea level budget closure cci
- sea level cci
- ocean colour cci

Ice

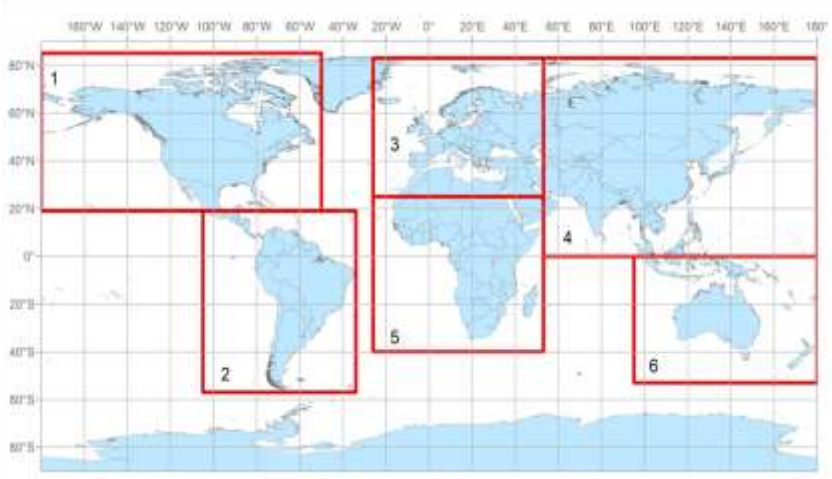
- antarctic ice sheet cci
- glaciers cci
- greenland ice sheet cci
- permafrost cci
- snow cci

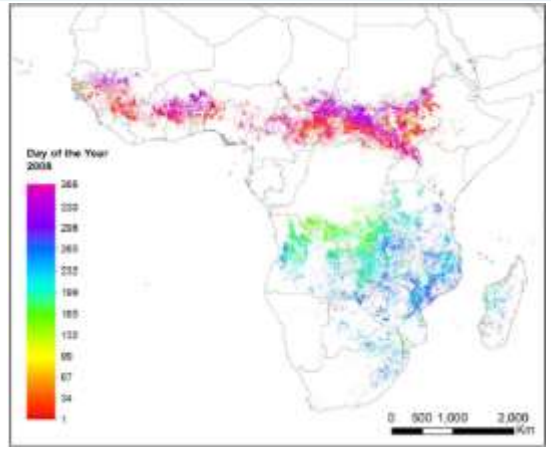
Transversal

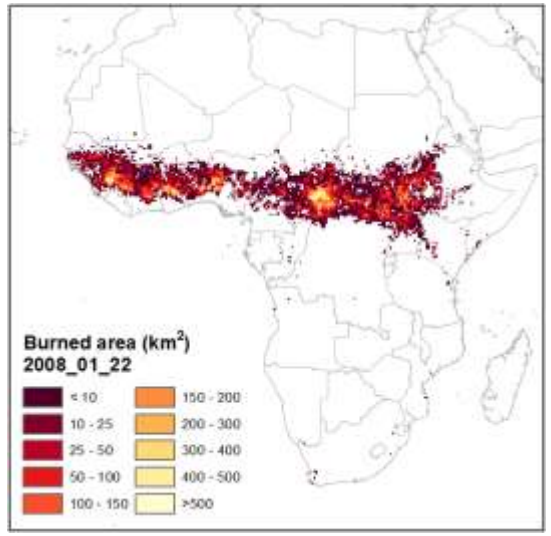
- cmug cci
- open data portal cci
- toolbox cci

BA product specifications

- Pixel product:
  - Monthly files, continental tiles, GeoTiff format.
  - 3 Variables: Day of detection (1-366), Confidence level (0-100), Burned land cover (derived from LC_cci).







- Grid product:
  - Monthly 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, and burned area of each land cover.

FireCCI BA algorithms

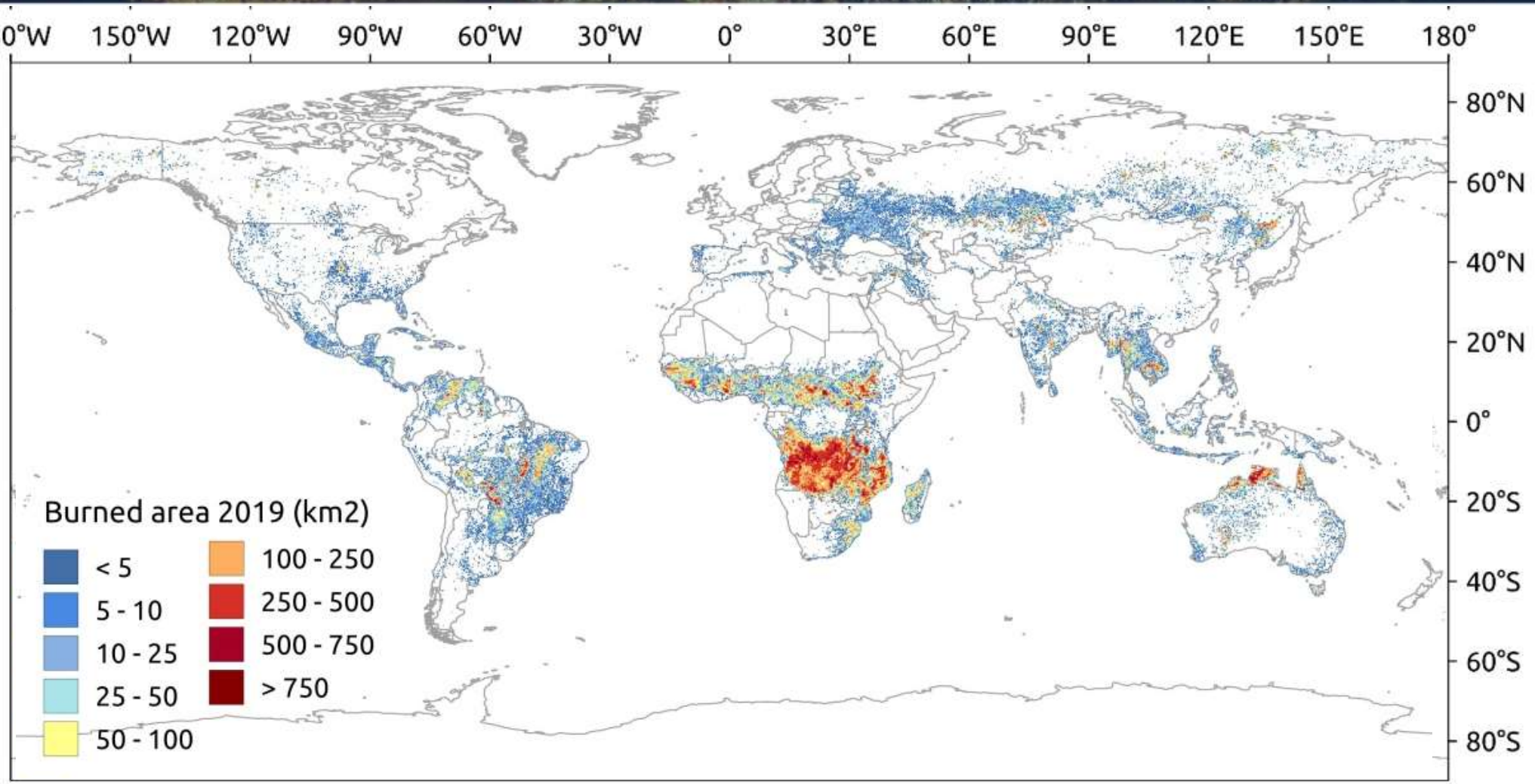
Adapted to the different input sensors:

- MERIS, 300 m.
- MODIS, 250m.
- Sentinel-3, OLCI 300 m
- Sentinel-3, SYN 300 m.
- AVHRR – LTDR, 5 km.
- Sentinel-1 SAR, 40 m
- Sentinel-2 MSI, 20 m.

Common approaches:

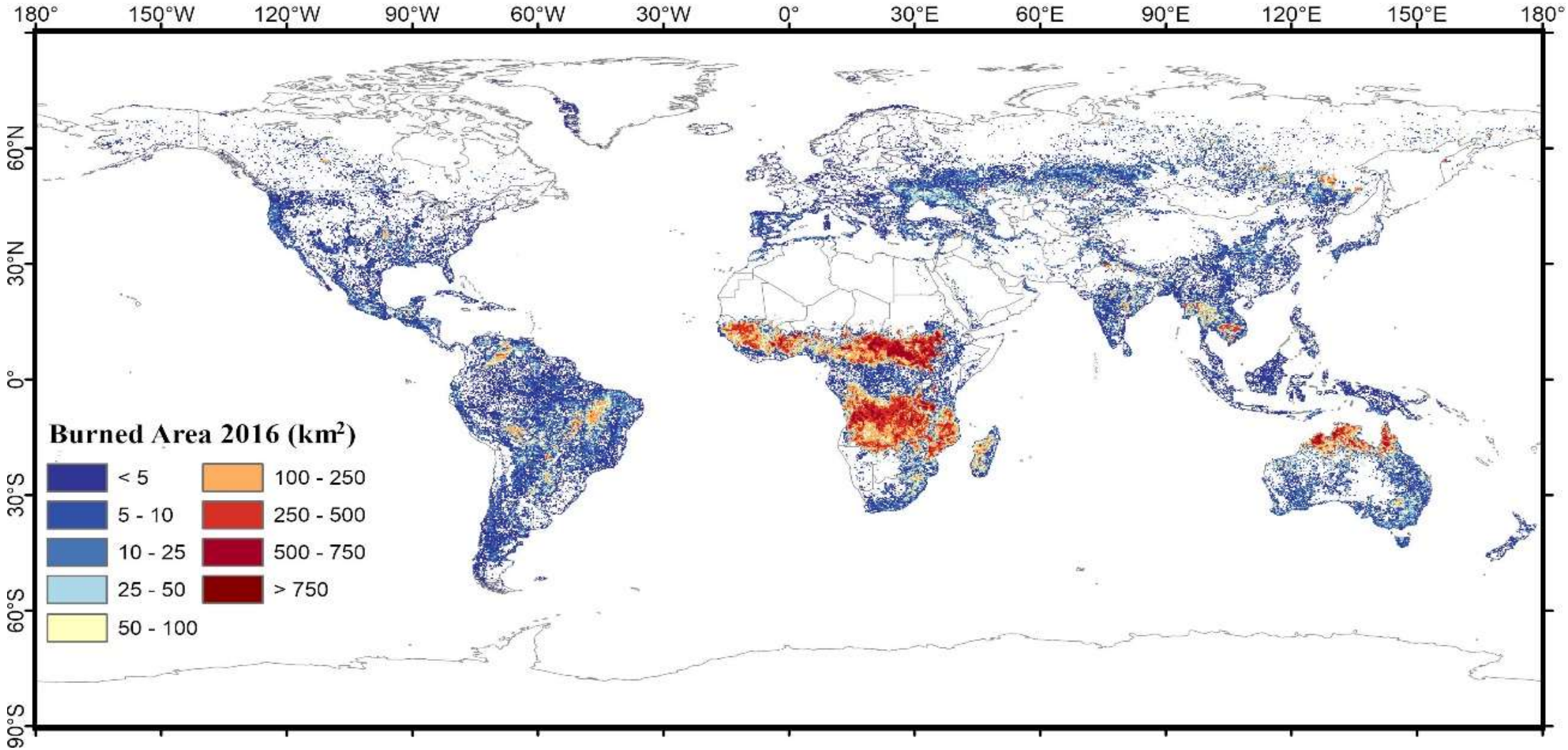
- Hybrid algorithms: active fires guide BA detection.
- Two-phase: seed + growing.
- Locally adapted.
- Based on temporal composites.

FireCCI51 (MODIS 250m + HS)



Lizundia-Loiola et al., 2020, RSE

FireCCILT11 (AVHRR 0.05 d)



Oton et al., 2021, IJAG

Most recent global products

FireCCIS310:

- Sentinel-3 SYN data 300 m + VIIRS AF.
- Only 2019 (foreseen 2020-22).
- Methods:
  - NIR —>NBR2,
  - MODIS —> VIIRS AF
  - LC CCI —> LC C3S.
- Compositing 20 days —> Flexible
- Tile-based+contextual —> Contextual.

Punjab

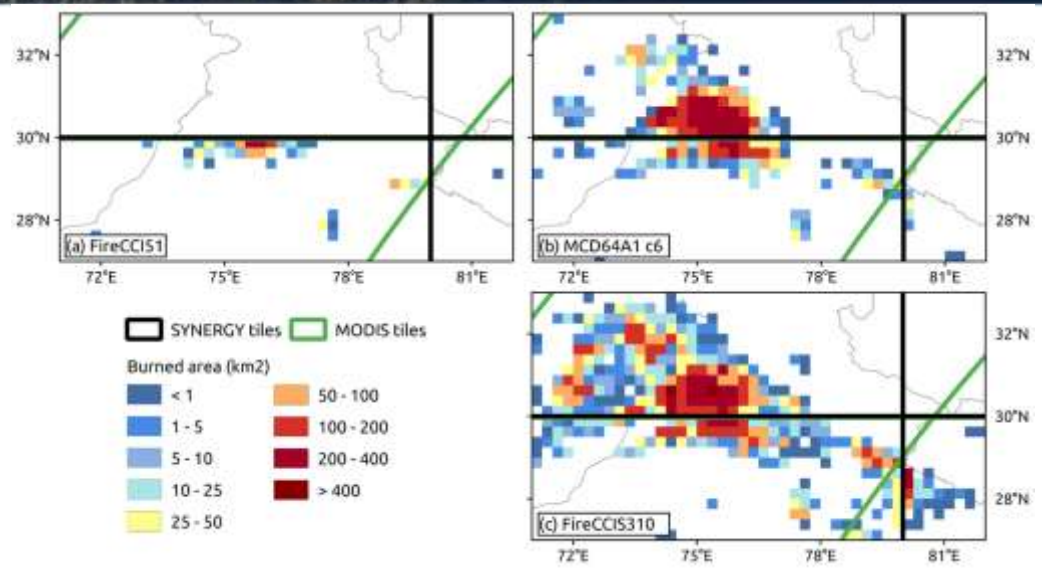
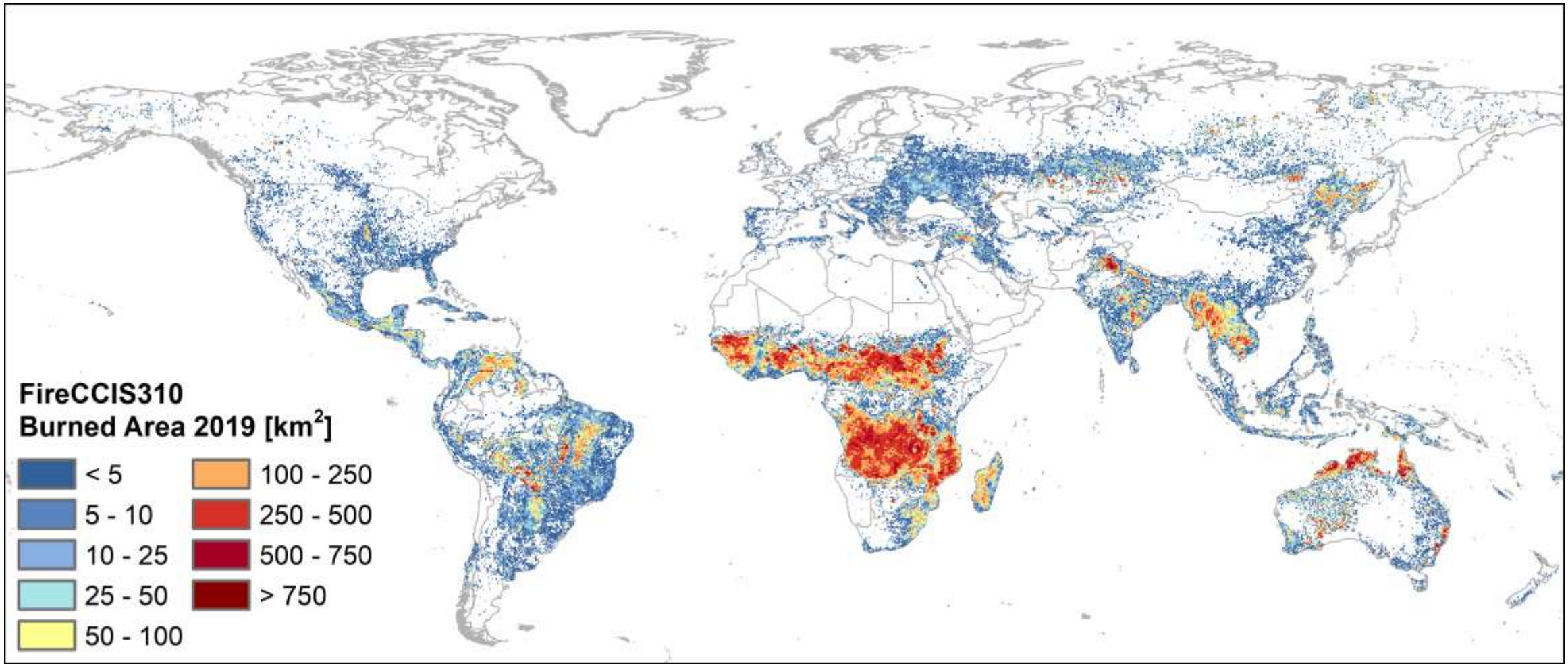


Table 4. Burned area (km^2) of the year 2019 for each product and biome.

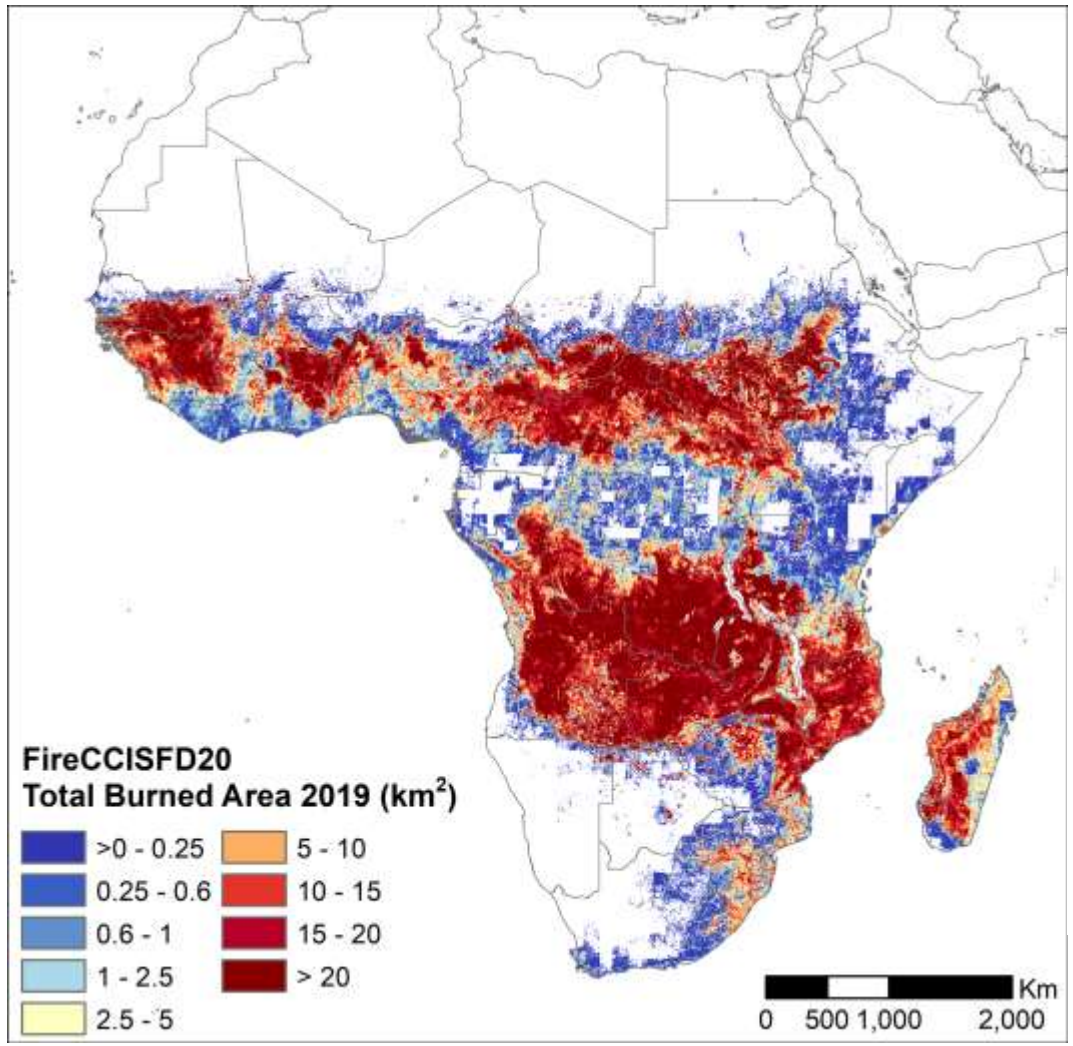
	FireCCI51	MCD64A1 c6	FireCCIS310	
Boreal forest	86711	72370	87145	
Deserts & xeric shrublands	116907	176164	253192	+116%
Mediterranean	29162	32364	39765	
Temperate forest	111999	105320	165621	+48%
Temperate savanna	165610	145221	220141	
Tropical forest	433493	400165	897703	+107%
Tropical savanna	2958452	2529860	3311552	
Tundra	11531	8437	12000	
Global	3913865	3469901	4987119	+27%

FireCCIS310 (OLCI + SLSTR at 300m)



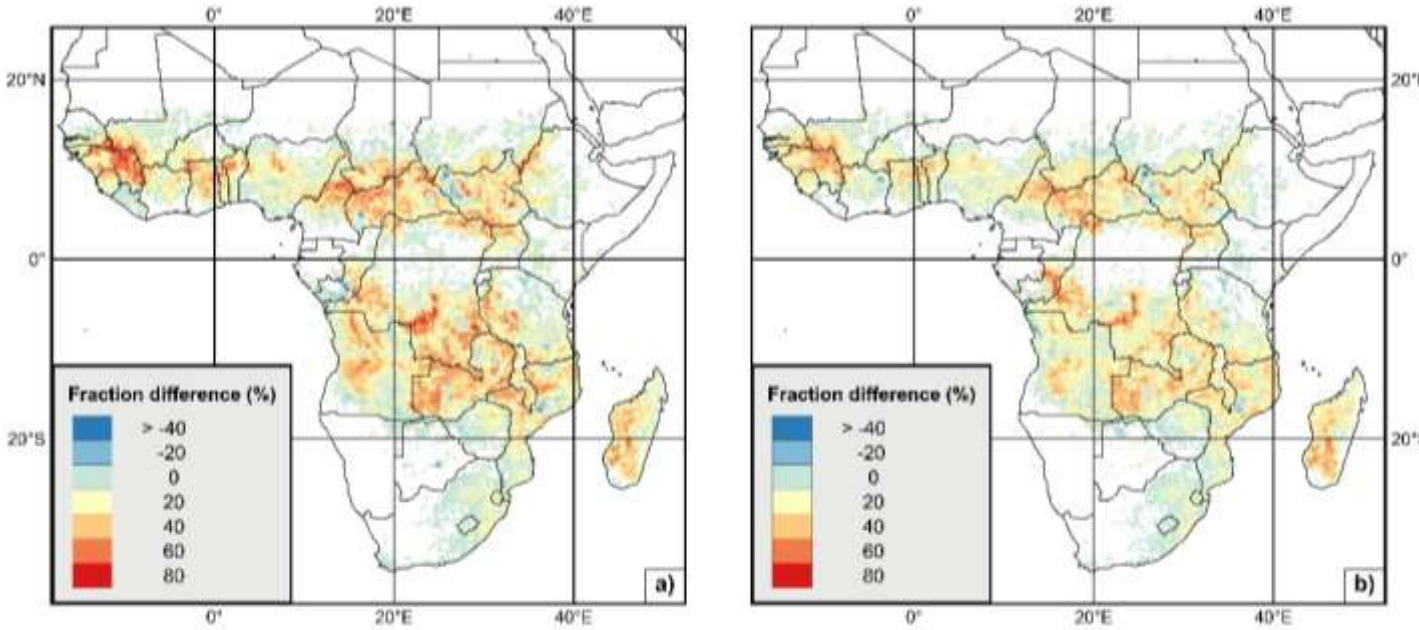
Lizundia-Loiola et al., 2022, RSE

Regional products: Africa (2019) Sentinel 2A & 2B



(Chuvieco et al., 2022, STOTEN)

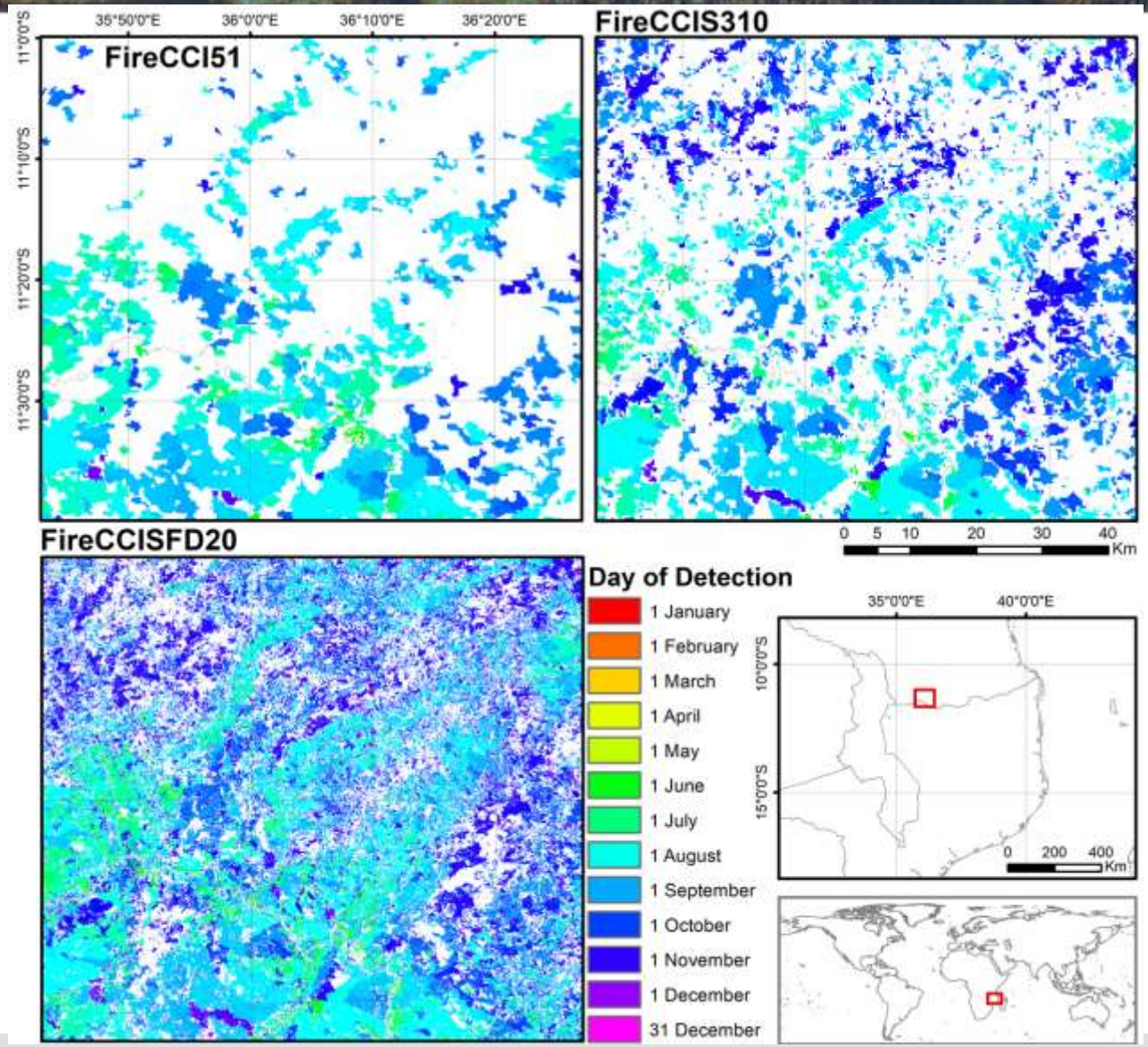
4.8 Mkm^2 just for Africa. More BA in all months
80% more BA than FireCCI51 (MODIS 250 m)
120% more BA than MCD64A1 (MODIS 500 m)



Difference in BA proportion between FireCCISFD20 and a) MCD64A1 and b) FireCCI51

Differences with existing global BA products

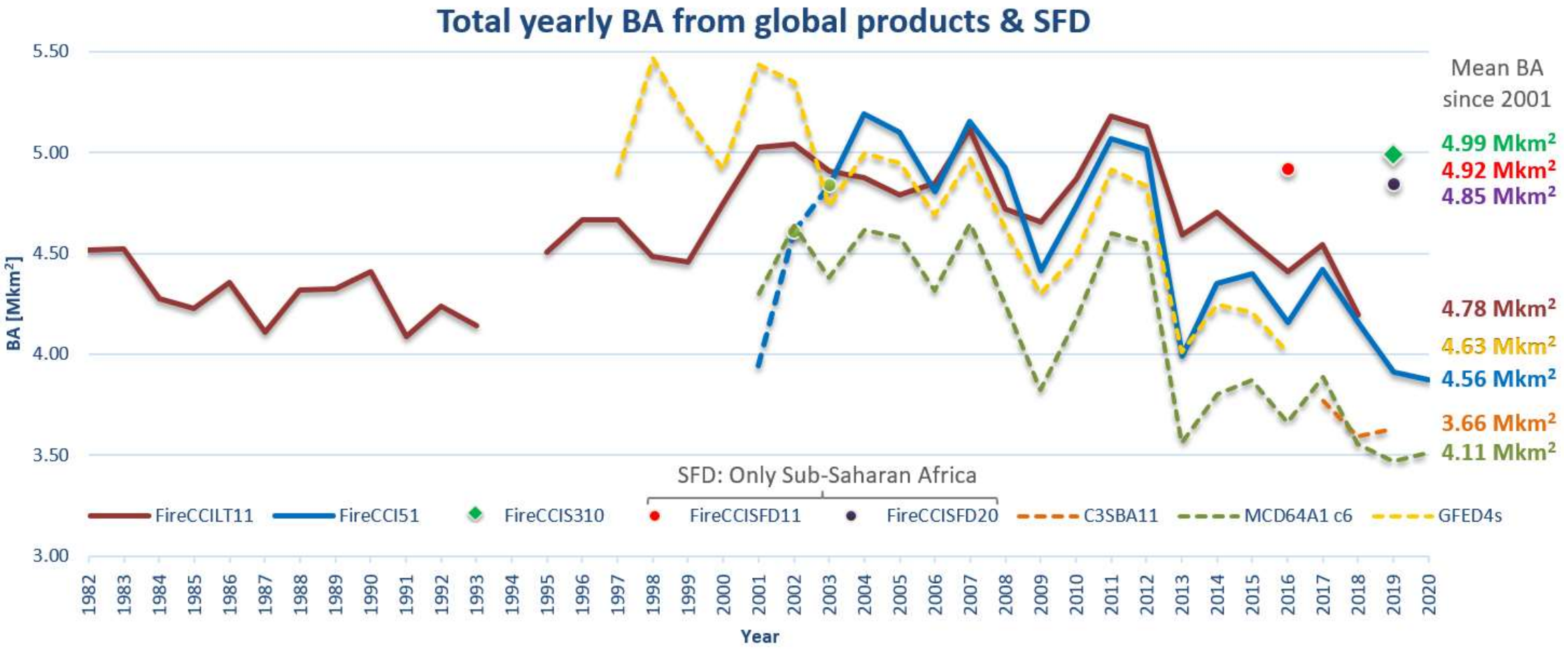
MODIS 250 m
+ AF 1000 m



SYN 300 m +
AF 375 m

S2 MSI 20 m
+ AF 375 m

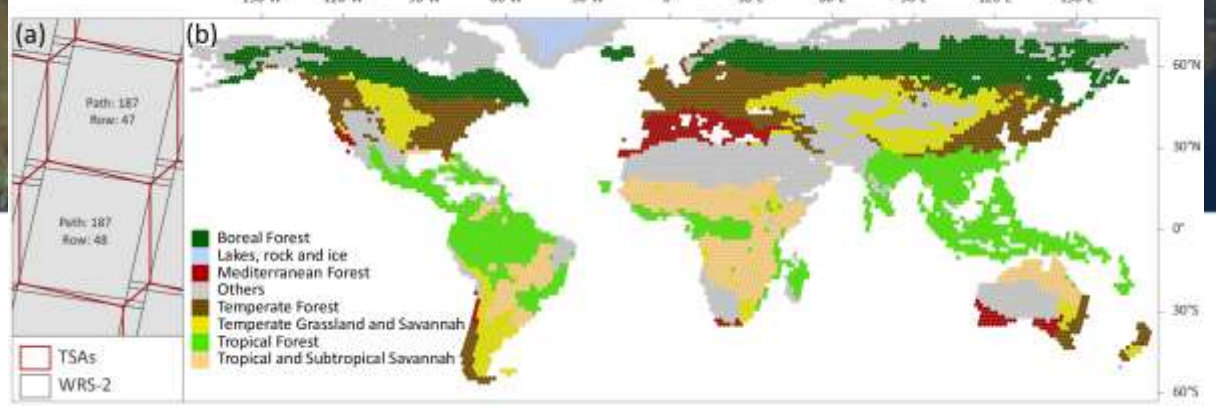
Fire trends in FireCCI products

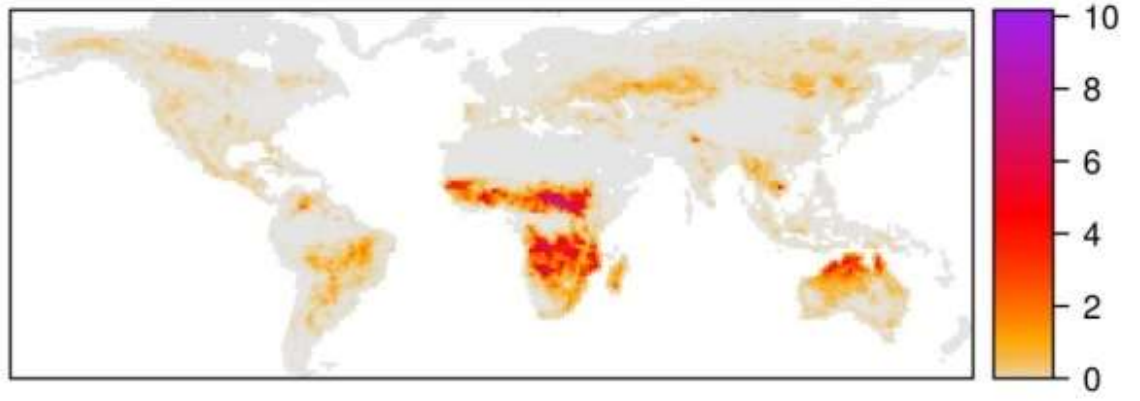


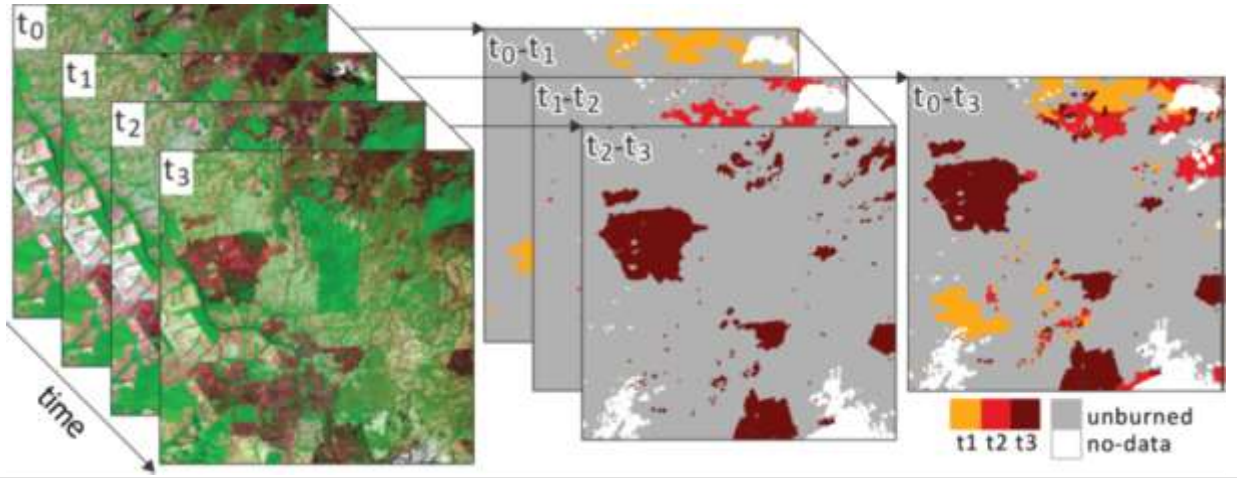
Validation

- Random stratified sampling of TSA
- Long-term sampling scenes:
  - Global: Franquesa et al., 2022 RSE.
  - Africa: Stroppiana et al., 2022 IJPRS.

Product	OE [%]	CE [%]	DC [%]	RelB [%]
FireCCISFD20	8.5	15.0	87.7	8.4
MCD64C6	56.5	21.1	56.0	-44,9
FireCCI51	52.2	25.1	58.4	-36.2







Emissions estimates

- GFED framework
  - 1.7 Pg C for SFD.
  - 67% more than GFED4s
- Land-cover specific estimates of biomass fuel consumption per BA unit.
  - 1.3 Pg C for SFD.
  - 61% more than GFED4s

African burned area and fire carbon emissions are strongly impacted by small fires undetected by coarse resolution satellite data

Ruben Ramo[a,b,1], Ekhi Roteta[c], Ioannis Bistinas[d,e], Dave van Wees[d], Aitor Bastarrika[c], Emilio Chuvieco[b], and Guido R. van der Werf[d]

[a]COMPLUTIG-Complutum Tecnologías de la Información Geográfica SL, 28801 Alcalá de Henares, Spain; [b]Environmental Remote Sensing Research Group, Department of Geology, Geography and the Environment, University of Alcalá, 28801 Alcalá de Henares, Spain; [c]Department of Mining and Metallurgical Engineering and Materials Science, School of Engineering of Vitoria-Gasteiz, University of the Basque Country, 01006 Vitoria-Gasteiz, Spain; [d]Faculty of Science, Vrije Universiteit, 1081HV Amsterdam, The Netherlands; and [e]Atos Nederland B.V. Burg, 1185MC Amstelveen, The Netherlands

Edited by Karen C. Seto, Yale University, New Haven, CT, and approved December 29, 2020 (received for review June 10, 2020)

Fires are a major contributor to atmospheric budgets of greenhouse gases and aerosols, affect soils and vegetation properties, and are a key driver of land use change. Since the 1990s, global burned area (BA) estimates based on satellite observations have provided critical insights into patterns and trends of fire occurrence. However, these global BA products are based on coarse spatial-resolution sensors, that small fires led to an additional 24 to 54% BA compared to previous estimates. Thanks to recent developments in satellite instruments and computing power, we can now map BA with substantially higher spatial resolution (≤30 m) and for large geographic regions (19–21), reducing the dependency on statistical methods and active fire detections

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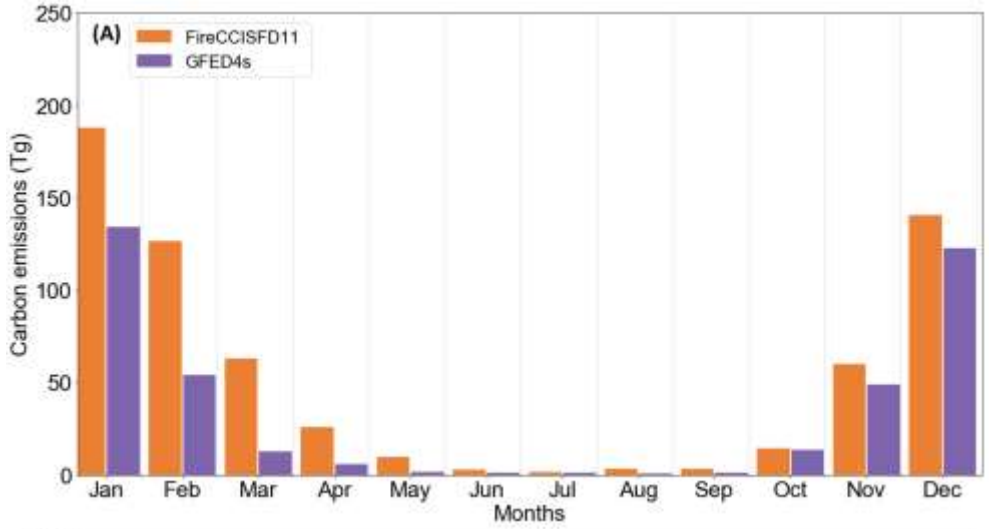
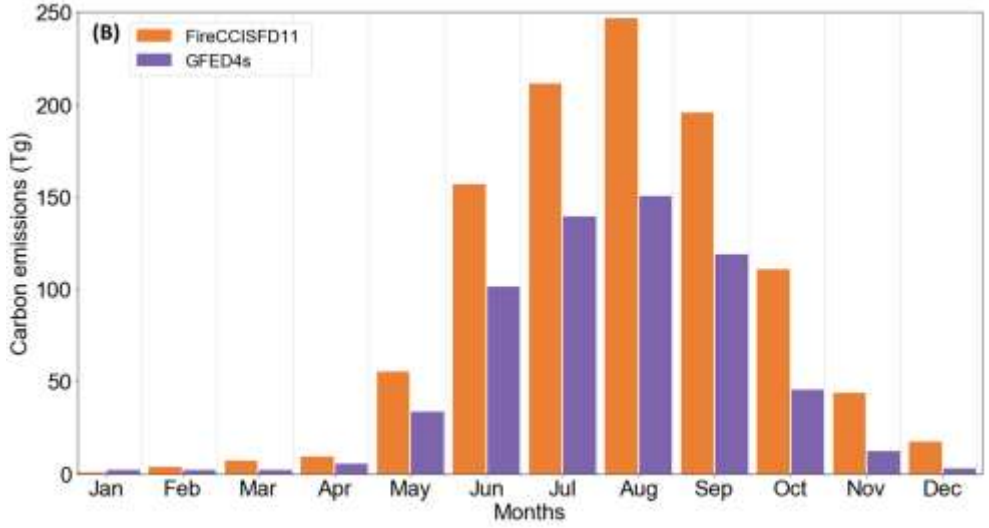
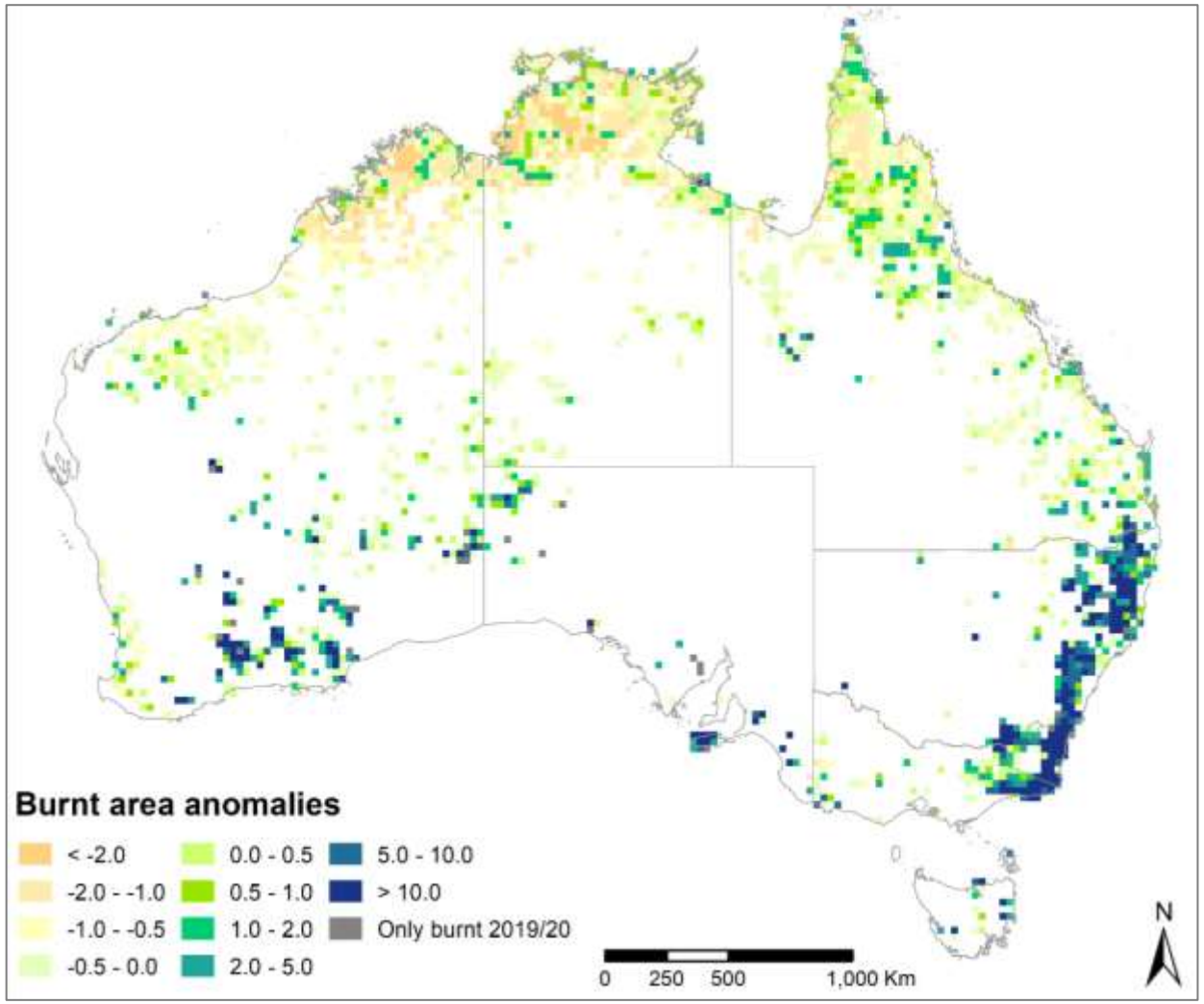




hemisphere (B)

Temporal anomalies



Bowman et al., 2020, Nature

Fire-and-rescue crew attend a blaze in Sydney, Australia, in 2019.

Wildfires: Australia needs a national monitoring agency

David Bowman, Grant Williamson, Marta Yebra, Joshua Lizundia-Loiola, Maria Lucrecia Pettinari, Sami Shah, Ross Bradstock & Emilio Chuvieco

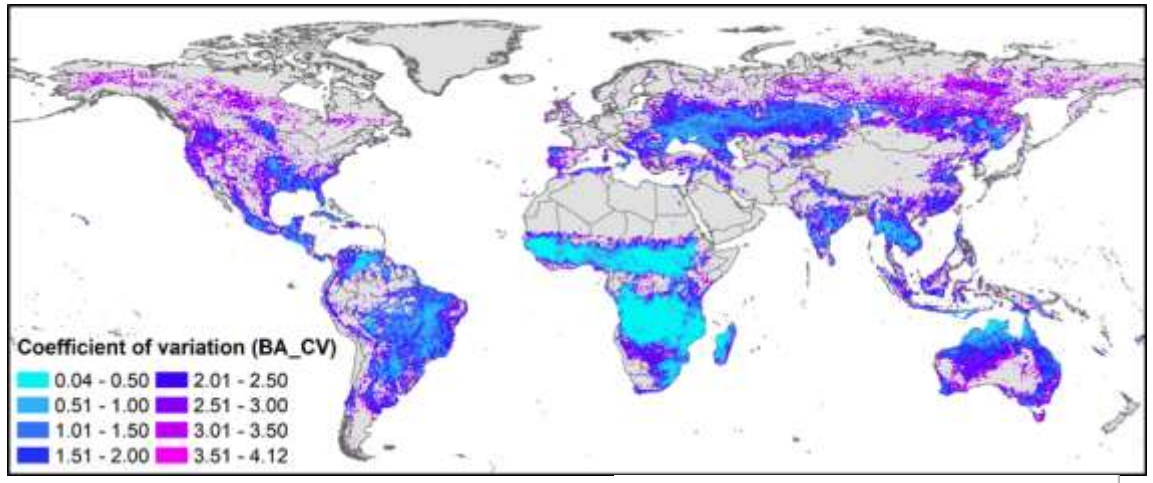
Comprehensive fire surveillance will strengthen resilience and adaptation to climate change.

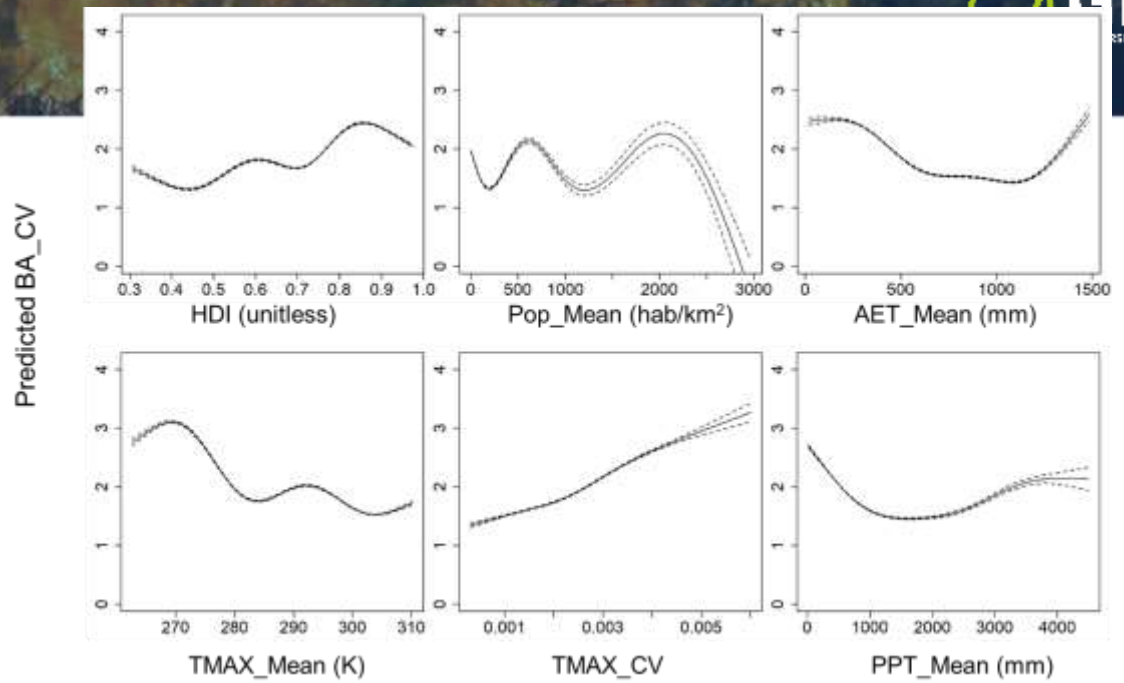
Just before the COVID-19 pandemic, bush fires in Australia destroyed more than 3,000 homes and burnt millions of hectares of vegetation. The crisis exposed the nation's fire monitoring system as being unfit for purpose. Precise real-time information about the area burnt and the intensity of the fires was not available when it was needed.

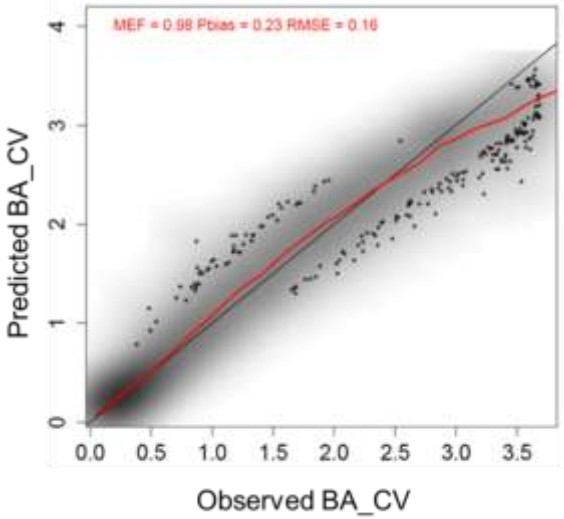
Australia does not have a central system for gathering and storing essential information about bush fires. State and territory governments, and even agencies within states, have different approaches. This worked fine when fires were smaller. But those in the 2019–20 season crossed multiple state borders.

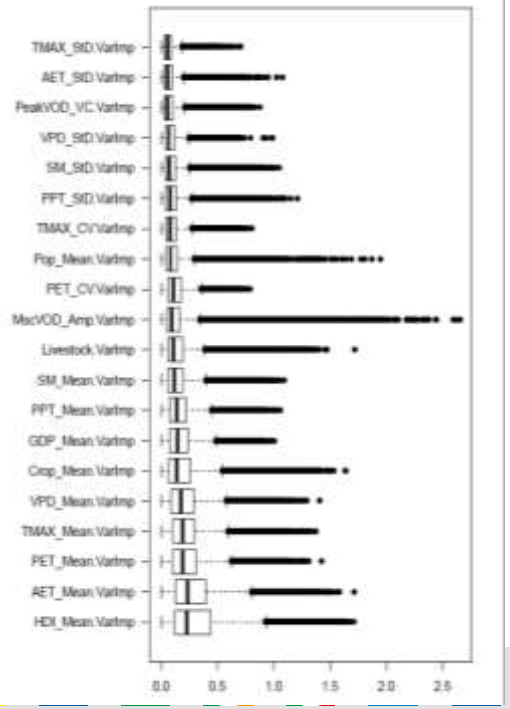
The blazes engulfed a huge geographic range and burnt for a duration and intensity that was beyond the experience of communities and fire managers[1]. Many Australians endured five months of smoke pollution that breached national air-quality standards. Usually, people would experience shorter bouts covering smaller areas[2].

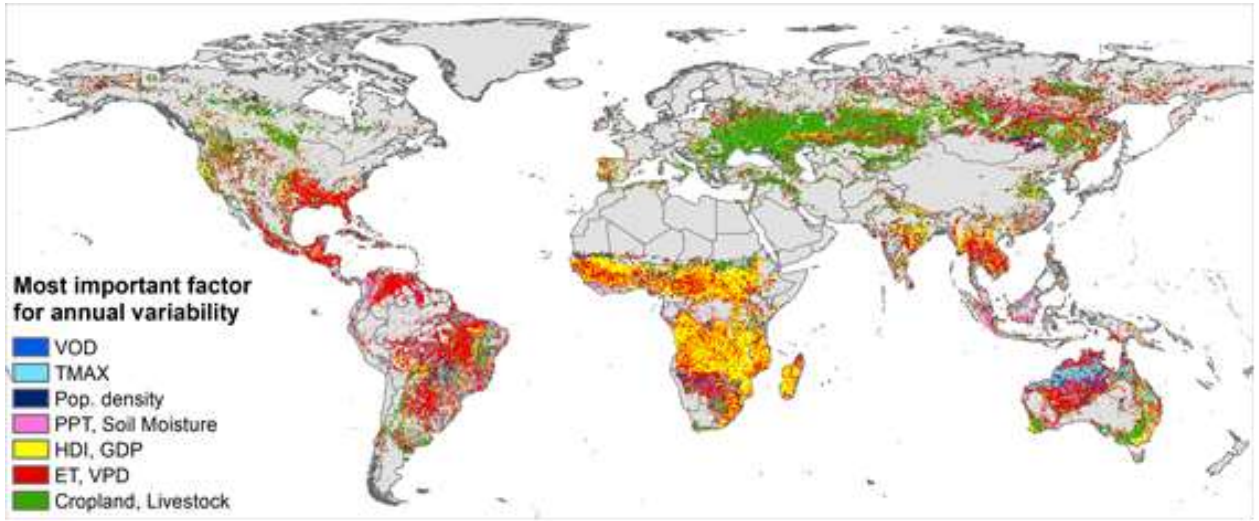
Drivers of fire variability











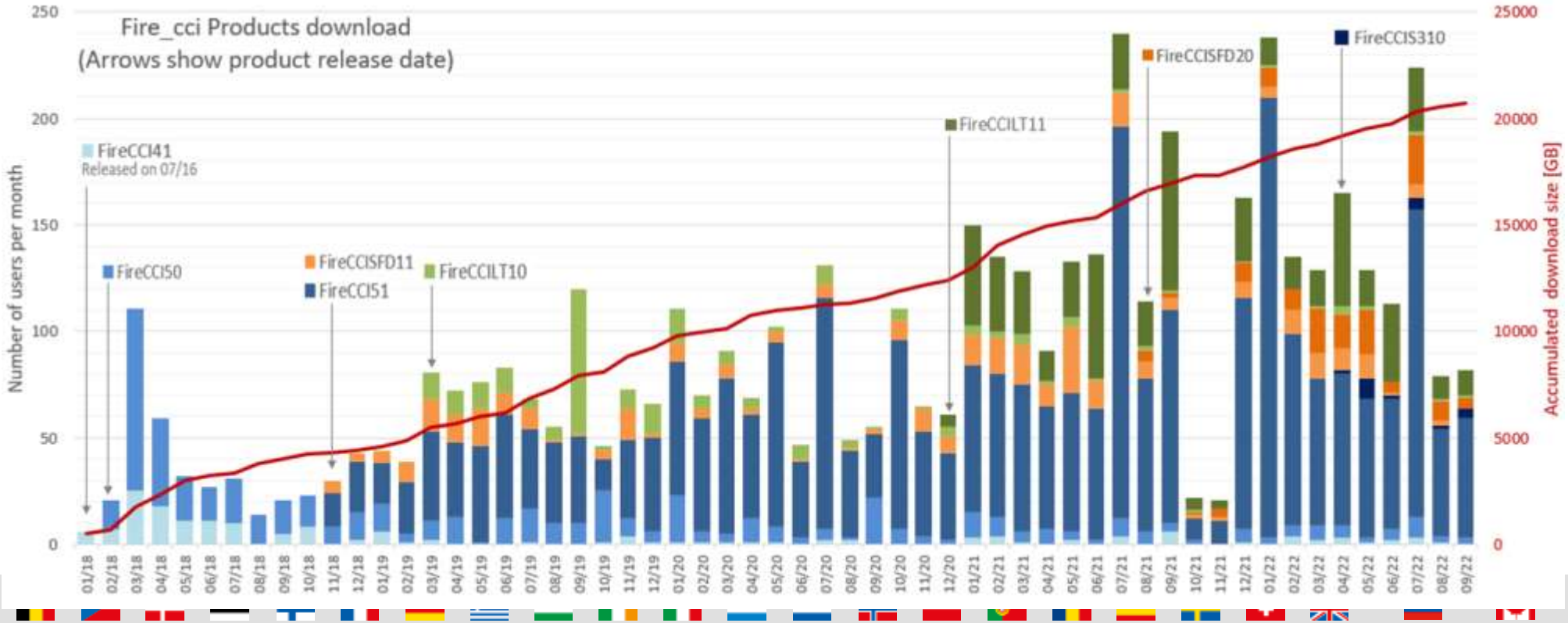
Chuvieco et al., 2021, STOTEN

Fire CCI products

Product Name	Main Input Information	Spatial resolution		Coverage
		Pixel	Grid	
FireCCI50	MODIS	250 m	0.25°	Global
FireCCI51	MODIS	250 m	0.25°	
FireCCIS310	Sentinel-3	300 m	0.25°	
FireCCILT11*	AVHRR-LTDR	0.05°	0.25°	
FireCCIM10*	FireCCI51, FireCCIS310, FireCCILT11, MCD64A1		0.25°	
FireCCISFD11	Sentinel-2	20 m	0.25°	Sub-Saharan Africa
FireCCISFD20	Sentinel-2	20 m	0.05°	
FireCCILTSFD	Landsat, Sentinel-2	30 m		Test sites: Sahel, S. America, Siberia
FireCCIS1SA10	Sentinel-1	40 m		Amazon
FireCCIS1S2AF10	S1 + S2	40 m		Test sites Africa

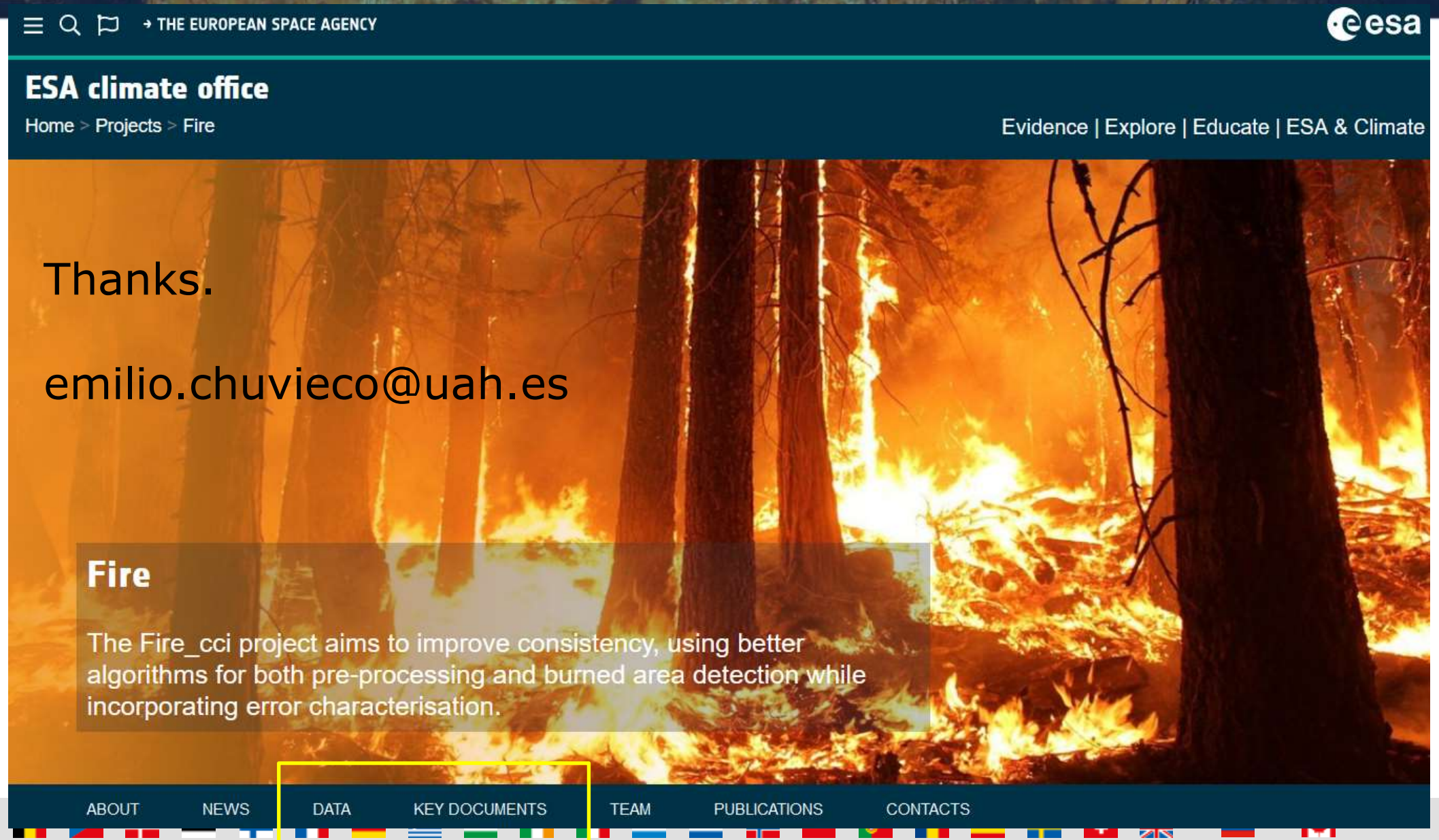
Dashed products: being produced in FireCCI+ Phase 2

1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022



42 countries,
>21 Tb
(<sept 2022)

https://climate.esa.int/en/projects/fire/



Thanks.

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