

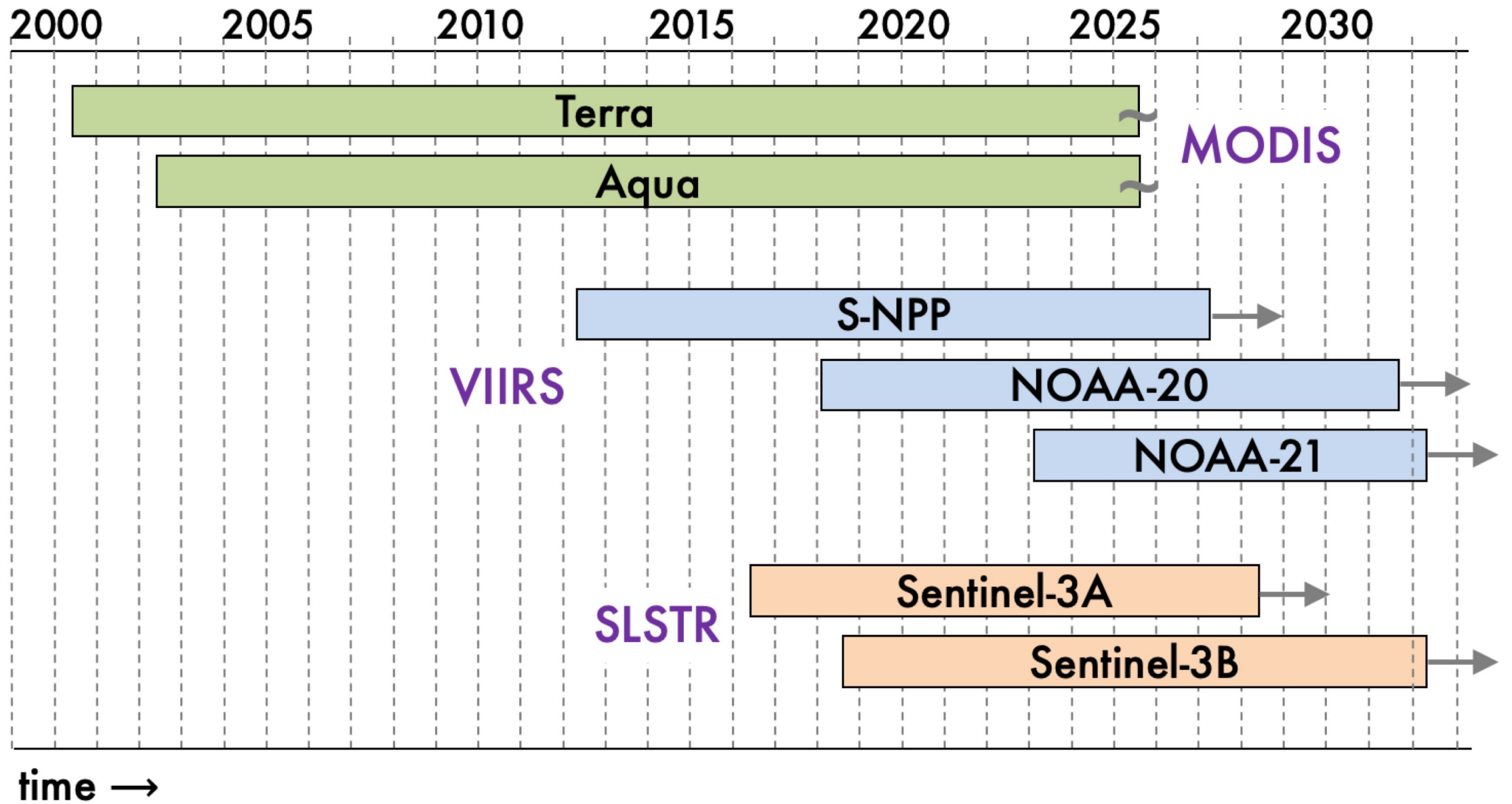
Terra/Aqua MODIS Fire Product Continuity Sentinel-3 Pilot Study Update

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University of Maryland

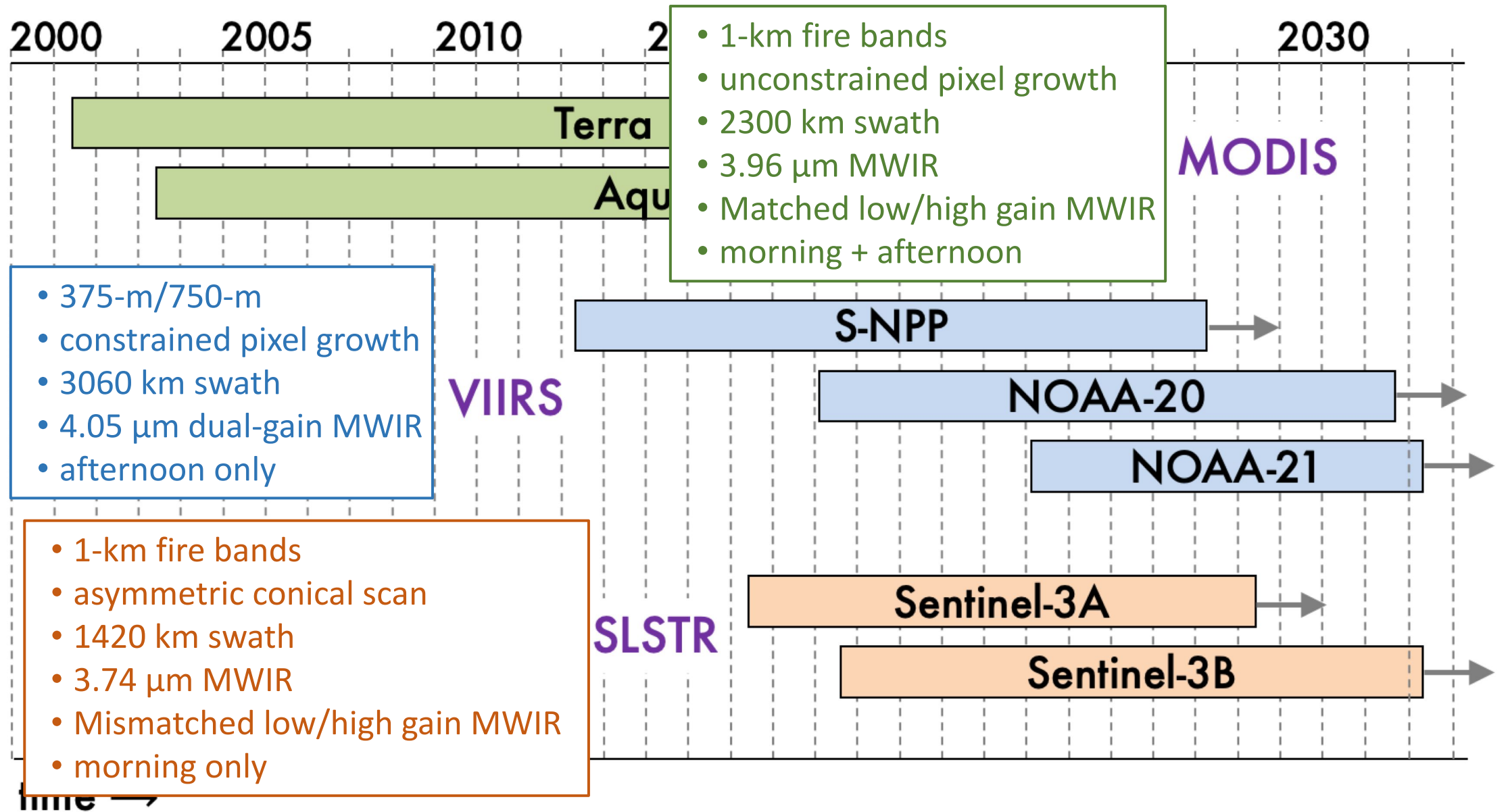
NASA's Land, Atmosphere Near Real-time Capability for EOS
User Working Group Meeting
21–22 June 2023

Relevant Sensors

- Moderate Resolution Imaging Spectroradiometer (MODIS)
 - On board NASA's Terra and Aqua satellites
- Visible Infrared Imaging Radiometer Suite (VIIRS)
 - On board NASA/NOAA Suomi-NPP, NOAA-20, and NOAA-21 satellites
- Sea and Land Surface Temperature Radiometer (SLSTR)
 - On board ESA's Sentinel-3A and Sentinel-3B satellites



Planned: Sentinel-3C (~2024), Sentinel-3D (~2028), NOAA-22 (~2028), NOAA-23 (~2032)



Sentinel-3A/3B SLSTR

- 10:00 local crossing time (sun-synchronous orbit)
- Sea and Land Surface Temperature Radiometer (SLSTR)
 - Oblique + nadir asymmetric conical scans
 - Quirks w/ respect to saturation and band-to-band co-registration
- Near-real time (NRT) and science-quality SLSTR active fire products available from EUMETSAT and ESA, respectively
 - Our focus is on SLSTR NRT active fire product for FIRMS

Summary of SLSTR Active-Fire Product Findings (1/3)

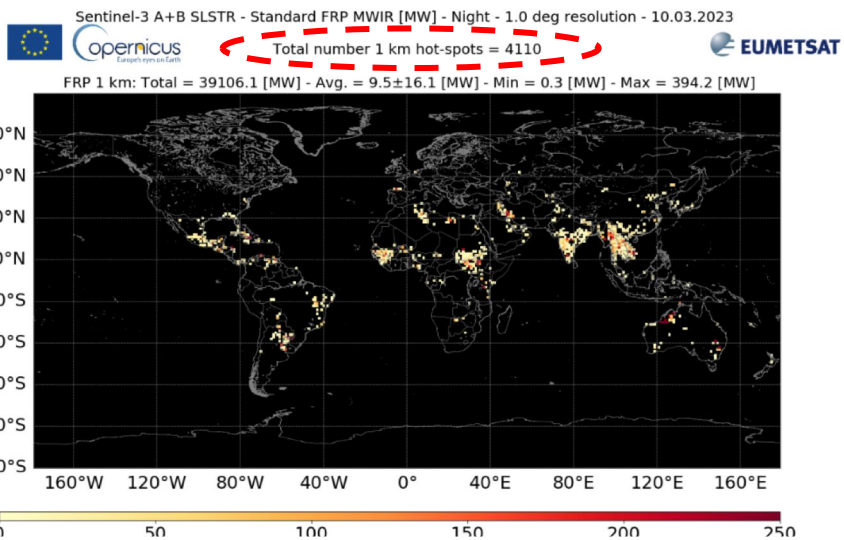
- Sentinel-3 NRT & standard (“NTC”) fire products are two distinctive processing branches due to the different European Commission mandates
 - No requirement for NRT and standard products to be aligned
- NRT product actually contains four different active-fire products made with four different detection algorithms
- Each SLSTR reports $\sim 3\times$ as many fire pixels as Terra MODIS
 - Higher sensitivity, especially at night
 - Constrained pixel growth + wavelength
 - Higher false alarm rate, especially along cloud edges
 - MWIR/LWIR misregistration + wavelength
- Significant differences in distribution of fire radiative power (FRP)



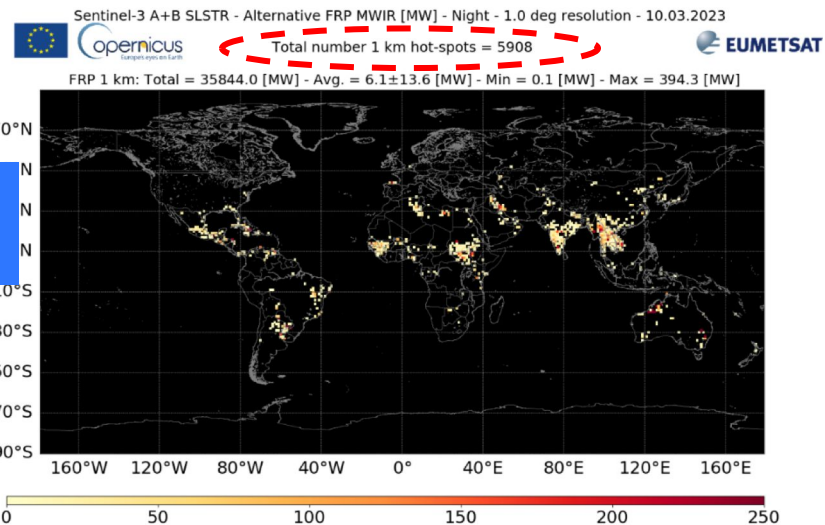
Sentinel-3 L2 NRT FRP Algorithm Summary

copernicus.eumetsat.int

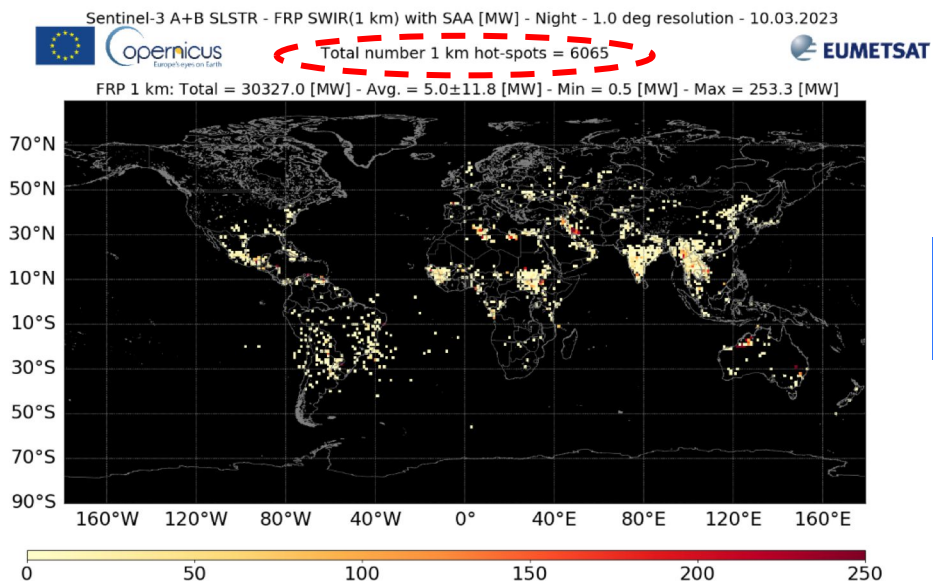
Standard
FRP MWIR



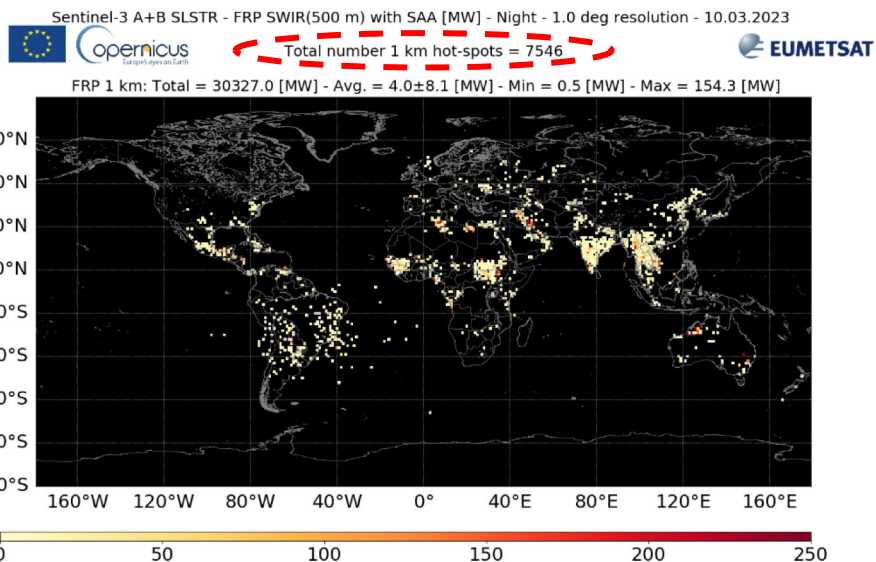
Alternative
FRP MWIR



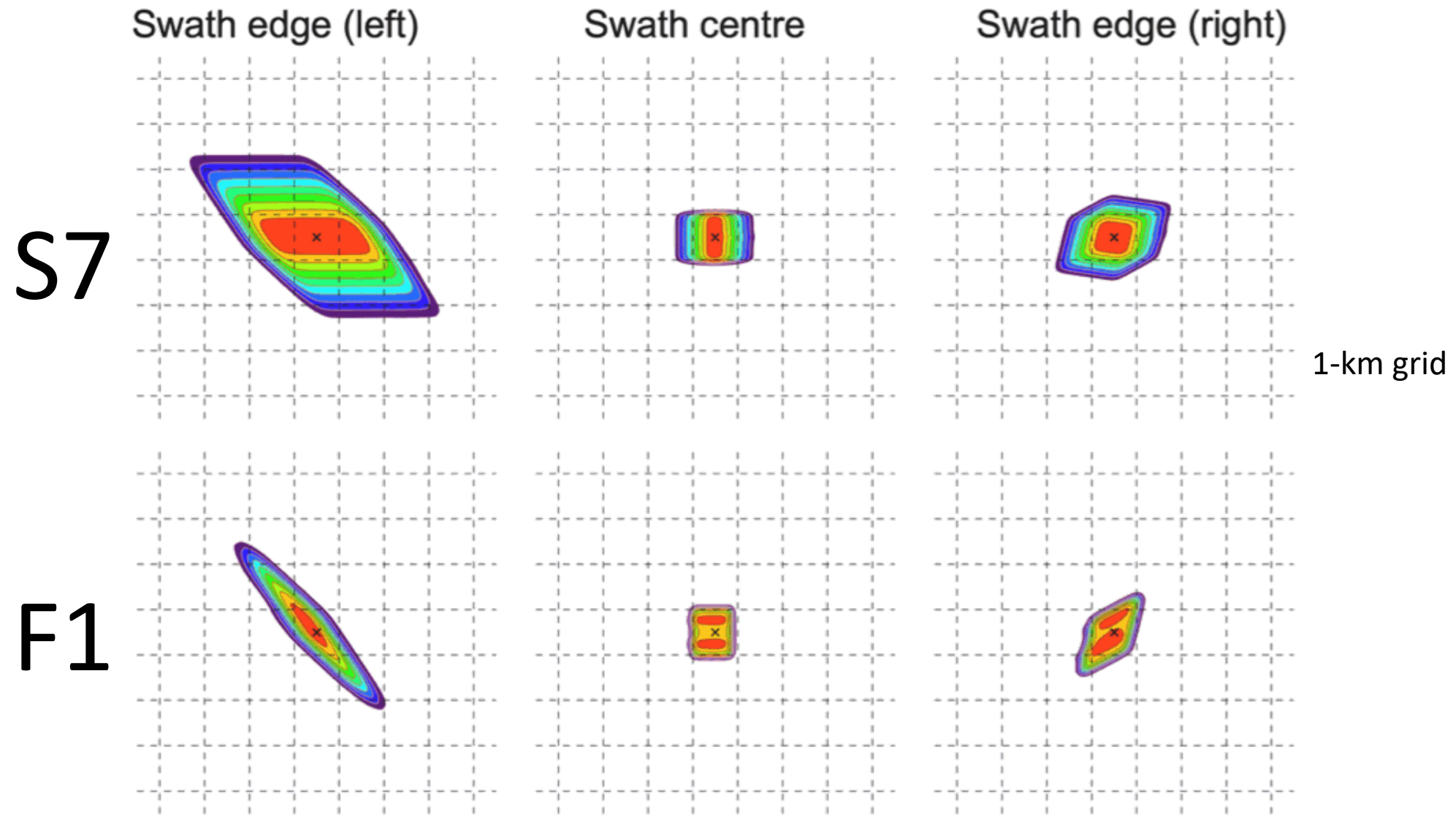
FRP SWIR
(1 km)



FRP SWIR
(500 m)



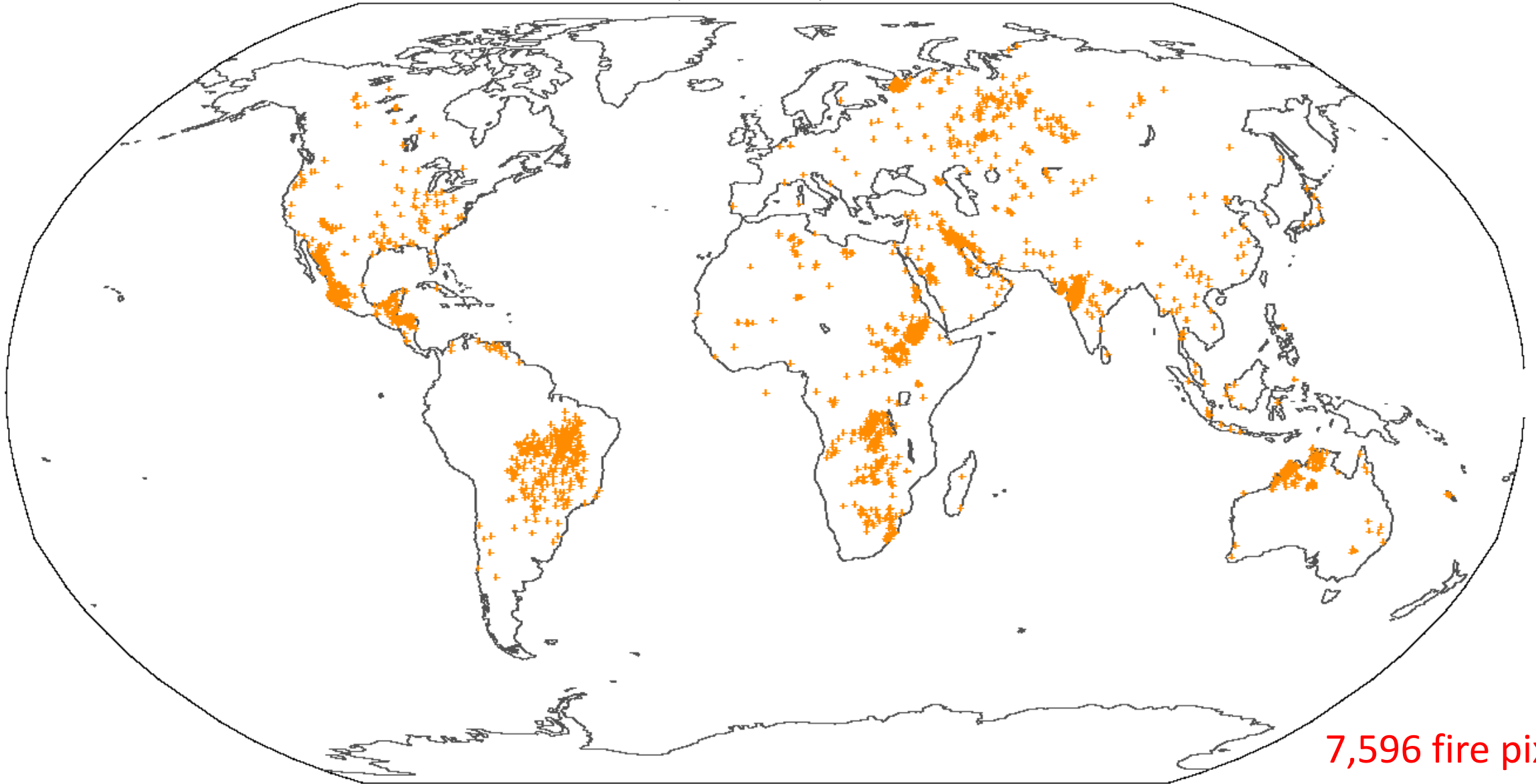
SLSTR Pixel Footprint



Global Comparison

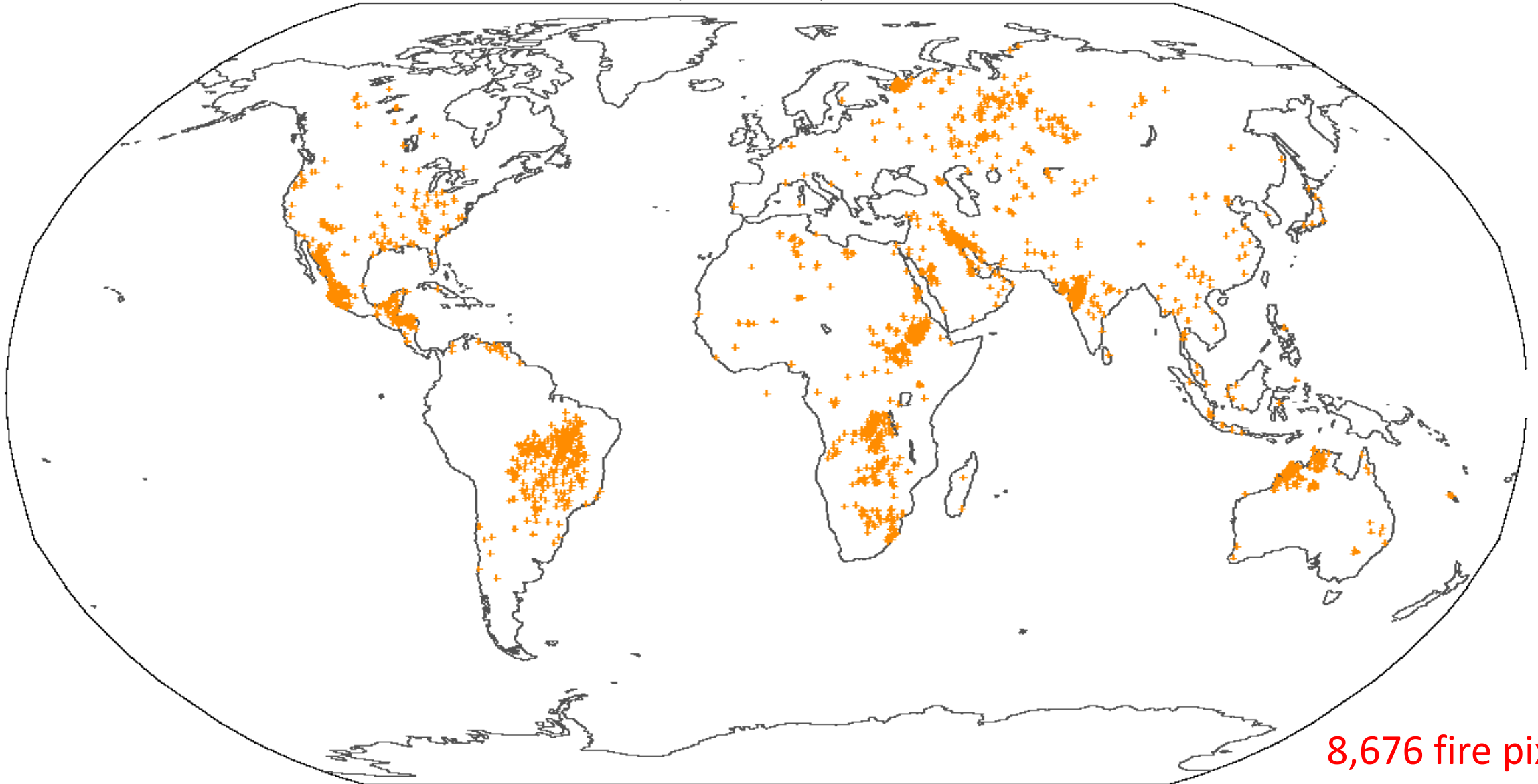
25 May 2023

25 May 2023 - S3A/B SLSTR



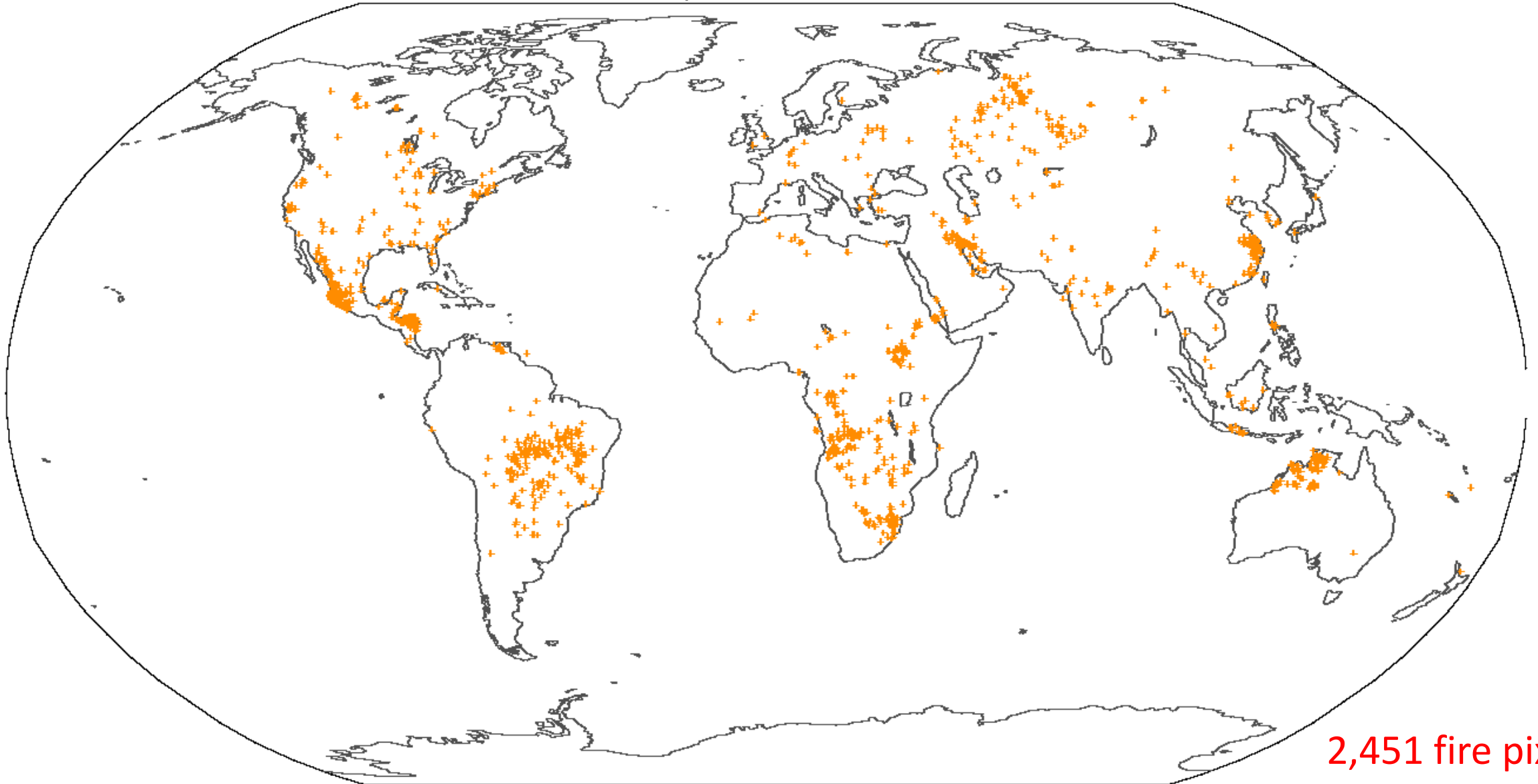
7,596 fire pixels

25 May 2023 - S3A/B SLSTR



8,676 fire pixels

25 May 2023 – Terra MODIS

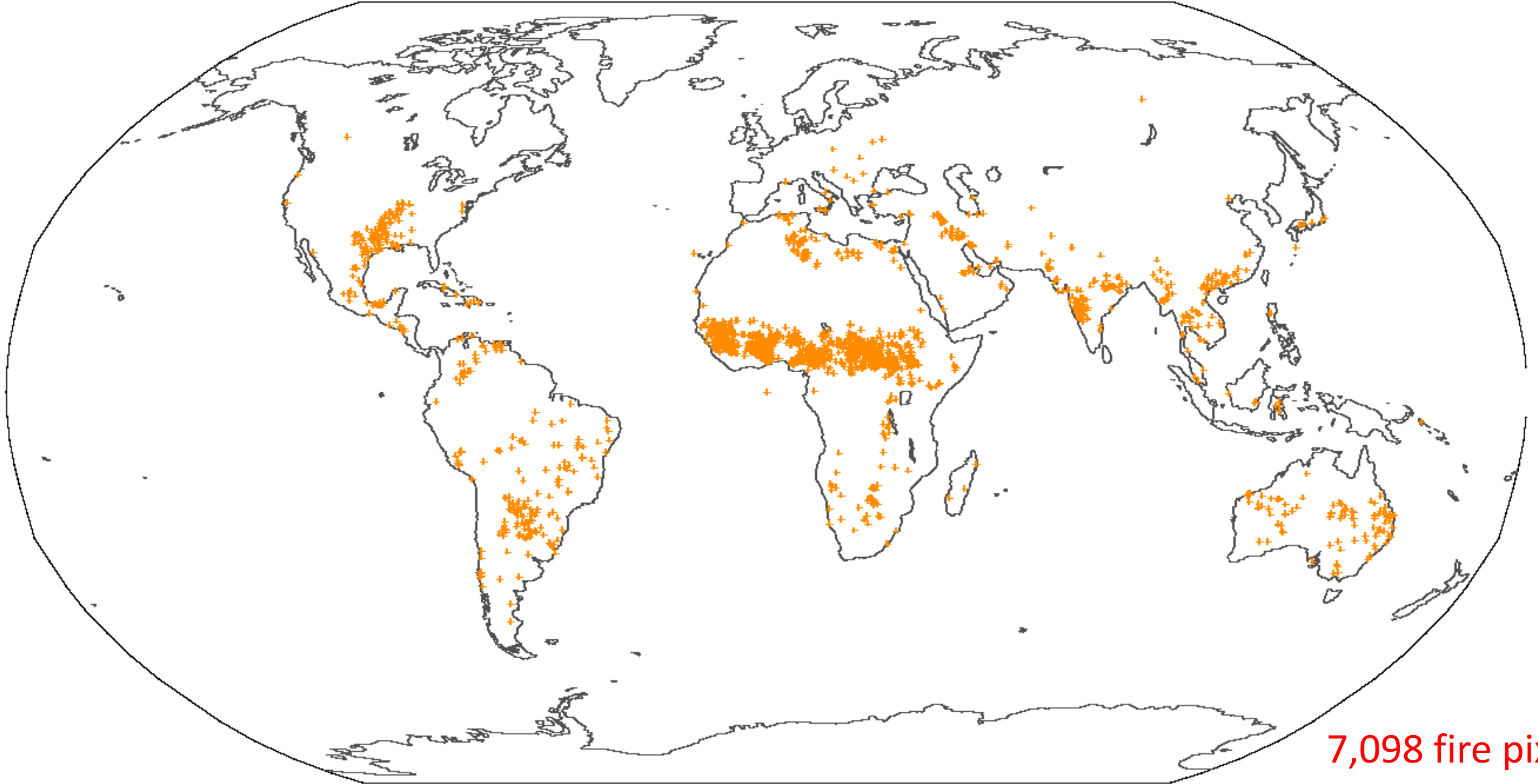


2,451 fire pixels

Global Comparison

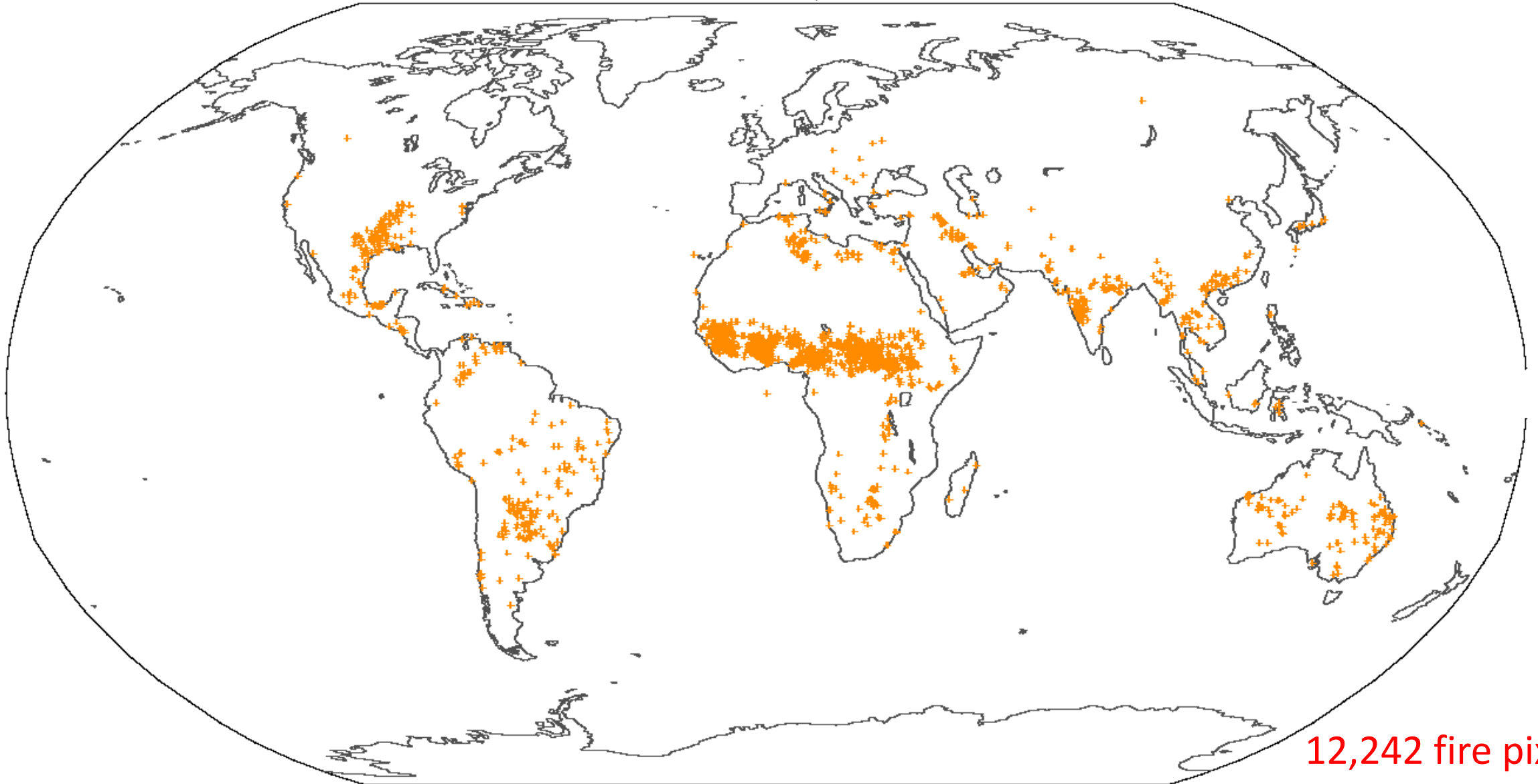
1 January 2023

1 Jan. 2023 - S3A/B SLSTR



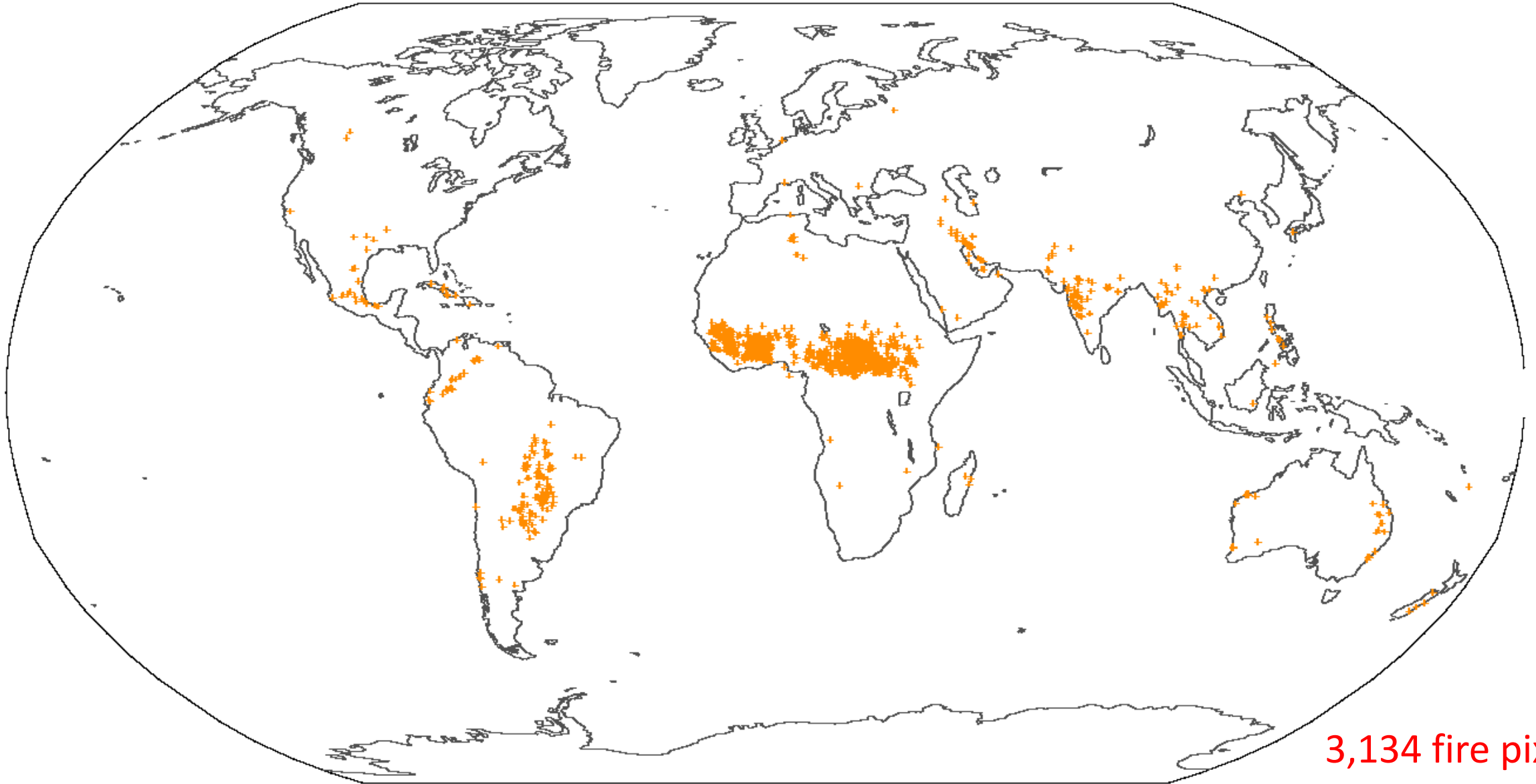
7,098 fire pixels

1 Jan. 2023 - S3A/B SLSTR



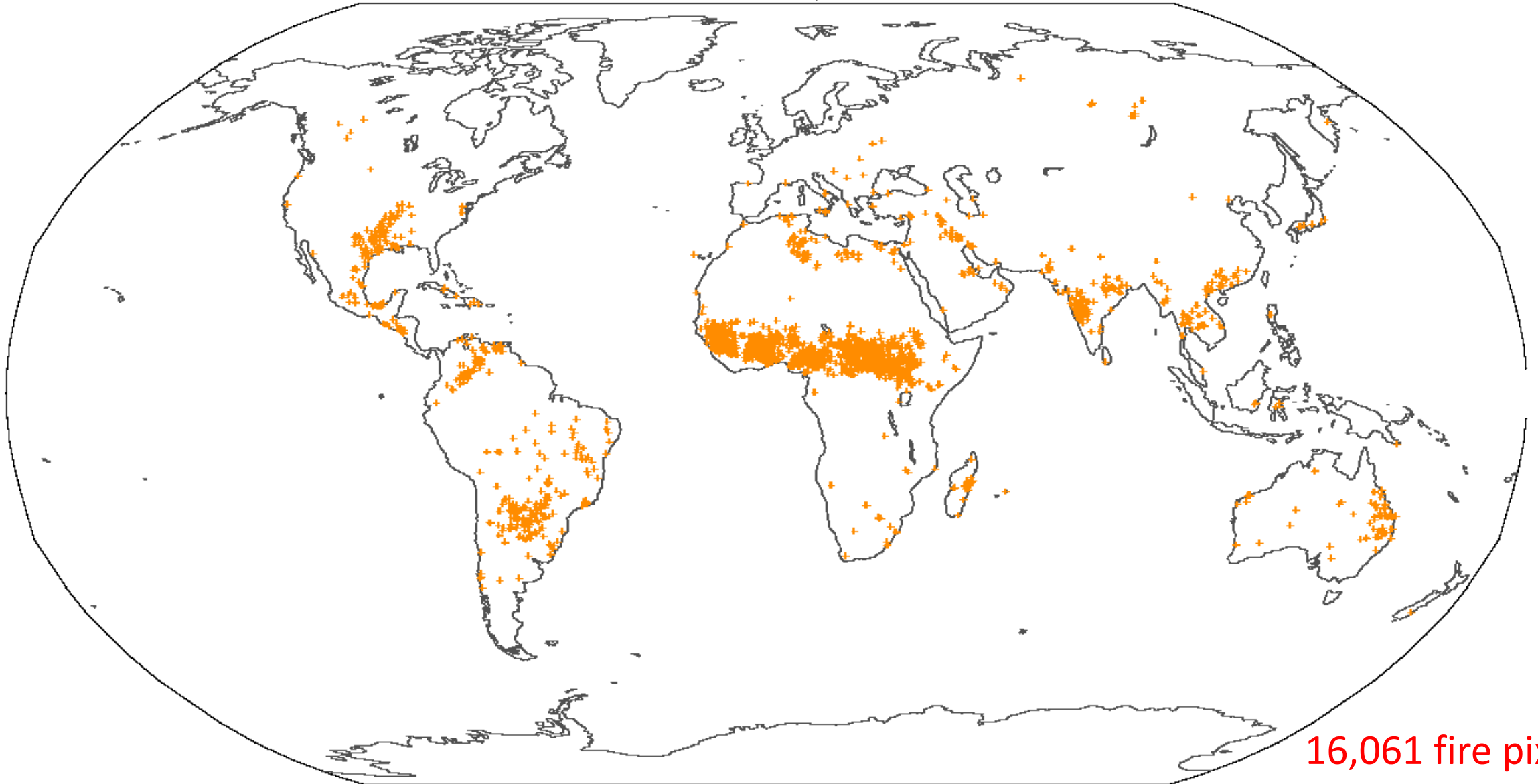
12,242 fire pixels

1 Jan. 2023 – Terra MODIS



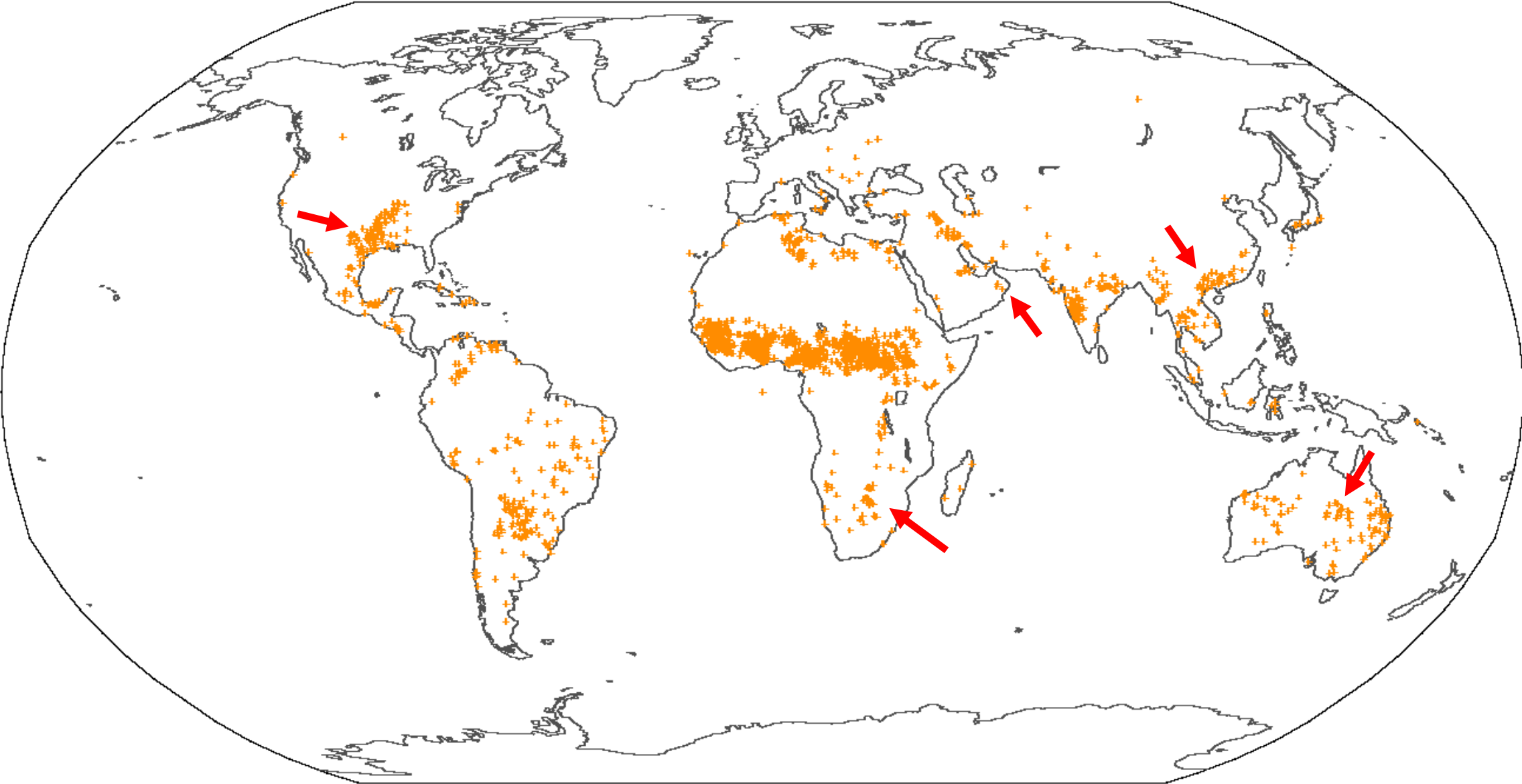
3,134 fire pixels

1 Jan. 2023 - S3A/B SLSTR

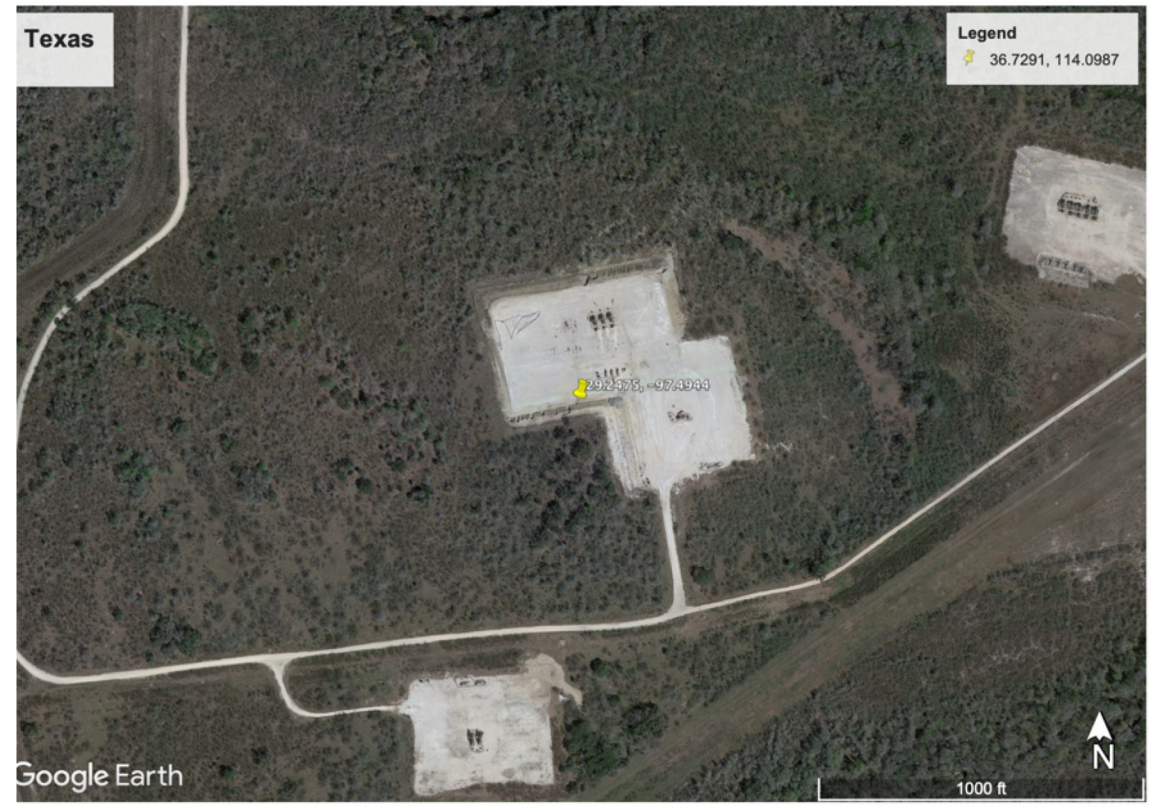


16,061 fire pixels

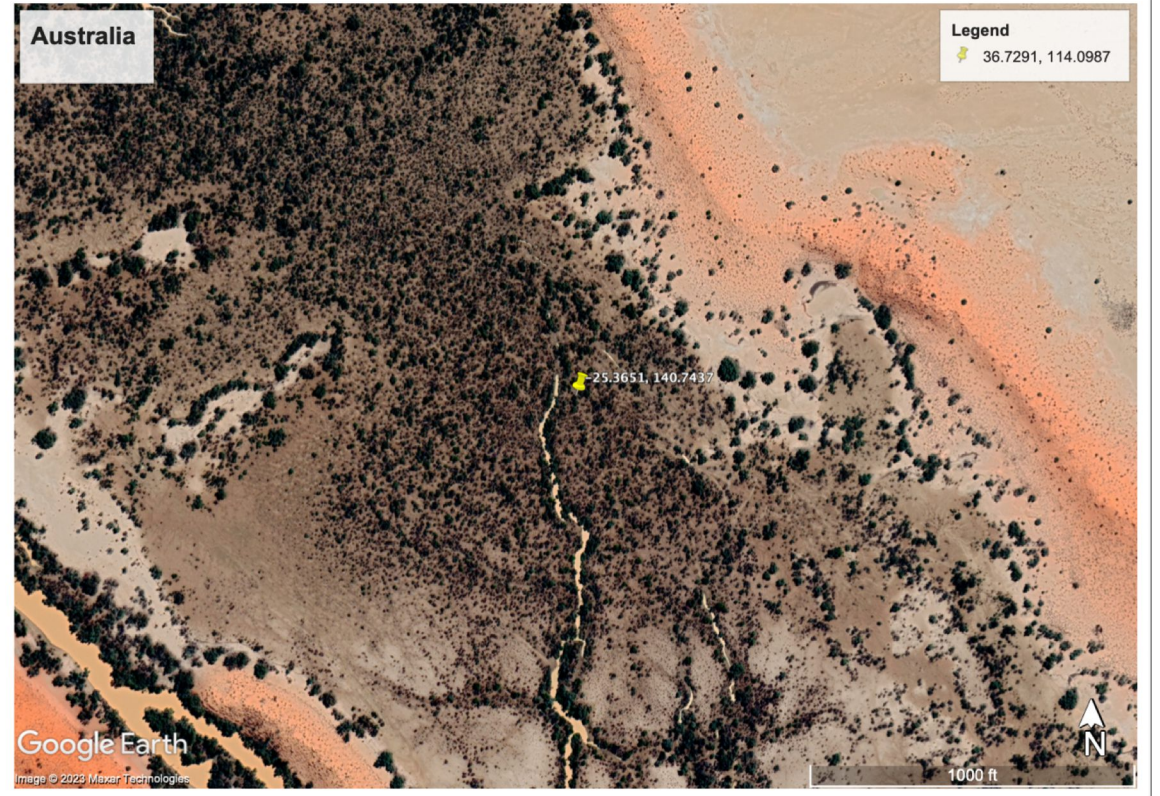
1 Jan. 2023 - S3A/B SLSTR



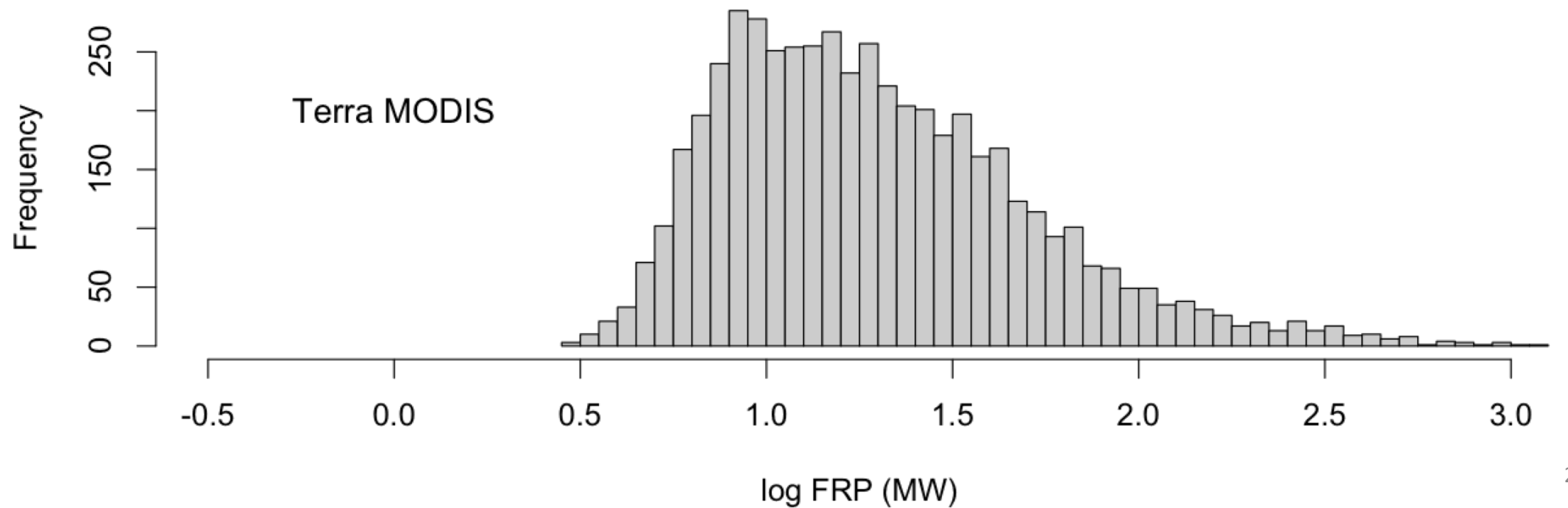
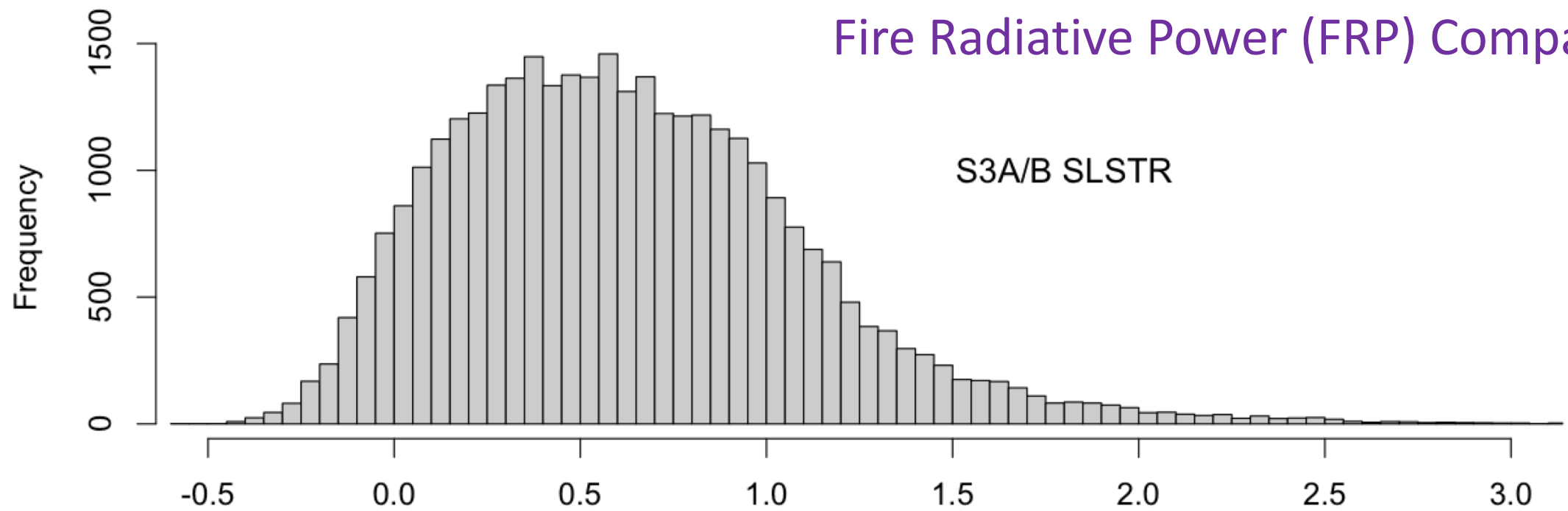
Urban - Texas



Shrubland



Fire Radiative Power (FRP) Comparison



Summary of SLSTR Active-Fire Product Findings (2/3)

- Assorted practical (but mostly manageable) product issues
 - Cumbersome product format (zip files)
 - NRT product is $\sim 60\times$ larger than MODIS swath product
 - Standard product is $\sim 300\times$ larger than MODIS swath product
 - Significant differences in contents of standard vs. NRT products
 - Most/all production software is proprietary
 - Detailed description of NRT detection algorithms is not yet available
 - Unorthodox “shared” product layers contain the outputs of separate detection algorithms

Unorthodox SLSTR NRT Fire Product Convention

- Some product layers are shared by the different detection algorithms
- Interrogate `confidence_MWIR` layer to determine if fire pixel was identified by the MWIR-based detection algorithm and/or the EUMETSAT SWIR-based algorithm
 - `confidence = -100` → SWIR
 - confidence value for common detection is unclear
- Alternatively, interrogate `FRP_MWIR` layer
 - `FRP = -1 MW` → SWIR

Fire Product Format: MODIS

MOD14.A2023145.0000.061.2023145092000.hdf

Each Level-2 HDF product file contains 5 minutes of swath data.

Fire Product Format: SLSTR

```
S3A_SL_2_FRP____20230524T235743_20230525T000243_20230525T014005_0299_099_144_____MAR_O_NR_002.SEN3.zip
|-- browse.jpg
|-- EOPMetadata.xml
|-- manifest.xml
`-- S3B_SL_2_FRP____20230524T235324_20230525T000009_20230525T023043_0404_080_002_____MAR_O_NR_002.SEN3
    |-- flags_in.nc
    |-- FRP_in.nc
    |-- geodetic_in.nc
    `-- xfdumanifest.xml
```

Each Level-2 NRT product zip file contains 5 minutes of swath data.

Summary of SLSTR Active-Fire Product Findings (3/3)

- NRT fire product is not yet widely used but is actively being updated by EUMETSAT
 - Numerous recommendations from our team
 - Problems we have reported include blank entries, invalid sample numbers, invalid attribute values, errors in pixel-level flags and metadata
 - NRT product will remain in a state of flux over the short term
- Continuing false-alarm assessment to facilitate filtering in FIRMS