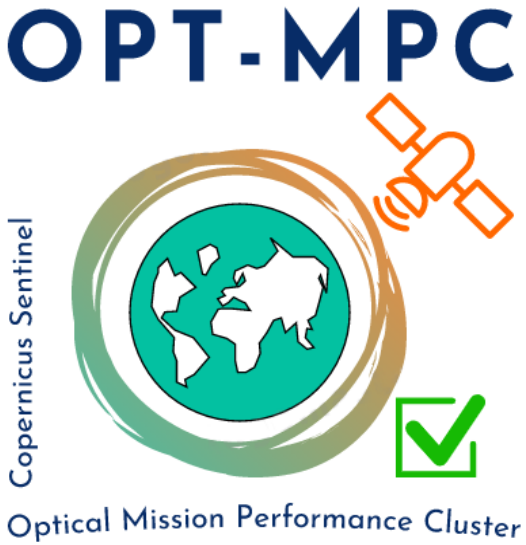

MONITORING SENTINEL-3 NTC FIRE PRODUCTS VIA COMPARISONS WITH GEOSTATIONARY SENSORS

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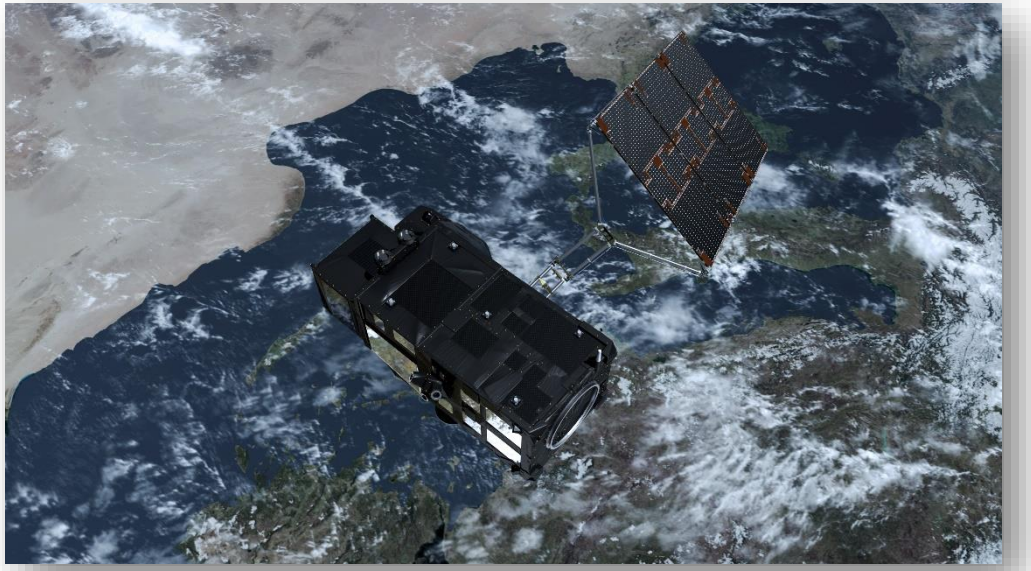
Sentinel-3 SLSTR

- Sentinel-3 A&B were launched in 2016 and 2018, respectively.
- Sentinel-3 C will be launched between Q4-2025 and Q4-2026.
- Sentinel-3s have morning orbit at 10:00 am

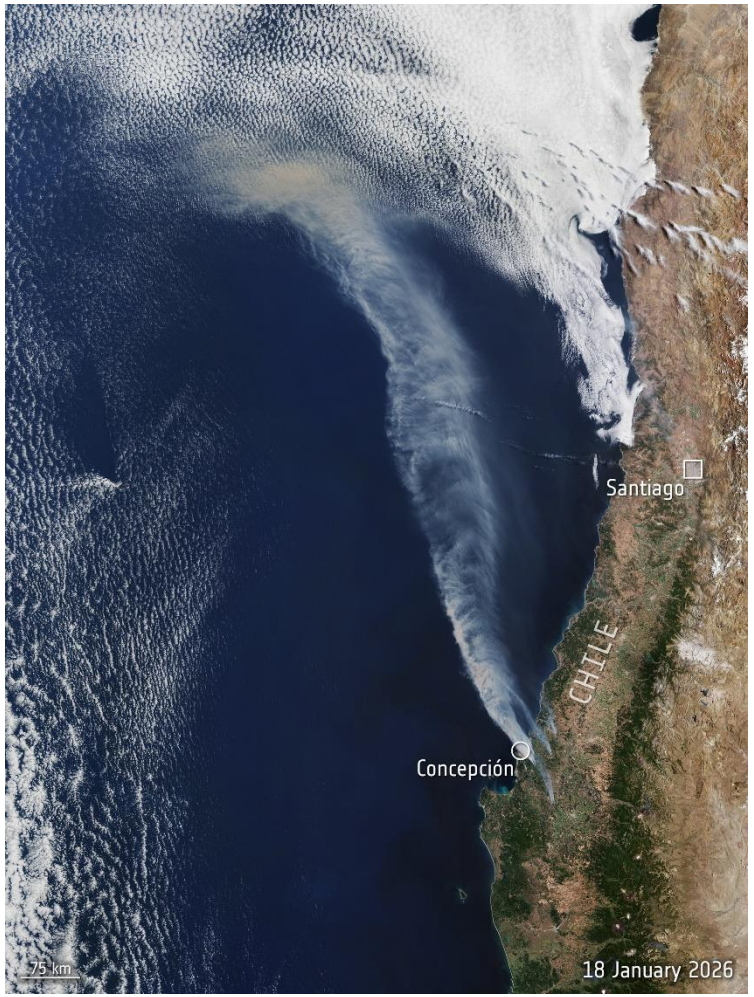
- Onboard is SLSTR, with:
  - 6 bands covering the VNIR
  - 3 bands covering the TIR
  - 1 km spatial resolution
  - 1400 km swath
- SLSTR can perform fire **detection** and **characterization** of the FRP
- The **FRP NTC products**, developed by the OPT-MPC, are generated by ESA and available through the Copernicus Data Space Ecosystem.



Sentinel-3 over land and ocean. [Credits: ESA]

SLSTR performance assessment

- The quality of the data products generated from SLSTR is monitored continuously, with routine validation of L1 and L2 products.
- Active fire products are challenging to validate, due to the ephemerality of the phenomena, and reference data samples, if they exists, almost never coincide with product estimates.
- Direct validation of SLSTR fire products used to rely on **Simultaneous Nadir Overpasses (SNOs) with MODIS Terra**.
- With the decommissioning of MODIS Terra alternative methods had to be investigated.



Smoke plumes from Chile wildfires seen by Sentinel-3.
[Credits: modified Copernicus Sentinel data (2026), processed by ESA]

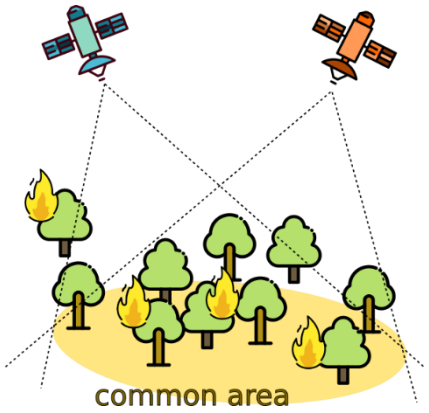
Meteosat Third Generation FCI

- MTG-I1 was launched on December 13th, 2022.
- Onboard if FCI, with:
  - 16 bands in the VIS and IR, including dedicated fire channels
  - A GSD at nadir of 1 km (fire band)
  - A full Disk scan every 10 min
- FCI can perform fire **detection and characterization** of the FRP
- FRP products from MTG-I1 are available on LSA-SAF from January 2025 onwards

Fires in central Africa as seen by MTG
[Credit: EUMETSAT]

➢ **GOAL:** assess whether MTG-I1 FRP products can be used to monitor SLSTR NTC FRP products

FRP product monitoring methodology



- Direct comparisons are made during Simultaneous Nadir Overpasses (SNO)
  - At most 5 minutes of difference between acquisitions
  - Limiting matchups to +/- 21.5° N and +/- 21.5° E so that MTG pixels remain close to 1 km²
  - Limiting the AOI to the area seen by all satellites

- To ensure the monitoring continuity from MODIS Terra to FCI, triple-SNOs (simultaneous acquisitions by SLSTR, MODIS, and FCI) over H1 2025 were studied
  - How different are the detection rates of SLSTR, MODIS Terra, and FCI?
  - Do they detect the same fires?
  - How much do they agree when it comes to characterization of joint detections?

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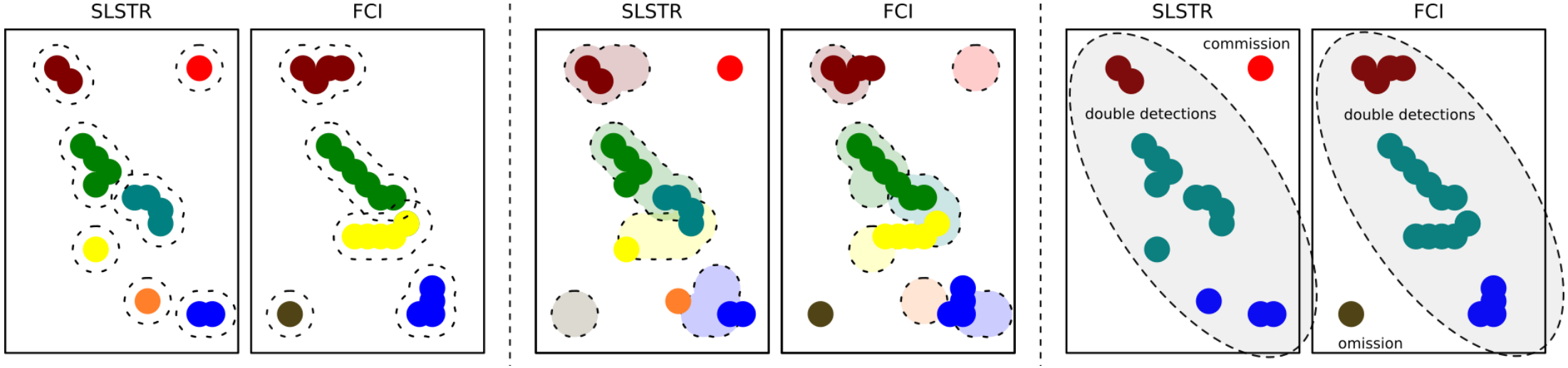
Direct validation methodology

- Assessing Active Fires Clusters (AFC) detection rates and characterization
  - A fire cluster is defined as an aggregation of nearby fire pixels, using a 9-connectivity.
  - A 2 km buffer is used as a tolerance to assess joint detection, allowing for 4 km of distance between AFC of two satellites to flag a double detection.



Example of the formation of pairs of clusters. At the end of the process, pairs of SLSTR and FCI clusters share the same color. At the end of the process, there remain three AFC double detections, 1 commission, and 1 omission,

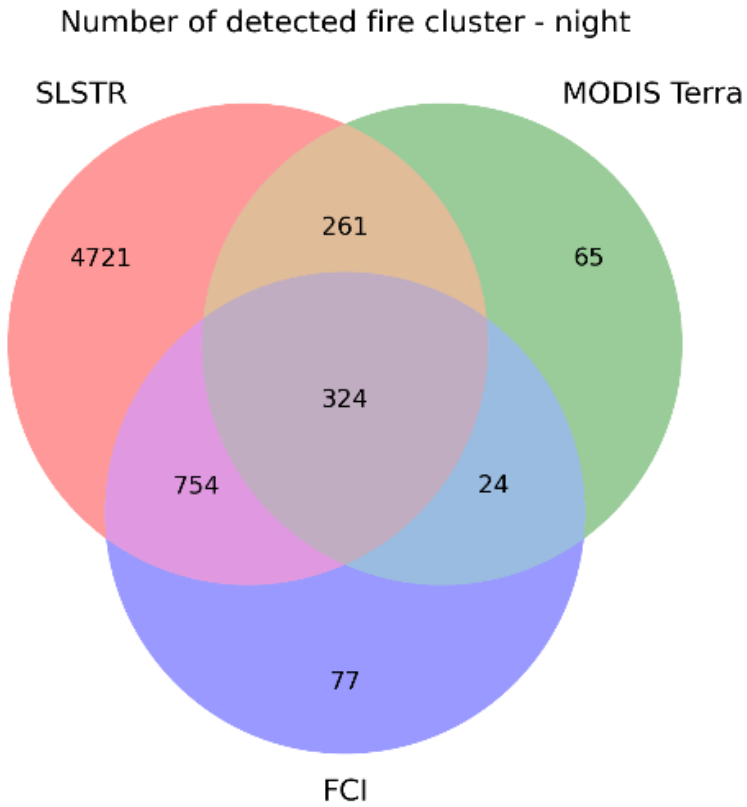
- For double (triple) detections, the FRP was compared at the cluster level between each satellite pair.

Triple SNOs – fire detection – nighttime

- Large number of SLSTR-only detections
  - More SLSTR-only detections than joint-detections with any given satellite

- FCI and MODIS-only detections are equivalent
- **The SLSTR-FCI pair is the satellite pair with the most joint detections** (754 + 324)
- SLSTR and FCI have more joint detections together than they have with MODIS

➔ **While SLSTR presents a lot of commissions, double detections are more frequent with FCI than with MODIS during nighttime**

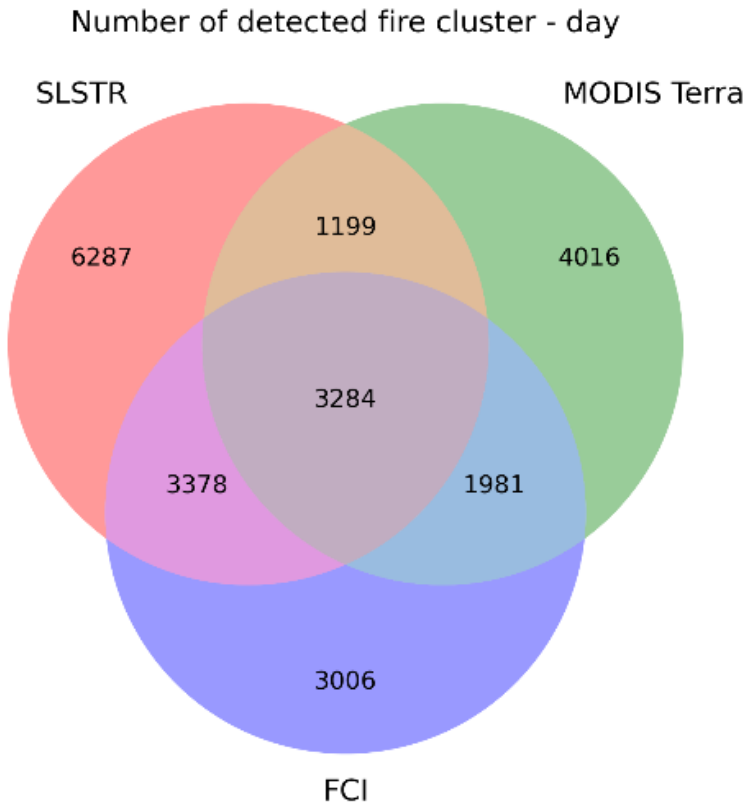


Triple SNOs – fire detection – daytime

- Less large number of SLSTR-only detections
  - Less SLSTR-only detections than joint-detections with any given satellite

- FCI and MODIS-only detections are equivalent
- **The SLSTR-FCI pair is again the satellite pair with the most joint detections** (3378 + 3284)
- SLSTR and FCI have more joint detections together than they have with MODIS

➔ **While SLSTR presents a lot of commissions, double detections are more frequent with FCI than with MODIS during daytime**

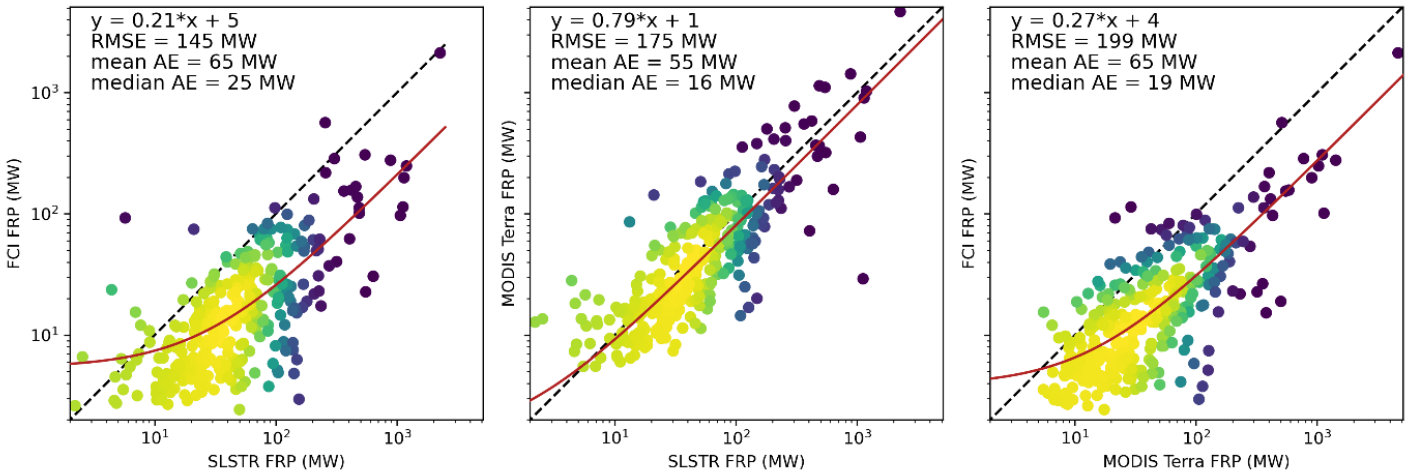


Triple SNOS - fire characterization

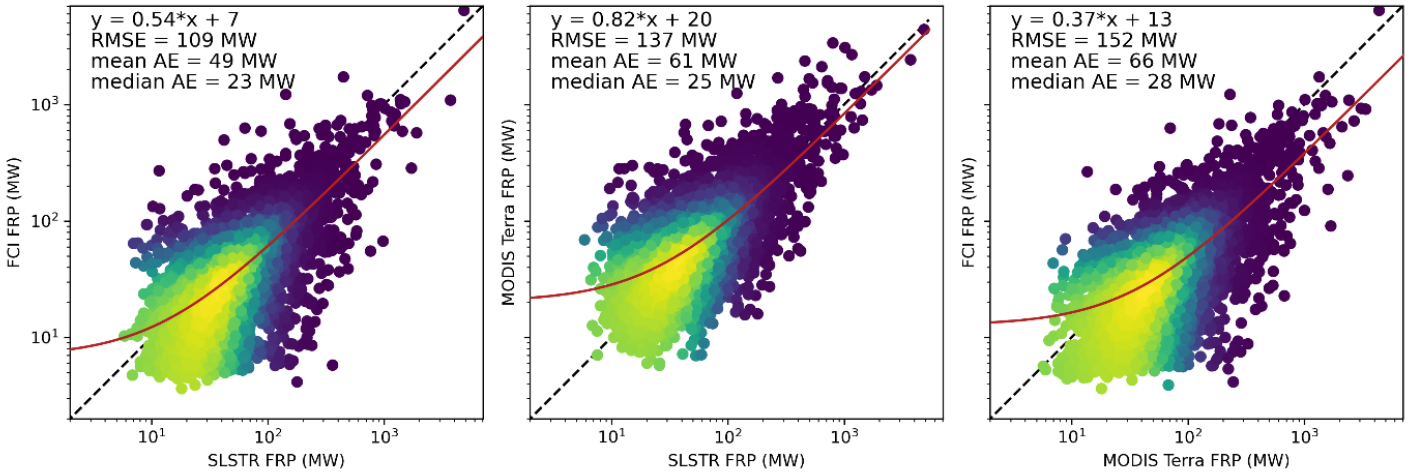
- For nighttime, few triple-collocation
  - **not many very large fires, representativity not so good**
  - the SLSTR-FCI pair has **slightly higher AEs** than the other pairs, but **RMSE is lower**.
  - **visible underestimation of the FRP by FCI compared to SLSTR and MODIS**

- For daytime, a lot of triple-collocations
  - **the SLSTR-FCI pair is the one most in agreement concerning fire intensity with all metrics**
  - **no striking underestimation of the FRP by a specific sensor**

Nighttime



Daytime



It appear that FCI is a suitable alternative, if not better, to MODIS Terra to perform the monitoring of SLSTR NTC FRP products

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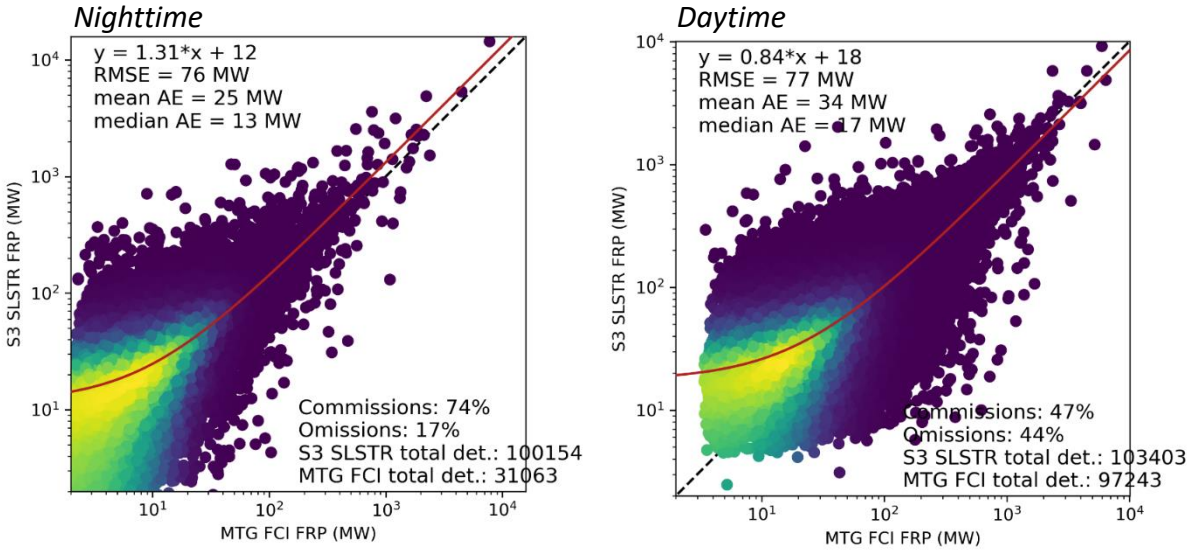
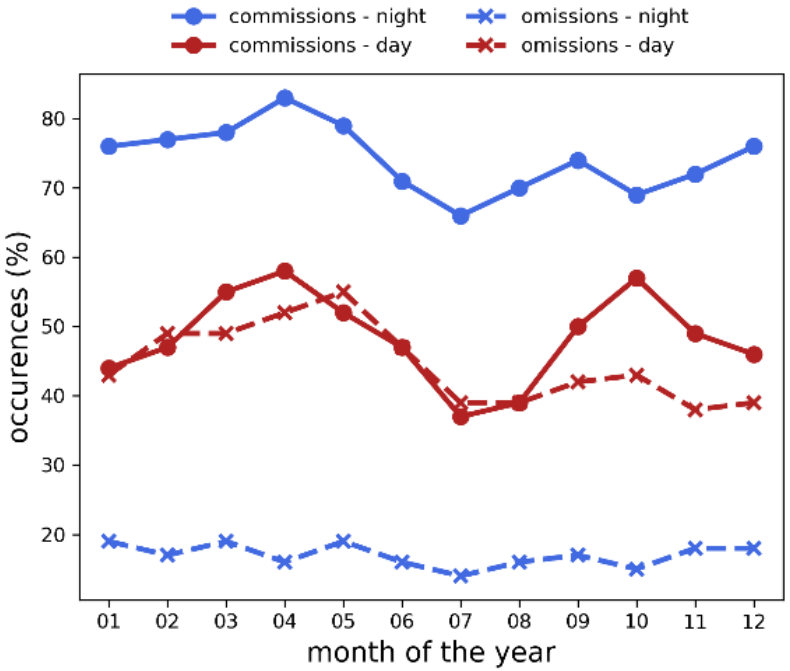
SLSTR-FCI Fire detection and characterization – 2025

- Using all data acquired over 2025, SLSTR NTC FRP products were monitored and compared to those from FCI.

- Nighttime:
  - SLSTR is slightly overestimating FRP compared to FCI
  - Median AE is 13 MW
- Daytime:
  - SLSTR is slightly underestimating FRP compared to FCI
  - Median AE is at 17 MW

- Detection rates are somewhat stable over the year
  - seasonal variations are visible for daytime, with more commissions outside of the fire seasons





Conclusion & Perspectives

- **MTG FCI is a suitable alternative to MODIS Terra to monitor SLSTR NTC FRP products**
  - ✓ SLSTR and FCI agree more often than the other pairs concerning fire detection
  - ✓ Statistics concerning fire characterization are similar and even better than the FCI-MODIS and SLSTR-MODIS pairs

- **Over 2025**, considering all SLSTR-FCI SNOs:
  - ✓ During nighttime, **74% of SLSTR fires were commissions**, and **17% of FCI fires were SLSTR omissions**
  - ✓ During daytime, SLSTR and FCI roughly detect the same number of fires, with **~45% commissions and omissions**
  - ✓ Detection rates are stable over the year
  - ✓ Characterization errors remain low for nighttime and daytime (~15 MW) over the year

- **S3A/B could fill the gap left by the decommissioning of Terra** concerning fire detection and characterization

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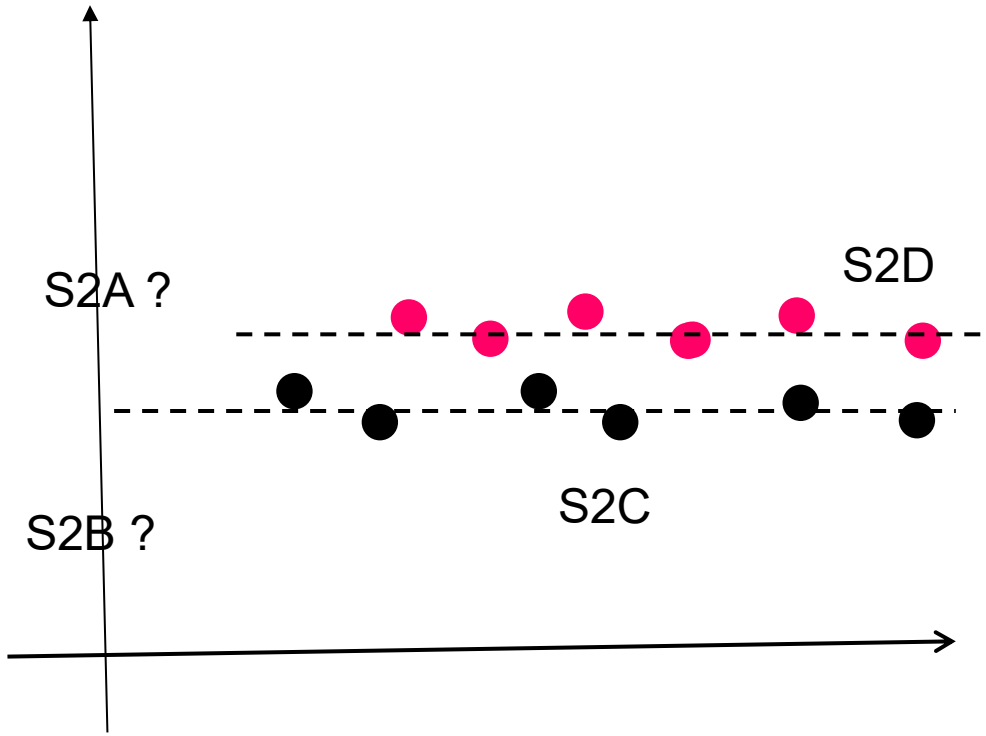
THANK YOU FOR YOUR ATTENTION

Benefit of a lunar acquisition with S2A

- Lunar calibration has a relatively large absolute uncertainty but is very accurate for relative radiometry
  - ✓ Inter-sensor
  - ✓ Over-time
- Lunar calibration models are expected to improve in the future and become a major reference for future missions
- Having a single S2A / S2B acquisition will already provide a robust comparison point with S2C and future Sentinel-2 units



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