



# MTG LI commissioning status

GLM Science Meeting 2023  
November 13, 2023

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## Introduction

- LI System in a nutshell
- LI monitoring during Commissioning
- LI modes and key milestones for science validation

## Science validation status

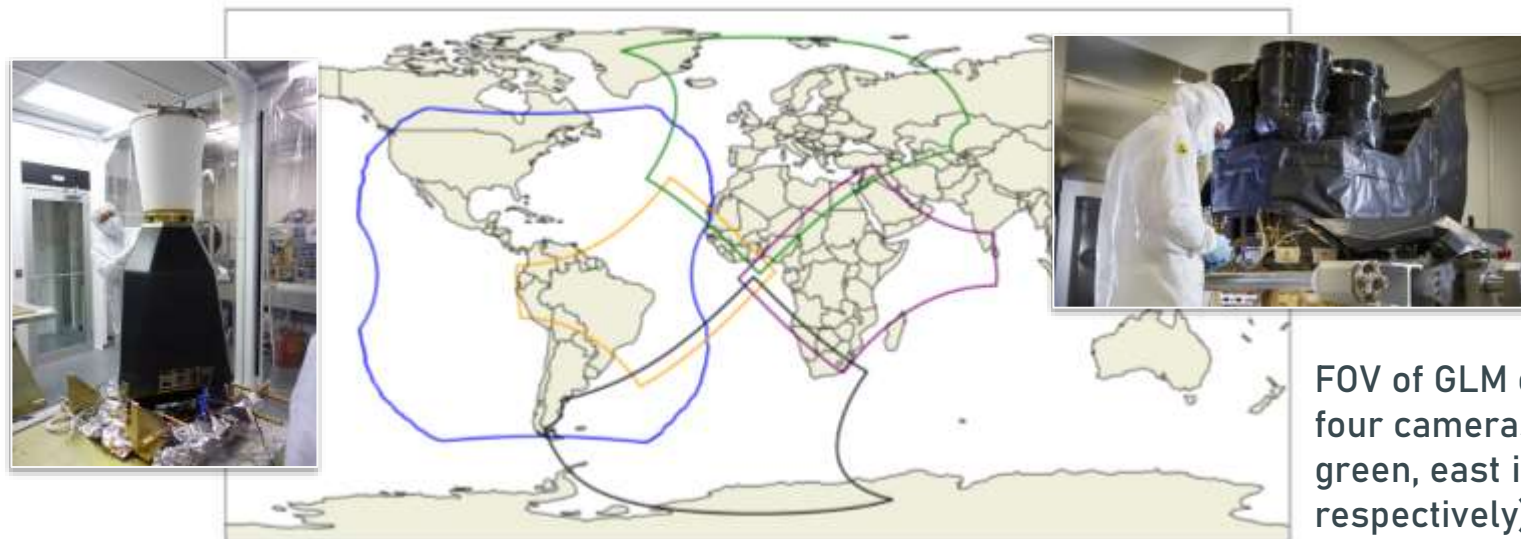
- Lightning in CAL acquisitions
- OPER acquisitions:
  - OPER low-sensitivity mode and LI goes public
  - First LI end-to-end performance assessment

## Conclusions and way forward



# LI System in a nutshell

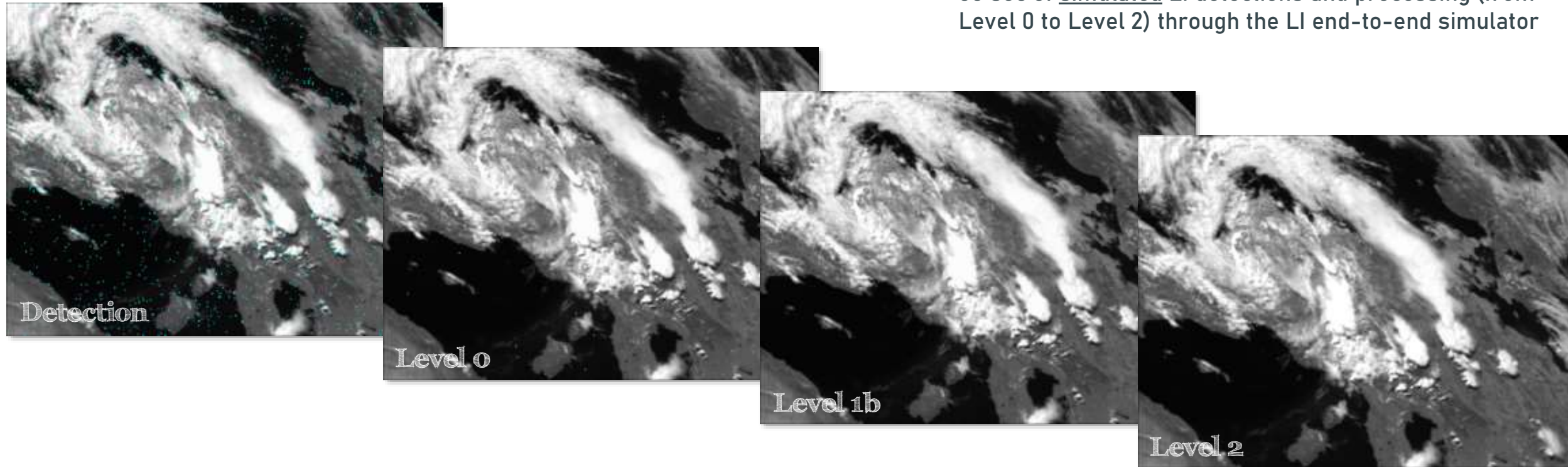
Key design feature	LI*	GLM
Detector	1000x1170 (x4) pixels CMOS	1372x1300 pixels CCD
Spatial resolution	4.5 km at Nadir (variable within the FOV; about 8 km over Europe)	8 km (nearly constant; 14 km at FOV edge)
Coverage	Up to 80 degrees North	Up to 52 degrees North
Spectral band	777.4 nm with 1.9 nm bandwidth	777.4 nm with 1 nm bandwidth
Integration time (frame rate)	1 ms	2 ms
On-board processing	Lightning detection and data filtering	Lightning detection
Bandwidth	30 Mbps (3x3 pixel window for each detection)	7.7 Mbps
Latency (timeliness)	1 min	20 sec
Detection efficiency	70-90% flash detection efficiency (expected)	70-90% flash detection efficiency



\*LI is manufactured by Leonardo (Italy) under the industrial prime contractor Thales Alenia Space (France) as part of the ESA lead MTG space segment development

FOV of GLM on GOES-16 (blue) and FOV of the four cameras of LI (west in yellow, north in green, east in purple, and south in brown, respectively)

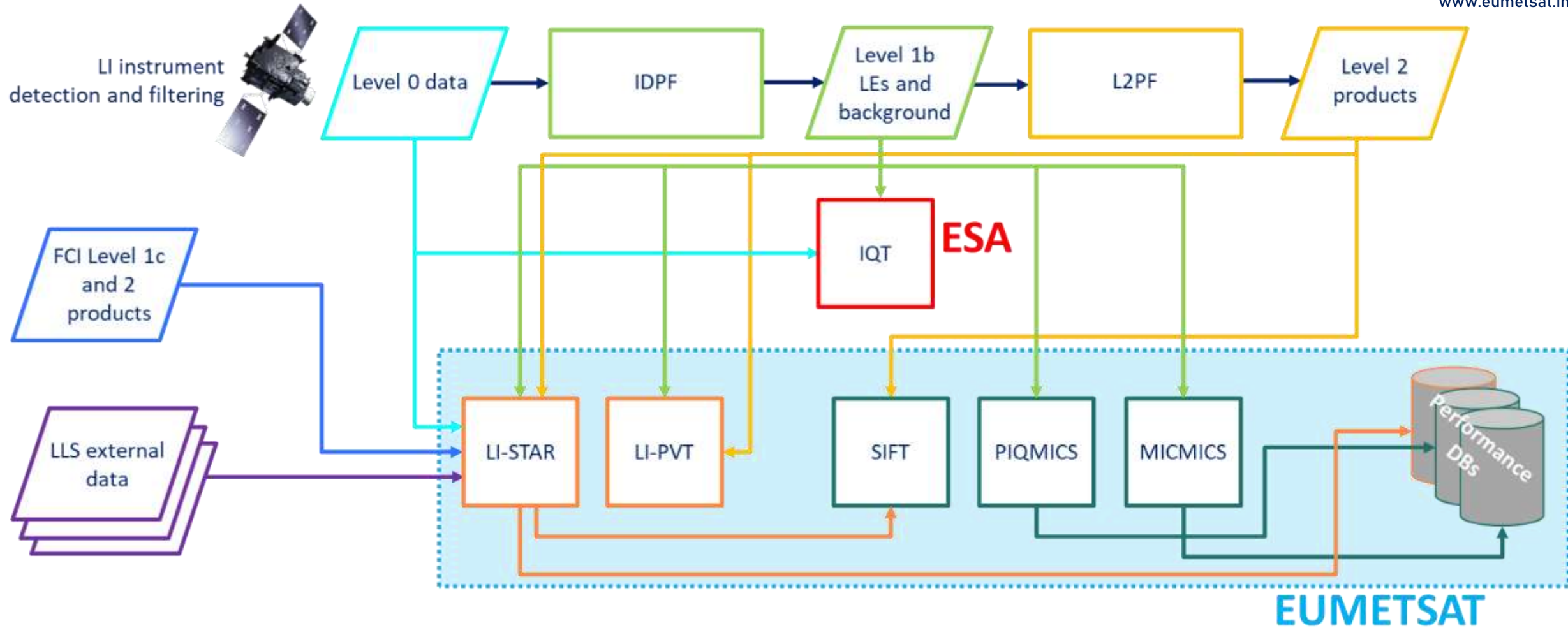
30 sec of simulated LI detections and processing (from Level 0 to Level 2) through the LI end-to-end simulator



- LI will be operated to send to the ground as many lightning events (LEs) as possible (with limits imposed by the downlink-bandwidth). Three processing steps take place on-board: detection + Level 0 filtering (Single-Detection Filter + Micro-Vibration Filter)
- The ground processing (Level 1b + Level 2) will remove the remaining false events
- EUMETSAT will have the possibility of accessing and monitoring all levels of processing



# LI Monitoring during Commissioning



IDPF: Instrument Data Processing Facility

L2PF: Level 2 Processing Facility

LEs: Lightning Events (i.e., LI pixel-based measurements)

IQT: Image Quality Tool

LLS: Lightning Location System

LI-PVT: LI Processing Visualization Tool

LI-STAR: LI STATistics and Reporting

PIQMICS: Performance Image Quality Monitoring and Characterization System

MICMICS: Mission Integrated Calibration Monitoring Inter-Calibration System

SIFT: Satellite Information Familiarization Tool (<https://sift.ssec.wisc.edu/>)



# LI modes and key milestones for science validation

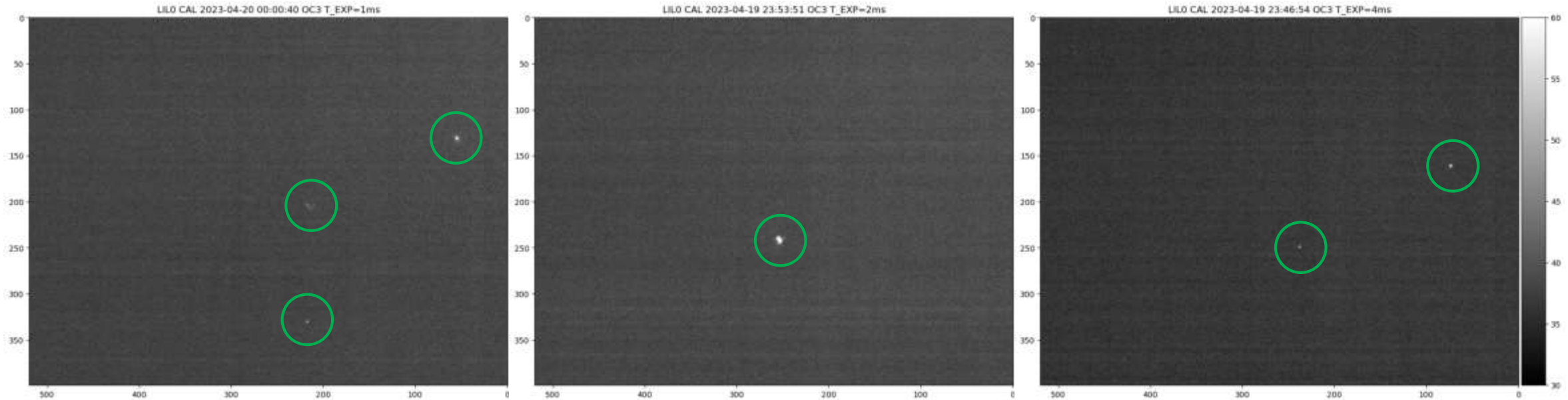
- CALibration: acquisition of multiple background images for detector characterisation with the possibility of varying the integration time;
- OPERational: lightning detection and acquisition of background images:
  - Continuous stream of lightning events;
  - One background image every minute for data navigation.

## Key milestones for science validation:

1. April 19 and 20, 2023: first successful CAL acquisitions during day and night.
2. May 25, 2023 successful OPER mode with lightning detection in low-sensitivity followed by continuous lightning detection over June, 2023 in the same mode.
3. July 3, 2023: release to the public of the first lightning detection videos.
4. June 29, 2023: first IQT LI Level 1b products over 24h (covering June 3, 2023 12:00UTC – June 4, 2023 12:00 UTC).
5. September 14, 2023: second IQT LI Level 1b products over 24h (covering July 12, 2023 12:00UTC – July 13, 2023 12:00 UTC).
6. October 2023: successful production of LI Level 2 products from the dataset covering June 3, 2023 12:00UTC – June 4, 2023 12:00 UTC.
7. November 1, 2023: first high-sensitivity IQT LI Level 1b products over 24h (covering July 12, 2023 12:00UTC – July 13, 2023 12:00 UTC).



## CAL observations in night-time containing images of lightning

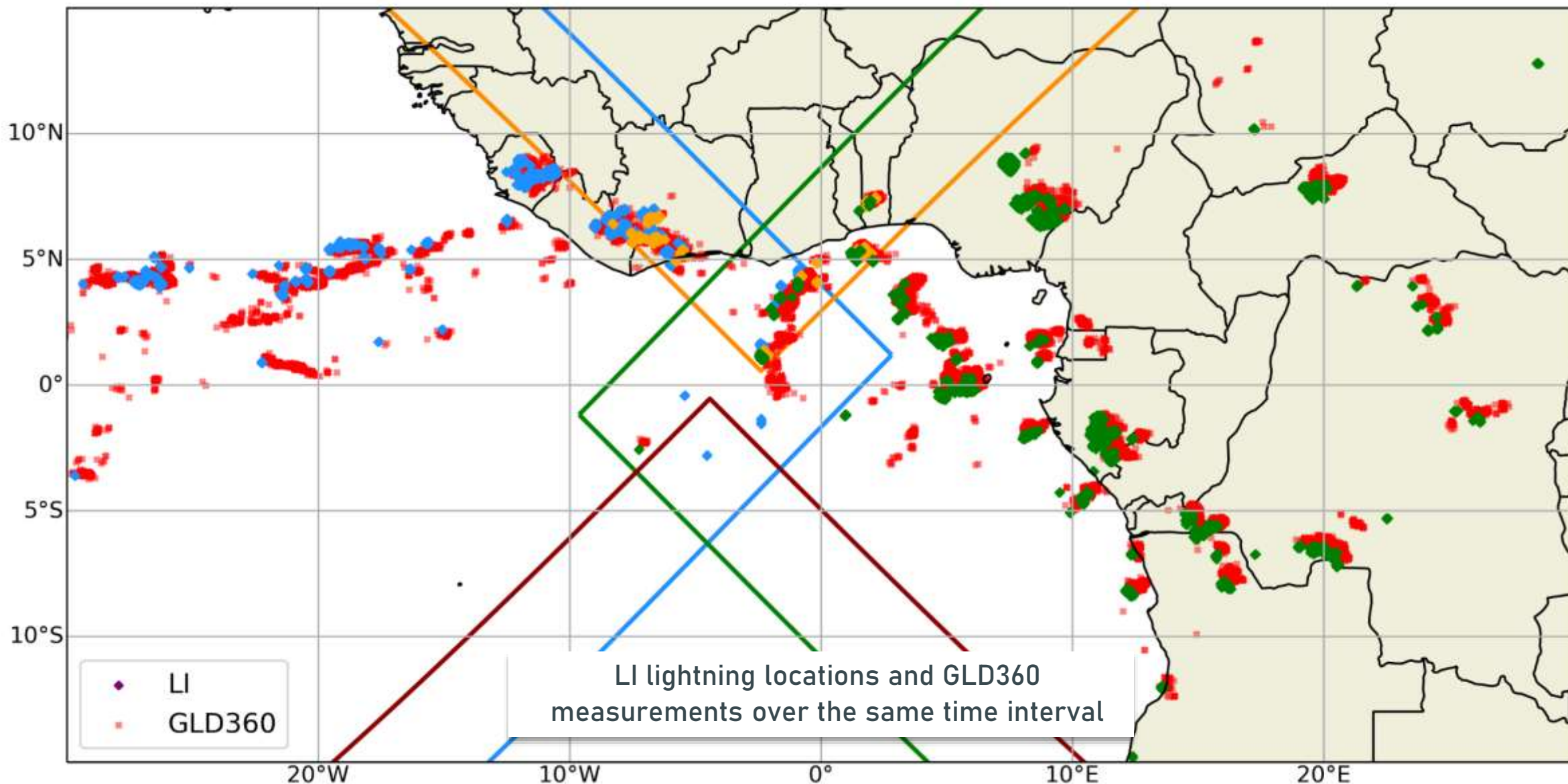


EUMETSAT experts derived the approximate geolocation of the lightning images.

This enabled a direct comparison between LI lightning images and lightning detections from GLD360 (ground-based lightning location system).



# In depth analysis of CAL acquisitions







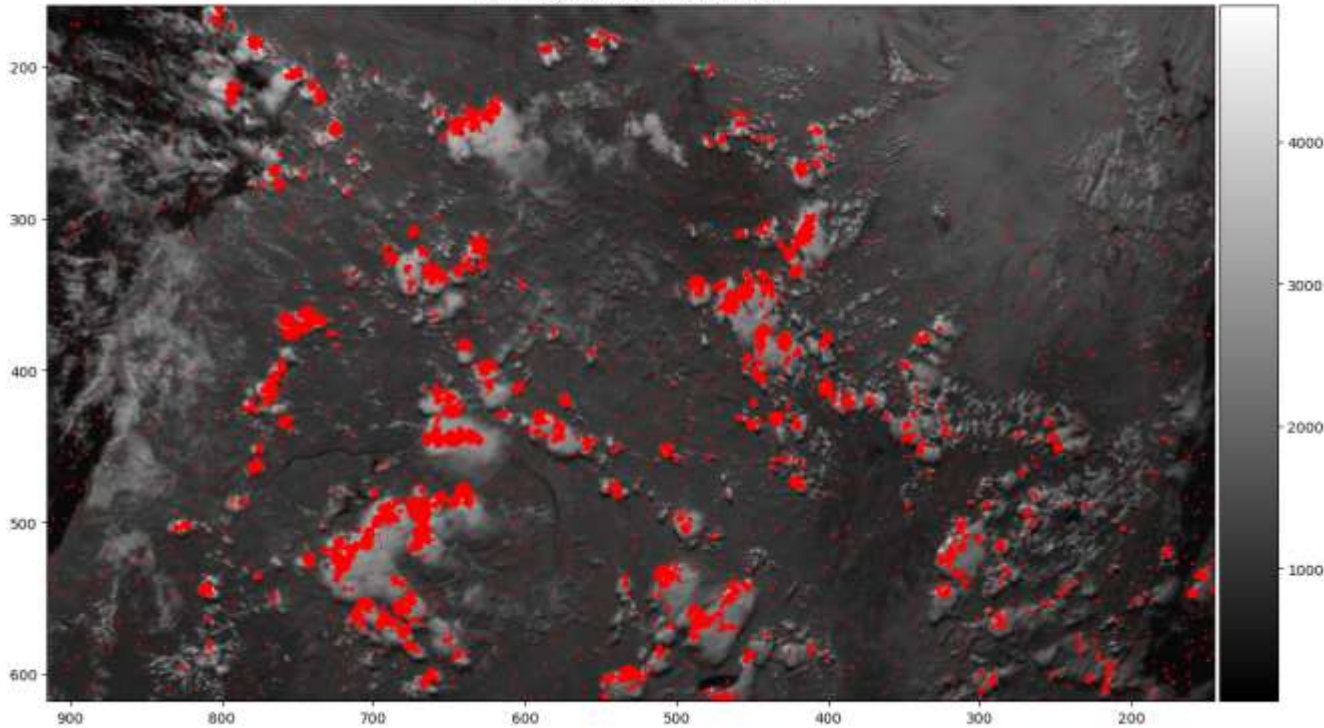
When operated in low-sensitivity mode, LI has limited sensitivity to noise.

LI generates lightning events in correspondence with convective cells and storms, i.e., where lightning occur.



# OPER low-sensitivity mode and LI goes public

LIL0 DT 2023-05-25 14:05:41 OC3

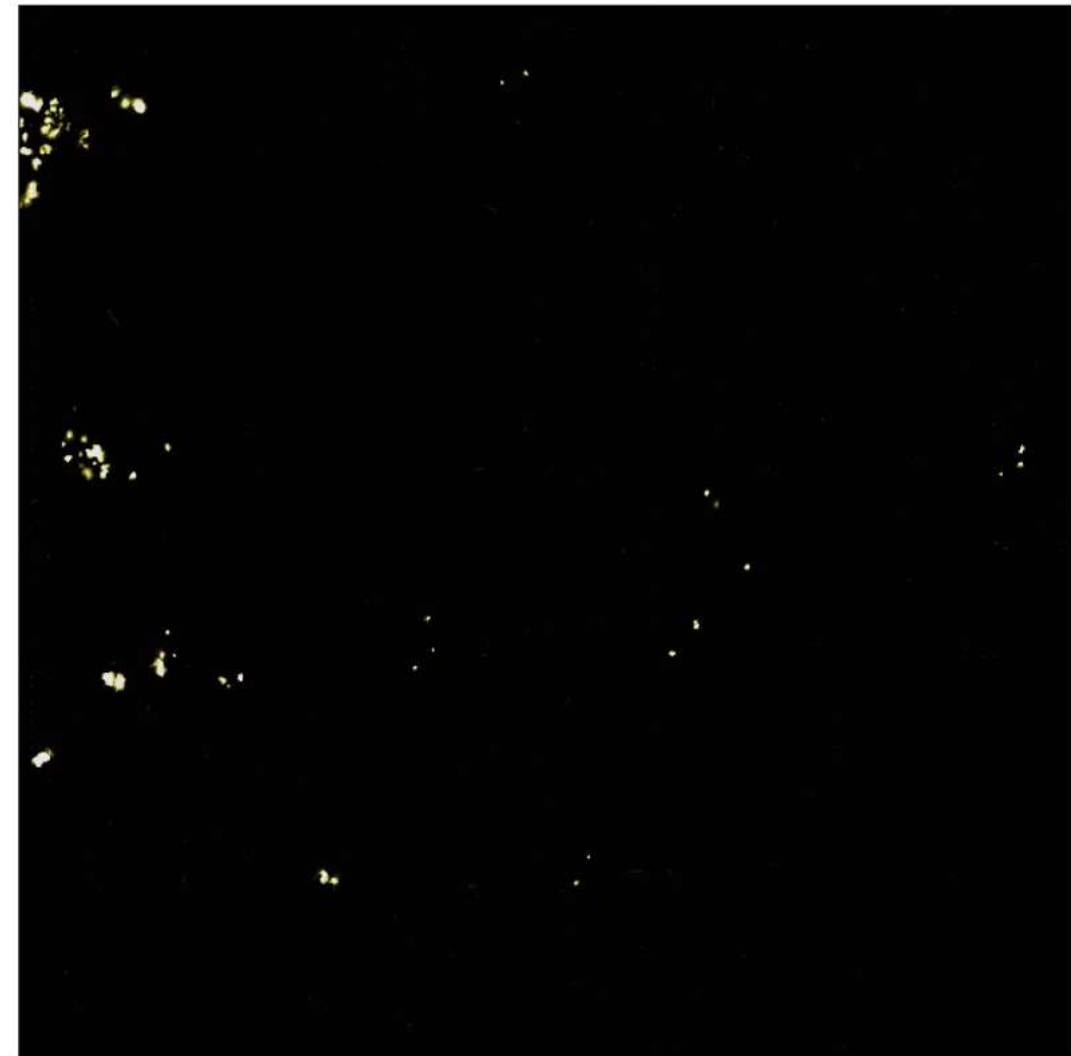


282503 DTs during 2023-05-25 14:03:30.186..2023-05-25 14:08:58.184

First evidence of successful lightning detection with LI (May 25, 2023 around 14:00 UTC) presented with a “flat” representation.

The quality of the data combined with the remarkable capability of LI of tracking lightning activity allowed EUMETSAT to present to the world the first LI lightning detections ([link](#)).

2023-06-07 00:00



Five days of lightning detections from June 7 to June 11, 2023 over the Red Sea (within the LI East camera) presented with a “weighted” representation.



The Image Quality Tool (IQT) version 3.5 of Thales Alenia Space (TAS) has been employed for the first INR tuning of LI data.

24h of LI Level 1b products were analysed by EUMETSAT experts to assess LI lightning detection performances relative to GLD360.

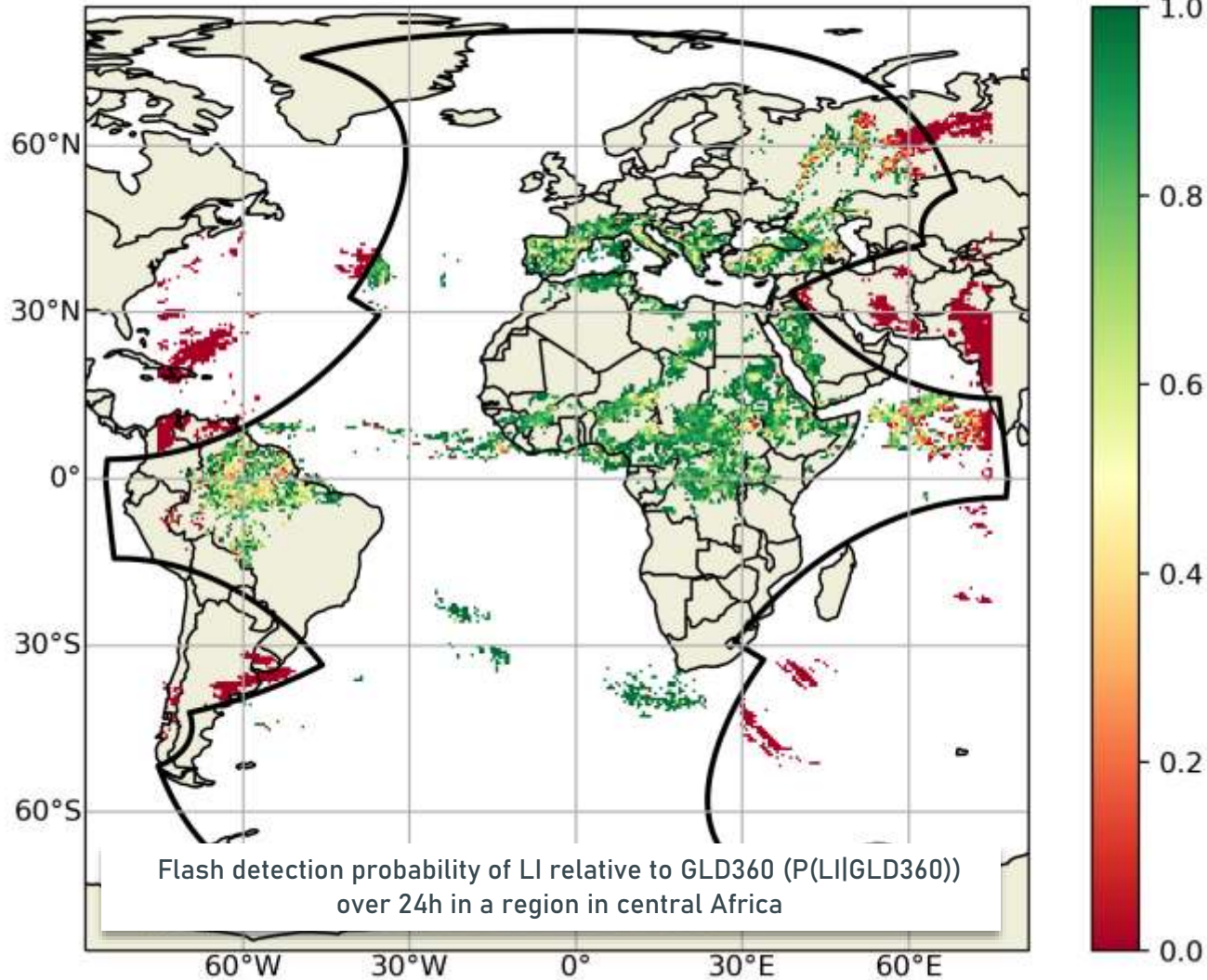
Level 1b data were processed with the L2PF to derive the first LI Level 2 dataset and EUMETSAT experts assessed LI lightning detection performances relative to GLD360 at Level 2.

Note: details of the analyses will be described in “MTG LI performance assessment” today at 2:50 pm Huntsville time.



# First LI end-to-end performance assessment (low-sensitivity)

P(LI | GLD360) Flashes  
85.0°N-85.0°S; 88.4°W-81.6°E  
2023-06-03T12:00..2023-06-04T11:59



Geographical area	Level 0 events			Level 1b events		
	Africa	Southern Europe	South America	Africa	Southern Europe	South America
N of matches	280968	53212	33930	268308	51449	31131
N of GLD observations	414044	77953	78584	249026	48495	41687
P(LI GLD360)	0.68	0.68	0.43	0.65	0.66	0.40

Geographical area	Level 2 groups			Level 2 flashes		
	Africa	Southern Europe	South America	Africa	Southern Europe	South America
N of matches	268305	51084	31565	206749	37222	24294
N of GLD observations	414044	77953	78584	249026	48495	41687
P(LI GLD360)	0.65	0.66	0.40	0.83	0.77	0.58
W-E location offset (km)	4.976	3.681	6.857	5.552	4.018	6.601
N-S location offset (km)	4.914	4.158	3.934	6.088	4.130	3.924

- The Level 2 processing was configured to be very conservative (sanity check) and to get rid only of particle strikes.
- Found consistency between performances at Level 1b and Level 2 groups.
- As expected, the flash FAR is still very high.



- The most important results derived so far show that:
  - ✓ The quality of LI Level 0 data is very high;
  - ✓ LI can image/detect lightning in CAL/OPER low-sensitivity mode;
  - ✓ Lightning detection performances at Level 1b in both low- and high-sensitivity mode have been assessed;
  - ✓ End-to-end lightning detection performances have been assessed in low-sensitivity mode. The average Level 2 flash DE is of about 73% over the entire FOV (maximum at 83% over Africa). Soon EUMETSAT experts will assess Level 2 performances in high-sensitivity mode.
- LI Mission Advisory Group activities in support to the LI Commissioning are on-going ([link](#))

## Next steps:

- Achieve stable LI Level 1b processing,
- Derive consolidated LI Level 1b lightning detection performances by analysing weeks of Level 1b products,
- Achieve stable Level 2 processing (after tuning)
- Derive consolidated LI Level 2 lightning detection performances by analysing weeks of Level 2 products,
- Provide the first Level 2 data to Users in Q1 2024.



**Thank you!**  
Questions are welcome.