



**LMLEO**

## **A new lightning mapper in low Earth orbit**

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# What is LMLEO?

- LMLEO is a new lightning mapper designed for Low Earth Orbit
- LMLEO reuses the components of lightning mapper designs intended for GEO, reconfigured into a smaller LEO instrument, greatly reducing non-recurring development expense
  - Same electronics modules. Signal chains tend to have high NRE
- LMLEO weighs < 35 kg, uses < 100 W and < 2 Mbps downlink

## LMLEO Technology Heritage



LMLEO uses mature technologies with low development risk

# LMLEO Science Value Proposition

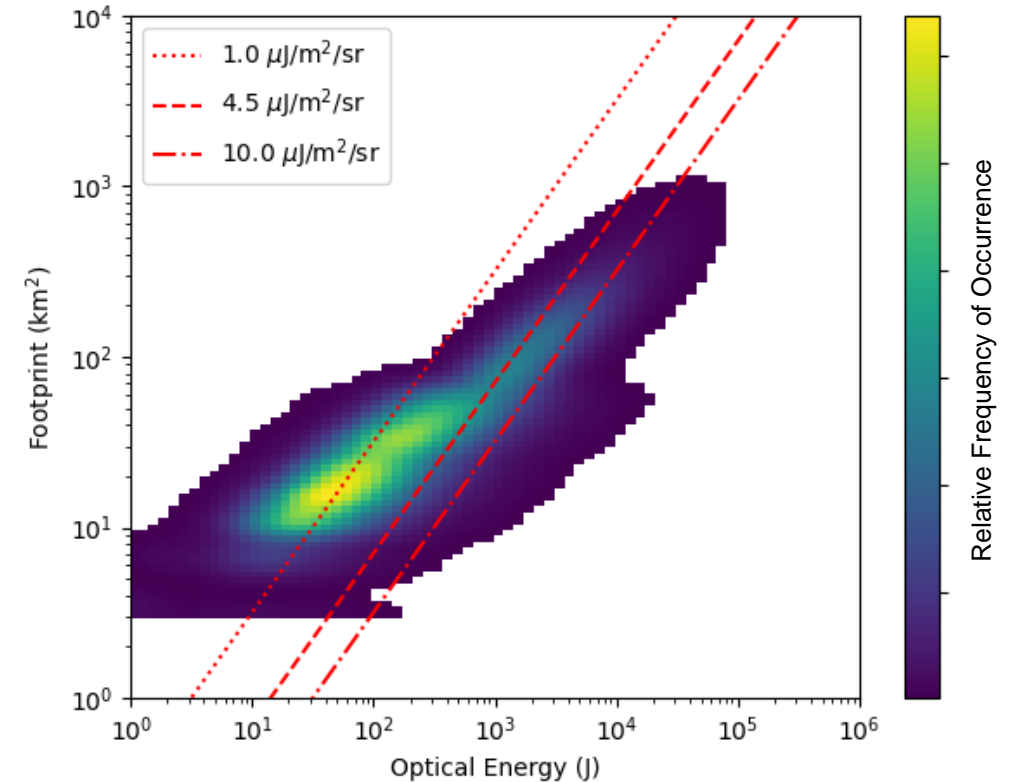
1. **Resume and continue global coverage** for an essential climate data record previously observed by the Lightning Imaging Sensor (LIS, retired 16 November 2023)
2. **Provide accurate cross-calibration** for all the lightning mappers in the GEO ring
  - Measure their sensitivity in detail by seeing what they can't
  - Arrive on orbit ~1 year before GeoXO, to support LMX Calibration / Validation
3. **Enable novel lightning observations** from space by providing unprecedented ground sample distance and sensitivity for an optical lightning mapper
  - Could add 2<sup>nd</sup> spectral channel (337 nm UV) with minor focal plane modifications

There is high value in LEO lightning science

# Lightning Phenomenology

- Being closer in LEO provides an enormous  $1/r^2$  advantage compared to GEO
- LMLEO should encompass yellow area, with target values:
  - Sensitivity  $\sim 1 \mu\text{J}/\text{m}^2/\text{sr}$  (dotted red line)
  - Footprint  $\sim 10 \text{ km}^2$
- This can be done with a  $100^\circ$  fisheye lens scaled from LIS and optimized for modern materials and optical design methods

## Optical Pulse Energy and Size Distribution

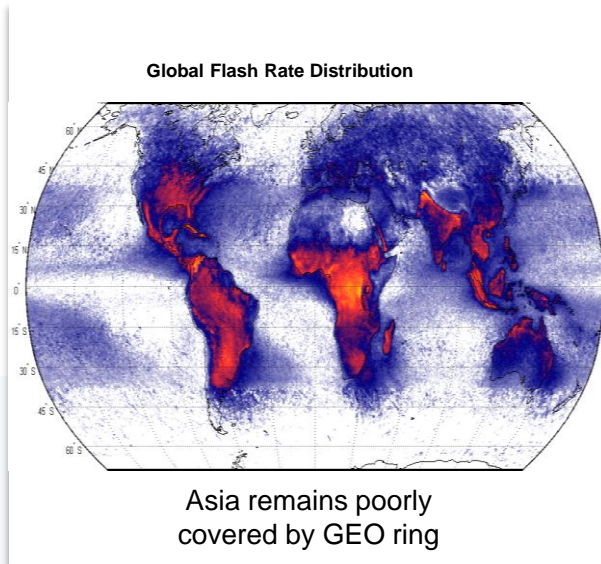


(distribution derived from LIS, FECS and GLM)

LMLEO design parameters target most of the lightning optical pulse distribution

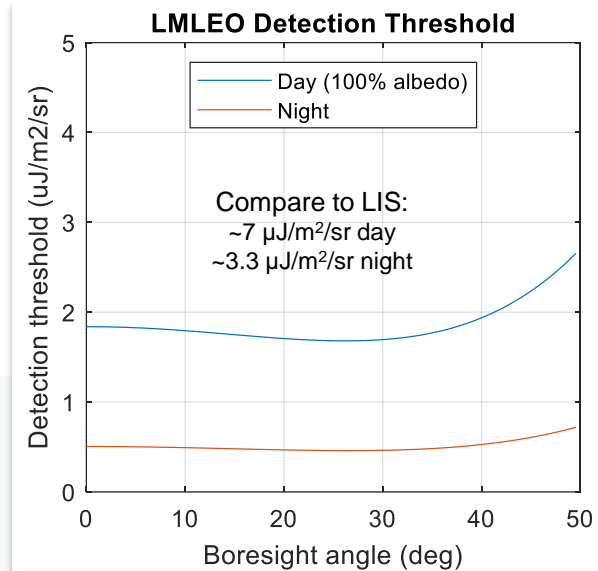
# LMLEO Predicted Performance

## Global Coverage



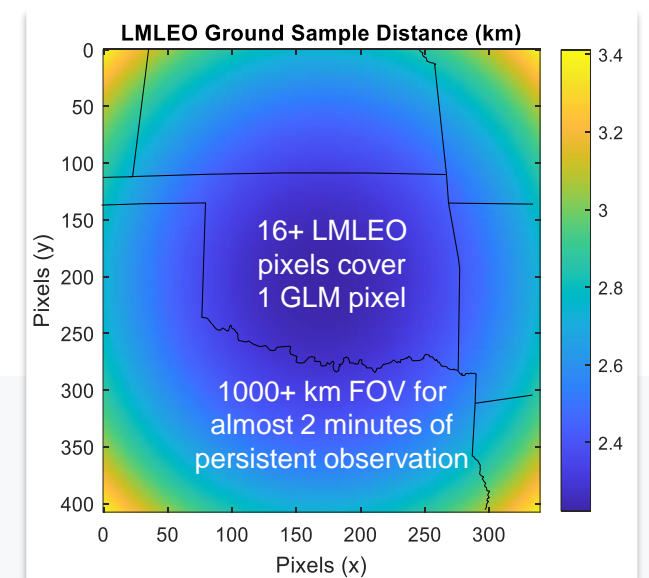
LMLEO measures an essential climate variable globally across seasonal and diurnal cycles, extending the climate data record

## High Sensitivity



LMLEO can observe smaller and dimmer optical sources than any lightning mapper ever flown (3x dimmer than LIS)

## High Spatial Resolution



LMLEO's fisheye optics provide a ground sample distance of 2.2 km at nadir (FOV average 2.6 km, 4x smaller pixel than LIS)

# LMLEO Path Forward

- Maturation of the instrument design in parallel with LMX
  - Funded partially by Lockheed Martin IRAD
- Orbit selection
  - 575 km altitude, 45.4° inclined orbit is affordably accessed by SpaceX Bandwagon ride share
- Investigate teaming possibilities and mission scope
  - Instrument only or full mission?
  - Deliver hardware or deliver data?
  - How best to fund the effort?

We are eager to build a team and support behind LMLEO!

***LOCKHEED MARTIN*** 