The DLR-ZKI Wildfire Monitoring System

September 27th, 2022

Remote Sensing | Leveraging Remote Sensing and Geoinformatics Fire and Related Emissions for Environmental Health

Michael Nolde, Florian Fichtner,
Nico Mandery, Torsten Riedlinger

DLR


Greece, 2007
MODIS, 26th August 2007
DLR
0
50
100 km


Bolivia, Brazil, Paraguay, 2019
Landsat, 25th August 2019
DLR
0
5
10 km


Bolivia, Brazil, Paraguay, 2019
Landsat, 25th August 2019
DLR
0
5
10 km


DLR


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Intergovernmental Panel on Climate Change (IPCC) report, Feb. 2022

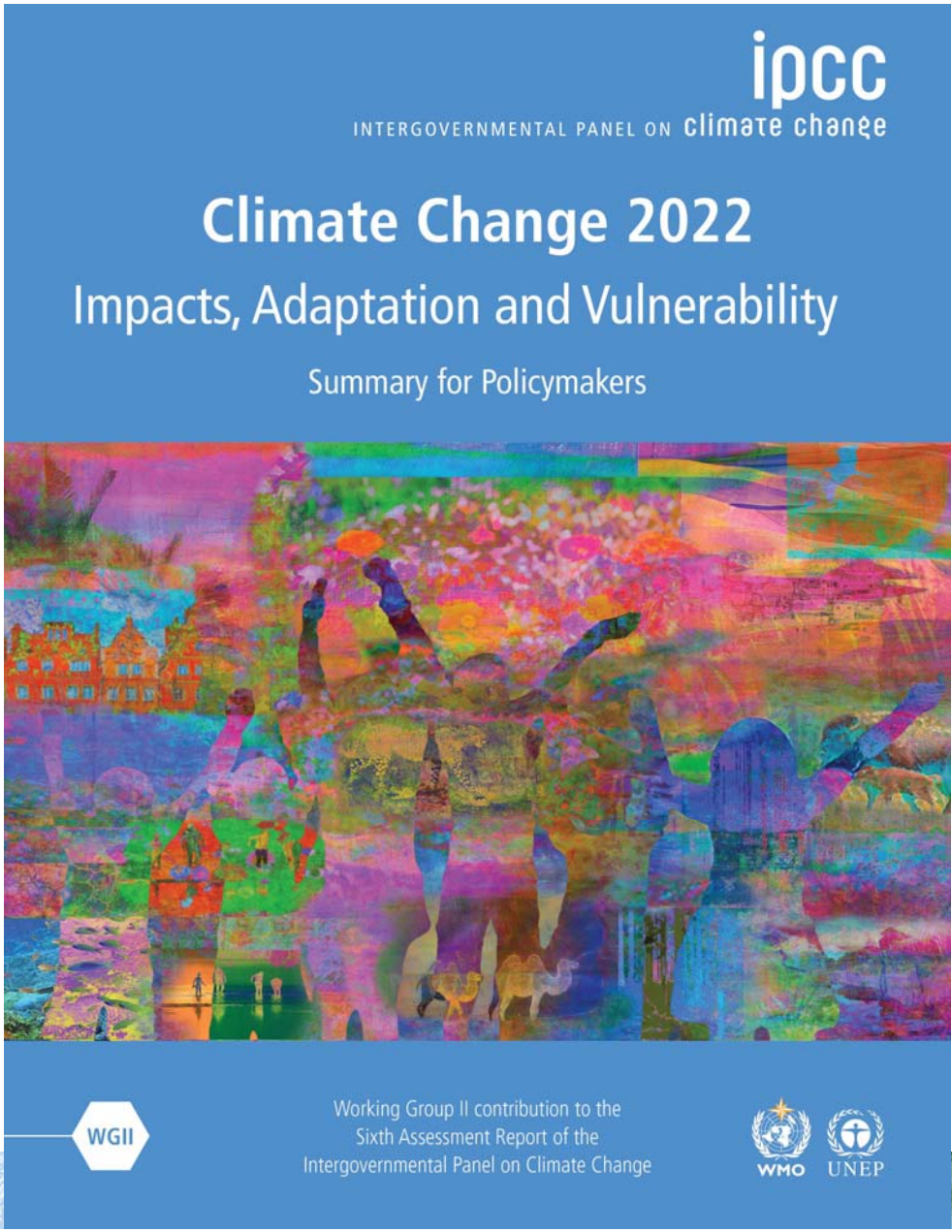
Increasing number of droughts, heat waves and wildfires

Increasing frequency:

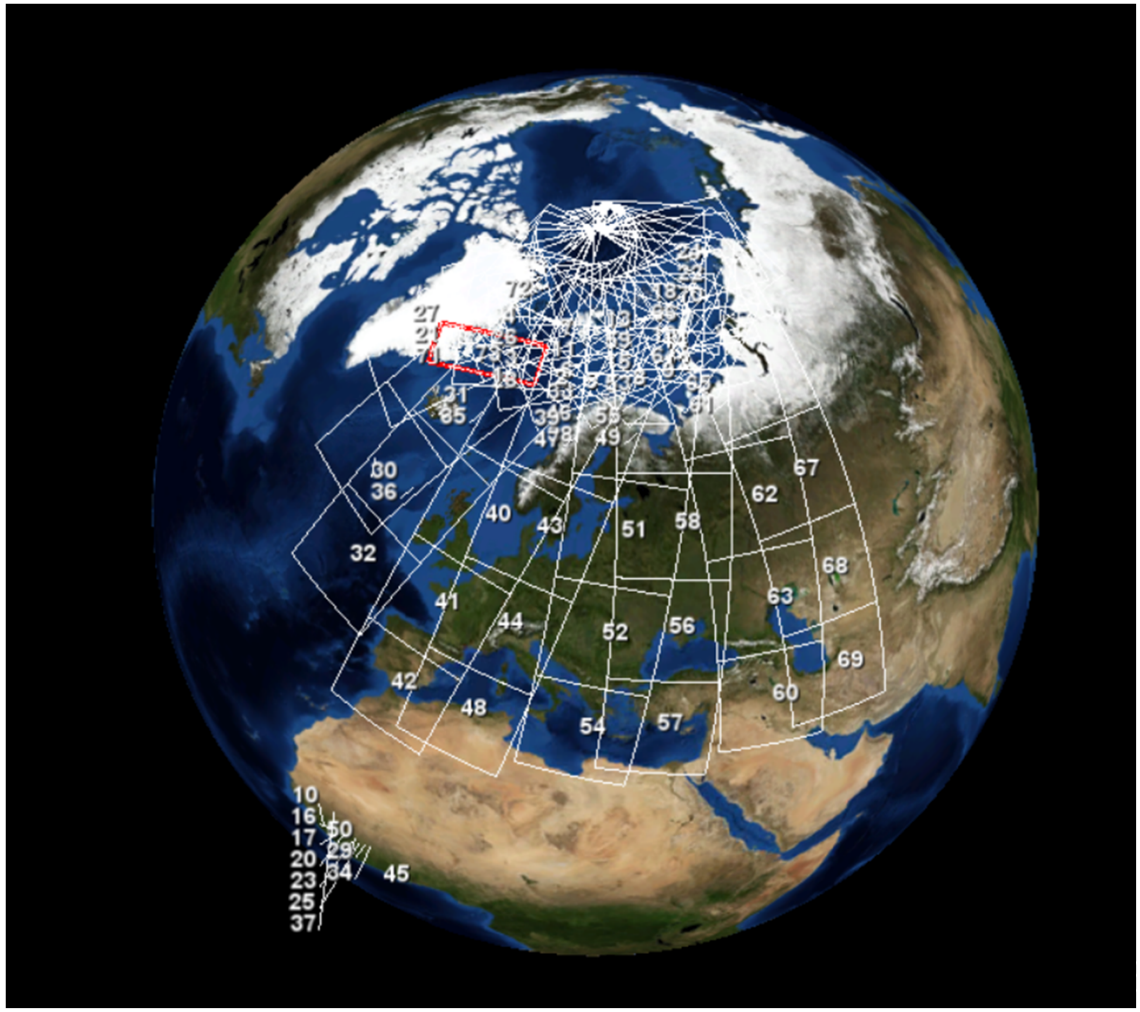
- 400 year fires → 50 year fires

global annual fire suppression cost by the end of the century:

- RCP4.5: $1 billion (60 % increase to 1980–2009)
- RCP8.5: $1.9 billion (119 % increase to 1980-2009)



Dataset	Version	Sensor	Provider	AOI	Time range	Spat. Res.	Temp. Res.	Timeliness
ZKI Fire Monitoring	2.1.2	S3-OLCI	DLR-GZS	Europe	2016/04 – today	300m	daily	**Hours**
C3SBA	1.0	S3-OLCI	Copernicus CDS	Global	2017/01 – 2020/10	300m	daily	Months
MCD64A1	6.1	MODIS	NASA	Global	2000/11 – 2021-10	500m	daily	Months
EFFIS (semi-automatic)	--	MODIS (+)	Copernicus EMS, JRC	Europe (+)	2012 – today	250m (+)	daily	**Hours/Days (office hours)**
Fire.cci BA	5.1	MODIS	ESA	Global	2001/01 – 2020/12	250m	daily	Months/Years
Fire_cci LT BA	1.1	AVHRR	ESA	Global	1982/01 – 2018/12	5000m	daily	Months/Years
CGLSBA	3.0.1	S3-OLCI / S3-SLSTR	Copernicus Land / VITO	Global	2014/04 – 2021/03	300m	daily	Months



Acquisition segments of Sentinel-3 A/B (example for 2021-07-01)

Sentinel-3

Sentinel-3 overpasses: Oberpfaffenhofen

	Morning	Afternoon
S3 A	~11.15	~19.30
S3 B	~12.00	~20.15

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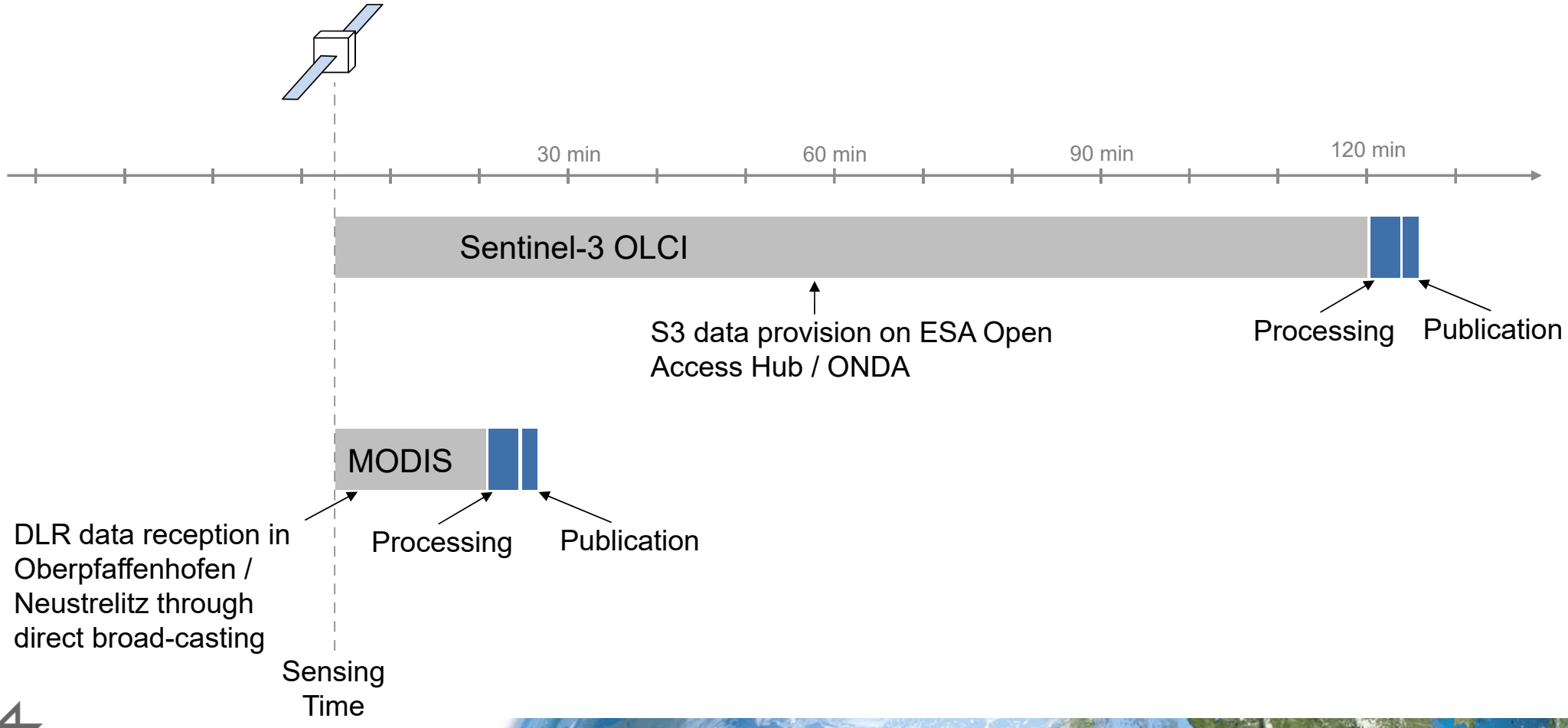
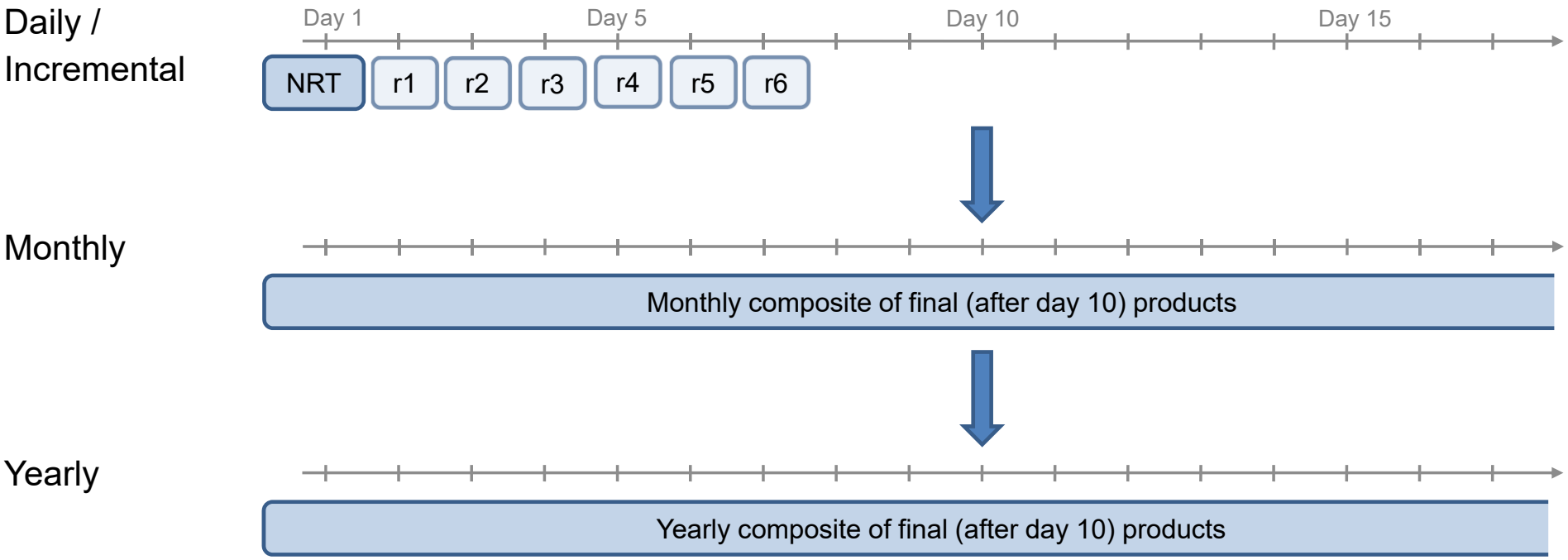
Timeliness


30 min
60 min
90 min
120 min
Sentinel-3 OLCI
S3 data provision on ESA Open Access Hub / ONDA
Processing
Publication
MODIS
DLR data reception in Oberpfaffenhofen / Neustrelitz through direct broad-casting
Processing
Publication
Sensing Time

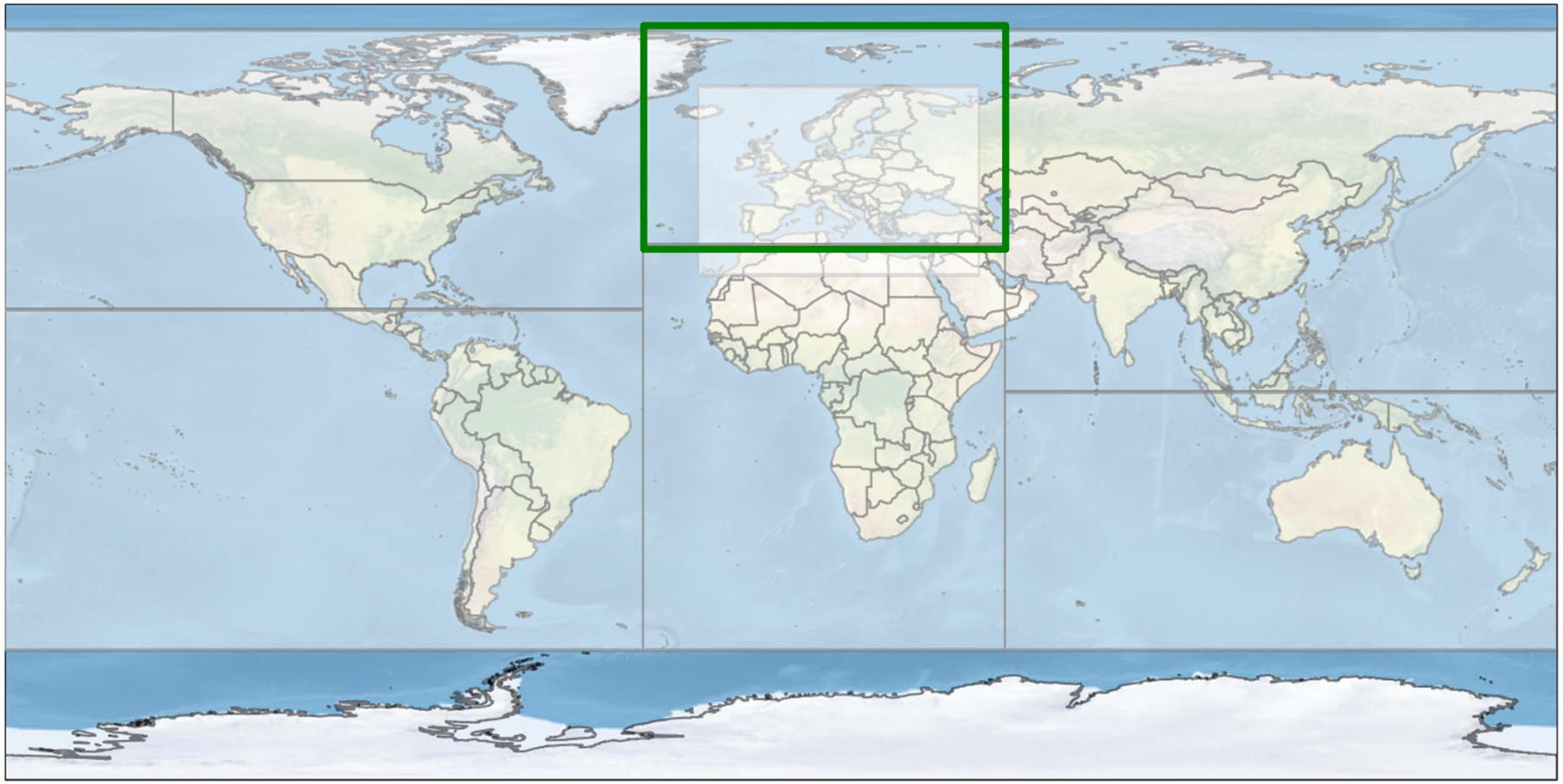
r : Revision

Products

Currently: Monitoring of Europe, 4 overpasses / day (summer time), Sentinel-3 A/B OLCI, 300 x 300m

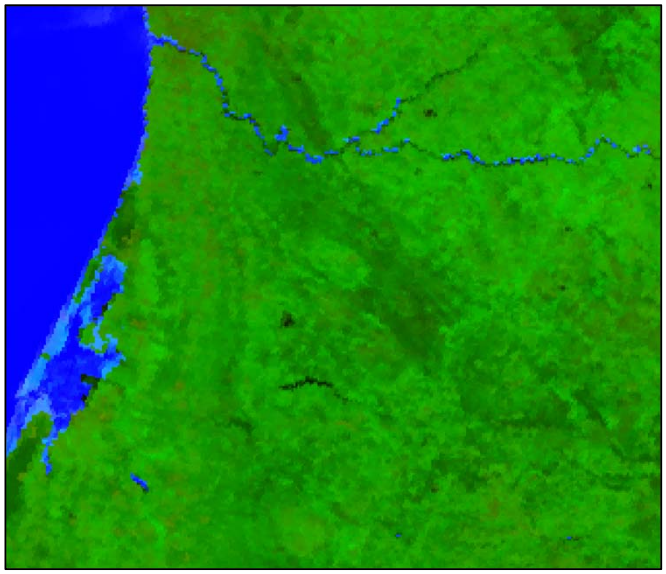


Monitoring area

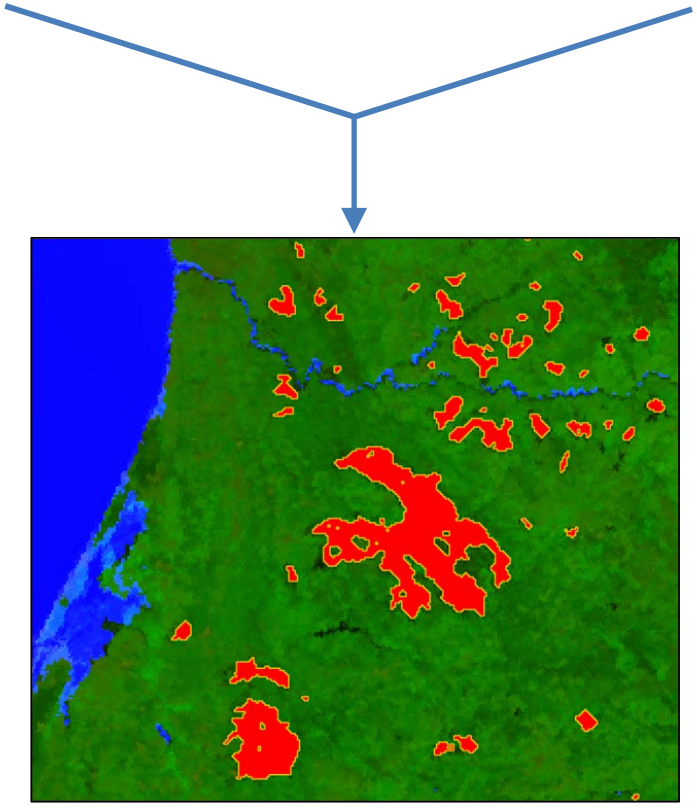


Burned Area Mapping – Change Detection approach

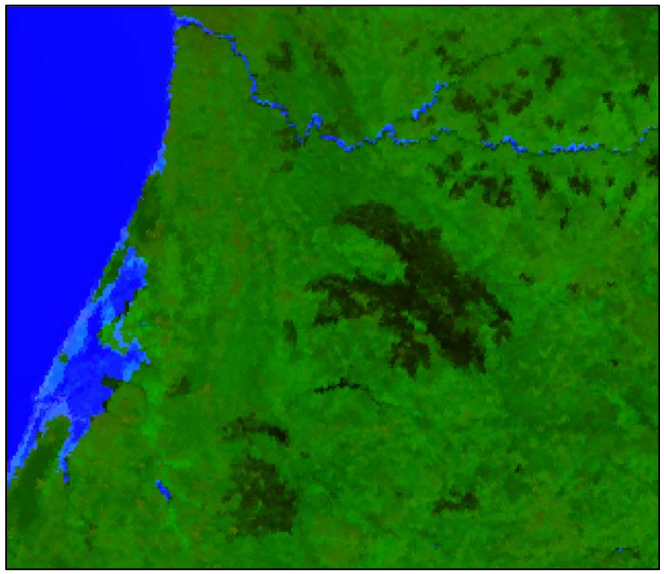
Example: Northern Portugal, August 2016



Pre scene (red/NIR), Sentinel-3 OLCI, 26.7.2016



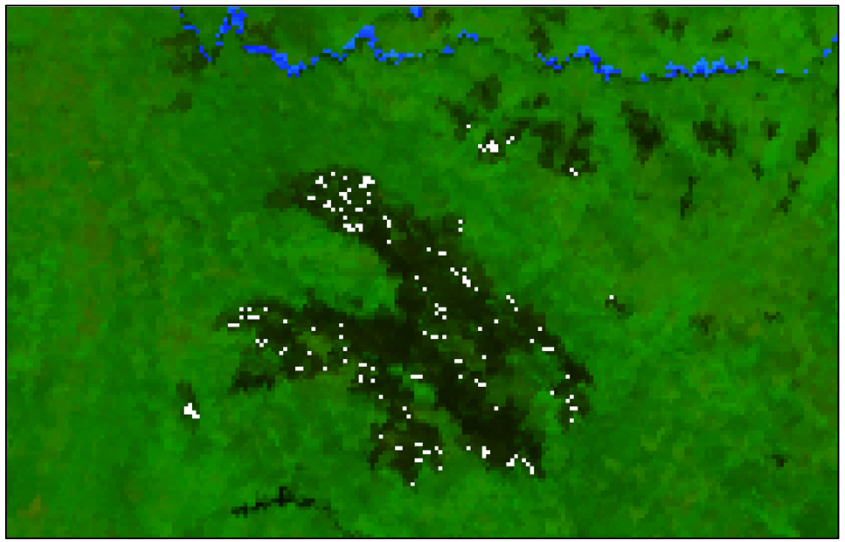
Final mapping result



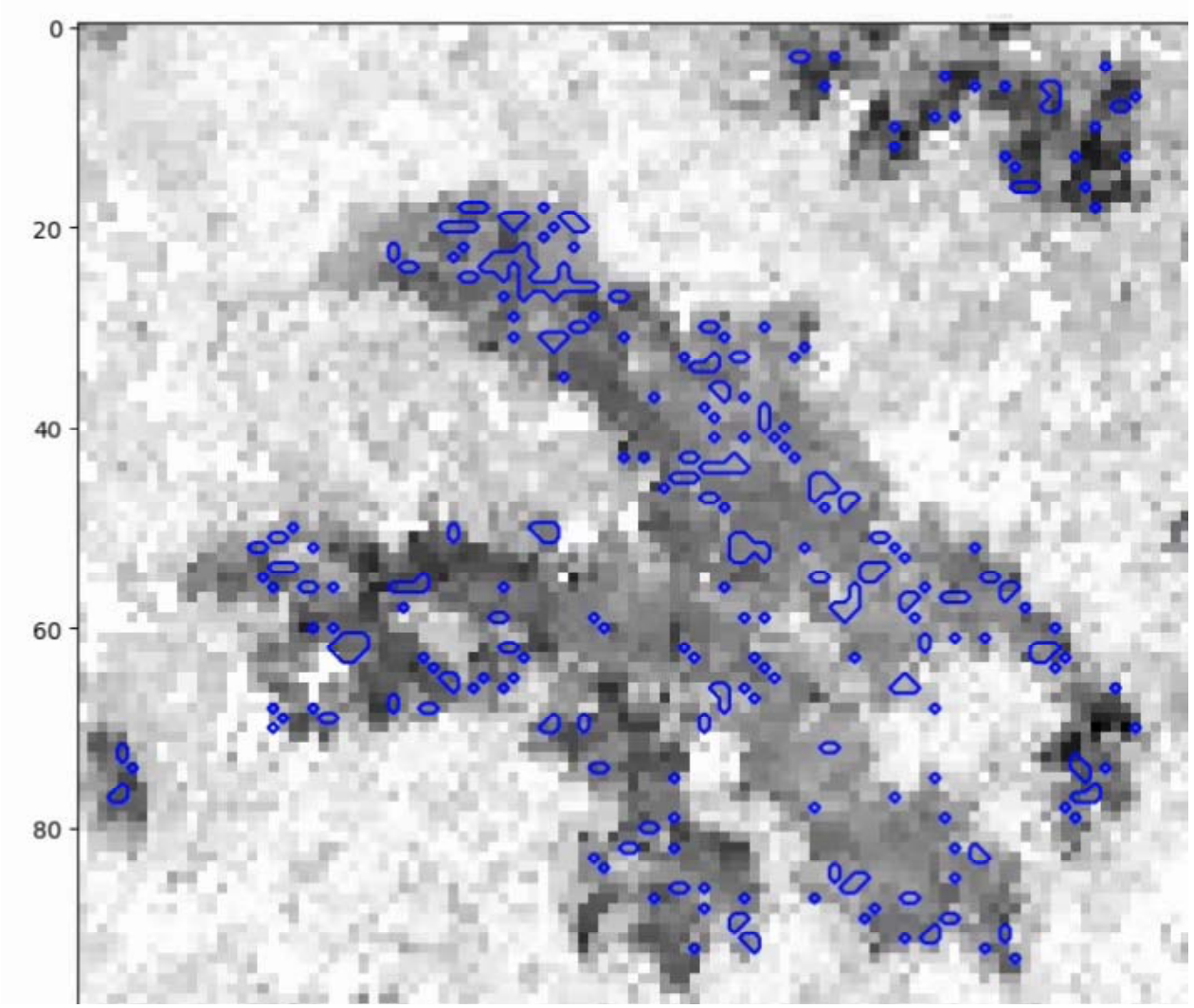
Post scene (red/NIR), Sentinel-3 OLCI, 6.9.2016

Extraction methodology: Morphological snakes

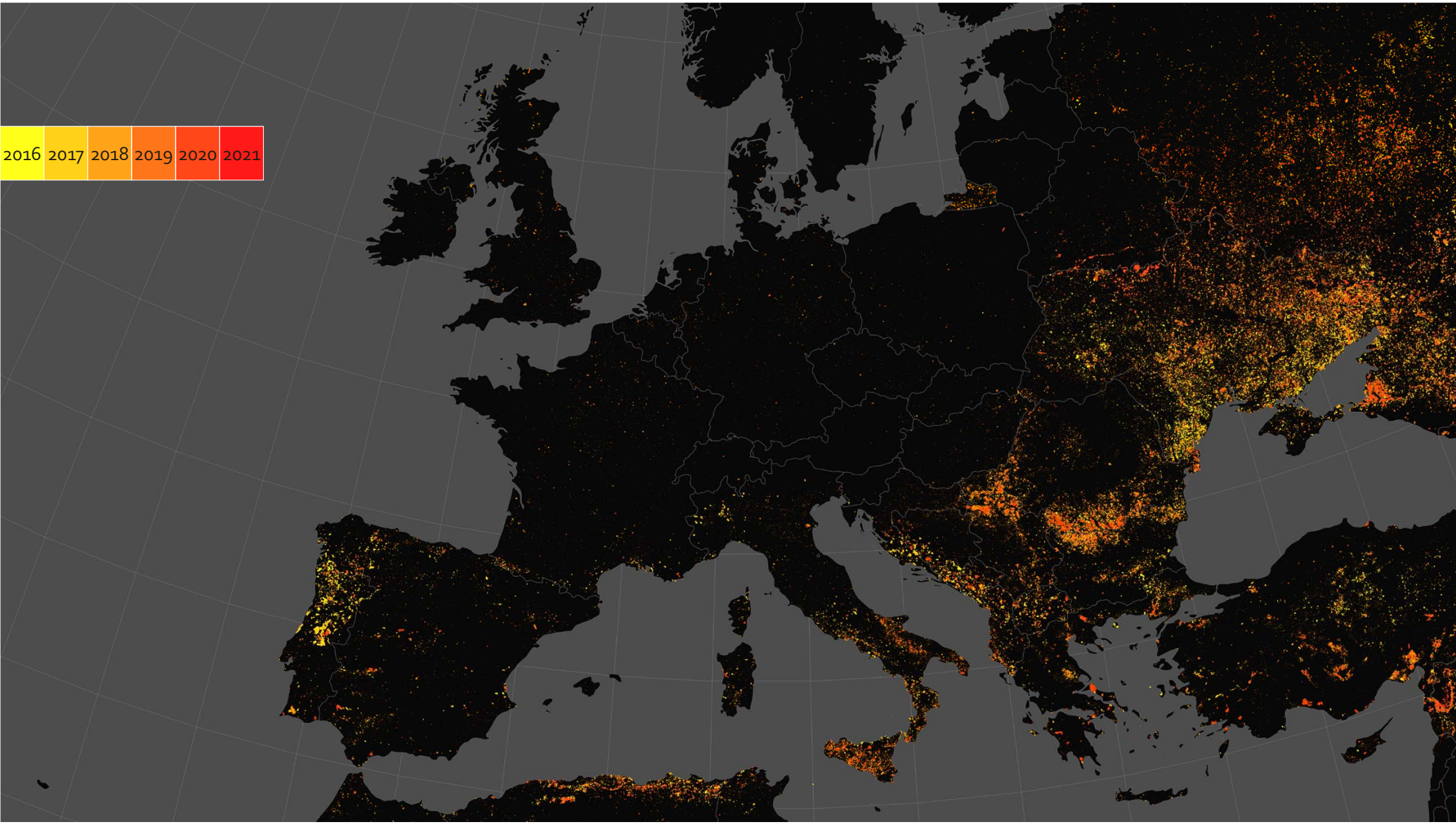
(Active Contour Level Sets)



Sentinel-3 (OLCI) cutout showing a burnt area in northern Portugal, August 2016 (white: Active Fire locations)



Animation showing the growing of the active contour


2016
2017
2018
2019
2020
2021

Brandflächen Monitoring

2016 2017 2018 2019 2020 2021

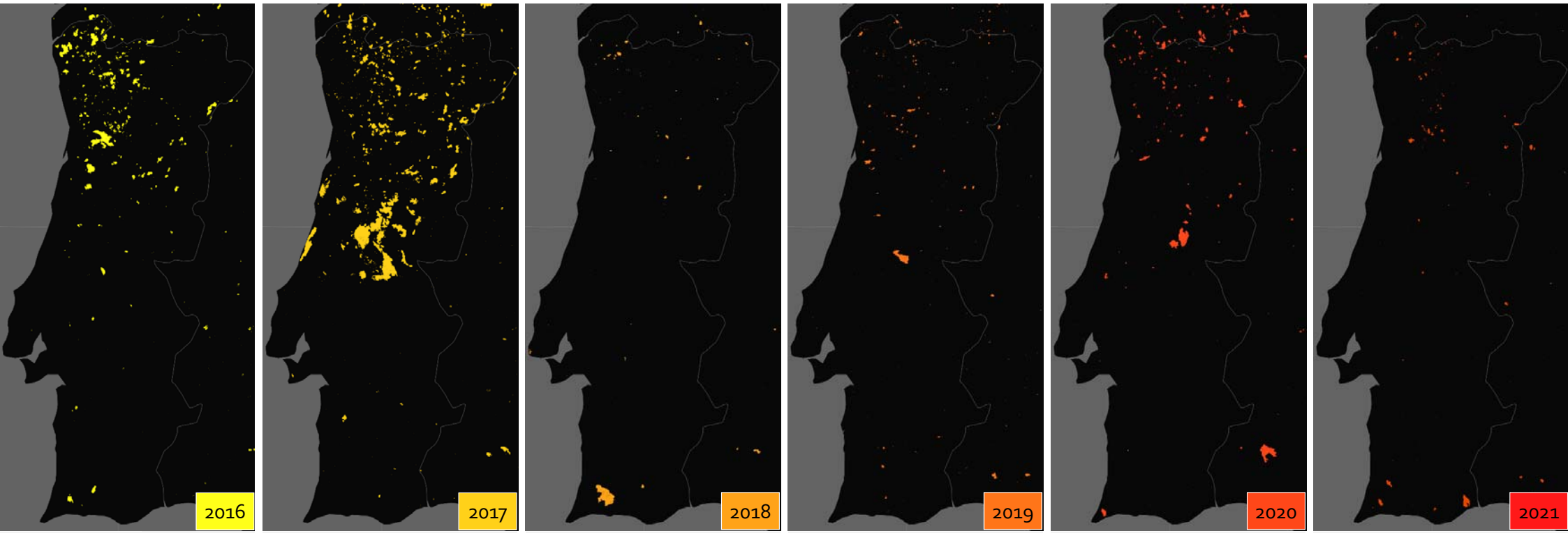
Alle verfügbaren Sentinel 3A/3B Daten prozessiert

Ergebnisse über EOC Geoservice als Tages-, Monats,- Jahres- Komposit

Brandflächen
(in mio. ha)

Jahr	Alle	Wald
2016	4,11	0,65
2017	5,16	1,32
2018	3,41	0,50
2019	4,87	0,89
2020	2,99	0,73
2021	3,67	0,94

Waldbrandflächen in Portugal seit 2016



	2016	2017	2018	2019	2020	2021
Fläche [ha]:	145.079	339.525	36.648	33.496	63.923	29.027
Anzahl:	227	371	47	97	110	75
%-Fläche:	1,62	3,78	0,42	0,40	0,72	0,35

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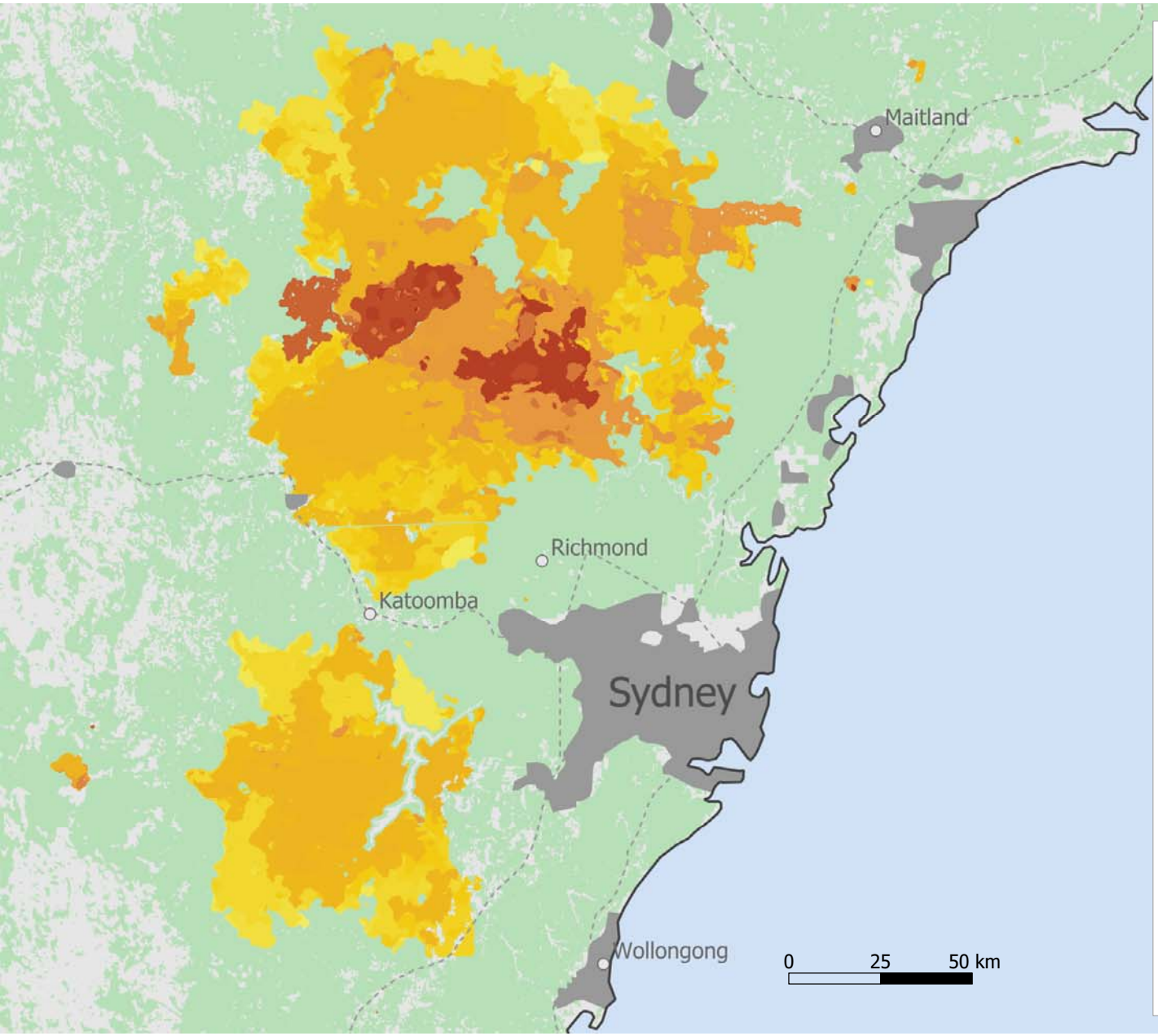


Australian Wildfires 2019/2020

DLR Burnt Area Analysis, using
Copernicus Sentinel-3 OLCI data

Start date:	1st November 2019
End date:	19th January 2020
Sentinel-3 A/B tiles:	326

Legend:

- Forest and Shrublands (ESA GlobCover, 2009)
- Urban Areas (Natural Earth)
- Major Roads (Natural Earth)

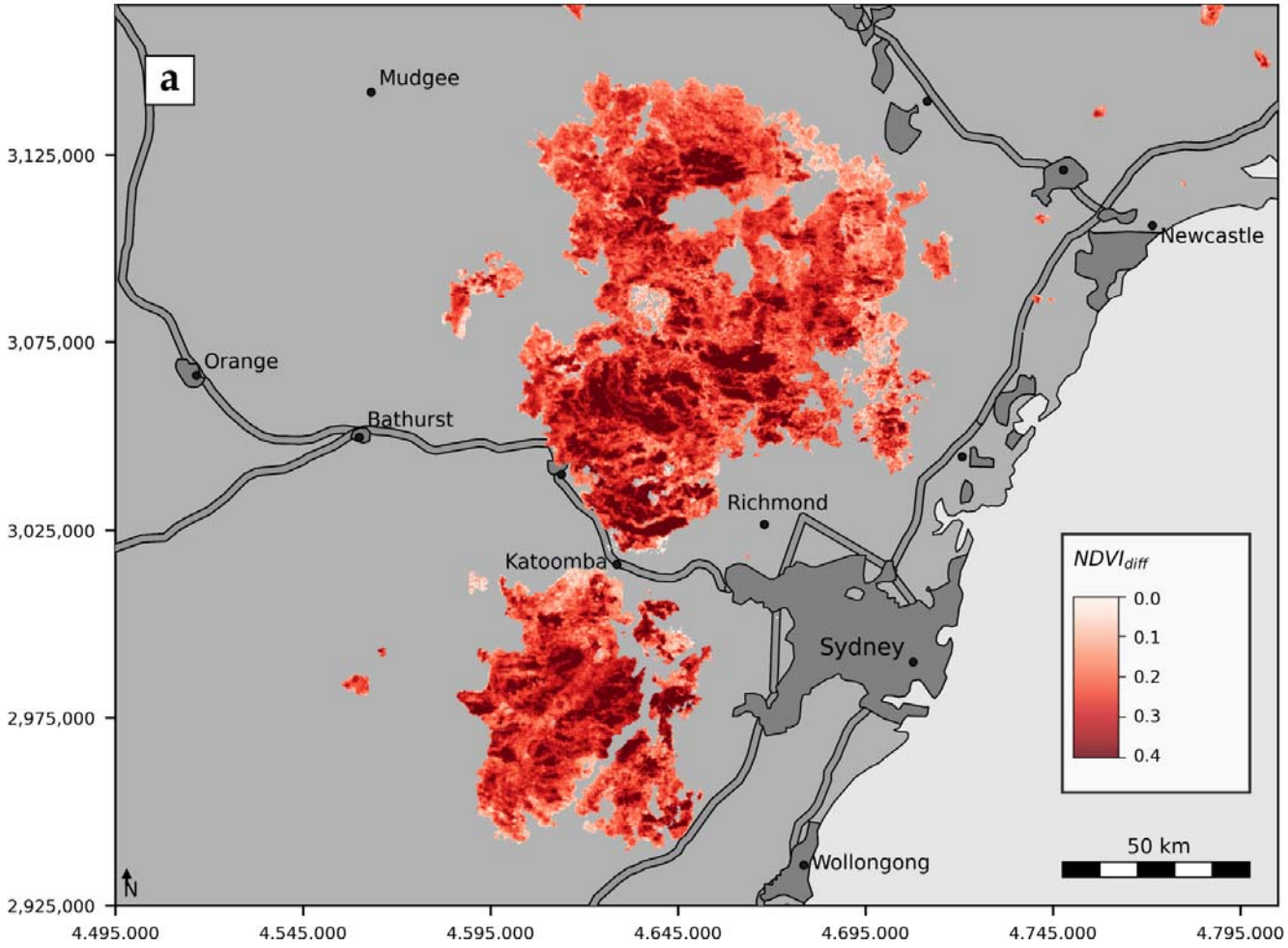
Burnt Area detected for the fires around Sydney:

12 764 km²
1.28 million ha
4 928 mile²

1st Nov. 2019 — 19th Jan. 2020

Map produced 20th January 2020 by ZKI@DLR.DE

Copernicus The European Earth Observation Programme
ZKI
DLR



Fire severity

Australian Wildfires 2019/2020

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Map produced 20th January 2020 by ZKI@DLR.DE

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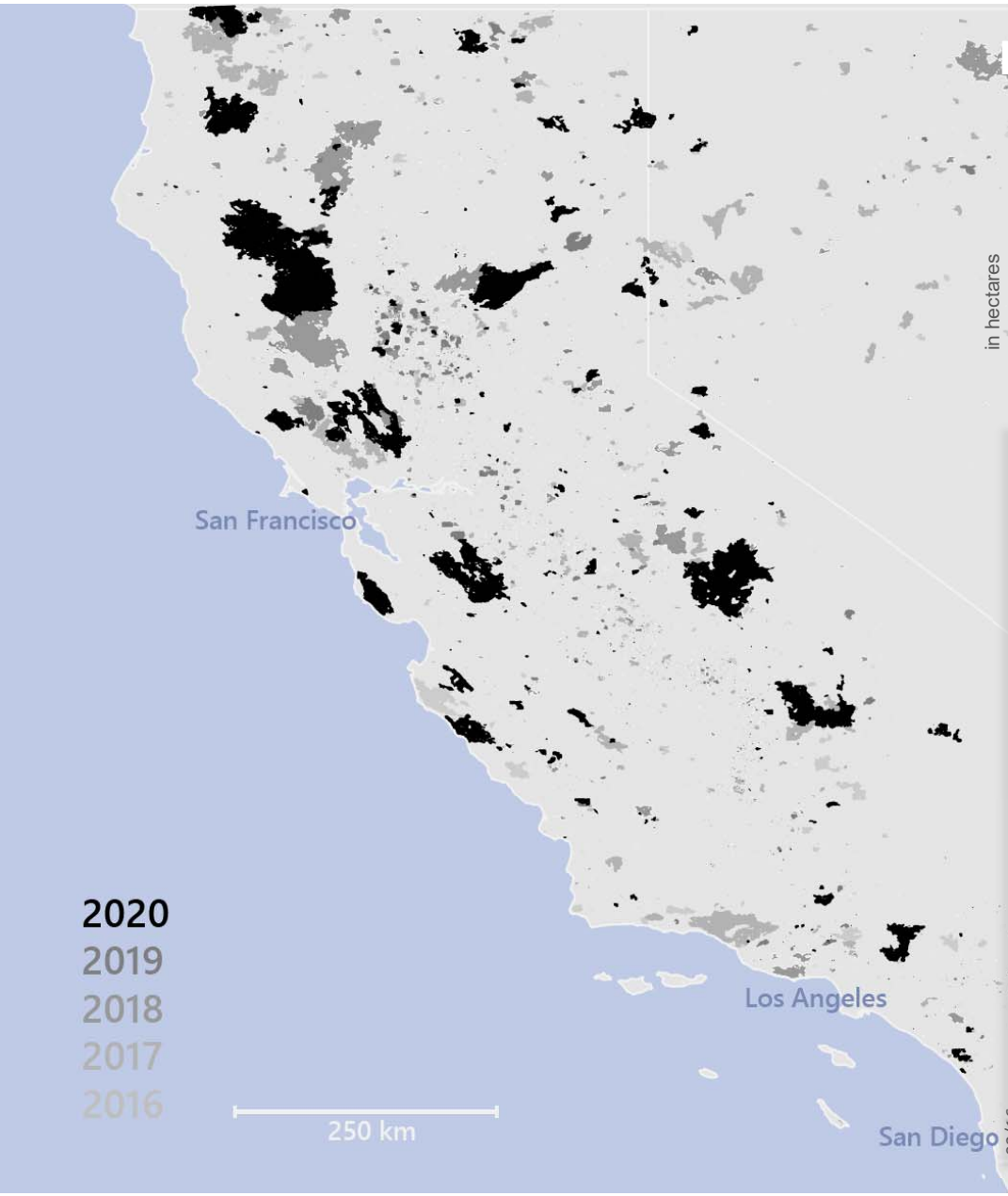
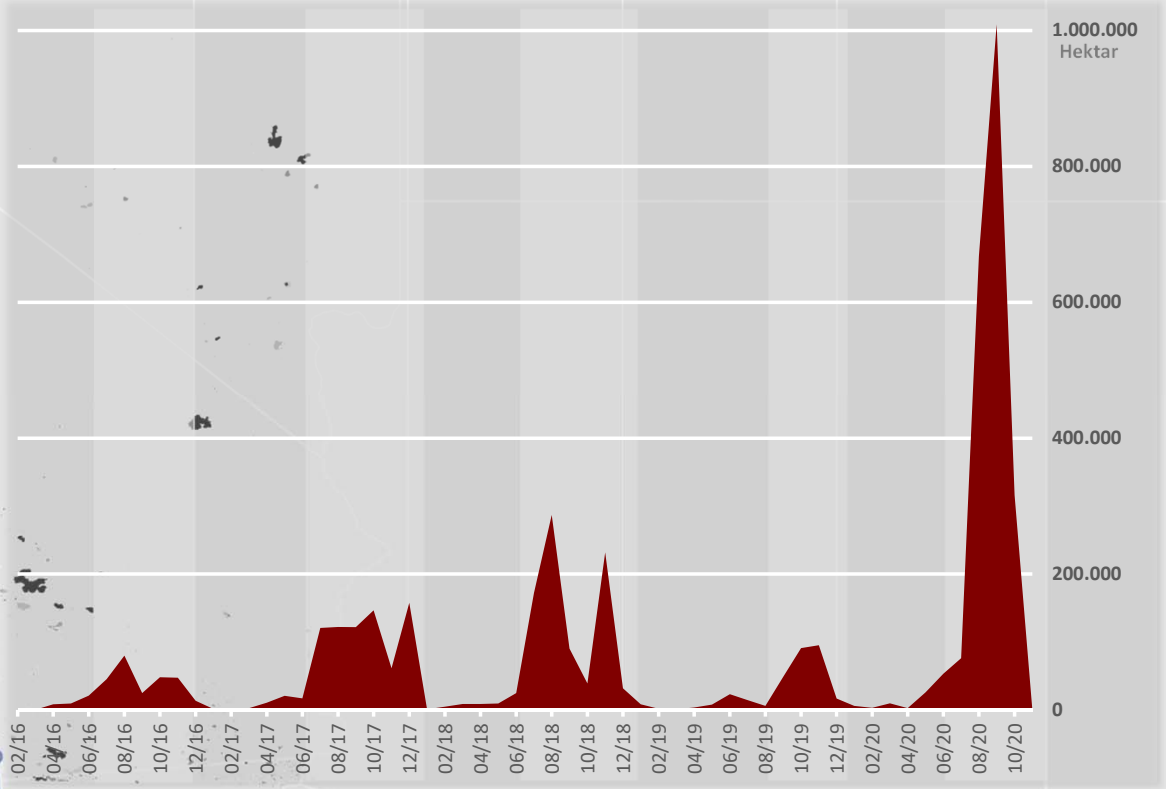
BURNED AREA MONITORING USING SENTINEL-3



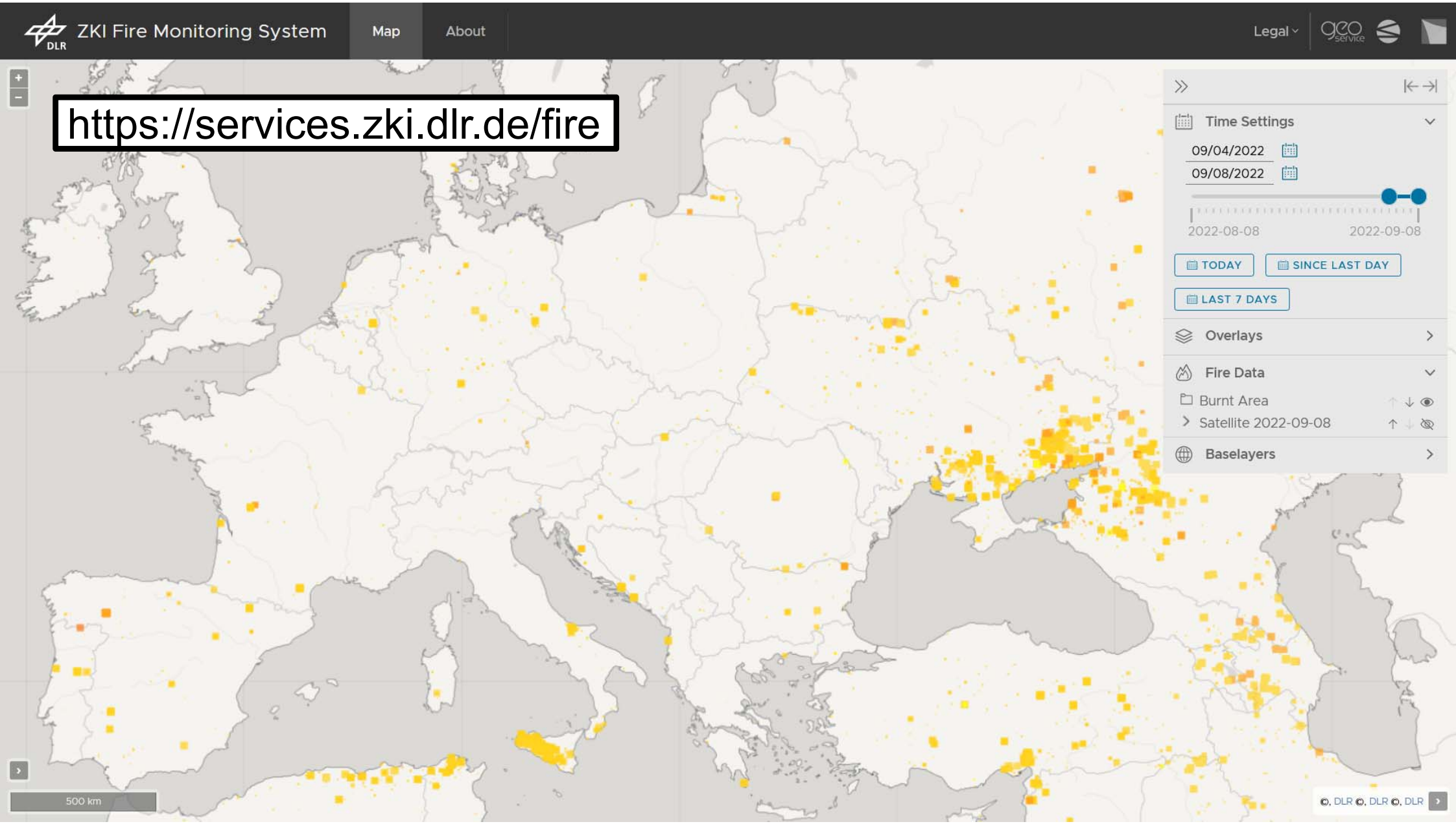
Analysis for California

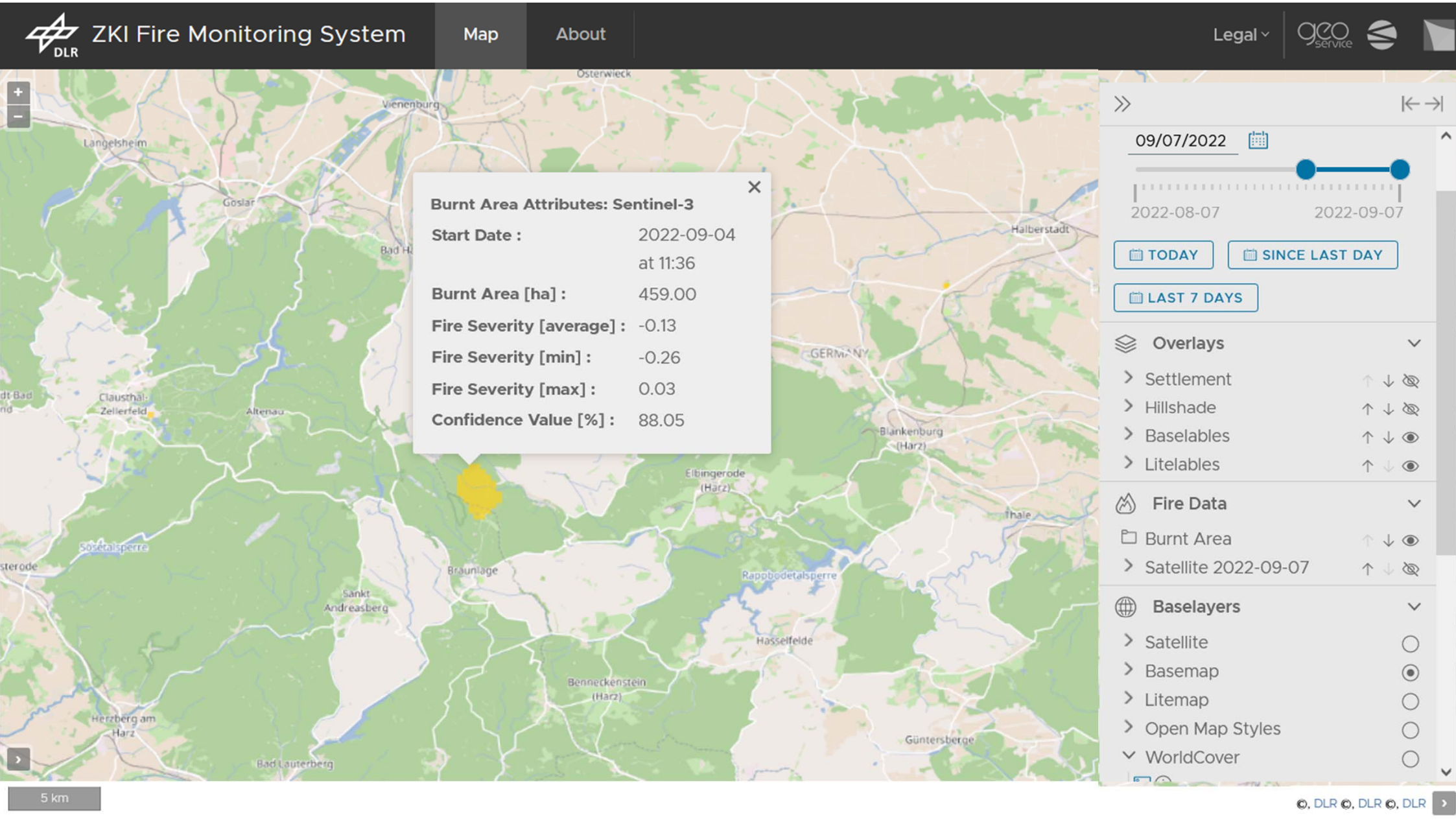
in hectares

2016	2017	2018	2019	2020	
283.647	609.835	653.019	218.801	1.691.800	DLR
220.457	458.120	587.712	124.728	n/a	NASA
270.950	626.627	799.288	112.213	1.723.096	CalFire*



*CalFire (official statistics), see https://www.fire.ca.gov/stats-events/


ZKI Fire Monitoring System
Map
About
Legal
https://services.zki.dlr.de/fire
Time Settings
09/04/2022
09/08/2022
2022-08-08
2022-09-08
TODAY
SINCE LAST DAY
LAST 7 DAYS
Overlays
Fire Data
Burnt Area
Satellite 2022-09-08
Baselayers
500 km
© DLR © DLR © DLR


ZKI Fire Monitoring System
Map
About
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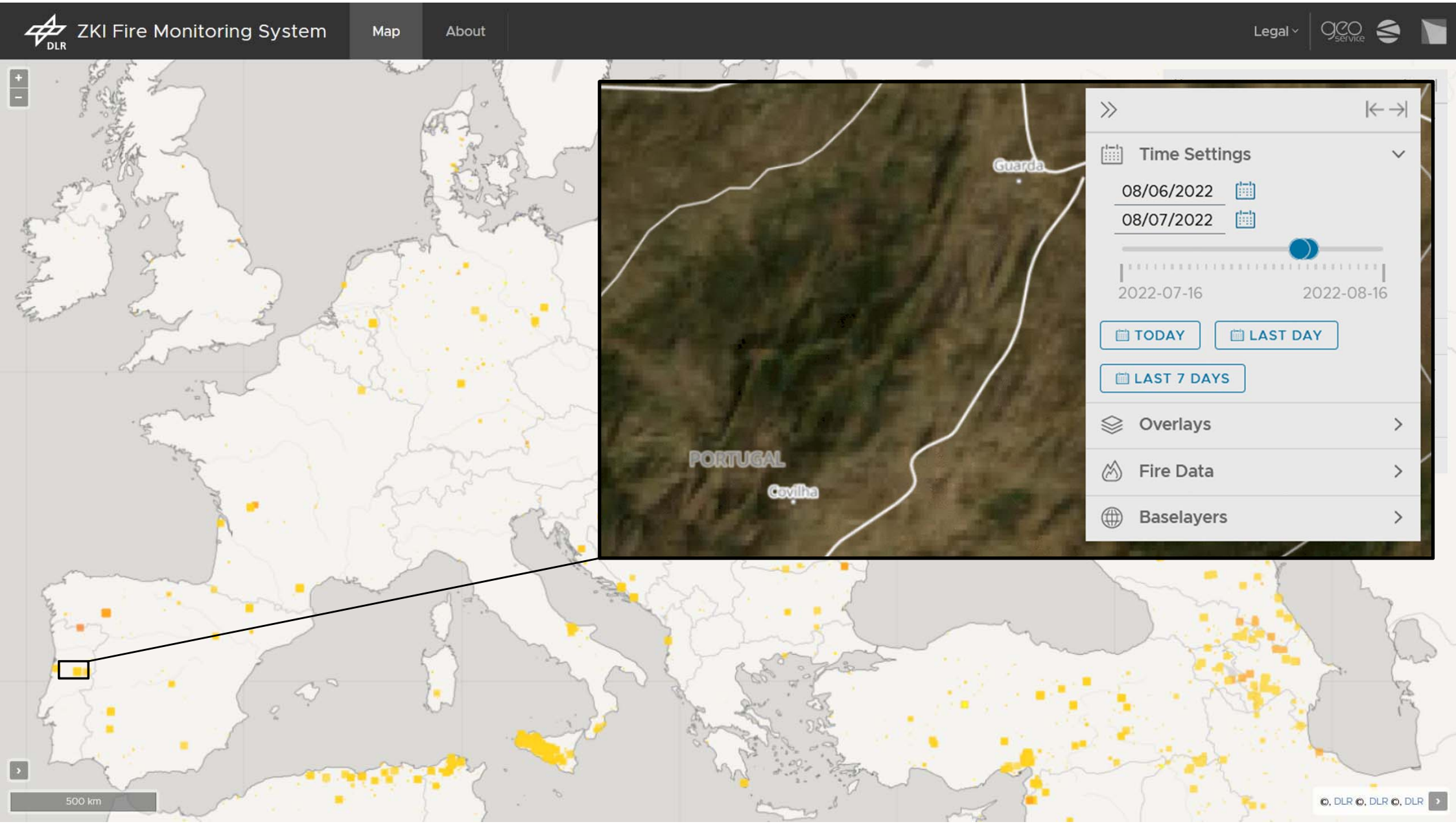
Burnt Area Attributes: Sentinel-3
Start Date : 2022-09-04 at 11:36
Burnt Area [ha] : 459.00
Fire Severity [average] : -0.13
Fire Severity [min] : -0.26
Fire Severity [max] : 0.03
Confidence Value [%] : 88.05
09/07/2022
2022-08-07
2022-09-07
TODAY
SINCE LAST DAY
LAST 7 DAYS
Overlays
Settlement
Hillshade
Baselables
Litelables
Fire Data
Burnt Area
Satellite 2022-09-07
Baselayers
Satellite
Basemap
Litemap
Open Map Styles
WorldCover
Vienenburg
Langelsheim
Goslar
Halberstadt
Clausthal-Zellerfeld
Altenau
Elbingerode (Harz)
Braunlage
Sankt Andreasberg
Rappbodetalsperre
Hasselfelde
Benneckenstein (Harz)
Herzberg am Harz
Bad Lauterberg
Güntersberge
Thale
5 km
©, DLR ©, DLR ©, DLR


ZKI Fire Monitoring System
Map
About
Legal
Guarda
PORTUGAL
Covilhã
Time Settings
08/06/2022
08/07/2022
2022-07-16
2022-08-16
TODAY
LAST DAY
LAST 7 DAYS
Overlays
Fire Data
Baselayers
500 km
© DLR © DLR © DLR

UKIS Data Tutorial Application - Jupyter Notebook

https://github.com/dlr-eoc/ukis-data-tutorials

Allows online analysis of archived data

README.md

UKIS data-tutorials

launch binder License Apache 2.0

Notebooks and collection of resources around the datasets we published on EOC Geoservice.

Burnt Area Products

Daily, monthly and yearly burnt area products in the EOC Geoservice.

In burntarea/analyze_data.ipynb you can find some small example for how to get and use the products.

The daily product is based on a fully automated approach and provides the extents of burned areas two hours after the according scenes have been acquired by the Copernicus Sentinel-3 satellite. Additionally, attribute information about the severity of the fire as well as the exact detection time is included in the data. It is also possible to accurately track the evolution of each burnt area. The product is iteratively and automatically updated over a period of 10 days as new satellite data becomes available. This enables the continuous improvement of the accuracy of the derived extents by minimizing the influence of disturbing factors such as cloud cover. In addition to a daily product, the results are also available in summarized form as monthly and yearly composites. While the information of the daily product is always kept for the last 50 days, the archived monthly products are available as early as April 2016, and the first yearly product as early as 2017. This time series allows deriving large-scale developments in terms of size of affected areas and severity. In total, approximately 100,000 satellite scenes from the Ocean and Land Colour Instrument (OLCI) sensor on the Copernicus Sentinel-3 A/B satellites have been used for processing through the end of 2021. Via Web Map and Web Feature Services (WMS/WFS), the data can be easily integrated into existing projects and applications. The methodology for deriving fire areas has been scientifically published, and an analysis of large fires on the Australian East Coast in 2019/20 based on the methodology is also available.

EOC News article.

Contributors 4

- kambrium Martin
- fwfichtner Florian
- MWieland Marc
- mgnolde Michael

Languages

- Jupyter Notebook 100.0%

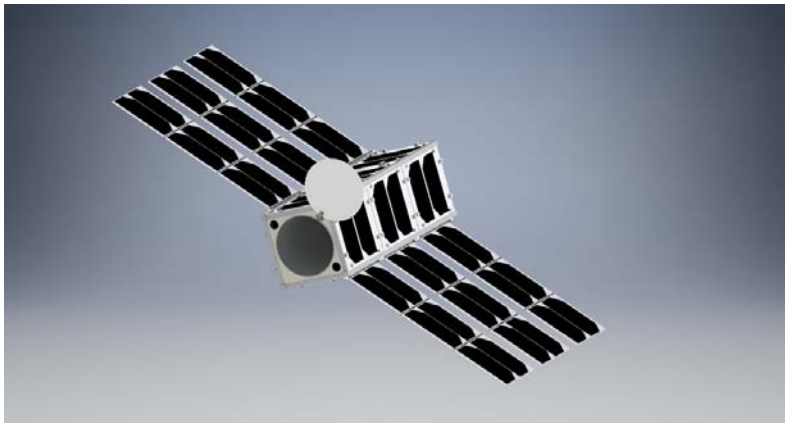
DLR UKIS

Technology transfer – cooperation with industry

DLR is always interested in collaborating with companies

- Access to geodata and services
- Joint research and development projects

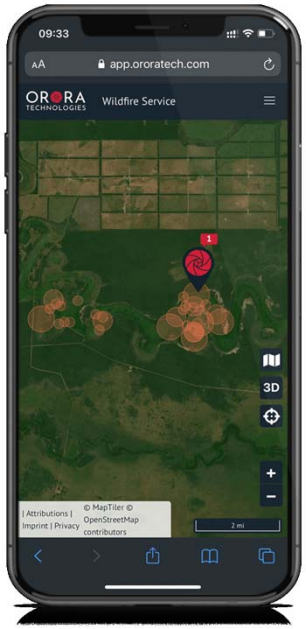
Technology transfer



- Project SERAFIM has started in May 2022, lead: OroraTech, Munich

- Funded by “Bayerisches Staatsministerium für Wirtschaft, Landesentwicklung und Energie (StMWi)“

- Aim to speed up fire detection times significantly by
    1. Launching a CubeSat constellation
    2. On-board processing



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