

# Airborne Lightning Observatory for FEGS and TGFs Campaign (ALOFT)

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ALOFT instruments:

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Ground Instruments:

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Marni Pazos, Yunjiao Pu, Oscar  
van der Velde, Camilo Velosa



## ***Main scientific objectives of ALOFT***

- *How and under what conditions are Terrestrial Gamma Flashes (TGF) produced?*
- *How extended in space and time are gamma-ray glows?*
  - Are gamma-ray glows and TGFs interrelated?

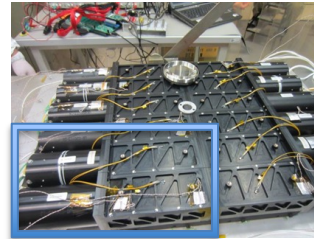
## ***All flights will be devoted to TGF search***

*In addition, ALOFT will (comes for free):*

- Perform International Space Station Lightning Imaging Sensor (ISS LIS) and Geostationary Lightning Mapper (GLM) validation
- Evaluate new design concepts for next-generation spaceborne lightning mappers.
- Make combined microwave and lightning measurements of tropical convection

## UIB-BGO: gamma rays:

- BGO:
  - 225 cm<sup>2</sup>, 300 keV to ~40 MeV, 27 ns
- Three LYSO/SiPM
  - 25 cm<sup>2</sup>, 15 ns
  - 1 cm<sup>2</sup>
  - 0.09 cm<sup>2</sup>

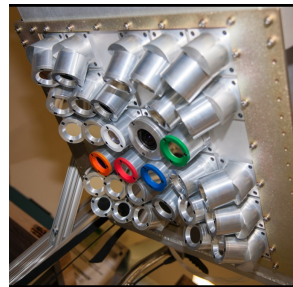
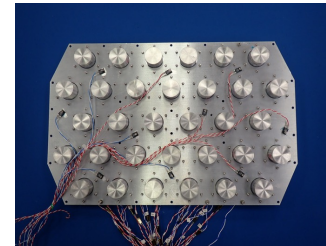


## iSTORM: gamma-rays:

- 32 CeBr: 100 keV – 8 MeV
- High spectral resolution

## Fly's Eye GLM Simulator (FEGS):

- Optical mapper:
  - 777 nm (25 phot), 337 nm, 500 nm, 868 nm, 1600 nm
  - 30 photometers total– 100 kHz
  - HD camera, 400-1000 nm
  - 10x10 km FOV
- Spectrometer:
  - Range: 200-850 nm
  - Resolution: 1.5 nm
  - Rate: 500 spectra/second (2ms integration)



## Electric Field Change Meter

- Fast (10 MHz) and slow (1 MHz)

## Lightning Instrument Package (LIP):

- Three component Electric field,
- 0.1 s resolution

## Cloud Information (radiometers and radars):

Advanced Microwave Precipitation Radiometer (AMPR): 10-85 GHz

Cloud Radar System (CRS): W-band

X-band Radar (EXRAD)

Conically Scanning Sub-millimeter-wave Imaging Radiometer (CoSSIR): 170-684 GHz

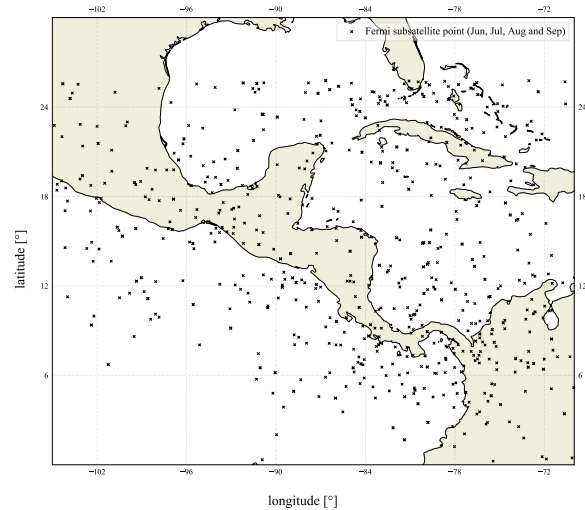
*Poster on ALOFT instruments:*

*Marisaldi: EGU23-9381 (Mon 24.04)*

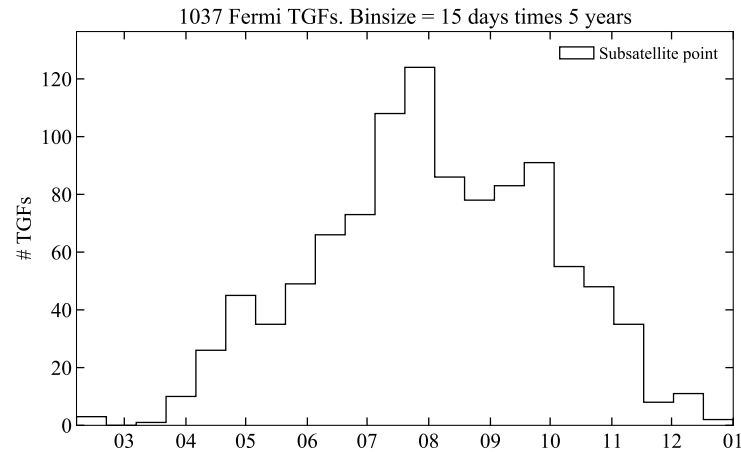
*With QR code to ALOFT web-page*

# ALOFT – where and when

## Where



## When



Observe TGFs in one of the most TGF-intense regions on the planet

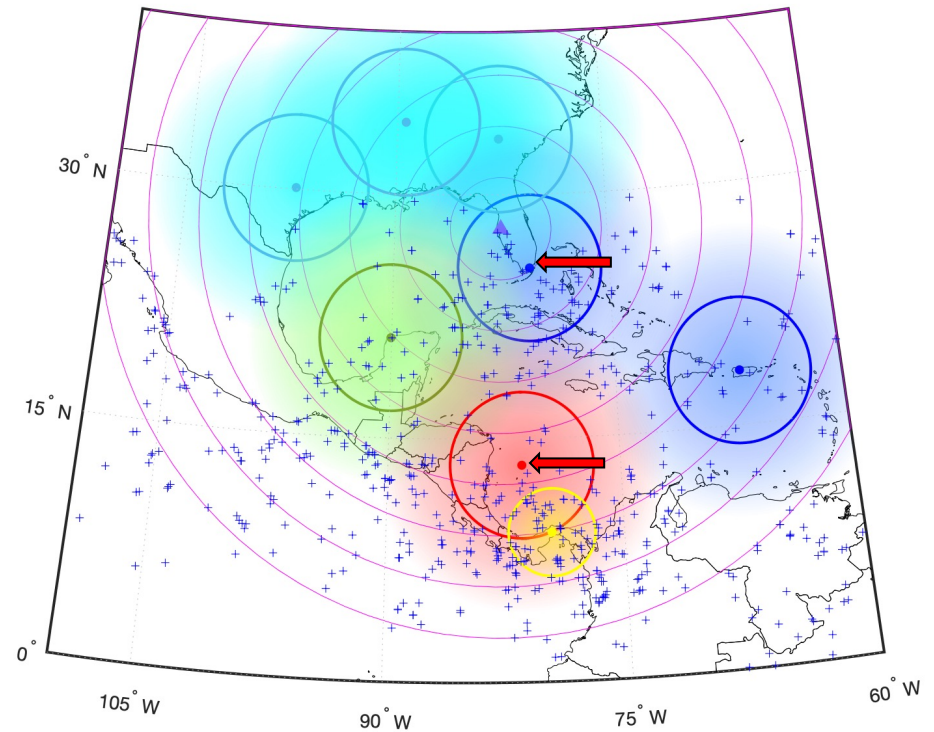
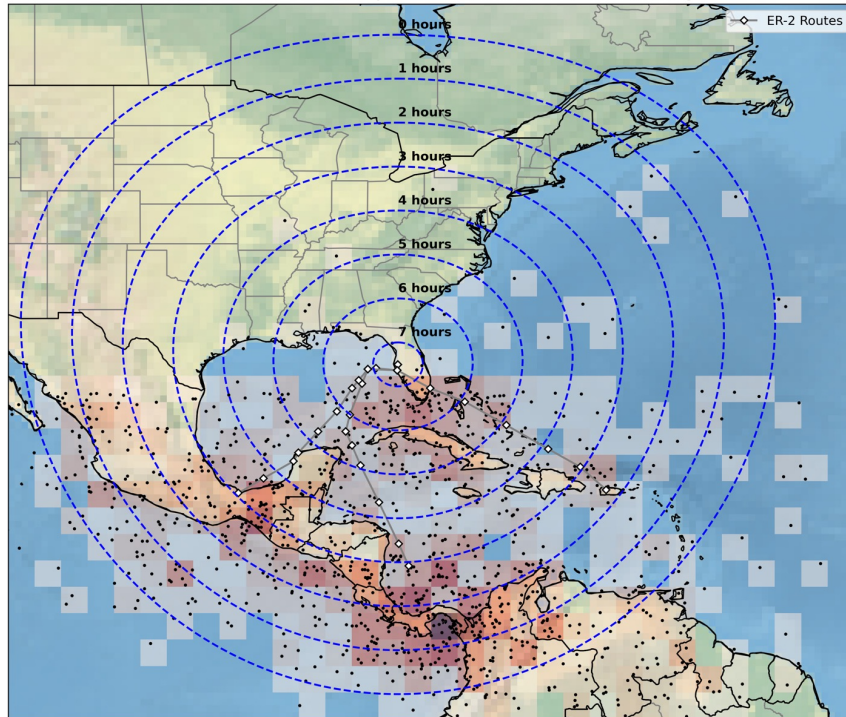
Observe gamma-ray glows in thunderstorms and their relation to TGFs

ER-2 flight planned for July 2023

20 km altitude (signal/background)

60 hours scientific flight

ALOFT Domain - TGF density + ER-2 Hours on Station, MacDill Basing

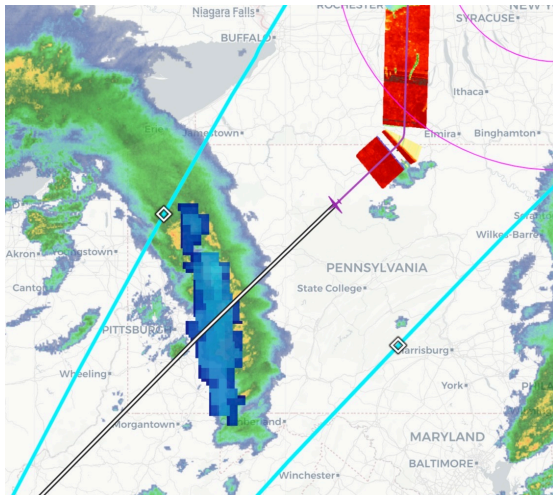


TGF density map  
Flight paths from MacDill, AFB, Tampa, Florida

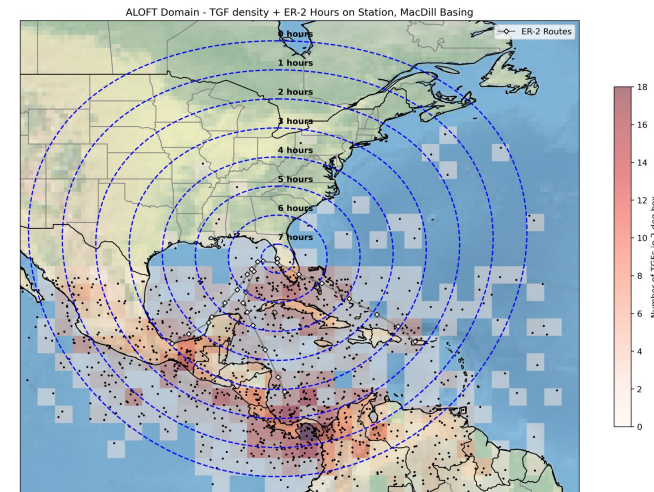
Ground radio sensors:

- LF (large circles)
- Electric field meter network (yellow)
- VHF interferometers (arrows)

# ALOFT flight paths planning - example

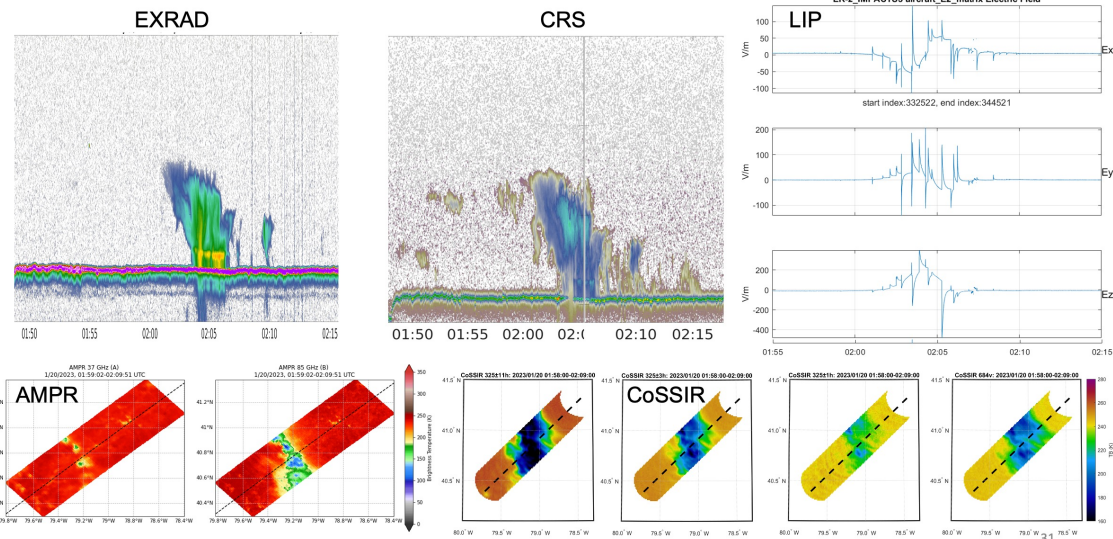


- Forecast team
- GOES:  
GLM (continuous)  
ABI – Vis/IR (5-10 min)



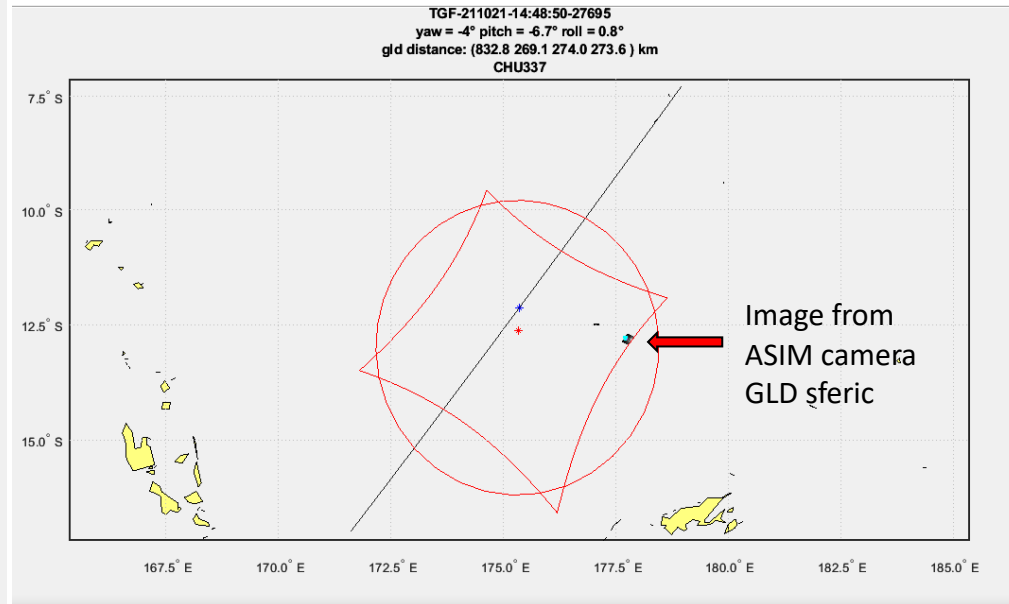
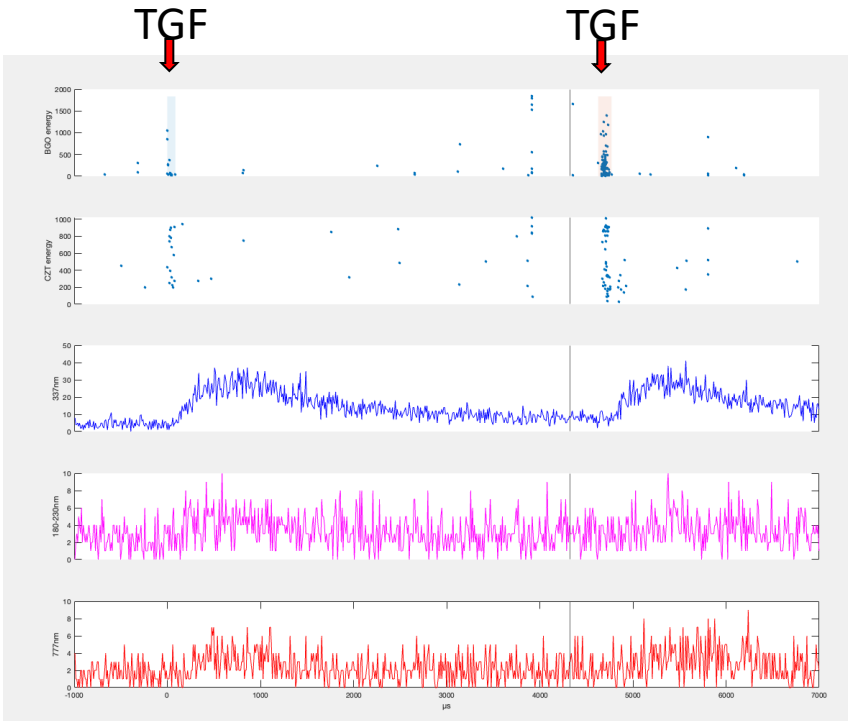
**Important for  
the analysis:**

## Example of Thunderstorm Overflight from IMPACTS



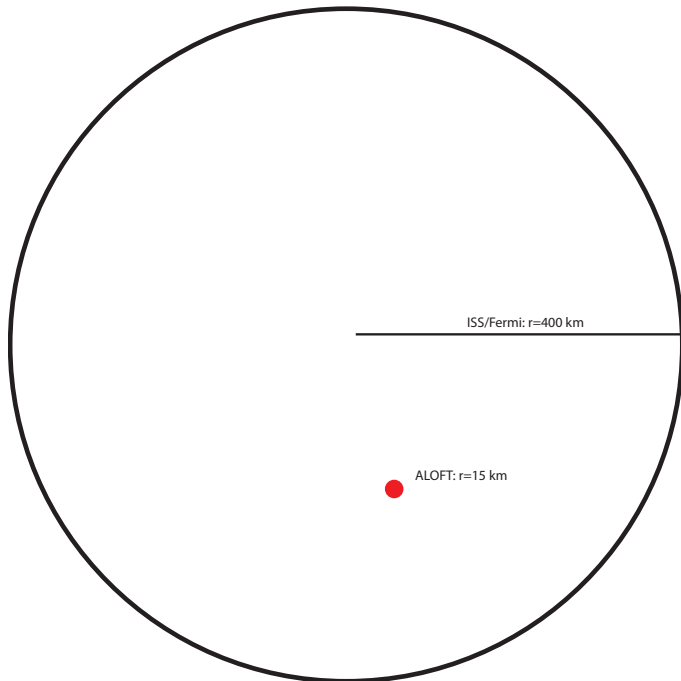
*TGF and optics seen by ASIM - a large scale illustration of what ALOFT will see*

Gamma-rays  
Optical photometers

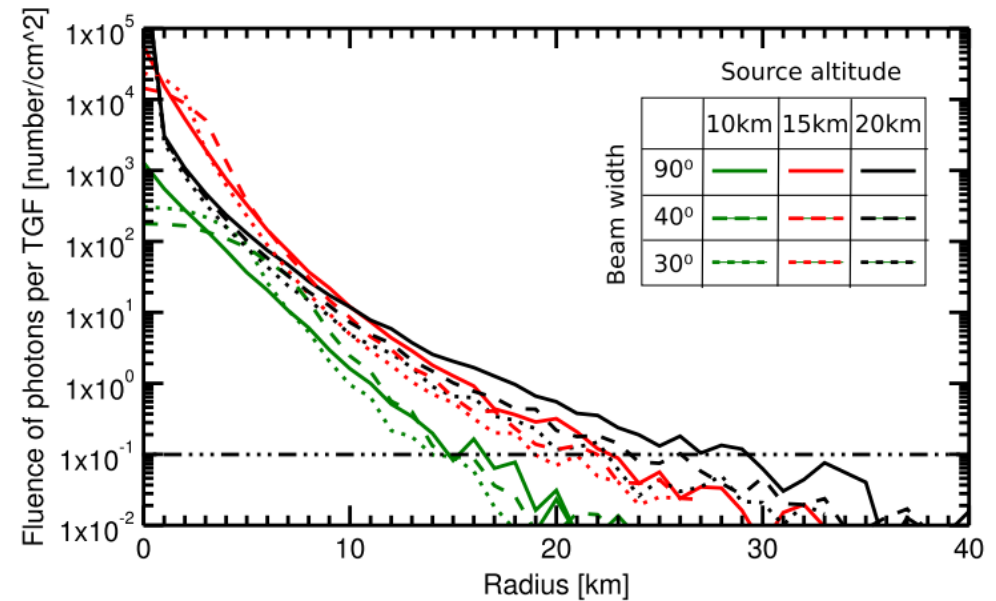


ALOFT will also have electric field measurements, later slide

## ASIM/Fermi FOV versus ALOFT



## The red and green lines



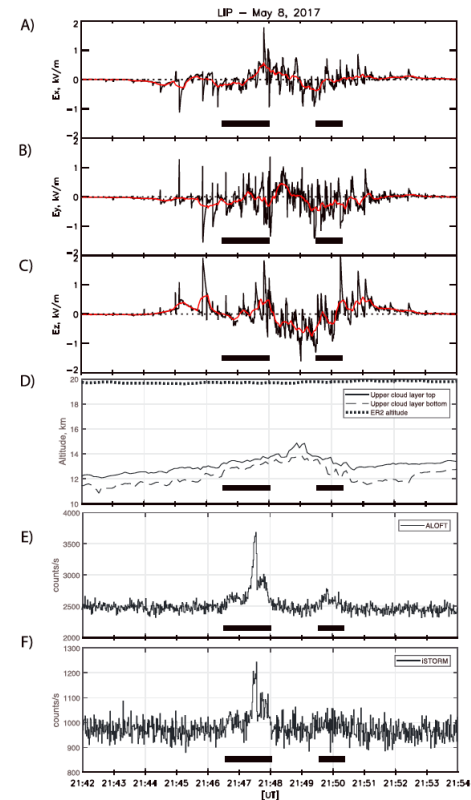
*Hansen et al., JGR, doi: 10.1002/jgra.50143, 2013*

Take home message:

- Be prepared for a wide dynamic range (4 orders of magnitude)
- Overpasses by TGF satellites: unlikely to detect the same event

ALOFT: FOV is small but **signal to noise ratio is huge**





LIP

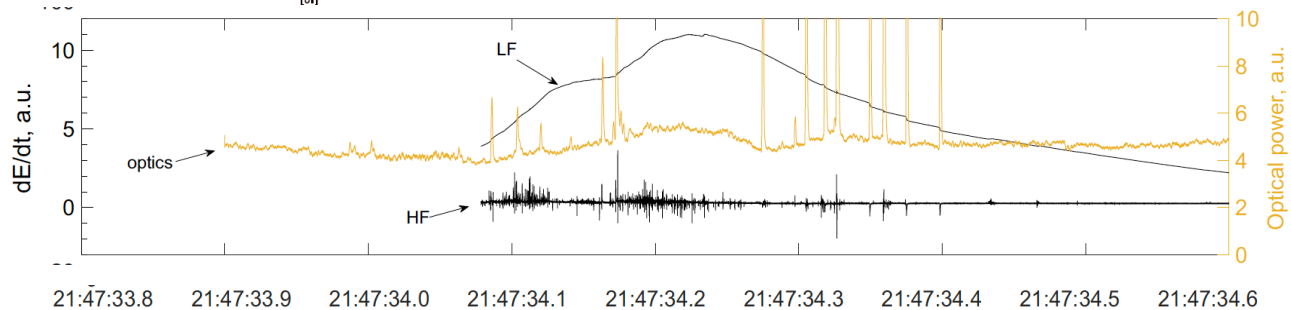
From the ALOFT in 2017  
(GOES-R Cal/Val flight campaign)

«Gamma-ray glow observations at 20 km altitude.»  
Østgaard et al., JGR,  
doi: 10.1029/2019JD030312, 2019

CPL  
Now: CRS

BGO

iSTORM



FEGS and EFCM

**Thank you**