

climate change initiative

→ FIRE

“Seguimiento de incendios con datos Copernicus”

Emilio Chuvieco, Grupo de Investigación en Teledetección Ambiental
Universidad de Alcalá



fire
cci

La observación remota aplicada al seguimiento de los ecosistemas

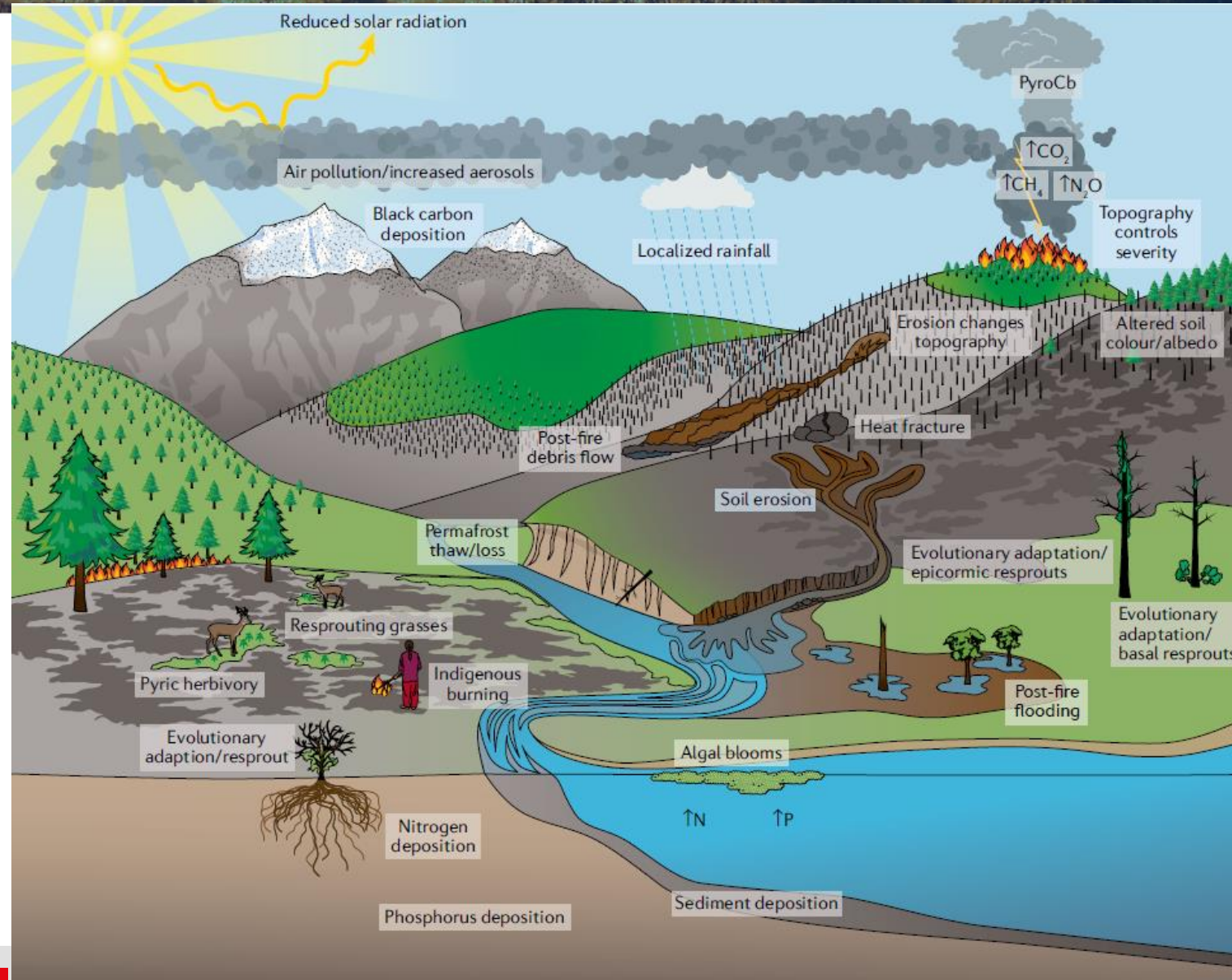


Guión

- Importancia global de los incendios, factores de ocurrencia y efectos.
- Proyecto FireCCI.
 - Necesidades de usuarios.
 - Desarrollo de algoritmos de área quemada.
 - Obtención de los productos.
 - Análisis de los resultados.



El papel del fuego en el sistema terrestre



Bowman al., 2020





Relevancia social de los incendios

BBC Sign in News Sport Reel Worklife Travel Future More Search

NEWS

Home Video World UK Business Tech Science Stories Entertainment & Arts Health World News TV More

World Africa Asia Australia Europe Latin America Middle East US & Canada

The Amazon in Brazil is on fire - how bad is it?

By The Visual and Data Journalism Team
BBC News

30 August 2019

f [social icons] Share

Amazon fires



NEWS

California exceeds 4 million acres burned by wildfires in 2020

SHARE THIS [social icons]

CALIFORNIA WILDFIRES

California exceeds 4 million acres burned by wildfires in 2020

More than 8,200 fires have consumed more than double the previous record, fire officials said.





ECV Fire Disturbance

- Burnt area (T.10)
- Active-fire maps (supplemental to T.10)
- Fire radiative power (FRP) (supplemental to T.10)





biomass
cci



fire
cci



high resolution
land cover
cci



lakes
cci



land cover
cci



land surface
temperature
cci

Tierra



aerosol
cci



cloud
cci



ghg
cci



ozone
cci



water vapour
cci

Atmósfera



salinity
cci



sst
cci



sea state
cci



sea ice
cci



sea level
budget closure
cci



sea level
cci



ocean colour
cci

Oceano



antarctic
ice sheet
cci



glaciers
cci



greenland
ice sheet
cci



permafrost
cci



snow
cci

Hielo



cmug
cci



open data
portal
cci

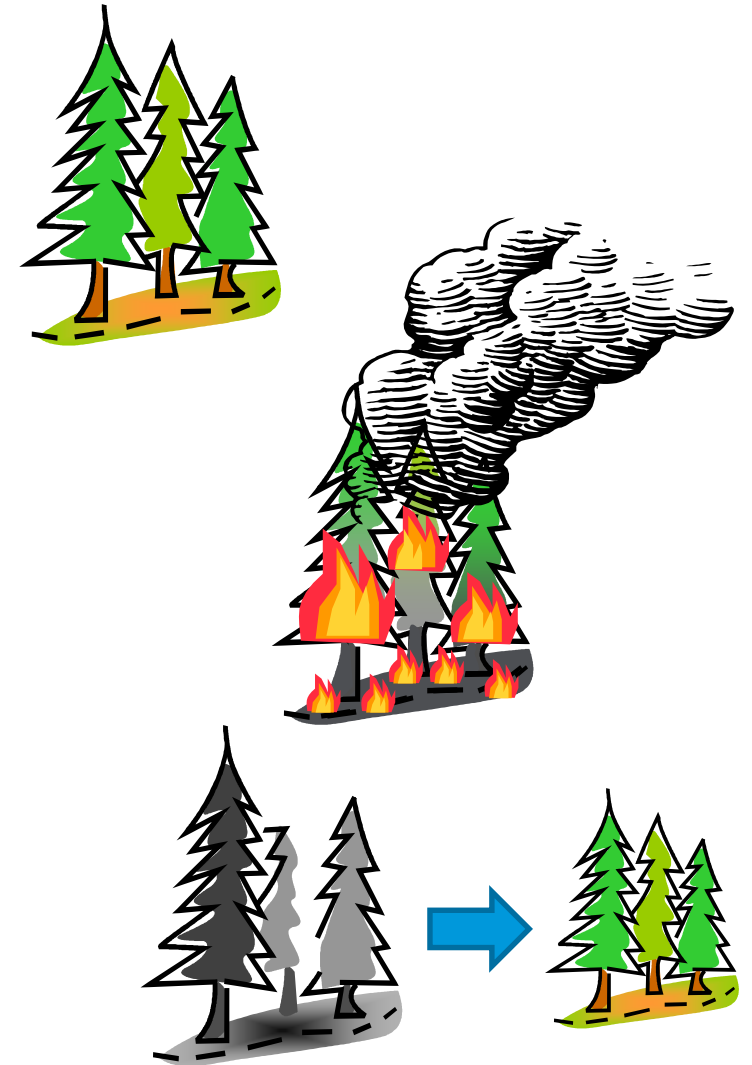


toolbox
cci

Trasversal

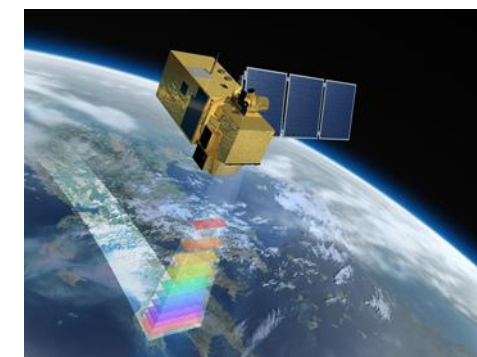
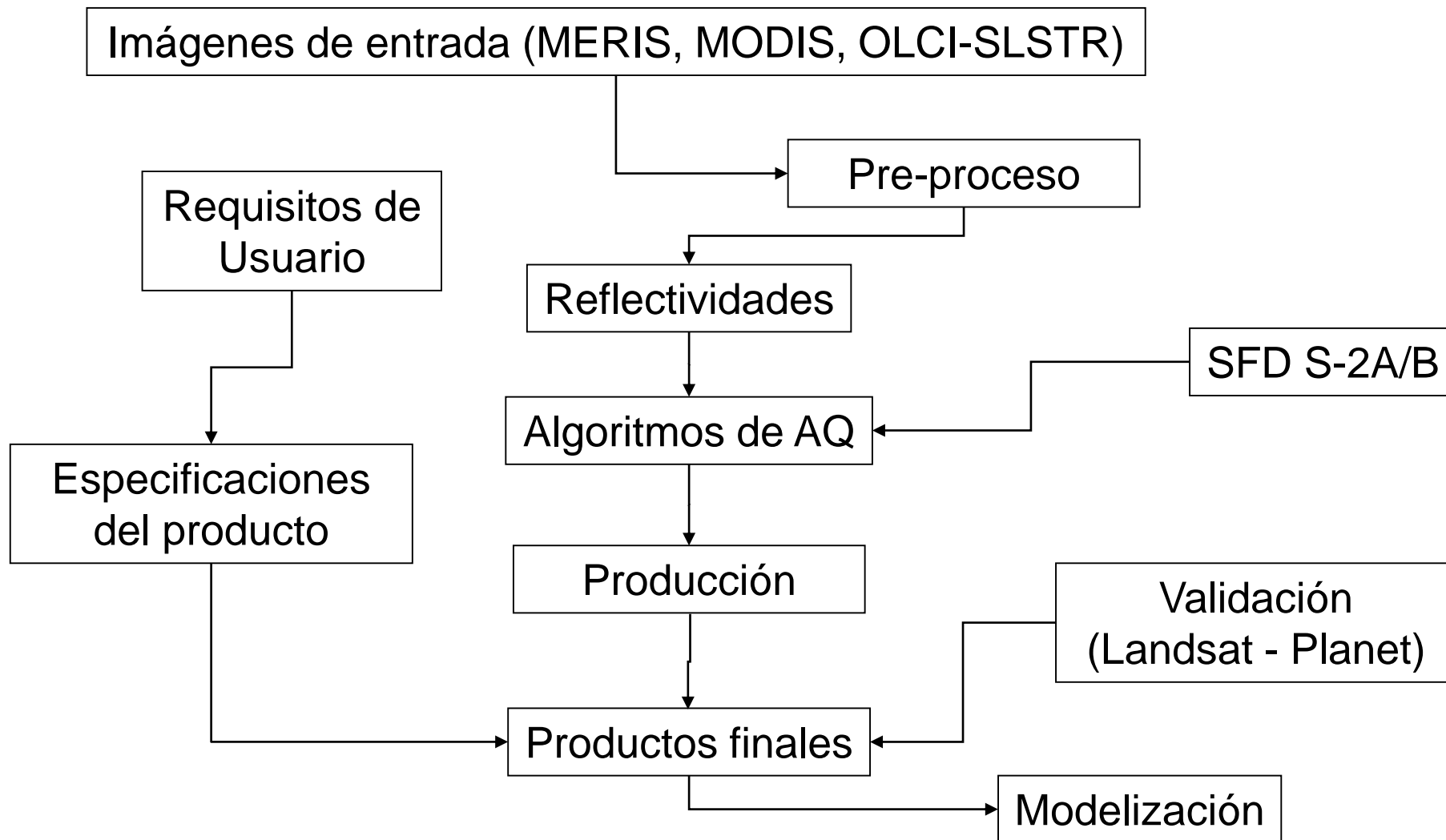


- Determinar condiciones de riesgo:
 - Cartografía de combustibles.
 - Estado hídrico de los combustibles.
 - Fragmentación del paisaje.
- Análisis de incendios activos:
 - Detección.
 - Seguimiento del frente de llamas.
 - Estimación de radiación.
 - Estimar emisiones a la atmósfera producidas por las quemas.
- Post-incendio:
 - Cartografiar áreas quemadas.
 - Severidad del fuego.
 - Regeneración de la vegetación.





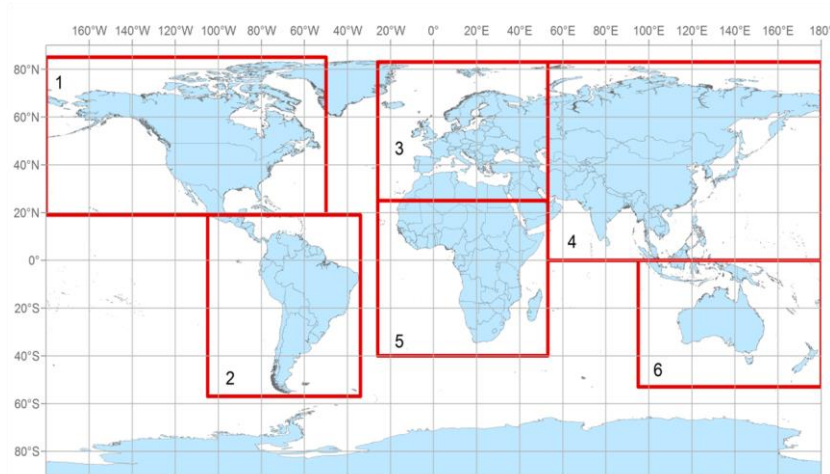
Flujo de trabajo en el Proyecto FireCCI



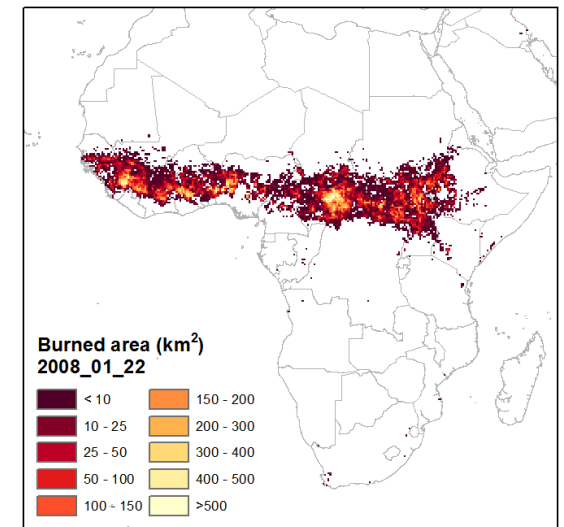
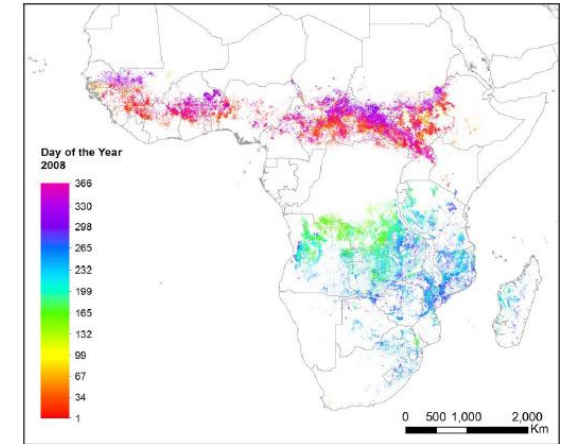


Especificaciones de los product FireCCI

- Pixel:
 - Archivos mensuales, continentales, GeoTiff.
 - 3 Variables: Dia de detección (1-366), Incertidumbre (0-100), LC quemado.



- Grid:
 - Archivos mensuales de 0.25 x 0.25°. NetCDF.
 - 23 variables: AQ , standard error, fracción de área quemada, de área observada y total quemado por LC.





Productos de AQ del Proyecto Fire CCI

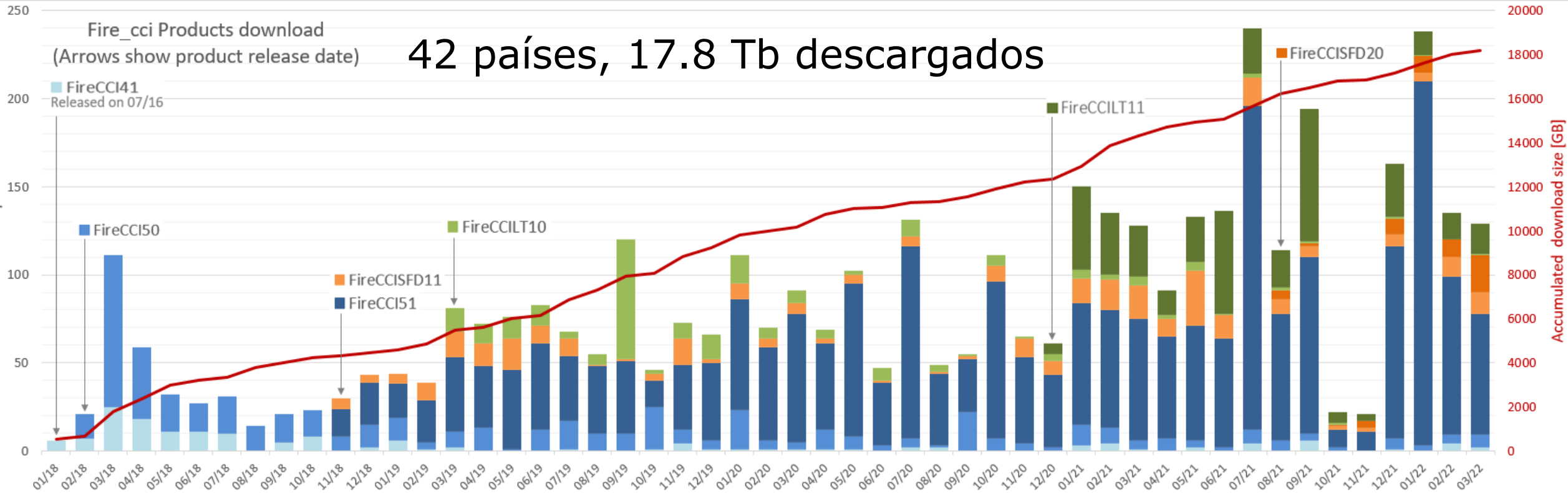


Globales:

- FireCCI41: 2005-2011, MERIS: 300 m.
- FireCCI51: 2001-2019, MODIS: 250 m.
- C3SBA10: 2017-2020, OLCI: 300 m
- FireCCIS310: 2019, SYN: 300 m
- FireCCILT11: 1982-2018: AVHRR: 5 km.

Regionales:

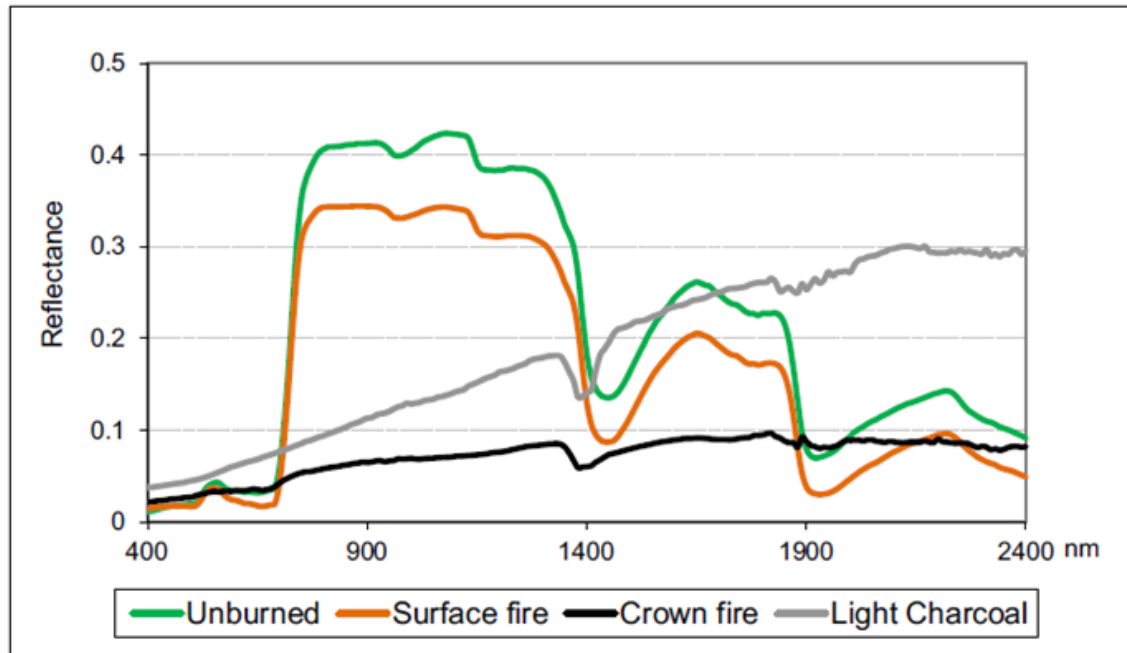
- Africa: FireCCISFD11: 2016 y 2019, Sentinel-2 20m
- Africa, Indonesia, Amazonia: FireCCIS1: 2016, Sentinel-1 40m.





Cómo detectar AQ con teledetección?

- Contraste espectral con la vegetación sana:



Chuvieco et al., 2019

- Contraste térmico con el terreno que no arde:





Desarrollo de algoritmos de área quemada

- Basados en el cambio de reflectividad post-incendio:
 - Tipo de incendio
 - Severidad del fuego
 - Tiempo después de la extinción.
- Contraste térmico con el entorno:
 - Ley de Planck, aumento no lineal de la temperatura.
 - Sensibilidad del sensor: resolución espacial y radiométrica.
- Algoritmos híbridos:
 - Combinan ambas bandas





Esquema del algoritmo FireCCI51

INPUT

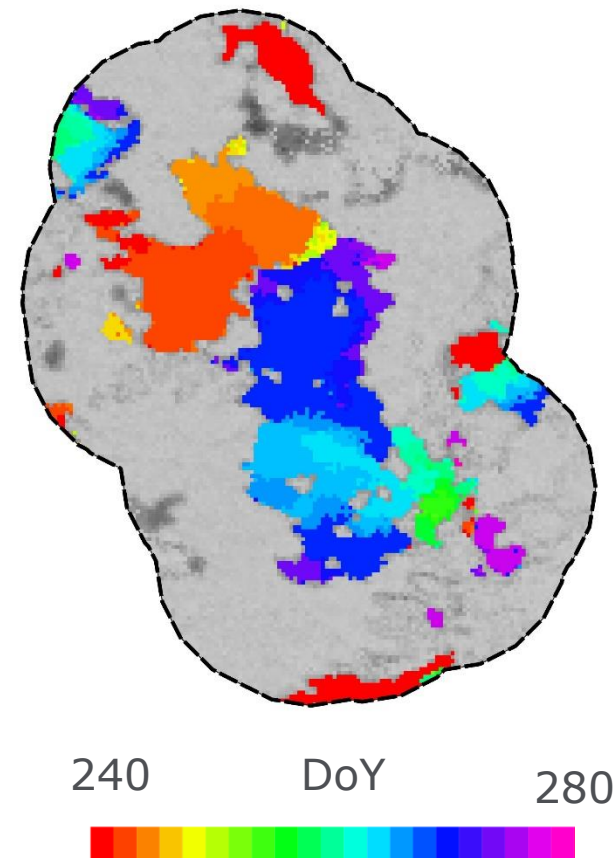
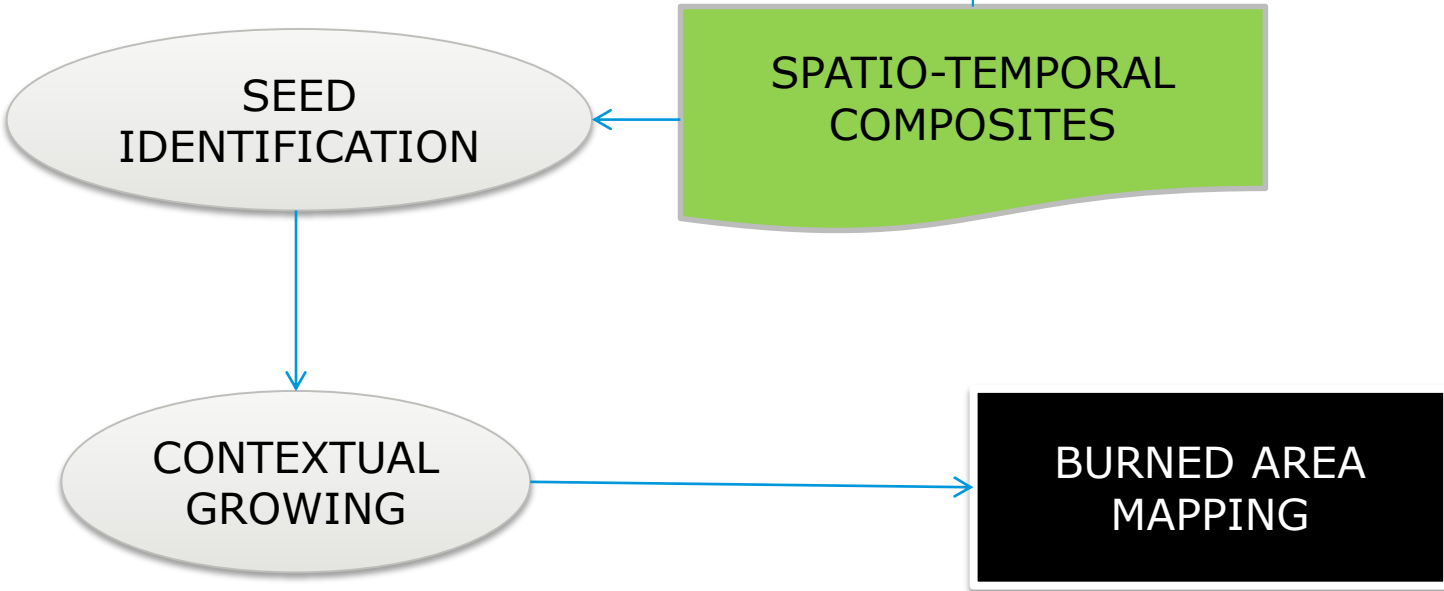
HOTSPOTS
(MODIS /
VIIRS)

LC
BURNABLE
MASK

MODIS 250
OLCI
SYN

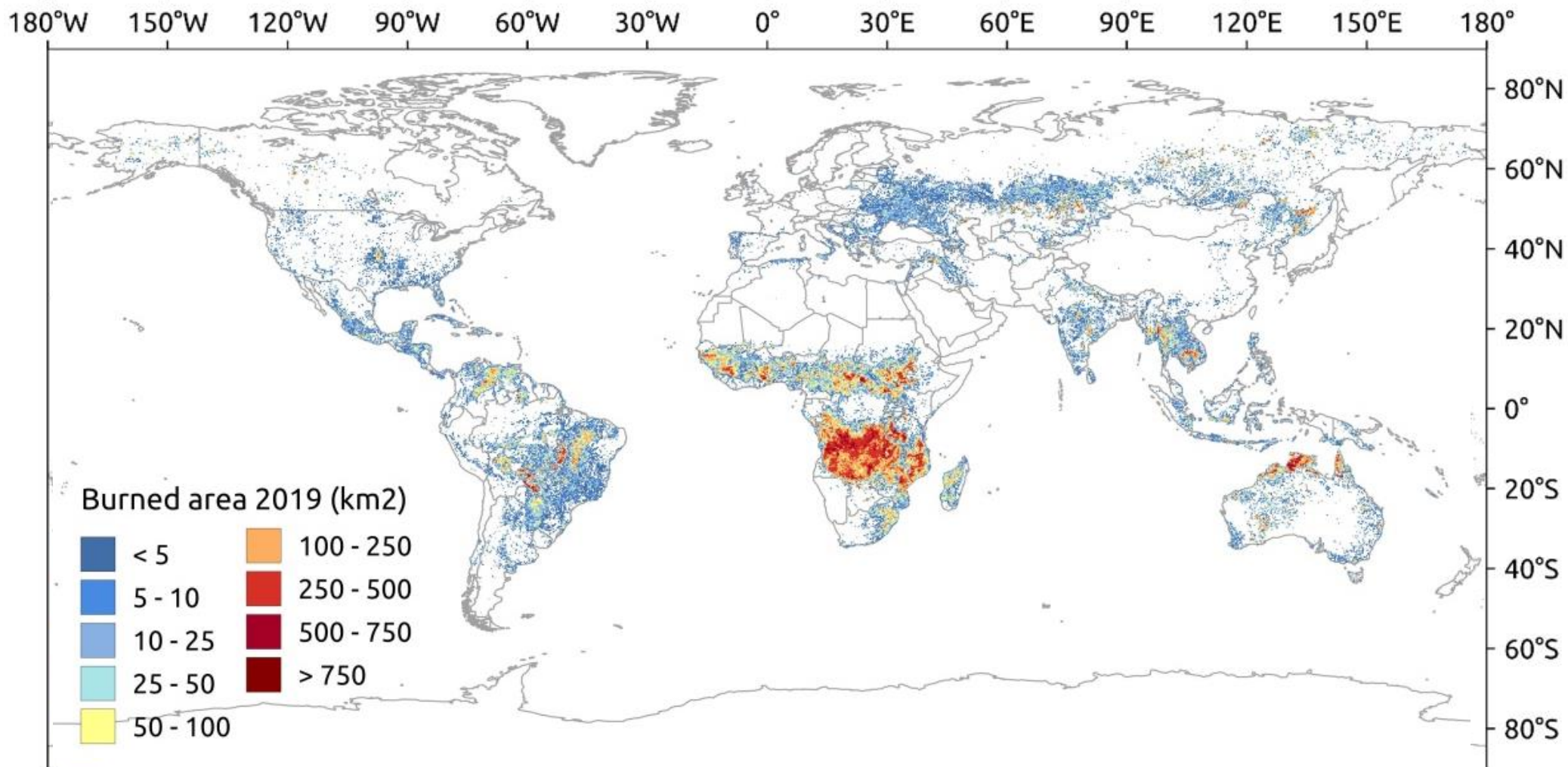
Quality Flags

BURNED AREA
MAPPING





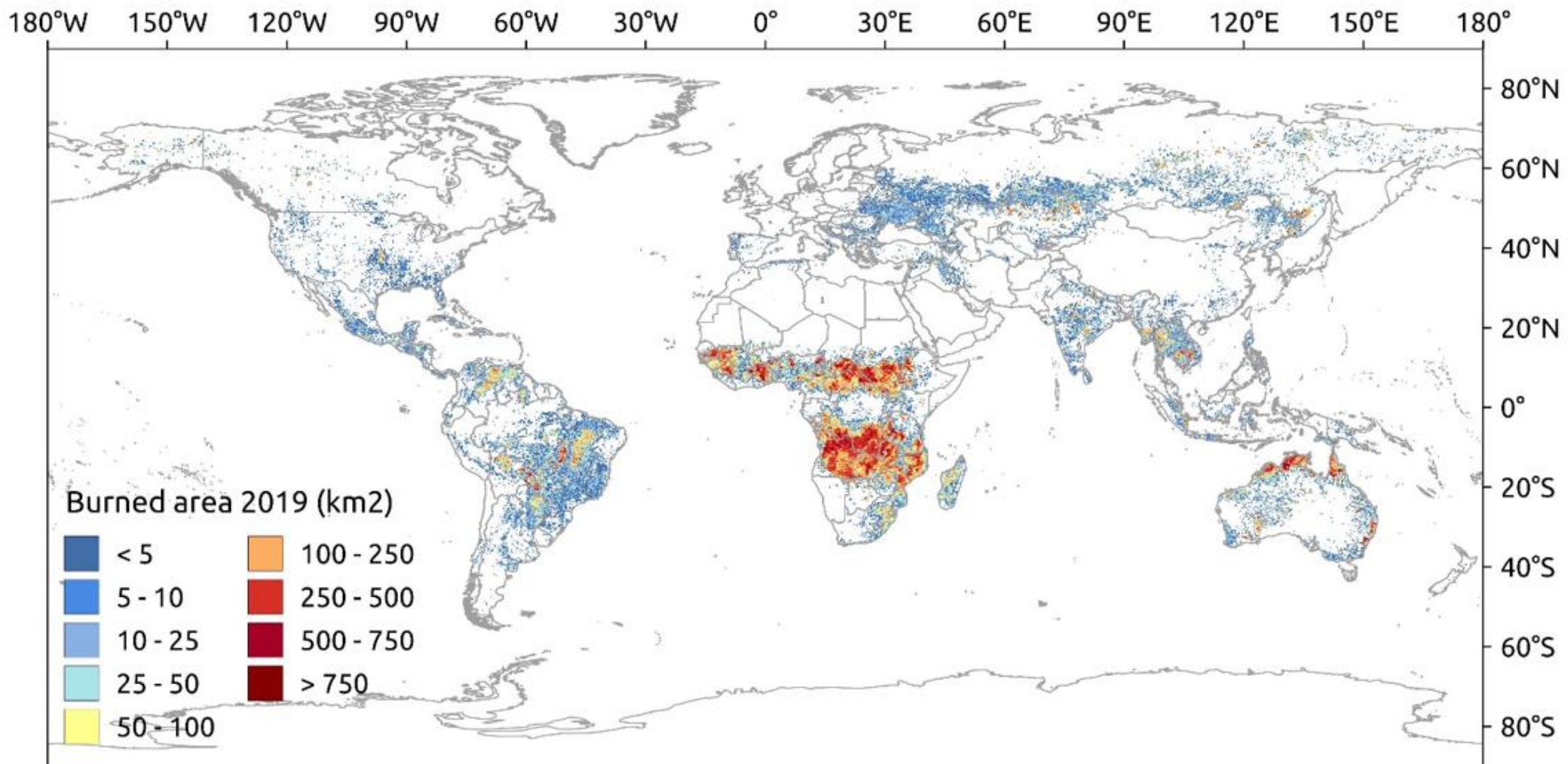
FireCCI51 (MODIS 250m + HS)



Lizundia-Loiola et al., 2020, RSE



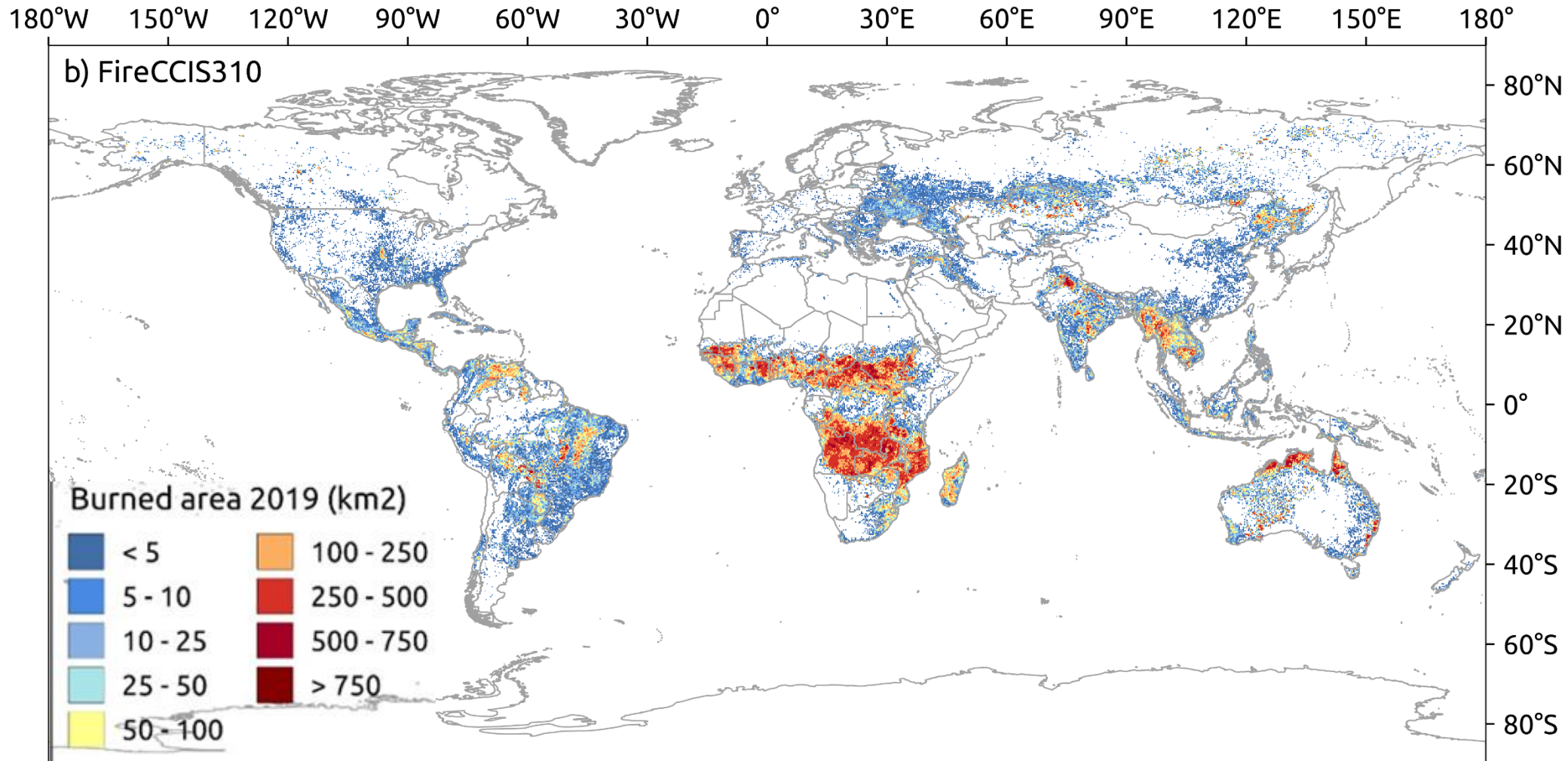
C3SBA10 (OLCI 300m + HS)



Lizundia-Loiola et al., 2021, RS



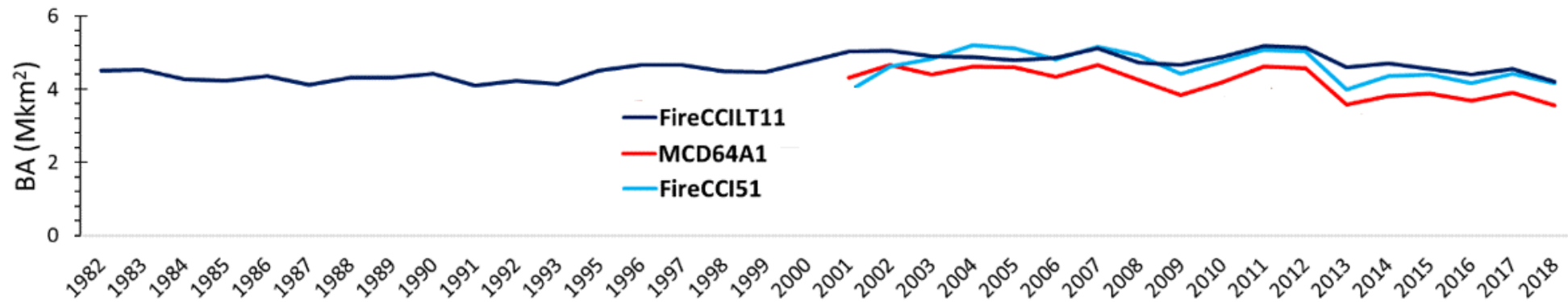
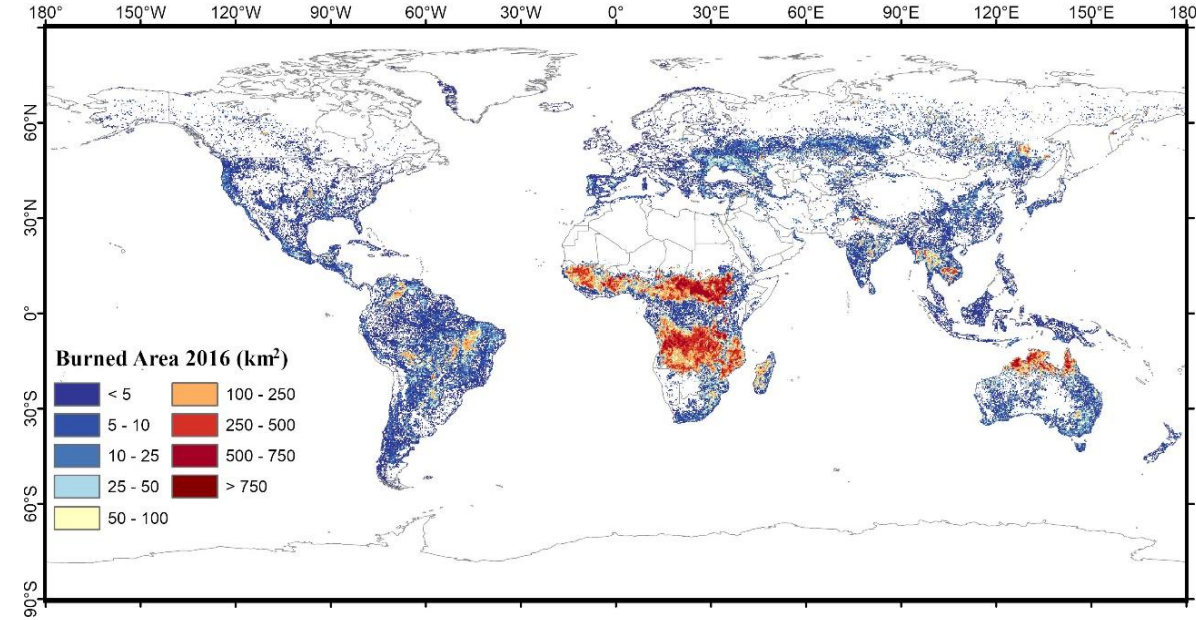
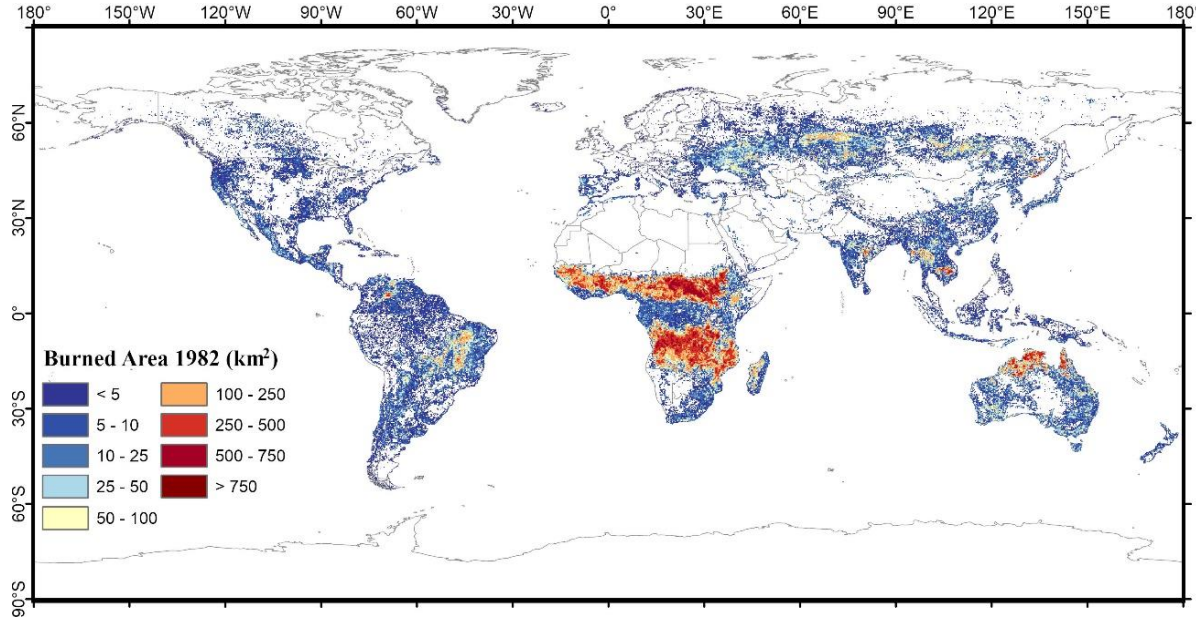
FIRECCIS310 (SYN 300m + VIIRS)



Lizundia-Loiola et al., 2022, RSE, In review



FireCCILT11 (AVHRR 0.05 d)



Oton et al., 2021, IJAG



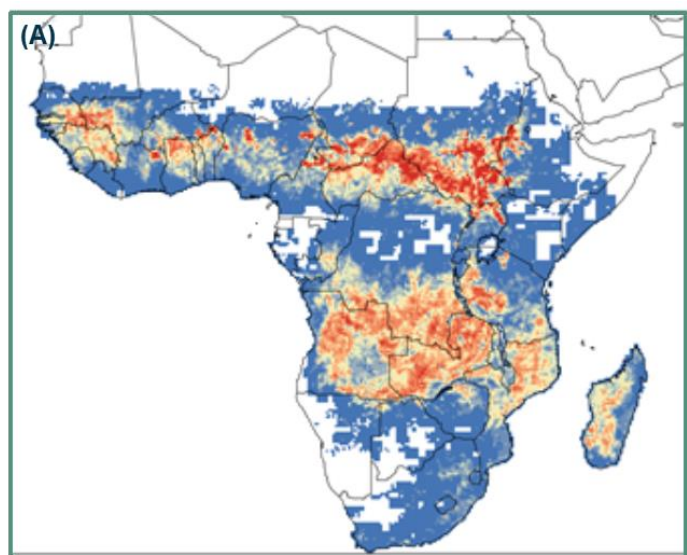


Productos regionales: Africa (2016) Sentinel 2A

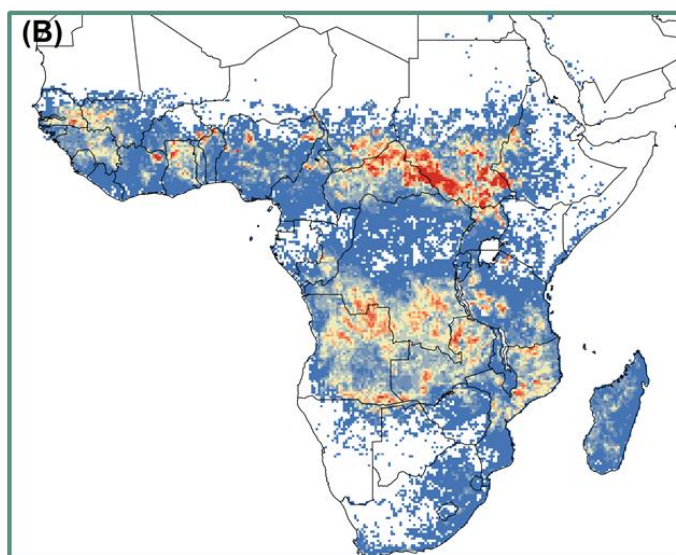
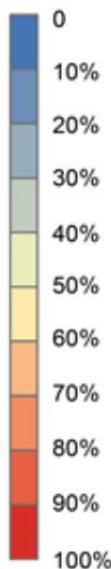


Product	<100 ha	>100 ha	Total (km2)
FireCCISFD11 (Sentinel-2)	2,024,070	2,871,045	4,895,115
MCD64A1 (NASA MODIS)	161,377	2,555,626	2,717,004
% of FireCCISFD11	7.97	89.01	55.50

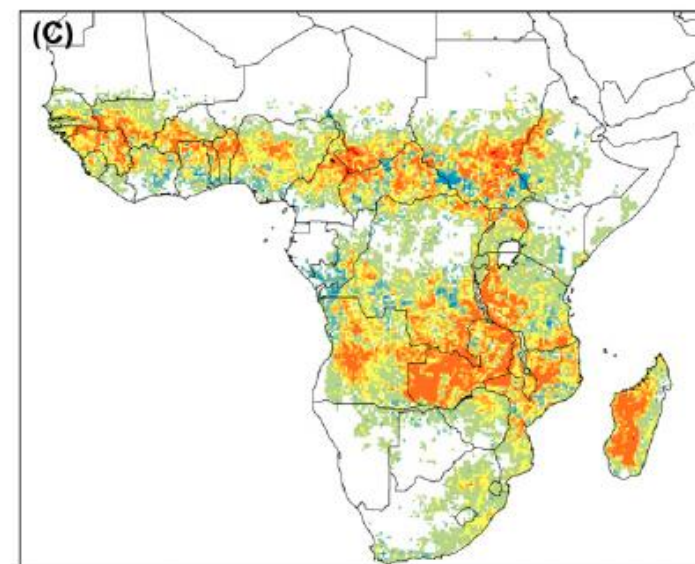
> 90% de los incendios pequeños no se detectan en los productos globales



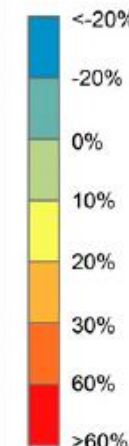
% of BA FireCCISFD11



% of BA GFED4s



BA FireCCISFD11-GFED4s

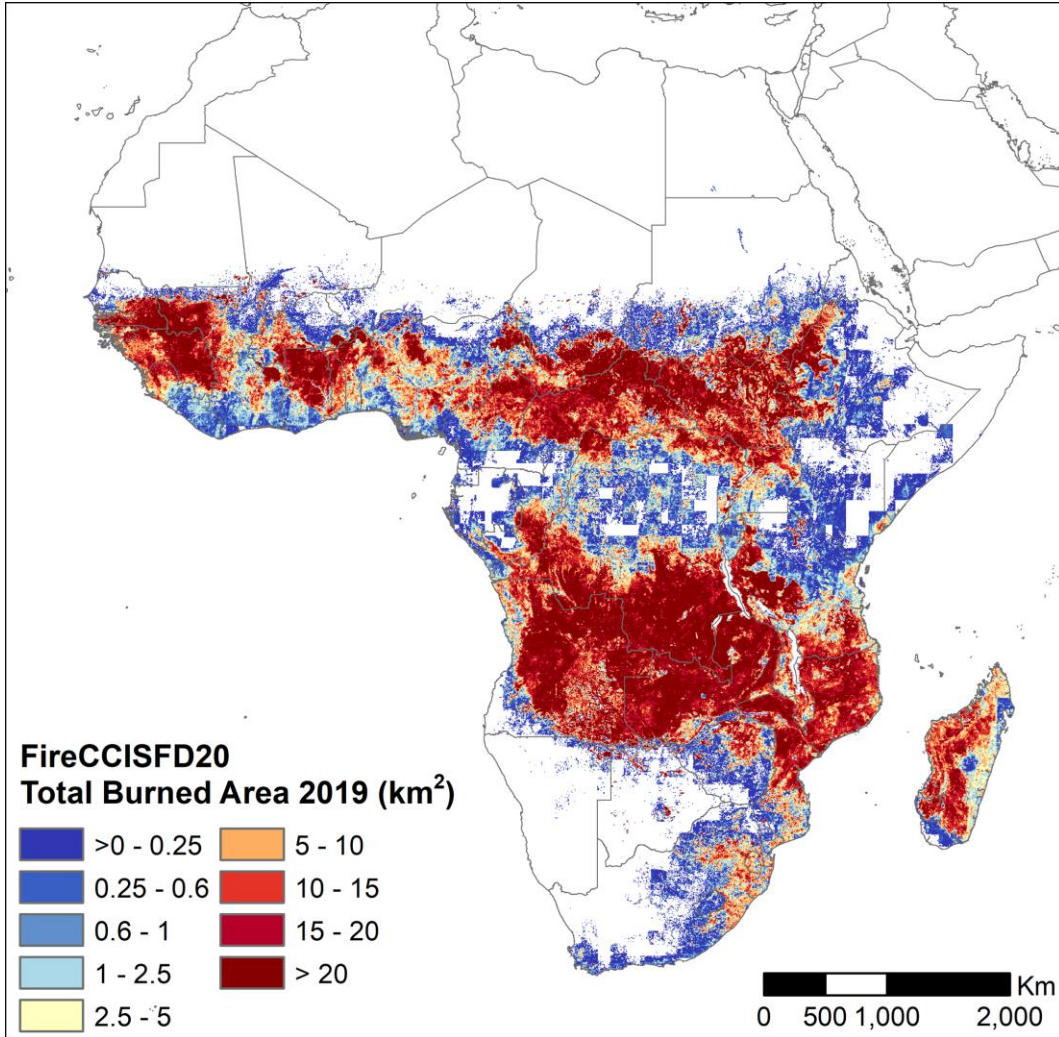


(Ramo et al., 2021, PNAS)



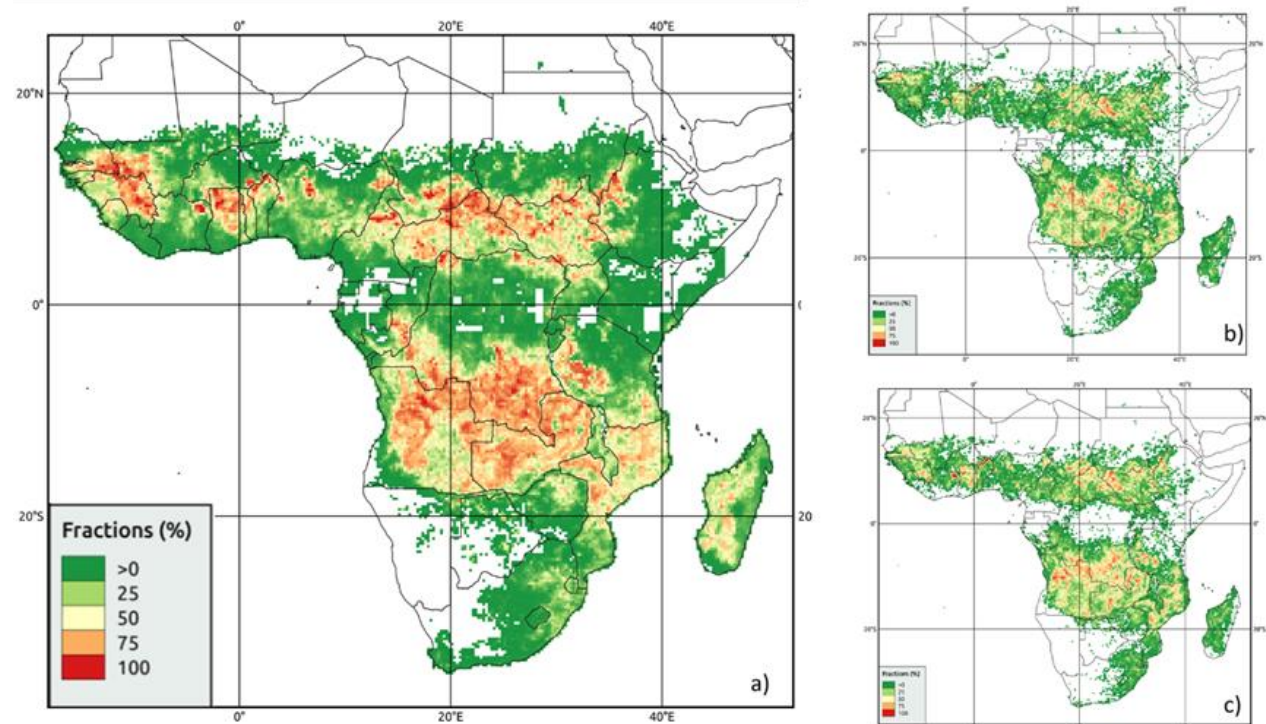


Productos regionales: Africa (2019) Sentinel 2A y 2B



(Chuvieco et al., 2022, STOTEN, review)

El producto detecta 4.8 Mkm² de AQ, 80% mas que el FireCCI51 (MODIS 250 m) 120% mas que MCD64A1 (MODIS 500 m)

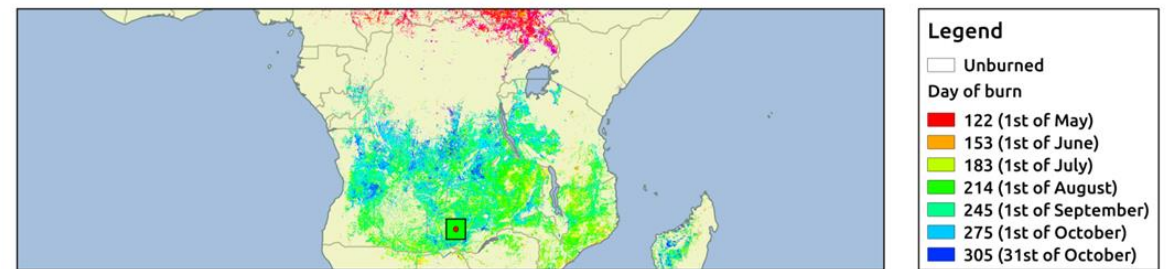
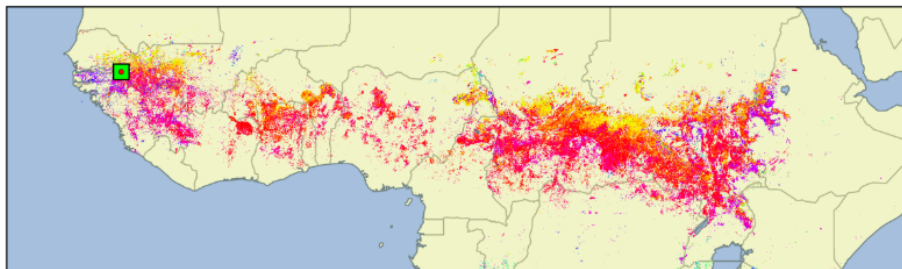
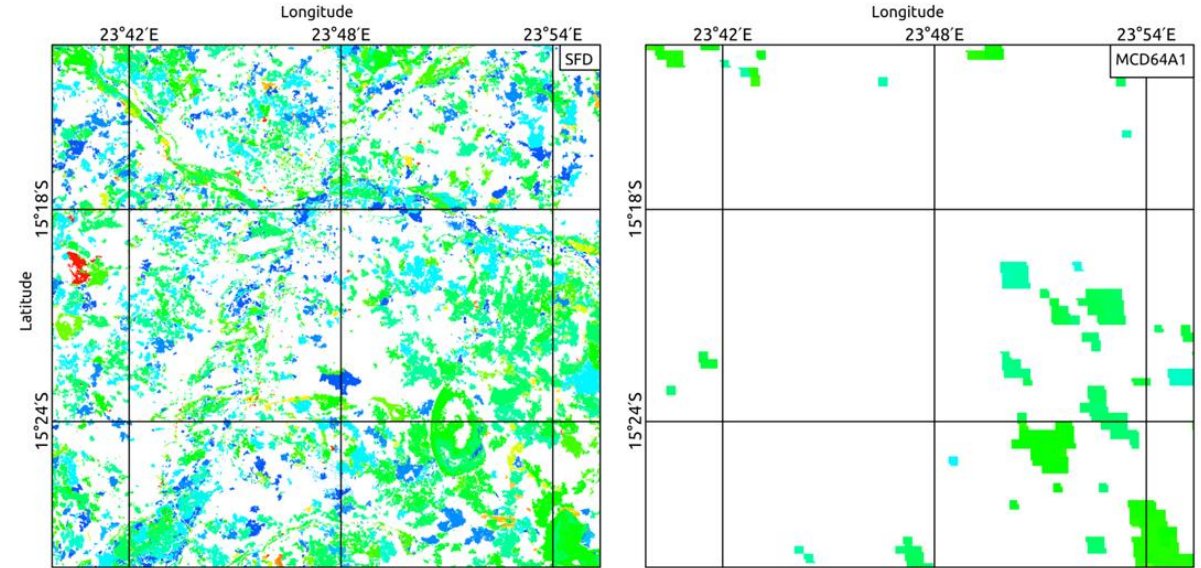
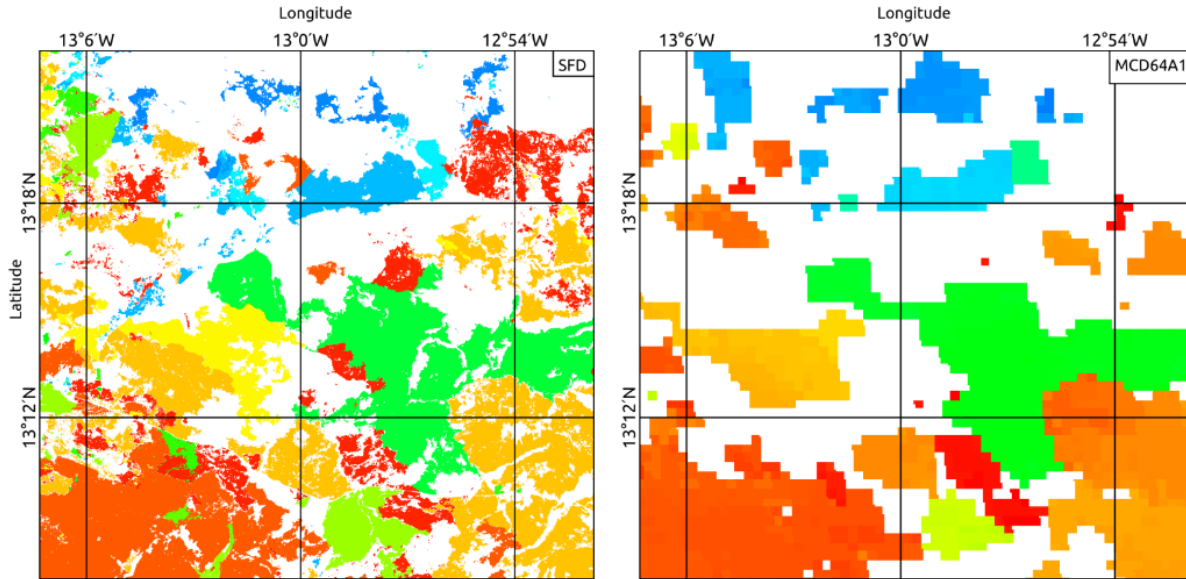


Fracción quemada: a) FireCCISFD20; b) MCD64A1, c) FireCCI51





Productos regionales: Africa (2016)

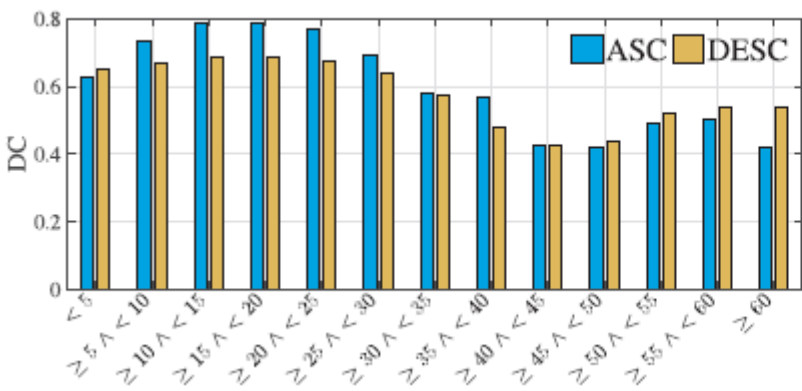
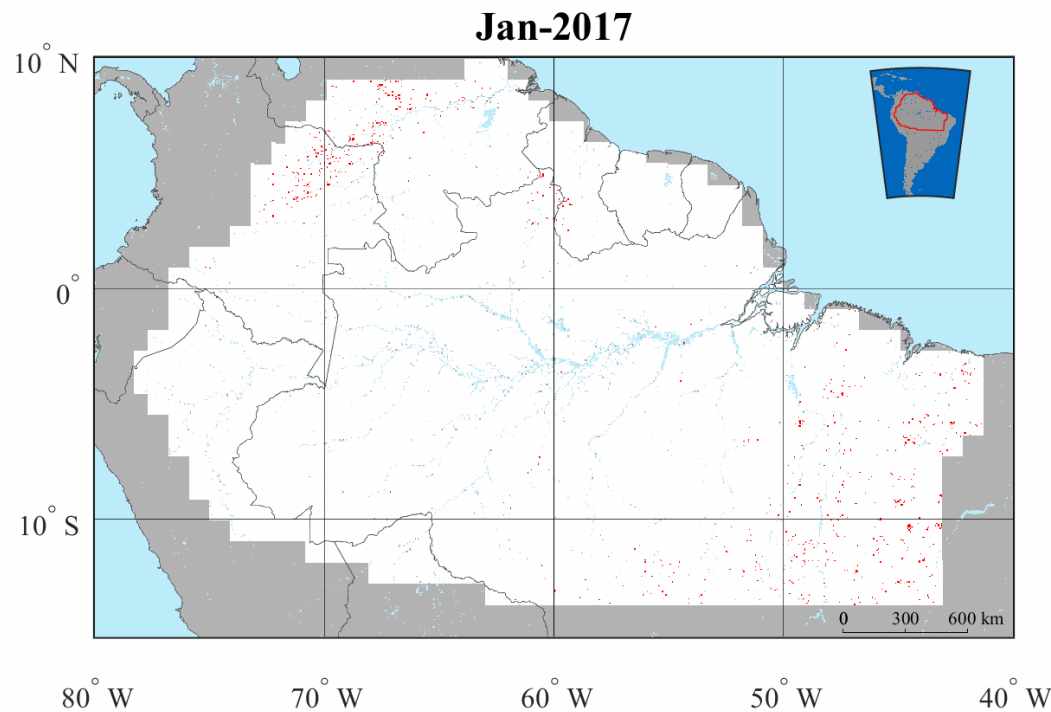
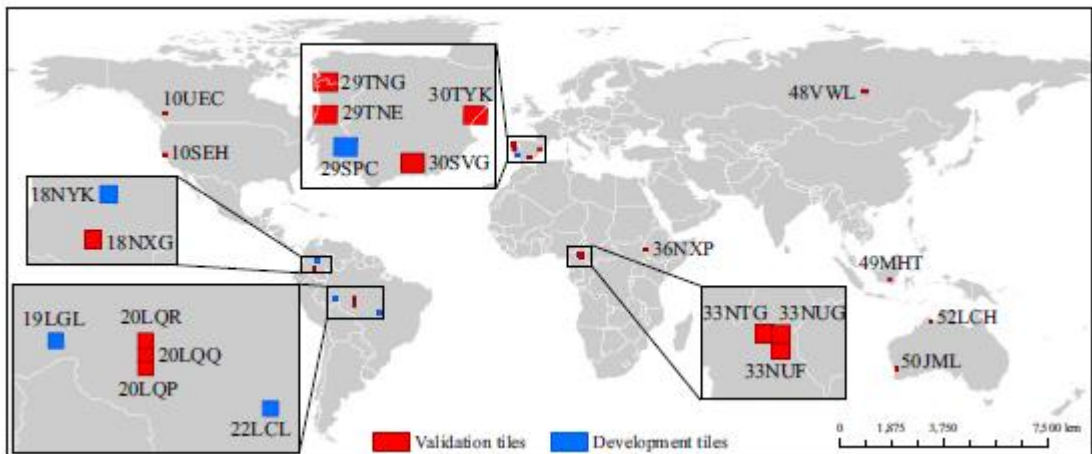


(Roteta et al., 2019, RSE)

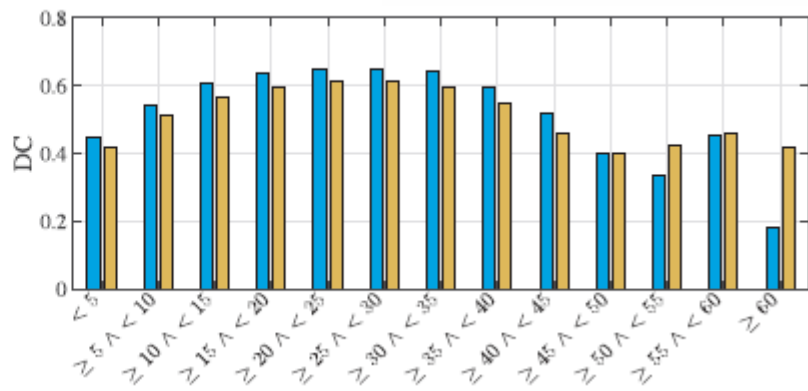




Amazon SAR-1



Accuracy by Local Incidence Angle



Accuracy by Slope angle

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Burned area detection and mapping using Sentinel-1 backscatter coefficient and thermal anomalies

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^b School of Ecosystem and Forest Sciences, University of Melbourne, Parkville 3052, Australia

ARTICLE INFO

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 Sentinel-1

ABSTRACT

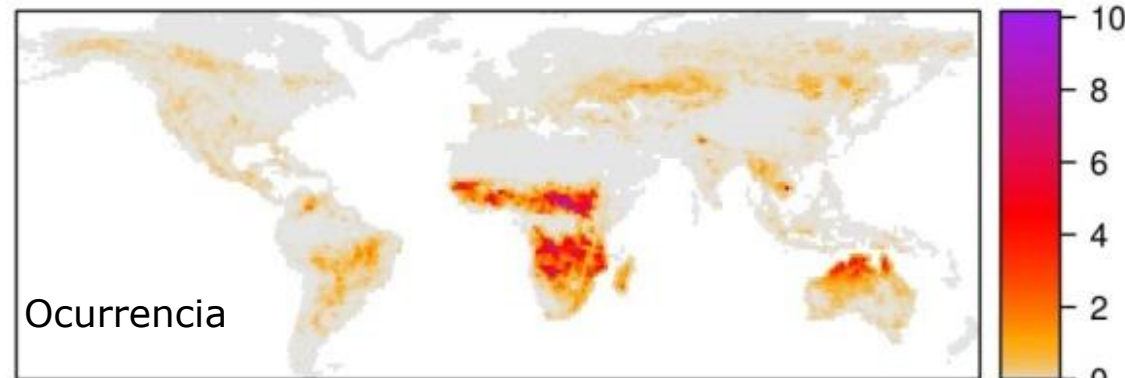
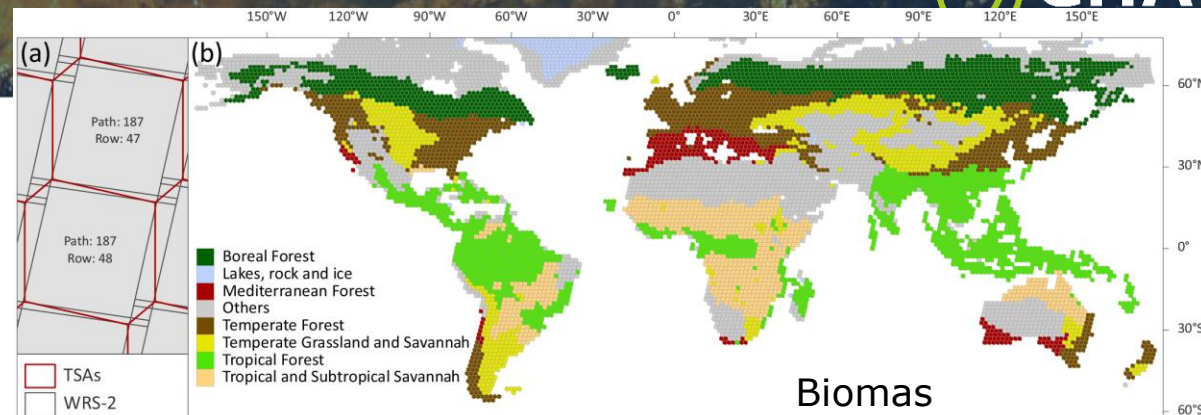
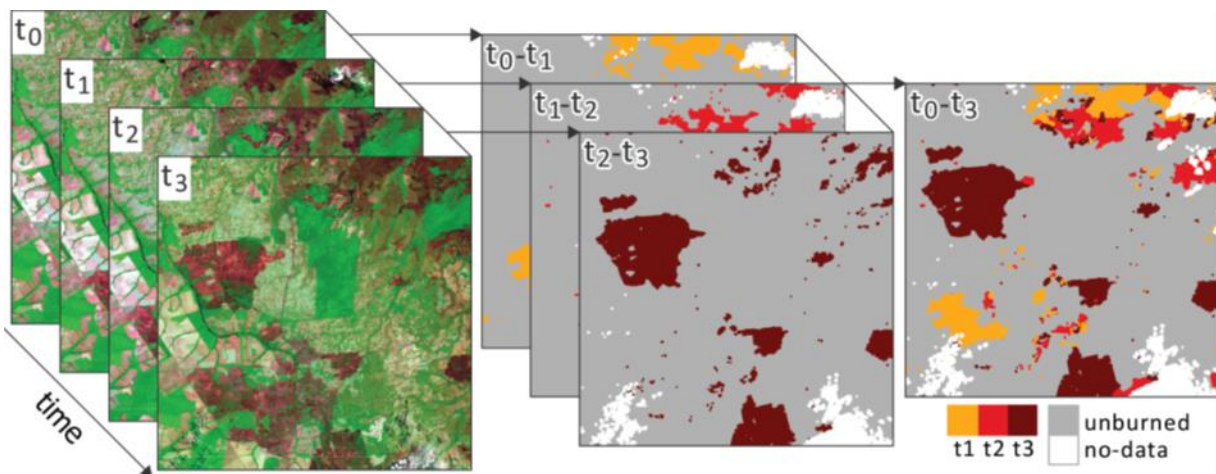
This paper presents a burned area mapping algorithm based on change detection of Sentinel-1 backscatter data guided by thermal anomalies. The algorithm self-adapts to the local scattering conditions and it is robust to variations of input data availability. The algorithm applies the Reed-XiaoLi detector (RXD) to distinguish anomalous changes of the backscatter coefficient. Such changes are linked to fire events, which are derived from





Validación

- Establecer un protocolo para obtener áreas de referencia:
 - Muestreo aleatorio estratificado sobre TSA.
- Definir métodos para obtener parámetros de validación:
 - Matriz de confusión.
 - Métricas y errores estándar.

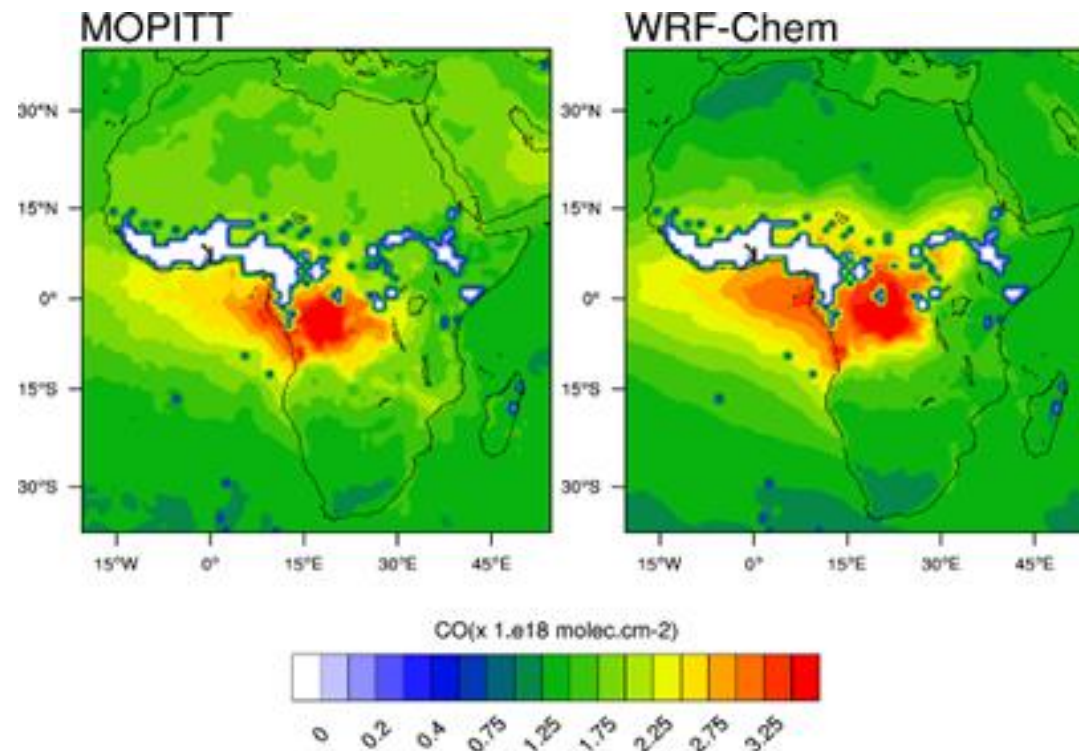
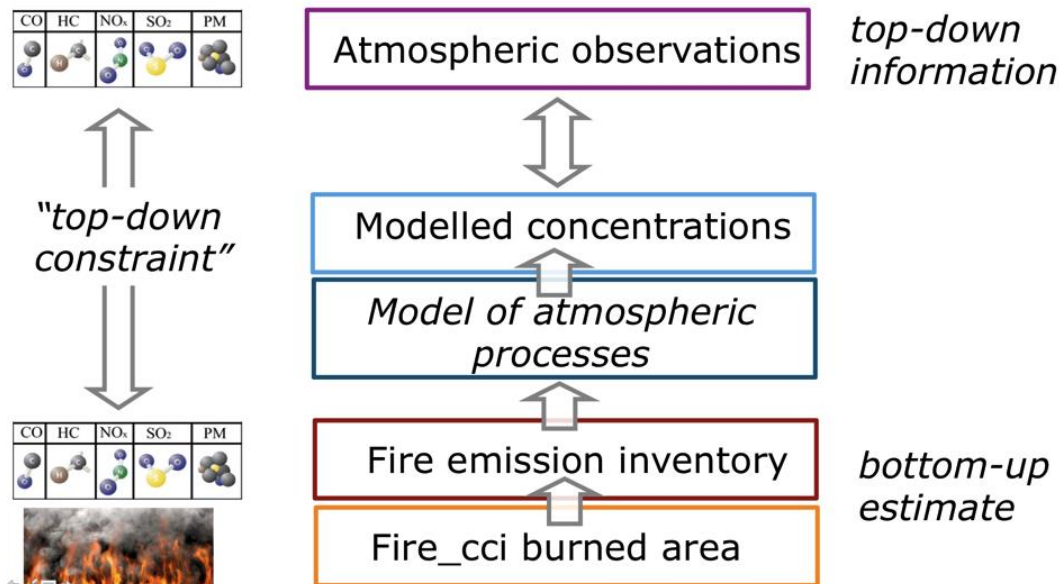


Producto	OE [%]	CE [%]	DC [%]	RelB [%]
FireCCISFD20	8.5	15.0	87.7	8.4
MCD64C6	56.5	21.1	56.0	-44,9
FireCCI51	52.2	25.1	58.4	-36.2

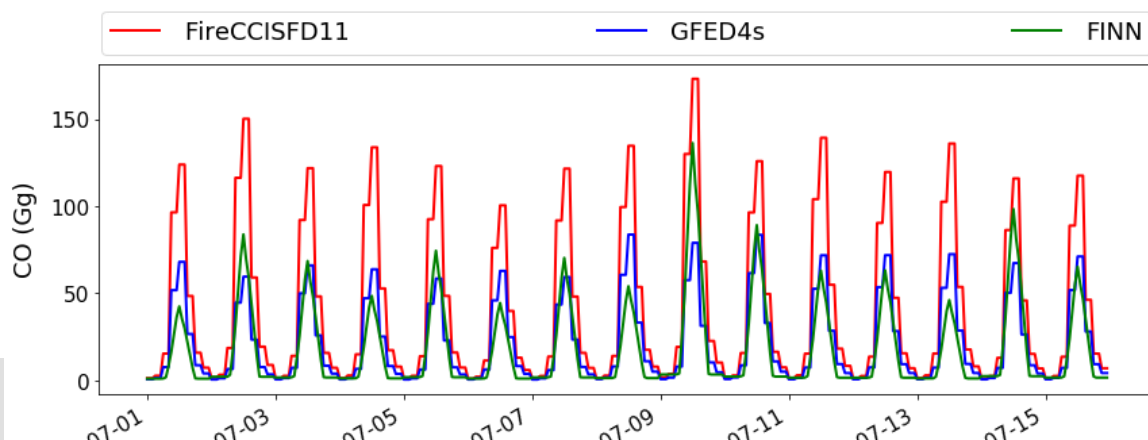


Uso de los productos: estimación de emisiones

- WRF-Chem Forecasting System for FireCCI+ (DKRZ, Hamburg, Germany)

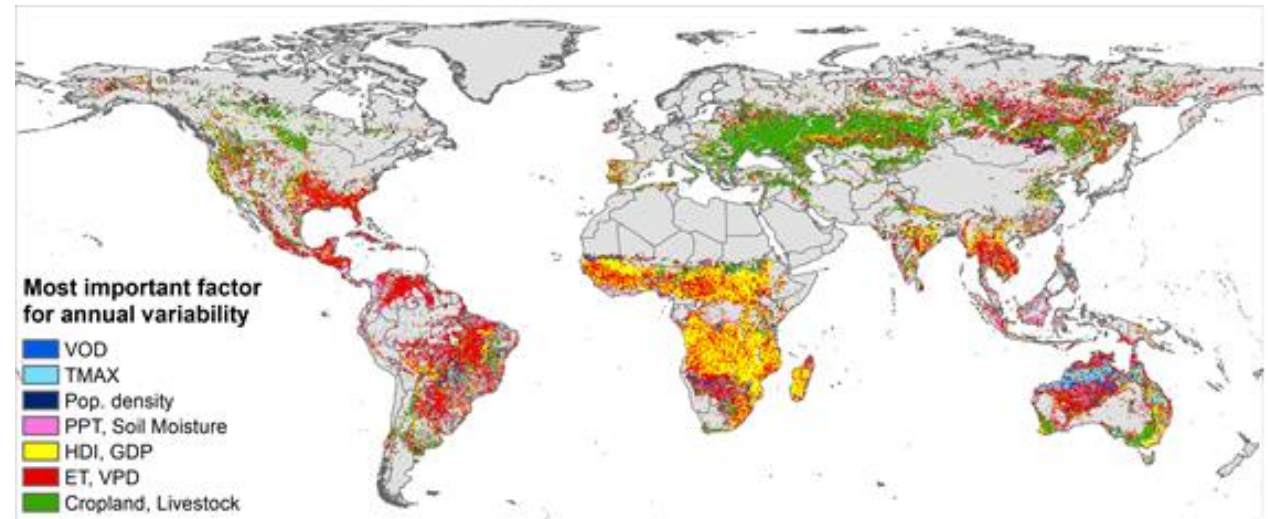
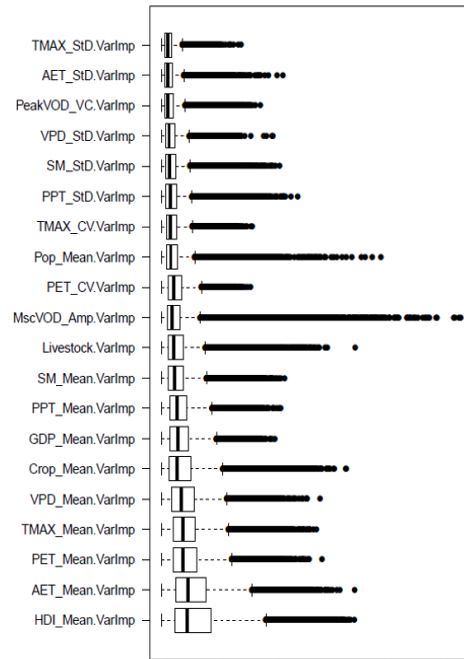
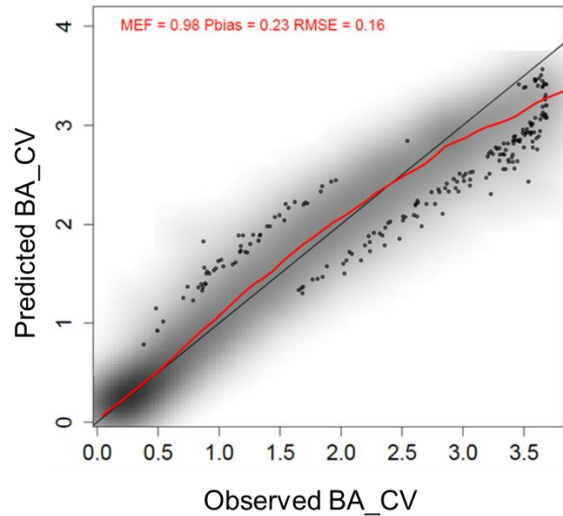
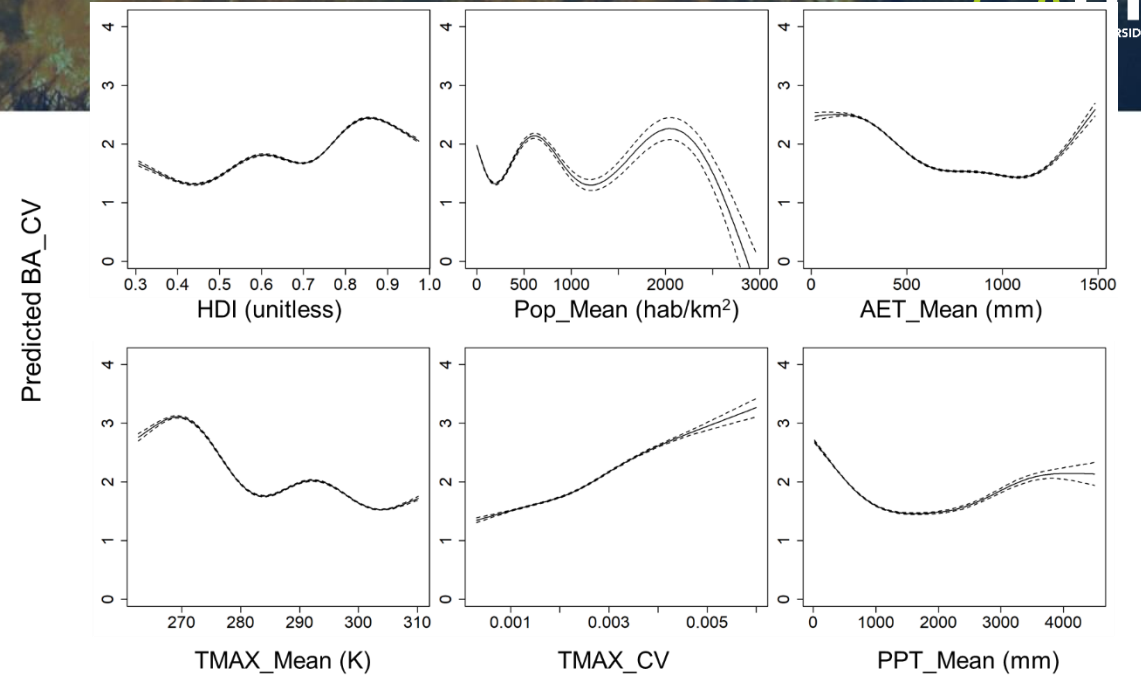
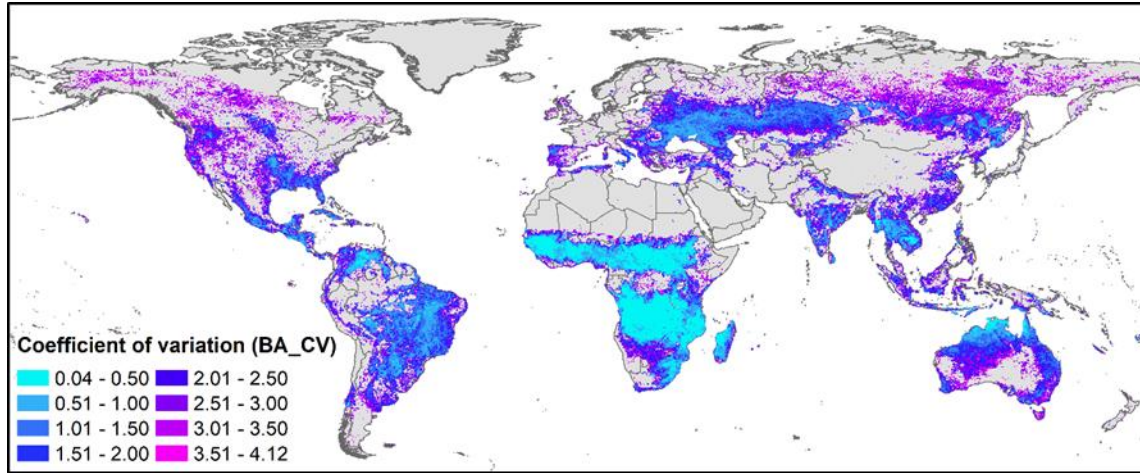


Heil et al., 2020, CAR





Factores en la variabilidad del fuego

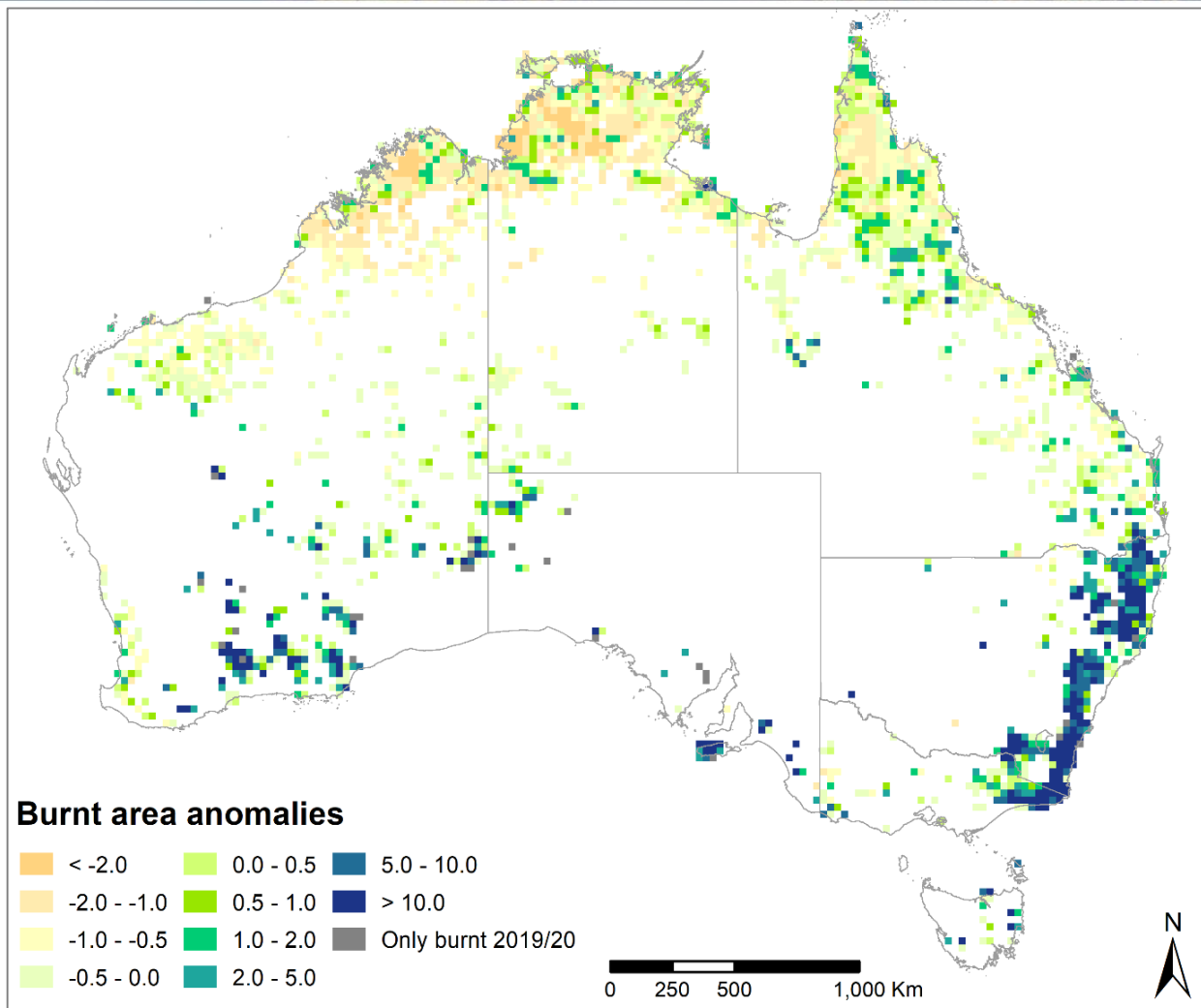


Chuvieco et al., 2021, STOTEN





Anomalías temporales



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-Lolola, Maria Lucrecia Pettinari, Sami Shah, Ross Bradstock & Emilio Chuvpico

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 managers¹. Many Australians endured five months of smoke pollution that breached national air-quality standards. Usually, people would experience shorter bouts covering smaller areas².





Resumen de los resultados (2010-2021)

- Primeros productos globales de AQ a partir de sensores de la ESA:
 - MERIS (2005-2011)
 - S-3 OLCI (2017-2019) y SYN (2019).
- Primera serie global de AQ a partir del AVHRR-LTDR (1982-2018).
- Primer producto a partir de los canales de 250m del MODIS (2001-2019).
- Primeros productos de AQ regionales:
 - S-2 (Africa).
 - S-1 (Amazonia).
- Análisis global de los productos:
 - Emisiones.
 - Modelos de Dinámica Global de la Vegetación.
 - Factores de ocurrencia.



ESA climate office

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Muchas gracias
emilio.Chuvienco@uah.es

Fire

The Fire_cci project aims to improve consistency, using better algorithms for both pre-processing and burned area detection while incorporating error characterisation.