

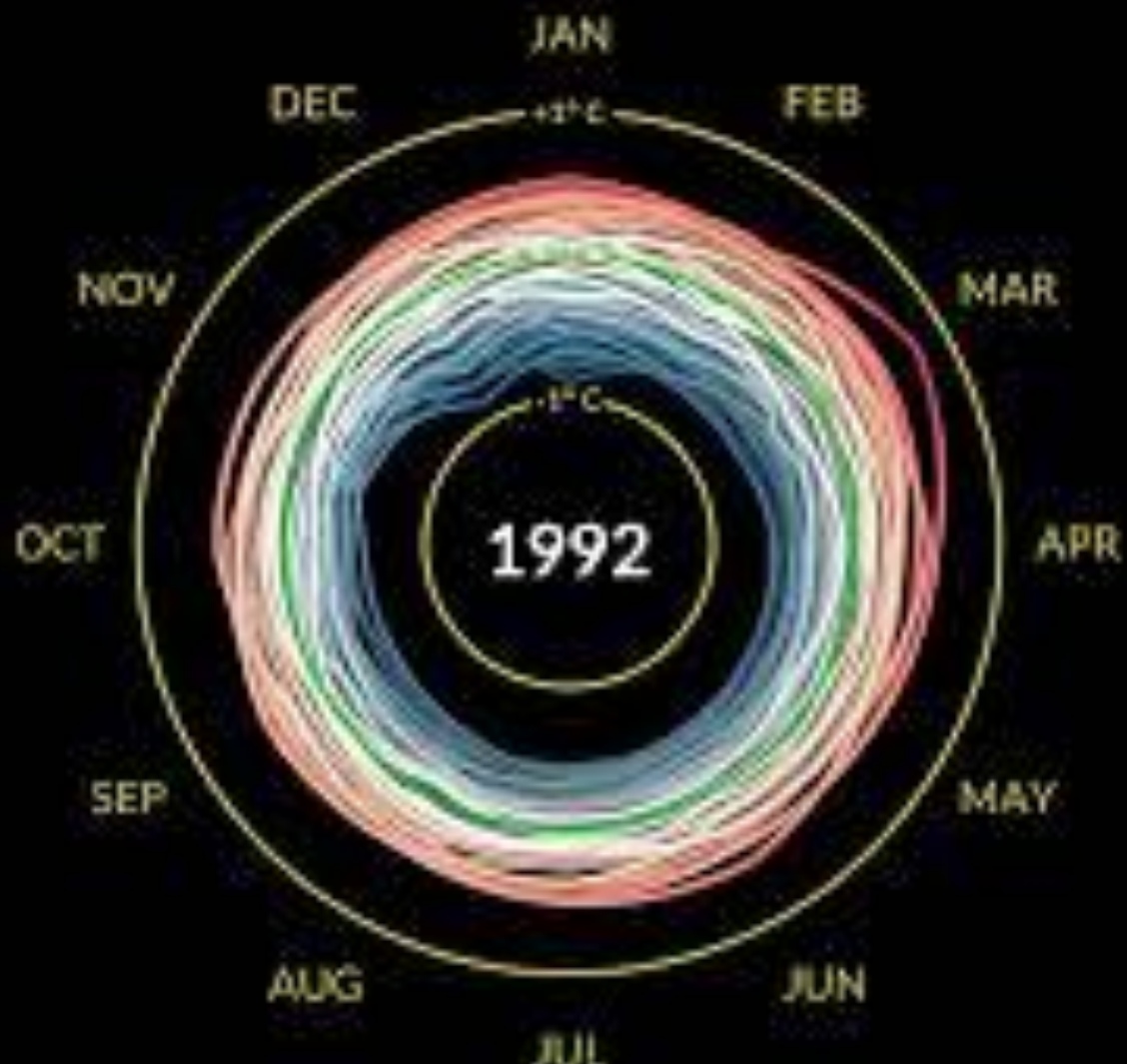
Realtime Thermal Data for Highly Dynamic Events

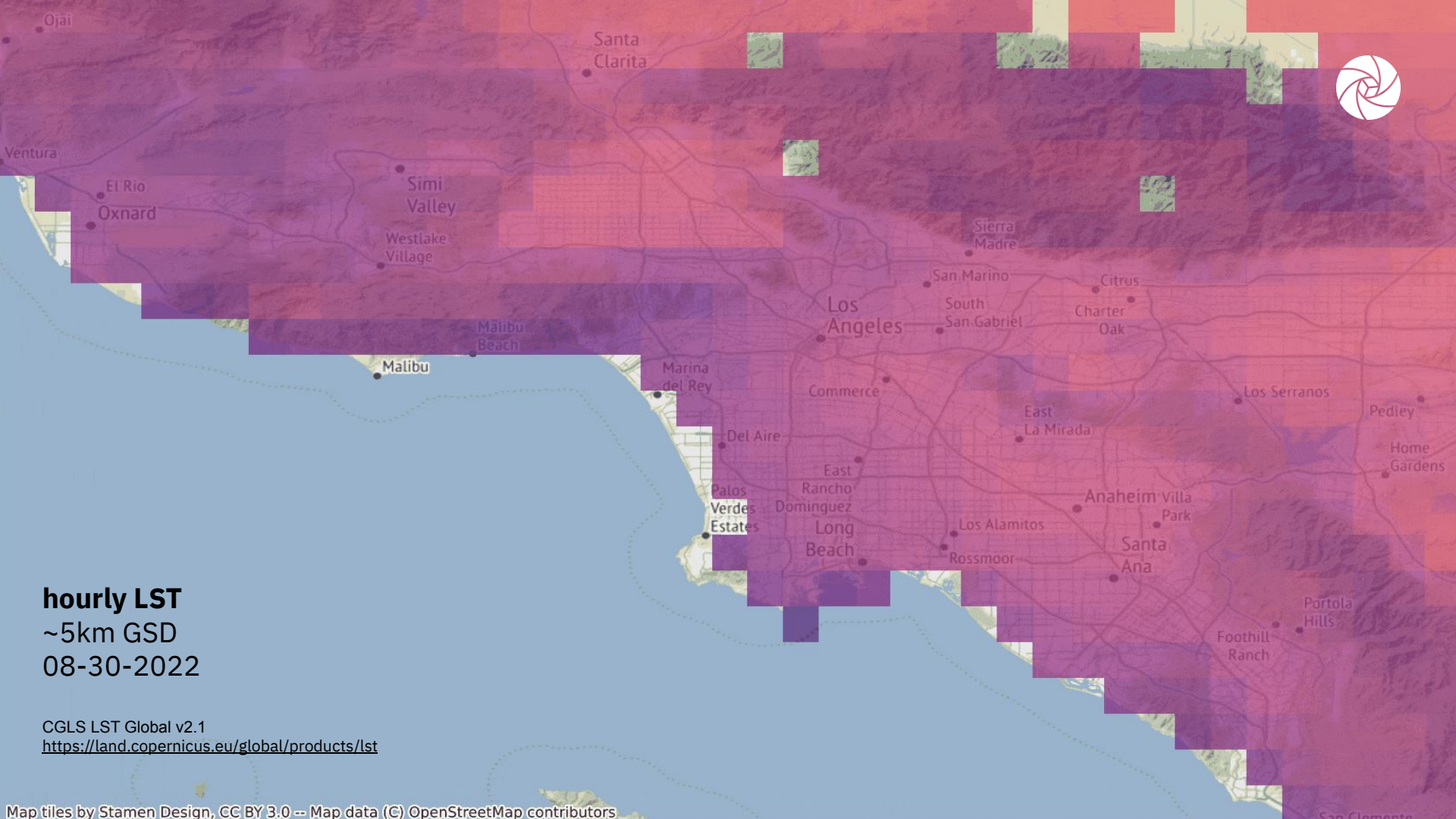
28.09.2023

Marc Seifert

CEOS WGCV IVOS Meeting







hourly LST
~5km GSD
08-30-2022

CGLS LST Global v2.1
<https://land.copernicus.eu/global/products/lst>



weekly LST
~30m* GSD
08-26-2022

Landsat-8, L2 LST

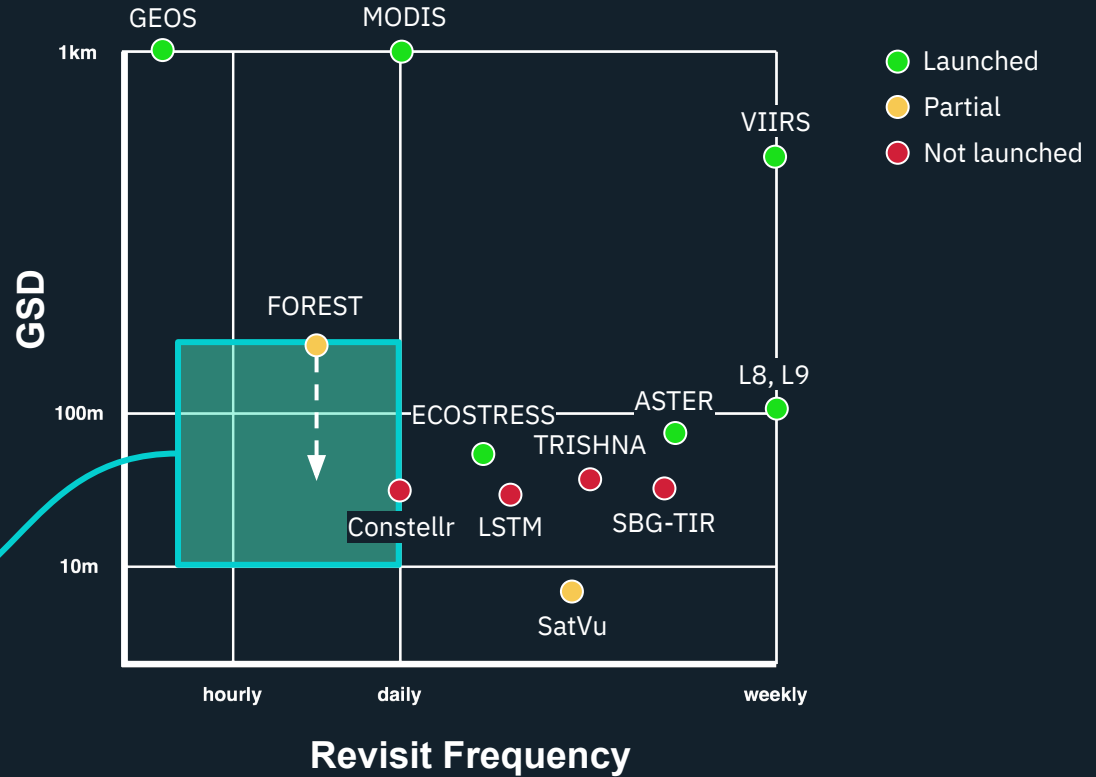
<https://www.usgs.gov/landsat-missions/landsat-collection-2-level-2-science-products>

*TIR B10 100m + high-resolution emissivity



Landscape of Thermal Infrared Data Products

Sweet spot for disaster management and mitigation



ORORA

TECHNOLOGIES

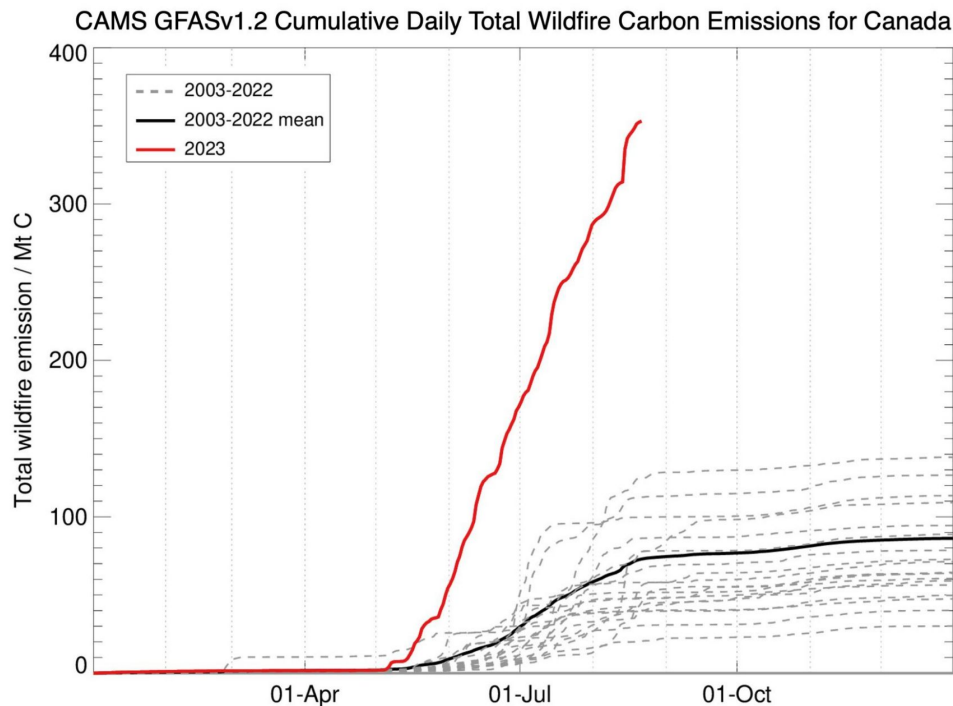
*Thermal intelligence
for a sustainable Earth*

- Munich-based startup with >90 employees
- In-house development of TIR imagers
→ 2 in orbit, 8 more in production
- Goal: 30 min revisit time worldwide
- Focus on wildfires & currently
monitoring over 160 Mio. ha of forest



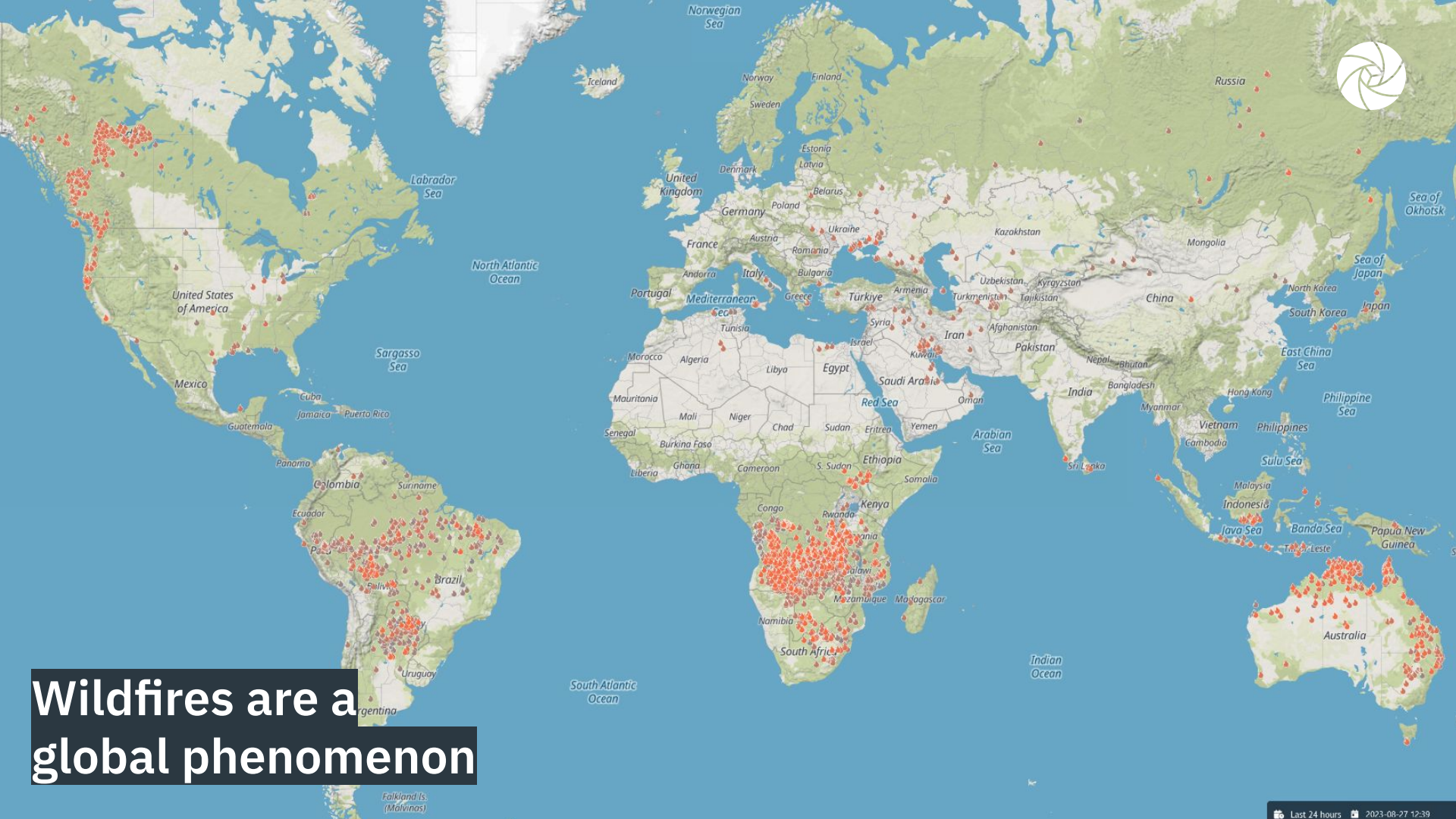
CO2 emissions of wildfires

in Canada **this** year



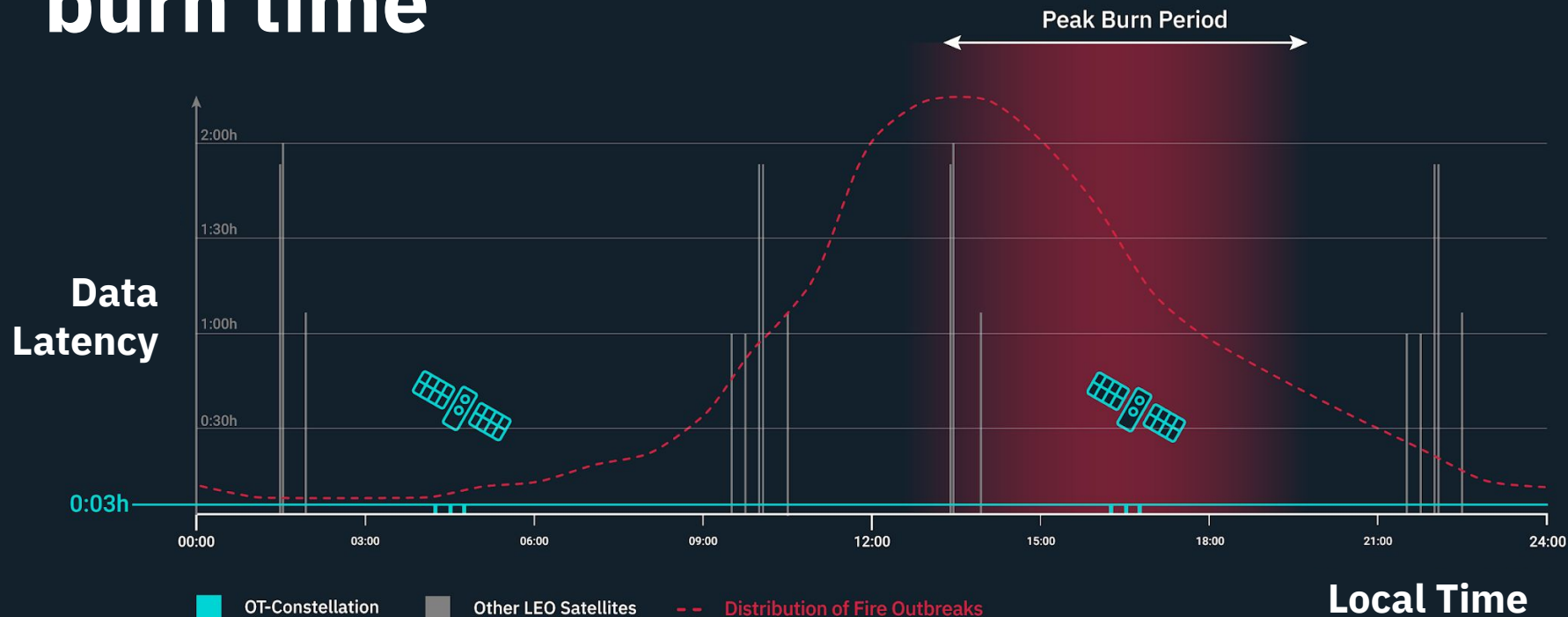
PROGRAMME OF
THE EUROPEAN UNION





Wildfires are a global phenomenon

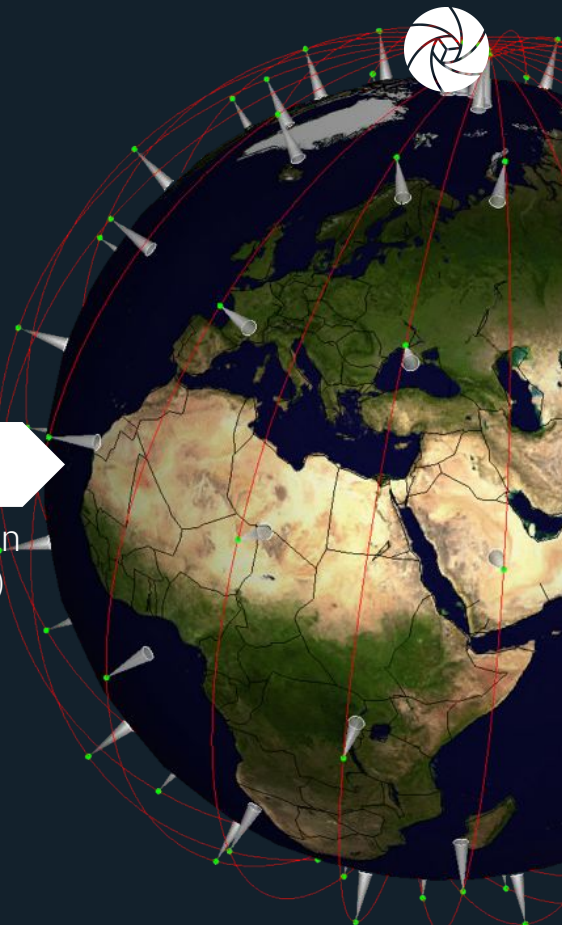
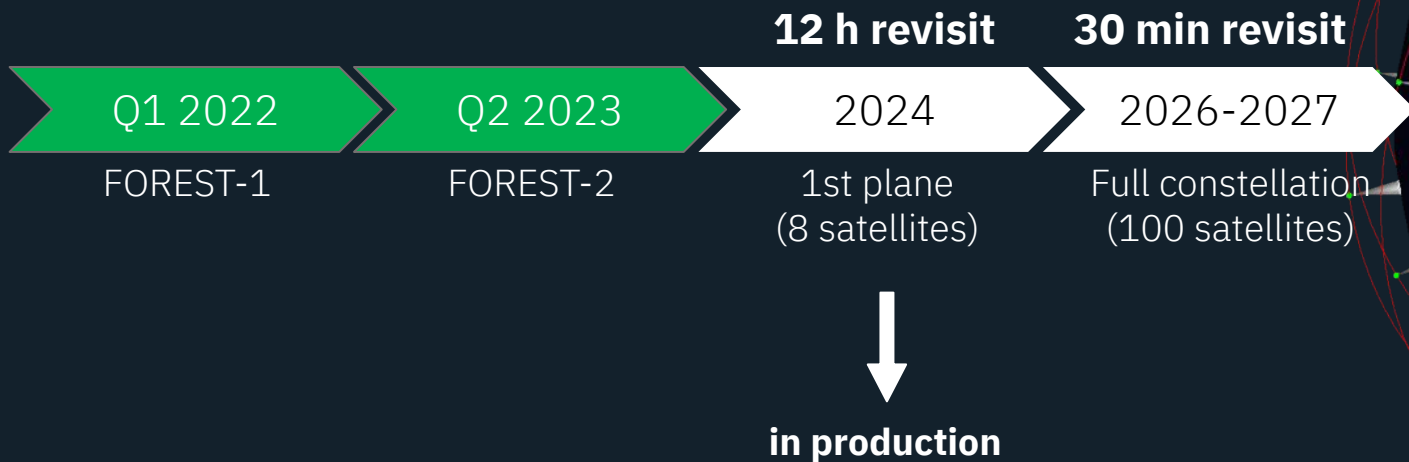
Wildfire peak burn time



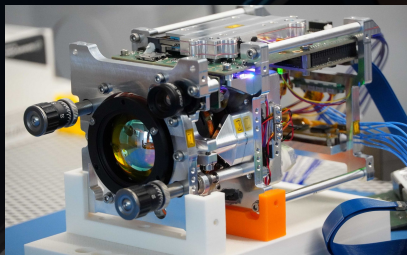
Constellation Development



Constellation & Timeline



FOREST Missions

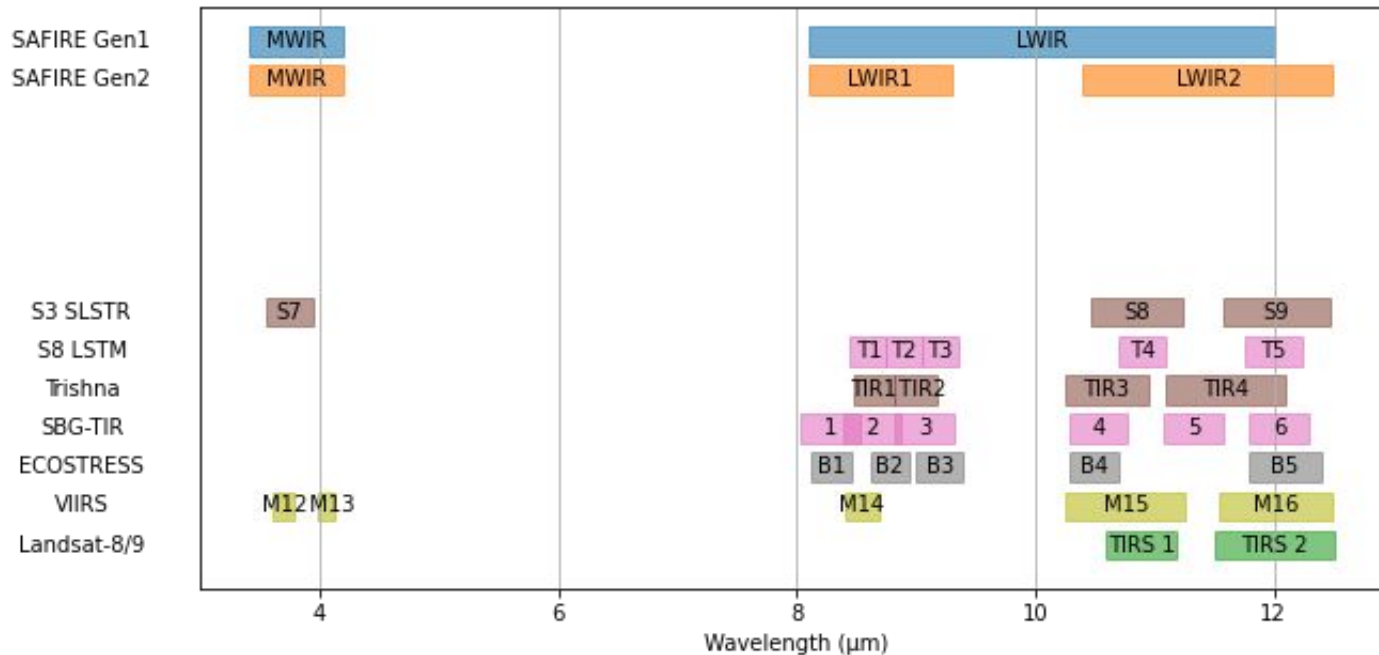


→ Batch production for first plane ongoing

Mission	FOREST-1	FOREST-2	Constellation OTC-P1
Satellites	1	1	8
Status	Launched Jan 22	Launched June 23	Launch mid-24
Orbit	LTDN 10:25	LTDN 13:30	LTAN 17:00 (TBC)
Global revisit time	~14 days	< weekly	twice daily
GSD	250 m	200 m / software enhanced 80 m	
Swath	160 km	410 km	

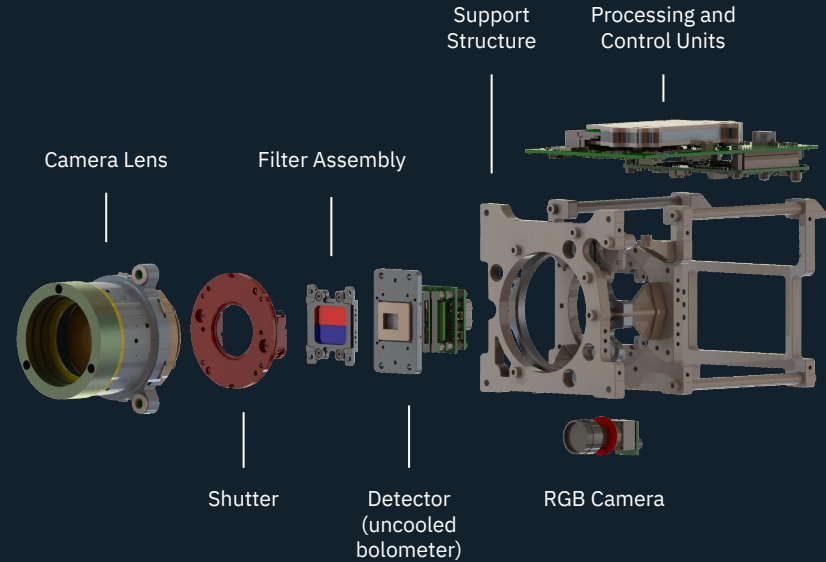
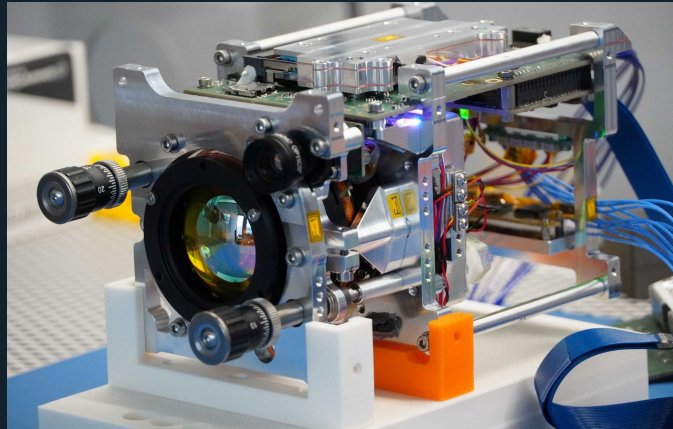


Spectral Bands



FOREST-1

Our first sensor

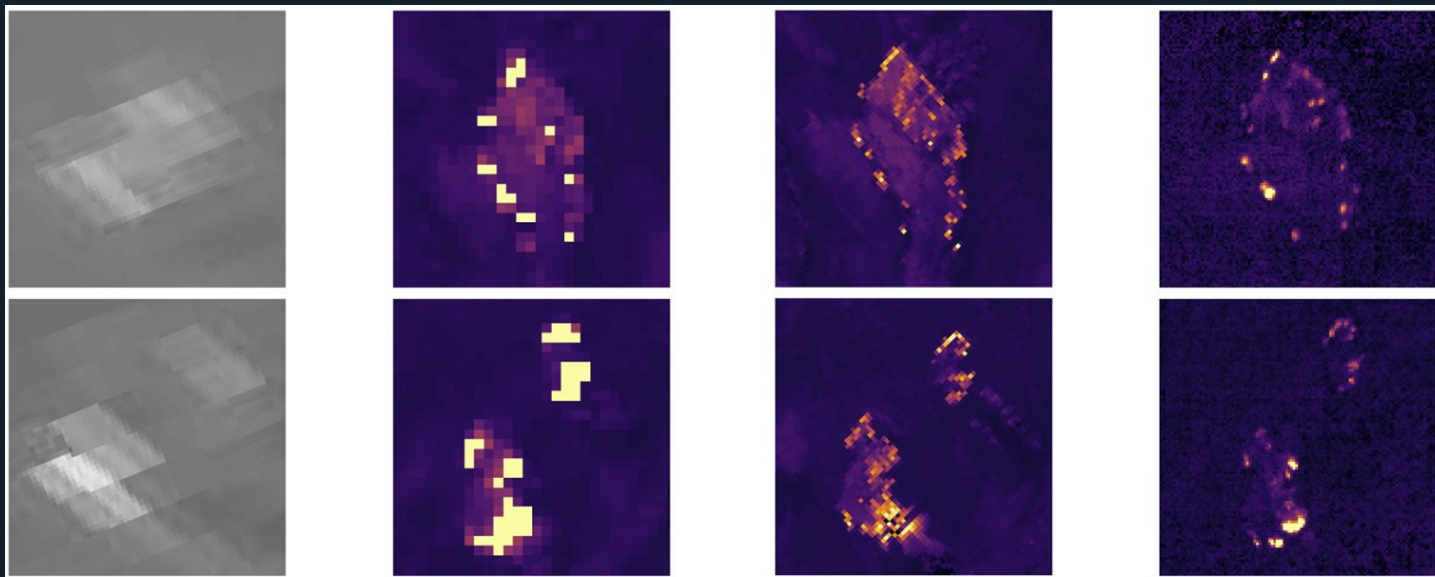


Fire Detection



Alaska - 01.07.2022 - 21:04 UTC

MWIR band



GOES-17 ABI (GEO)
21:04 UTC
GSD ~5km

Terra MODIS
21:40 UTC
GSD 1km

NOAA-20 VIIRS
21:30 UTC
GSD 375m

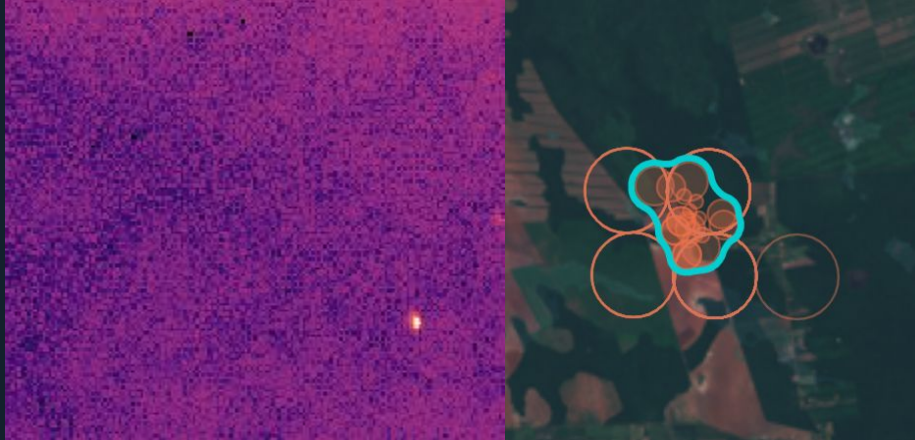
FOREST-1 SAFIRE
21:04 UTC
GSD 250m



On-Orbit Fire Detection

1. Process raw data on the satellite → detect fires
 2. Downlink detection via inter-satellite link
 3. Deliver information to customer
- Reduce latency from several hours to 5 min!

First on-orbit detection:



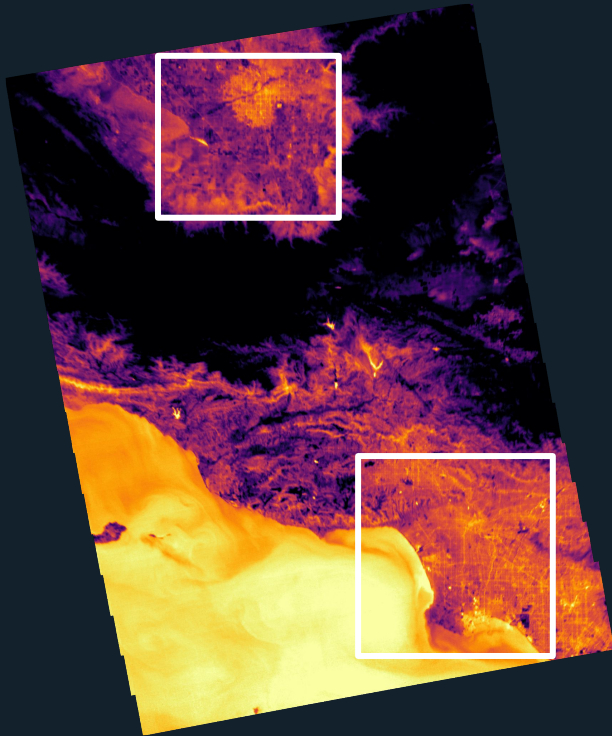
Smallest detected fire ~10 m



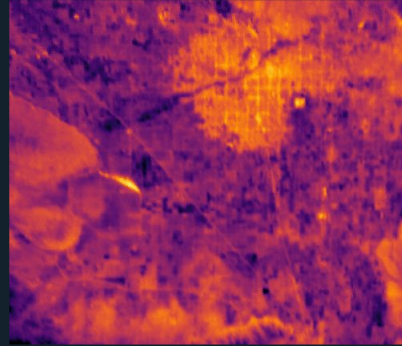


Urban Scenes

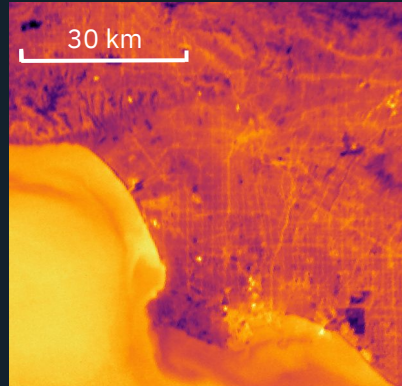
California - 23.09.2022 - 05:32 UTC (22:32 PST)
LWIR band



Bakersfield

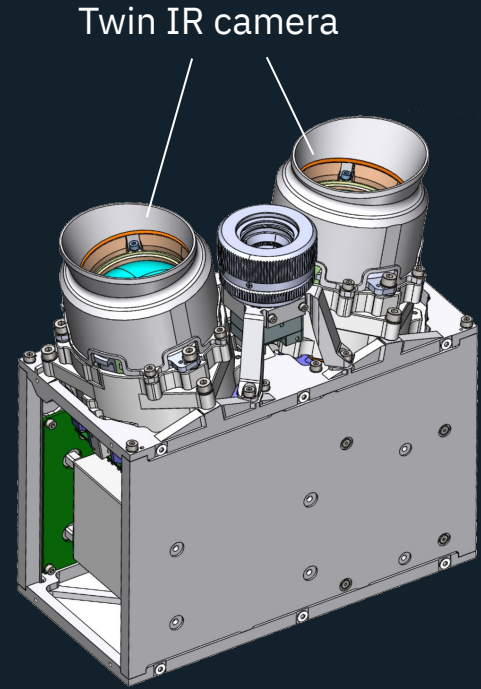
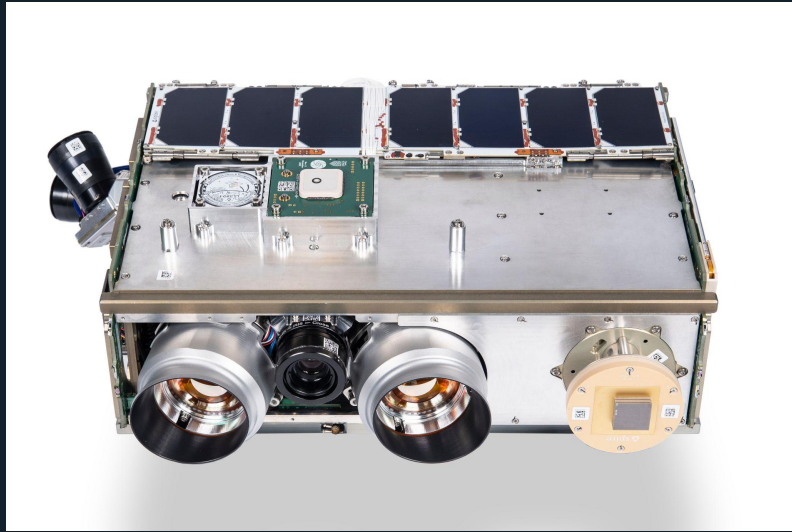


Los Angeles



FOREST-2

Our latest sensor

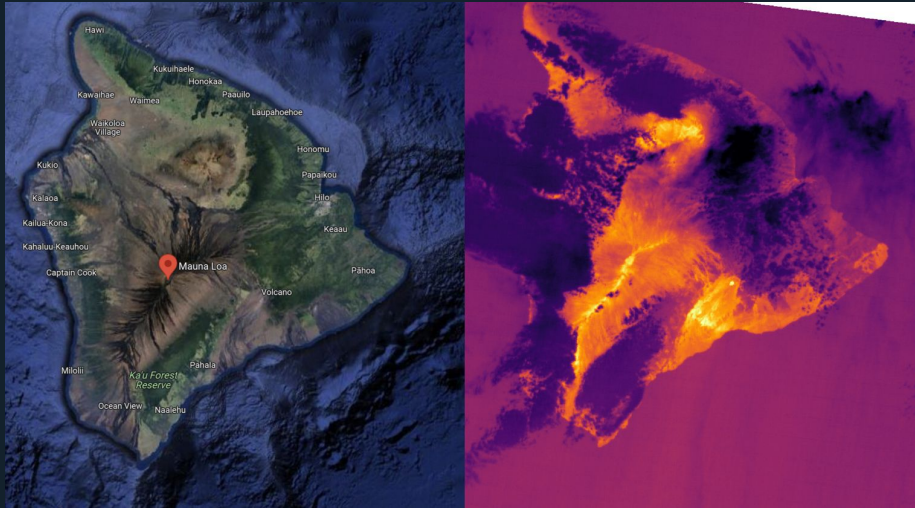




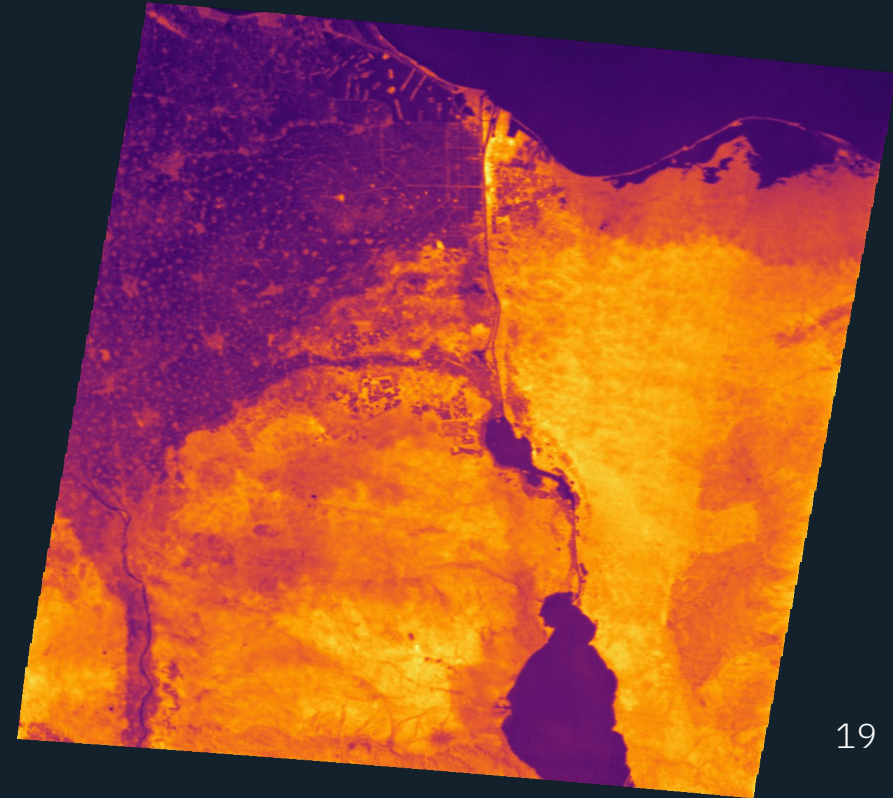
FOREST-2 First Images

(not radiometrically corrected yet)

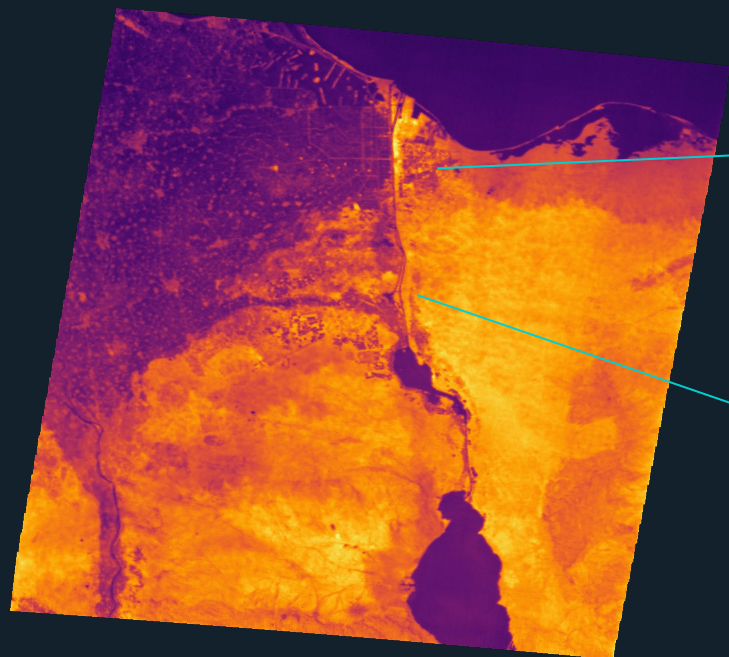
Hawaii



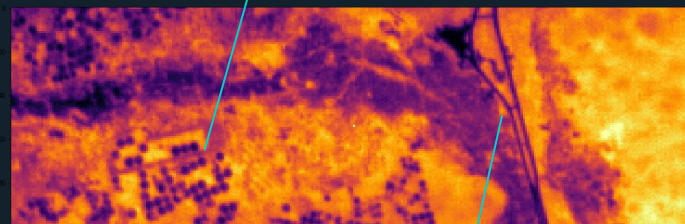
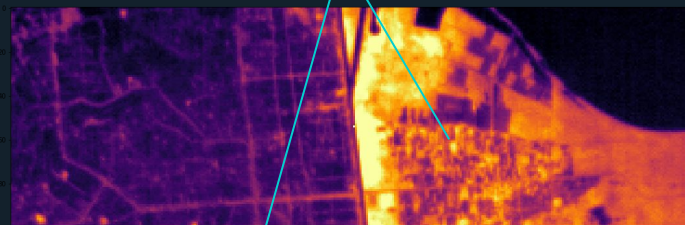
Suez Canal, Egypt



Suez Canal, Egypt



Agriculture land

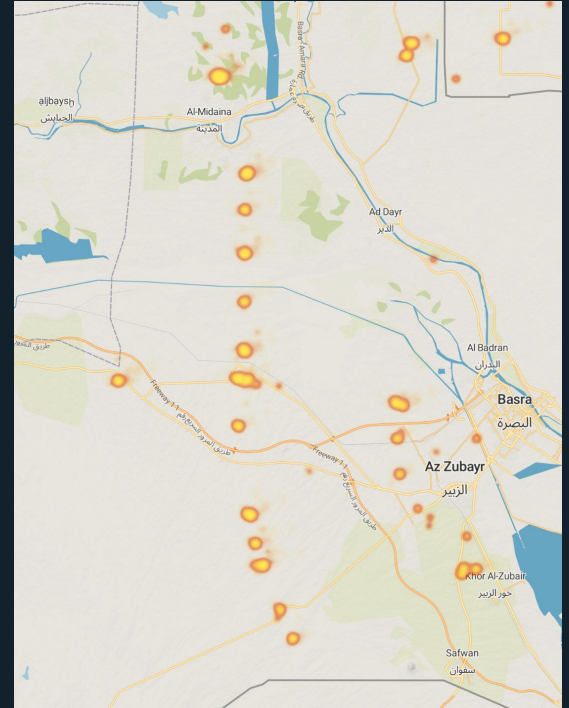
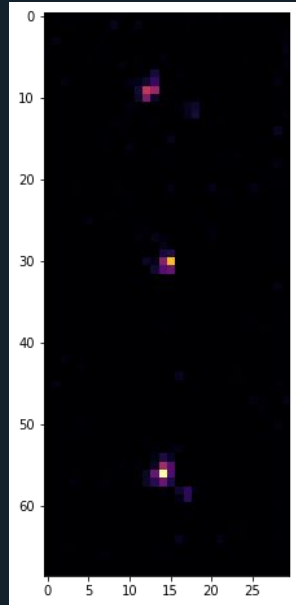
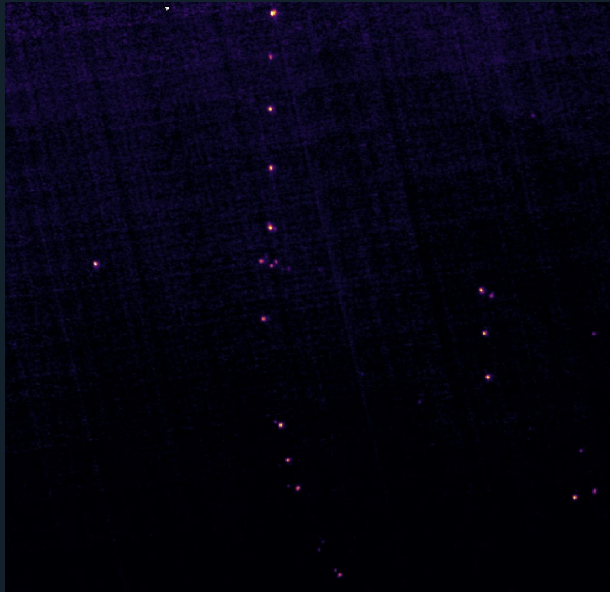


Sub-canals ~80 m
well resolved

Gas Flares



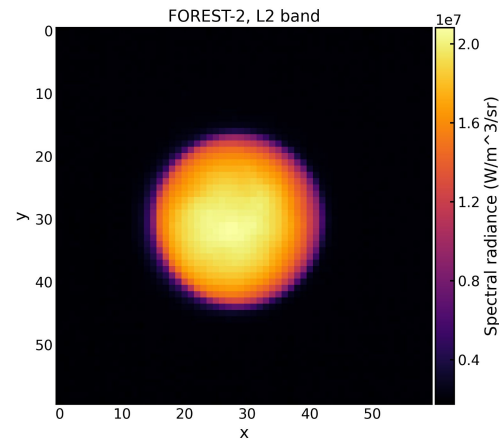
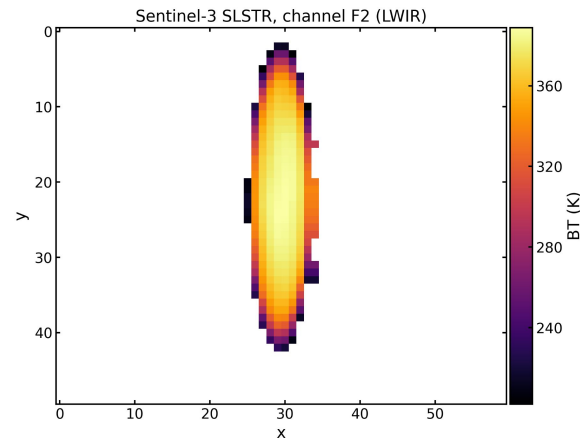
Basra Oil Fields, Iraq
MWIR
2023-08-26 00:23





Calibration

- Radiometric on-ground calibration
 - Using NIST-traceable blackbodies
 - Measuring gains and offsets
- In-flight calibration (L1)
 - Shutter as radiometric reference
 - Deep space observations
 - Calibration to S3-SLSTR fire bands via quasi-simultaneous Lunar acquisitions (WIP)



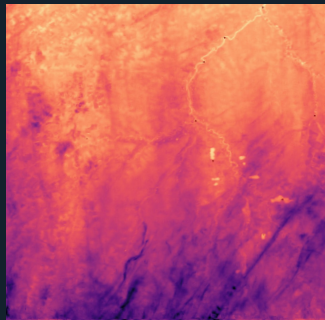


Validation & Data Quality

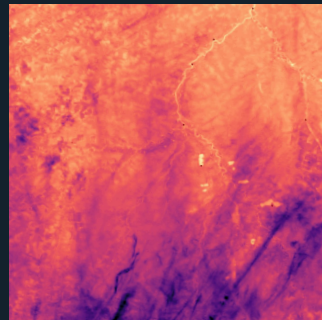
- Validation plan
 - Quasi-simultaneous Earth acquisitions with S3, VIIRS, ...
 - Ground stations (La Crau, Lake Tahoe, ...)
- OT part of ESA-CCM
 - Collaboration with Sentinel Mission Performance Cluster

**Quasi-simultaneous acquisition
Brazil (LWIR)
2023-07-29 04:55**

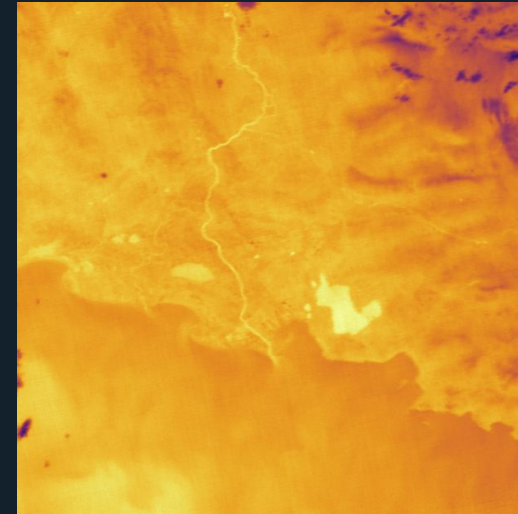
FOREST-2



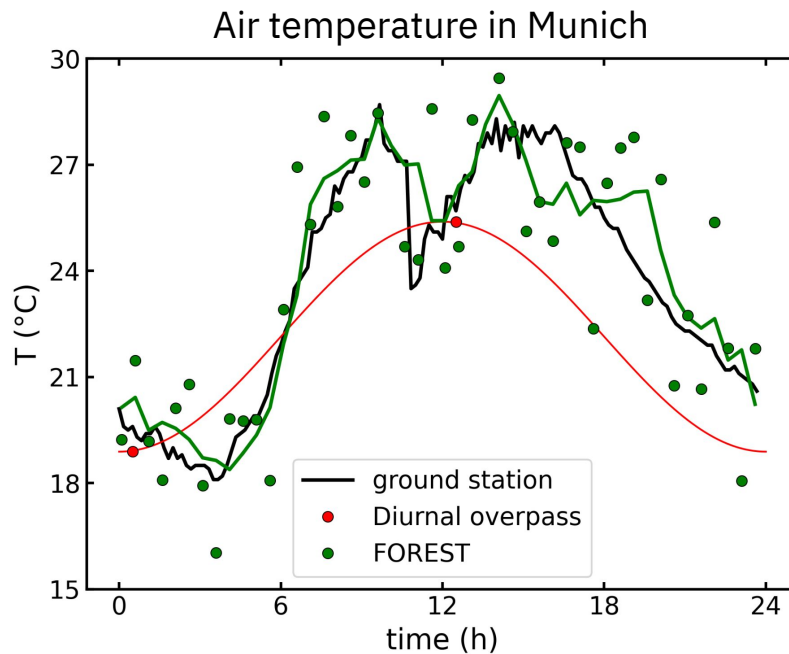
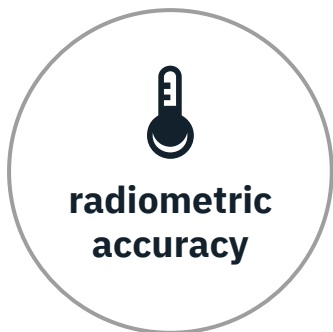
SNPP VIIRS



**TIRCALNet
La Crau - France (LWIR)
2023-08-05 00:31**



Trade Off



Summary

- High-frequency TIR data next year
- Cal/Val procedures in active development
 - Challenge: scaling to a constellation of 100 satellites
- Open for collaboration



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