MTG LI Performance Assessment

GLM Science Meeting 2023
November 13, 2023

Sven-Erik Enno, Bartolomeo Viticchiè, David Navia, Corvin-Petrut Cobarzan (EUMETSAT)

Agenda

Introduction

- Performance indicators of LI
- LI monitoring and performance assessment at EUMETSAT
- LI-STAR tool modes

First LI end-to-end Detection Efficiency (DE) and Location Accuracy (LA) assessment

- Data and method
- Results

Conclusions

Performance indicators of LI

LI is a very specific system: it is an imager devoted to lightning detection.

As all imagers, LI is characterized by:
- Radiometric performances, and
- Navigation (geometric) performances.

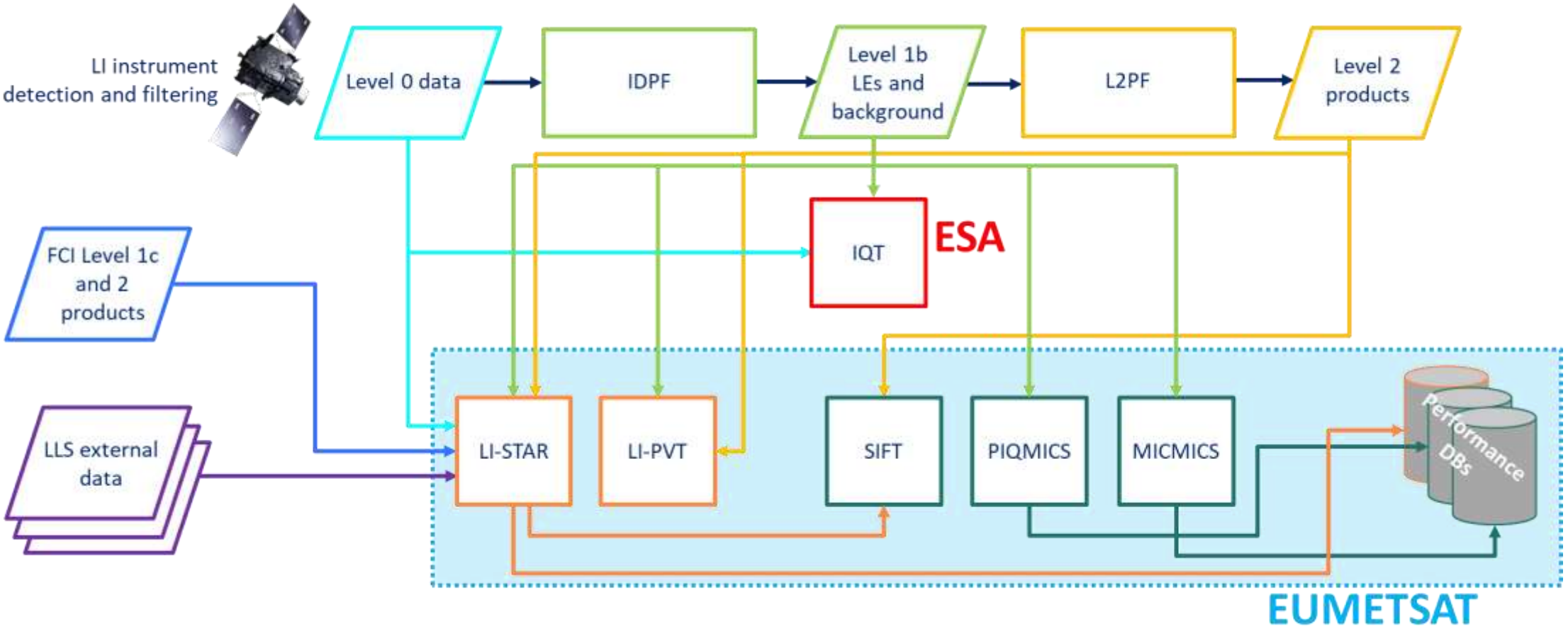
These performances are assessed using LI Level 1b and Level 2 data.

In addition (and most importantly), LI is characterized by lightning detection performances:
- Detection Efficiency (DE), and
- False Alarm Rate (FAR).

These performances can be assessed end-to-end (from Level 0 to Level 2).

LI performances are monitored by means of Off-line Tools (OFTs).

LI monitoring and performance assessment at EUMETSAT



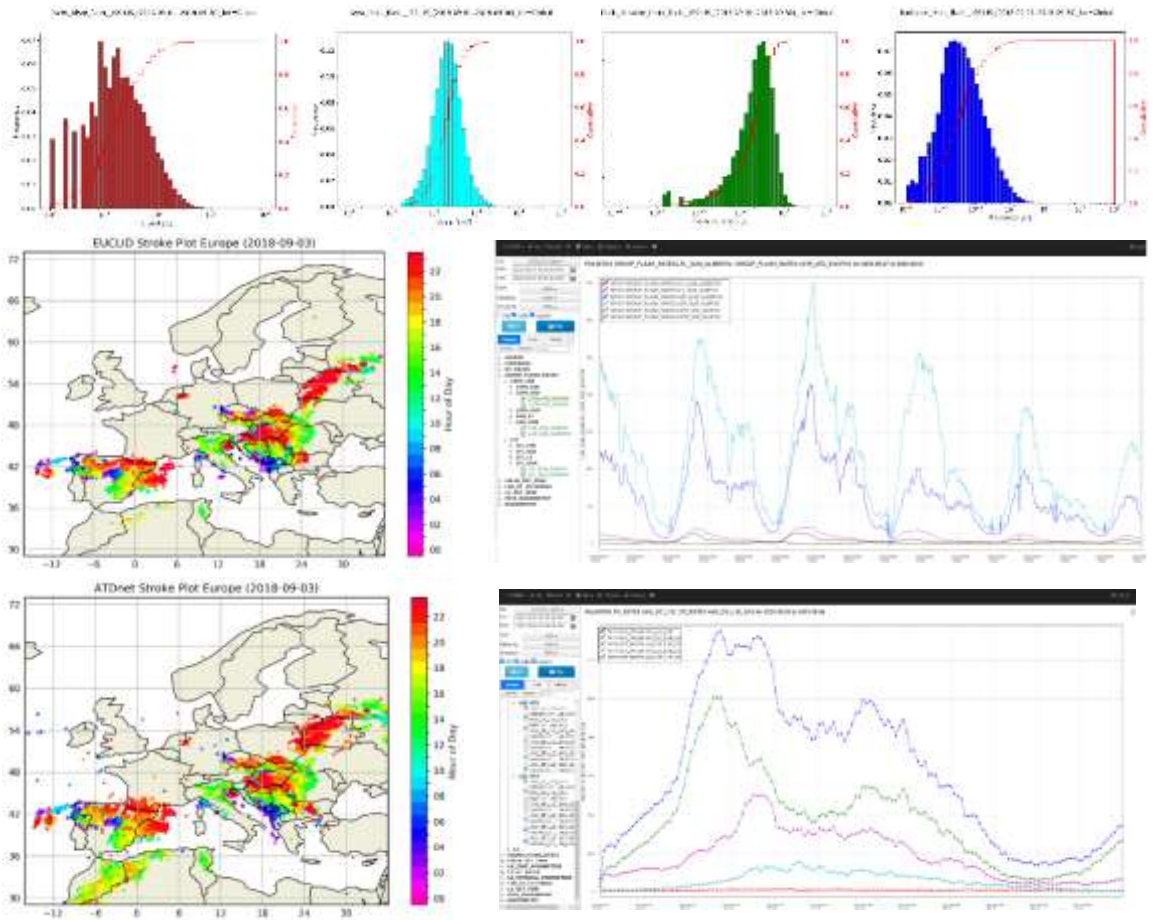
IDPF: Instrument Data Processing Facility
L2PF: Level 2 Processing Facility
LEs: Lightning Events (i.e., LI pixel-based measurements)
IQT: Image Quality Tool
LLS: Lightning Location System

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-STAR tool modes

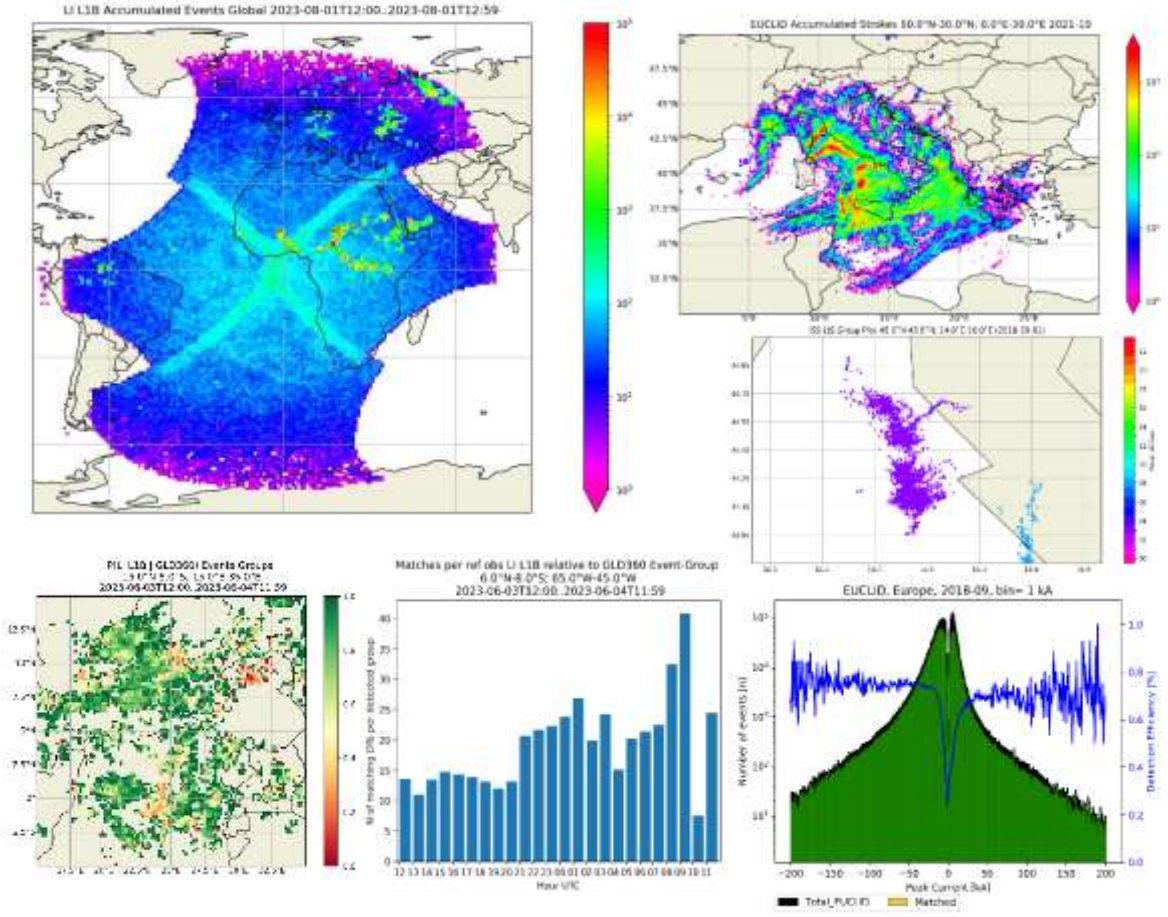
LI-STAR AUTOMATED MODE

A set of functions run daily in EUMETSAT CHART environment, the results can be accessed via the internal web.

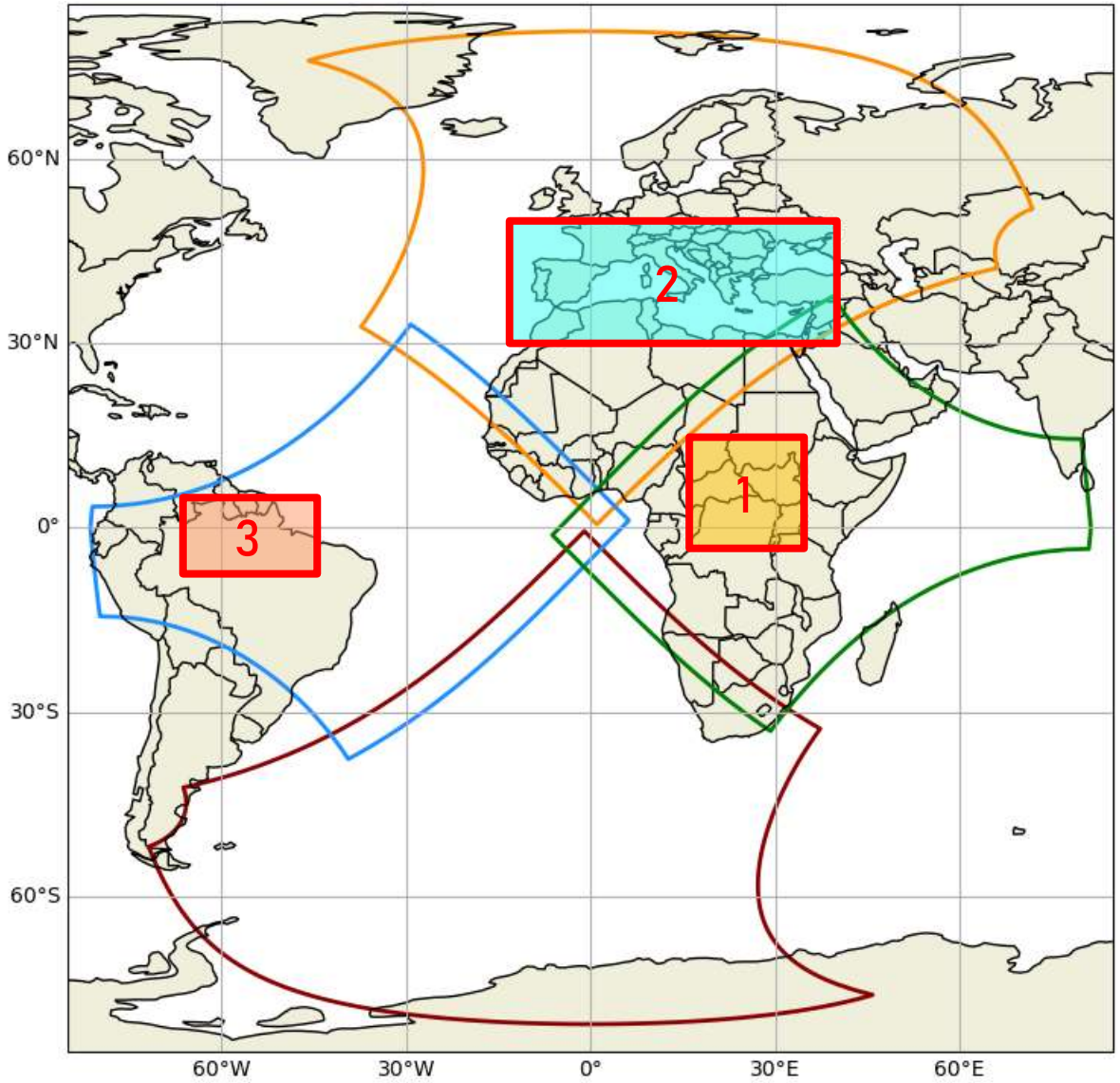


LI-STAR MANUAL MODE

Many more functions for detailed scientific analyses available in the manual mode, can be run from the terminal.



Data and method

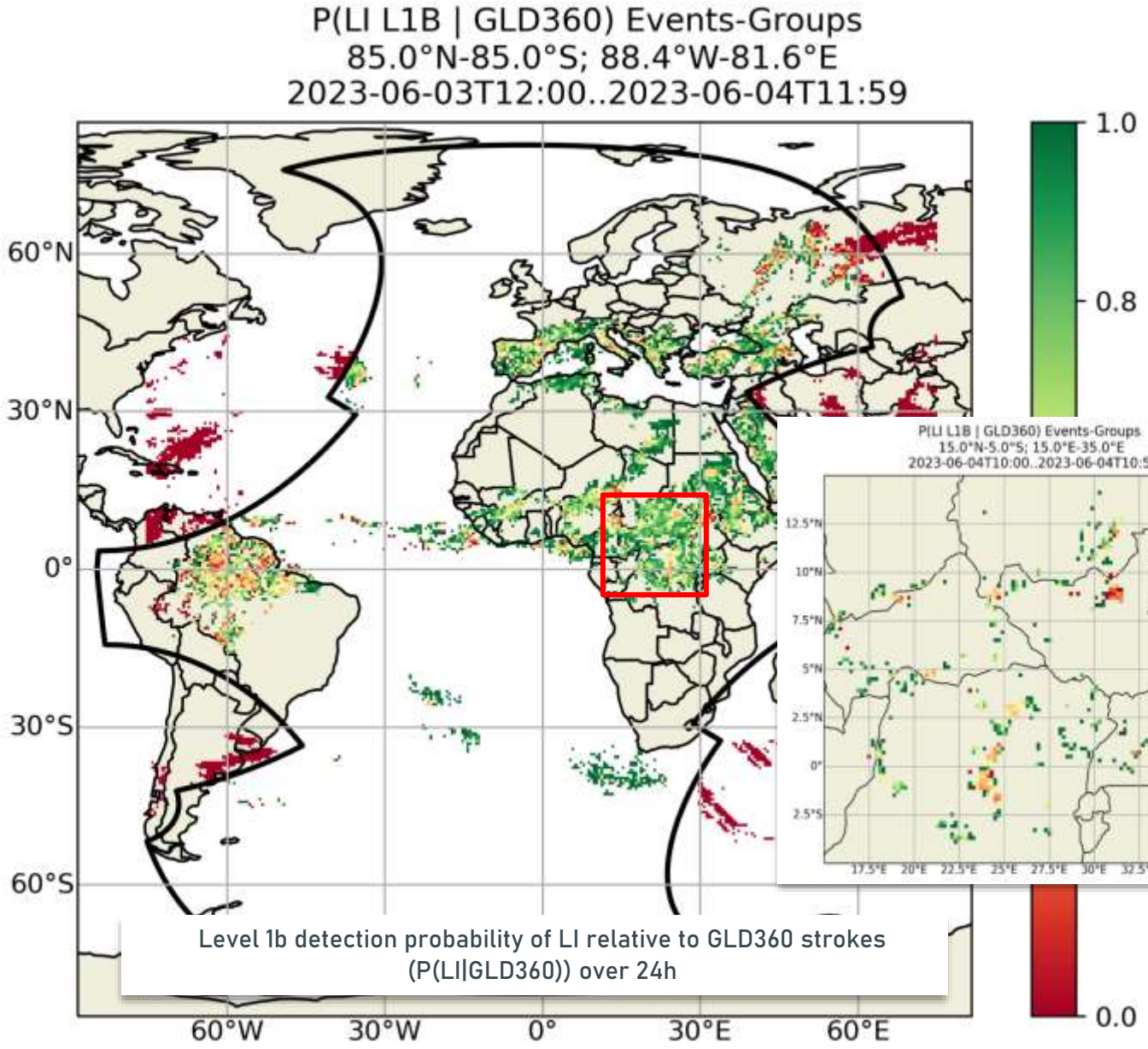


1. Central Africa (15°N-5°S, 15°E-35°E)
- Closest to the sub-satellite point.
- A lot of lightning.
- Smallest impact of parallax (correction).

2. Europe (30°N-50°N, 10°W-40°E)
- Performance in the EUM member states.
- Could have been larger but no lightning elsewhere in Europe during the 24H period.

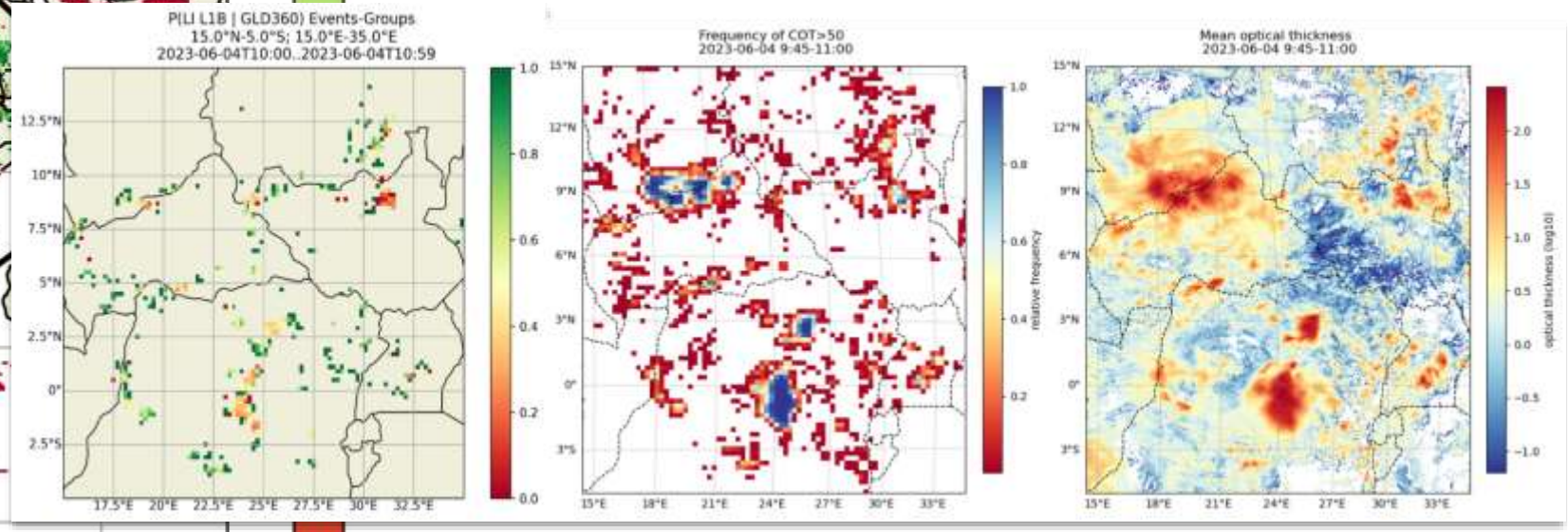
3. South America (6°N-8°S, 65°W-45°W)
- Far from the sub-satellite point.
- Most challenging to the LI in terms of detection.
- Also challenging for post-processing, especially parallax correction.

Results: LI Level 1b DE relative to GLD360



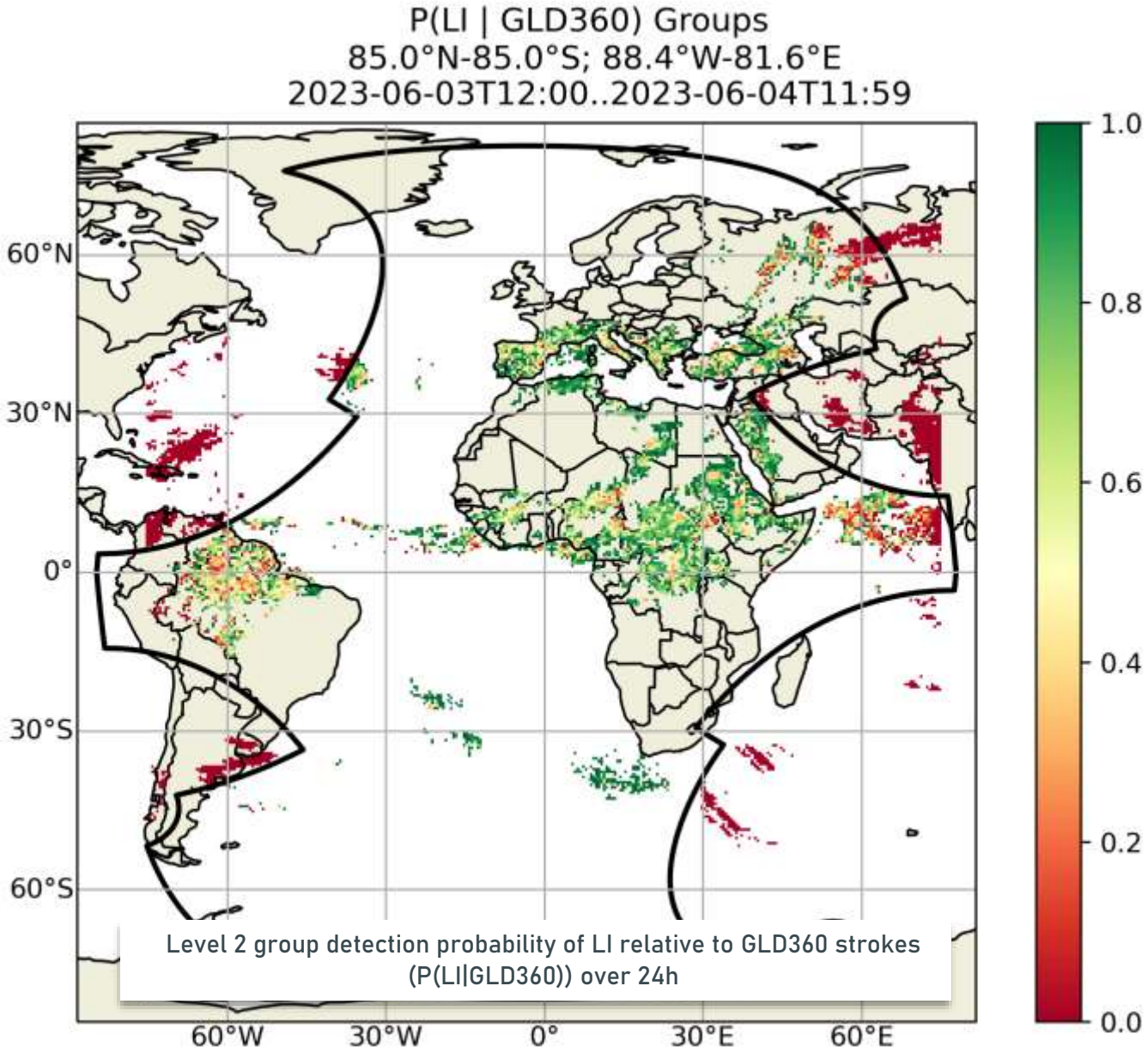
Level 1b detection probability of LI relative to GLD360 strokes (P(LI|GLD360)) over 24h

	Level 0 events			Level 1b events		
Geographical area	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



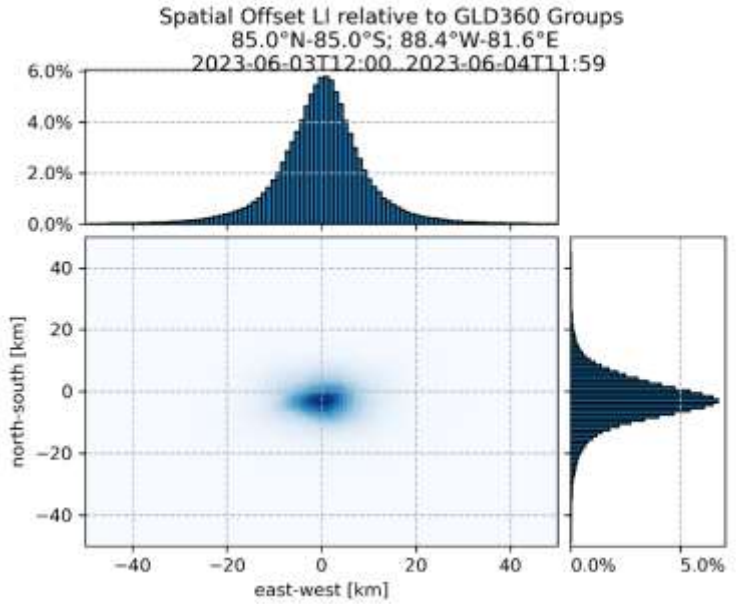
Correspondence between optically thick clouds and lows in LI Level 1b detection efficiency over Africa.

Results: LI Level 2 DE relative to GLD360



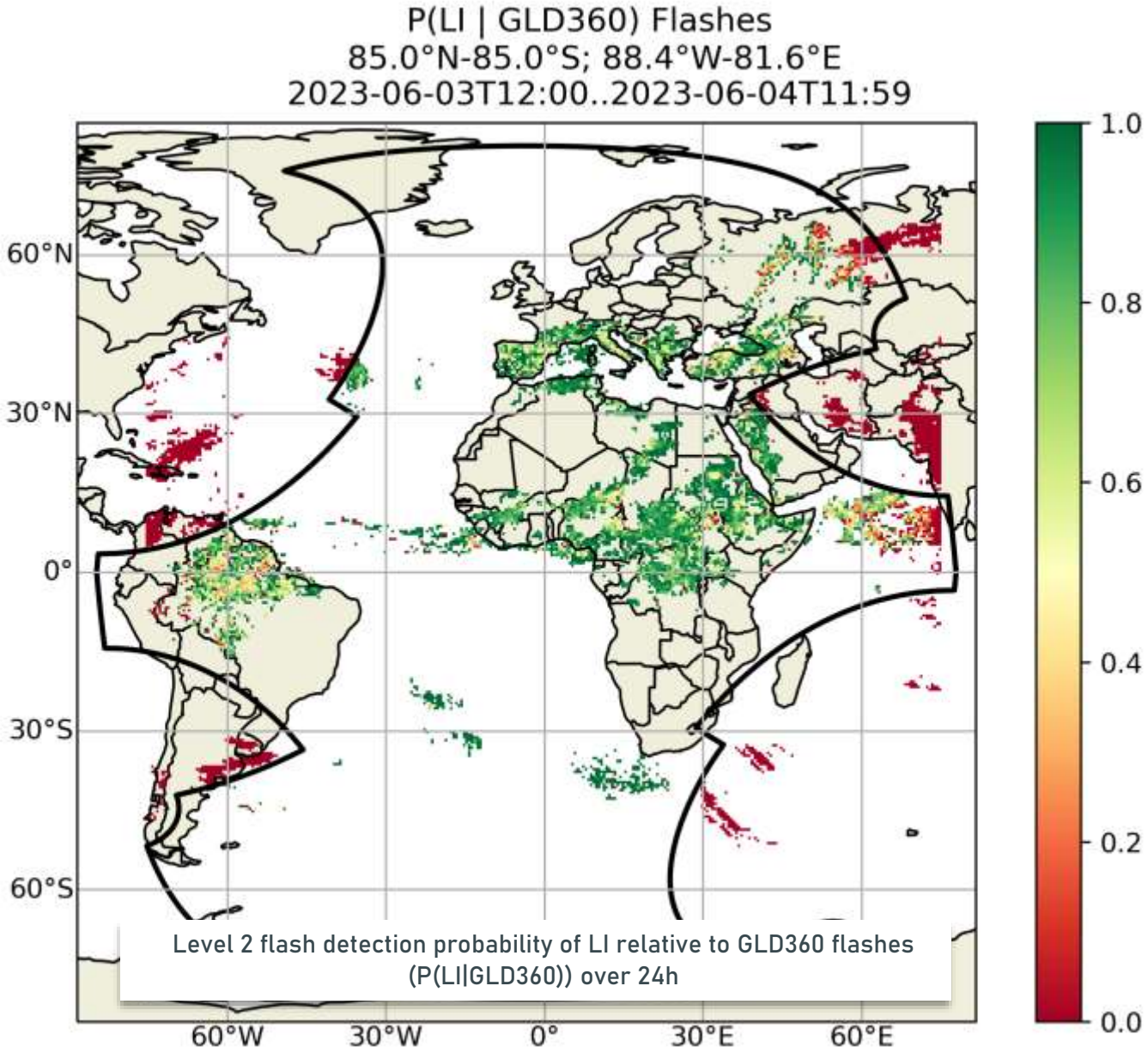
Level 2 group detection probability of LI relative to GLD360 strokes (P(LI|GLD360)) over 24h

	Level 2 groups			Level 2 flashes		
Geographical area	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



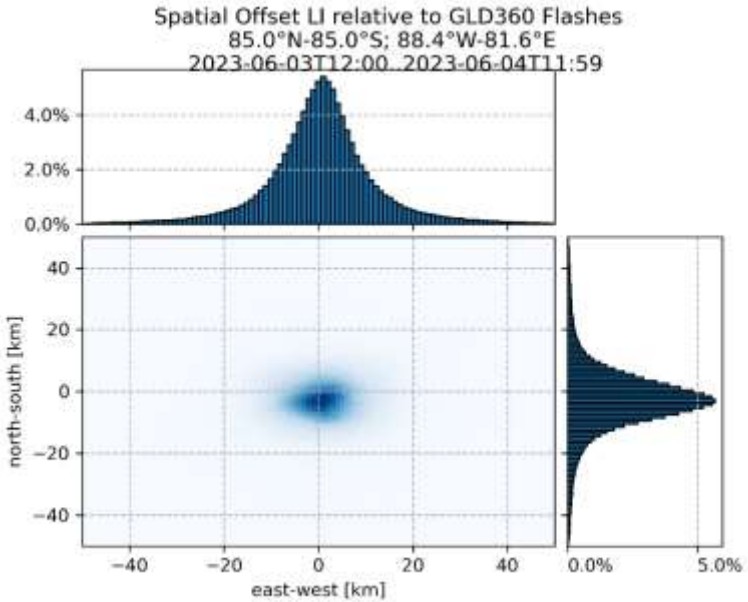
Spatial offset of LI Level 2 groups relative to GLD360 strokes.

Results: LI Level 2 DE relative to GLD360



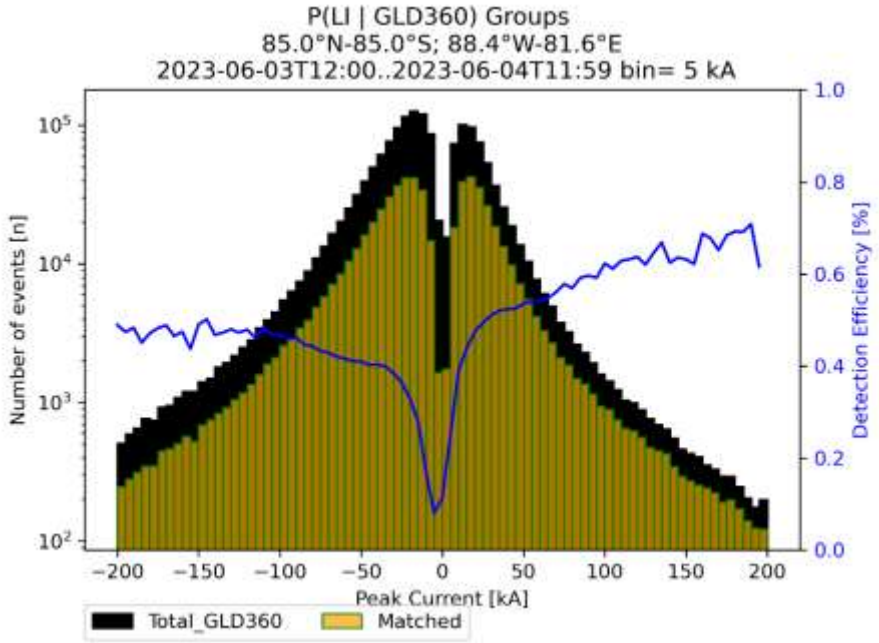
Level 2 flash detection probability of LI relative to GLD360 flashes (P(LI|GLD360)) over 24h

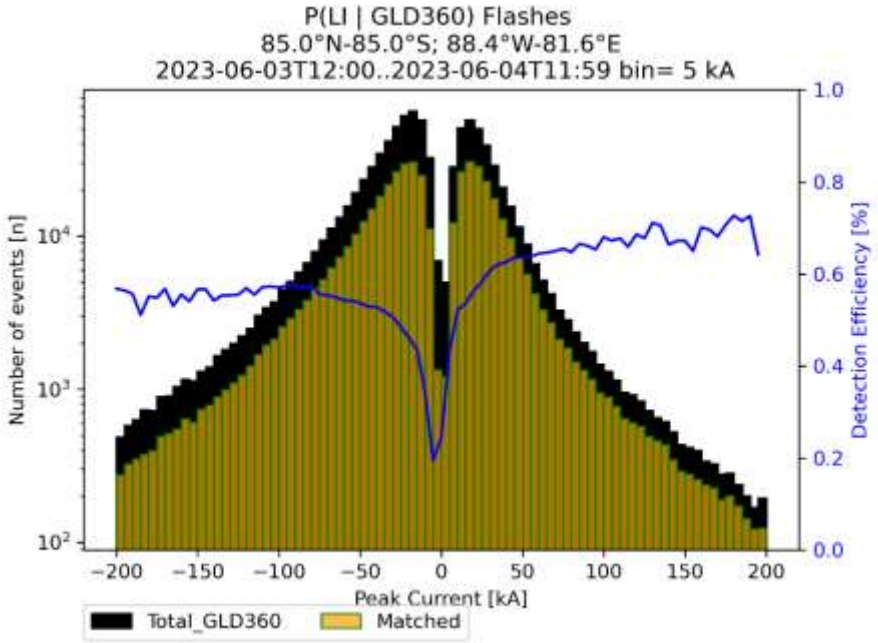
	Level 2 groups			Level 2 flashes		
Geographical area	Africa	Southern Europe	South America	Africa	Southern Europe	South America
N of matches	268305	51084	31565	206749	37222	24294
N of GLD observations	414044	77953	78584	249026	48495	41687
P(LI|GLD360)	0.65	0.66	0.40	0.83	0.77	0.58
W-E location offset (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



Spatial offset of LI Level 2 flashes relative to GLD360 strokes.

LI DE relative to GLD360 – peak current dependency





- Lower DE for strokes with low peak current.
- Highest DE for strokes with high positive peak current.
- This is expected due to the characteristics of positive CG lightning flashes–long horizontal lightning channels near the top of the cloud are often involved.

https://www.weather.gov/source/zhu/ZHU_Training_Page/lightning_stuff/lightning2/positive.html

Conclusions

24h of LI lightning data acquired in low-sensitivity mode have been processed end-to-end and LI experts have assessed lightning detection performances at different processing levels.

a. Level 0 (events to strokes): 60%
b. Level 1b (events to strokes): 57%
c. Level 2 (flash to flash): 73%

The assessment at Level 0 via matching exercise is possible in low-sensitivity mode due to the small amount of false events.

LI relative location offset with respect to GLD360 is of the order to 4-6 km.

Next steps:

- Process data acquired in high-sensitivity mode to assess the impact on end-to-end performances.
- Once the processing stability will be achieved, LI-STAR will perform continuous monitoring.

Thank you!

Questions are welcome.