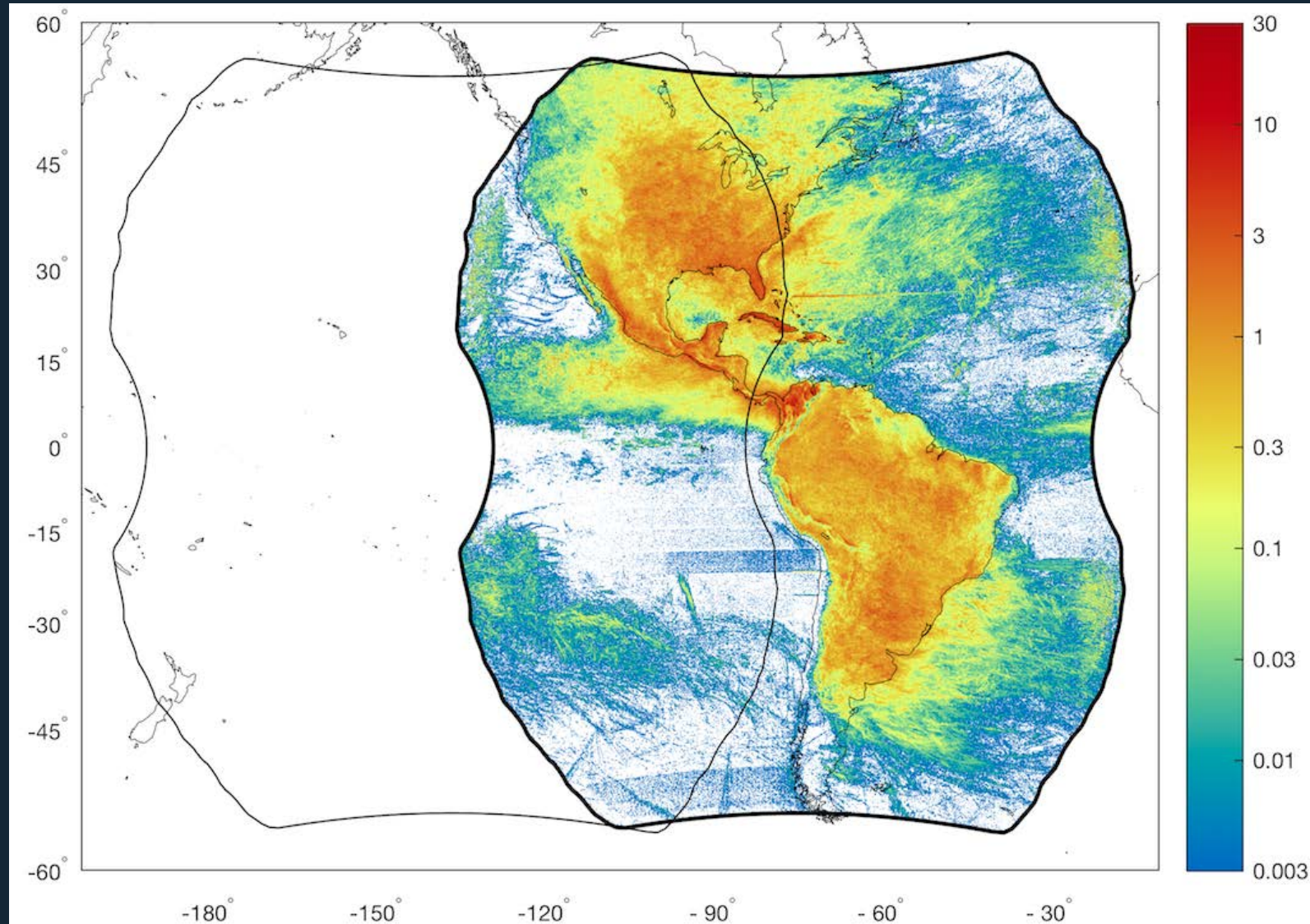


Cross-Referencing GLM and ISS-LIS with Ground-Based Lightning Networks

Katrina S. Virts, Richard J. Blakeslee, and William J. Koshak
NASA/Marshall Space Flight Center

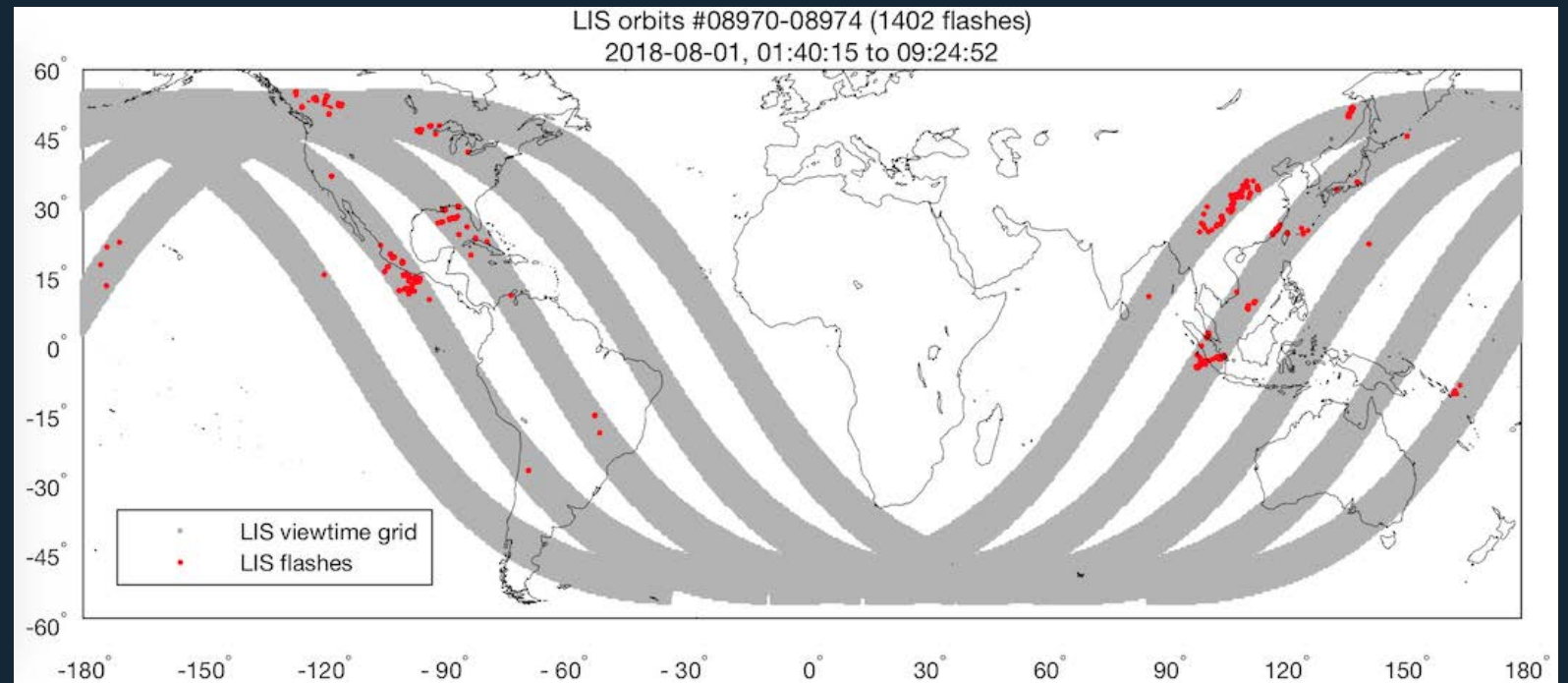
2019 AMS Annual Meeting
8 January 2019

Geostationary Lightning Mapper on GOES-16 and GOES-17



Lightning Imaging Sensor on the International Space Station (ISS-LIS)

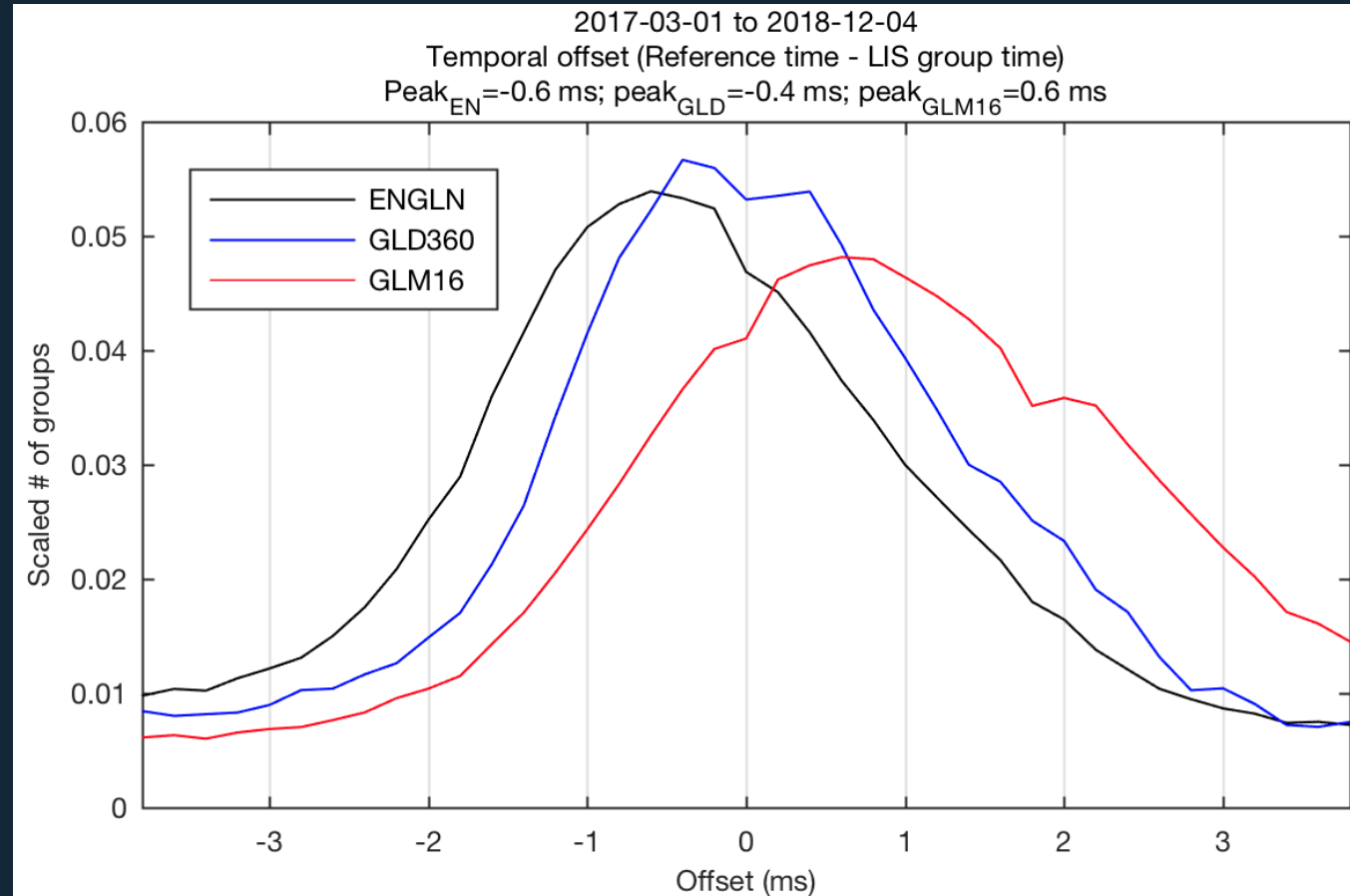
- Launched: 19 February 2017
- Low earth orbit (425 km)
- Field of view: approx. 600 km x 600 km
- Detects lightning to 54° latitude
- Provisional (P0.2) data now available
- L2 cluster filtering → events, groups, flashes



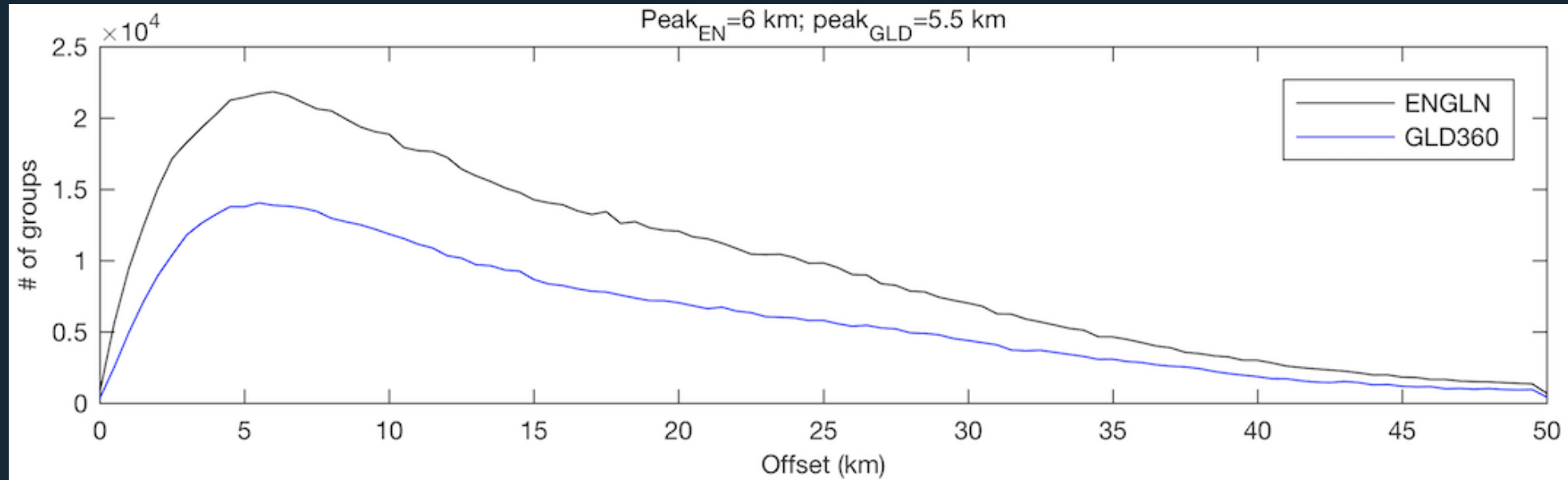
Reference Networks

- Earth Networks Global Lightning Network (ENGLN)
 - LF-HF lightning detection network
 - Total lightning
 - Nominally includes WWLLN strokes
- Vaisala Global Lightning Dataset (GLD360)
 - VLF lightning detection network
 - Primarily ground flash location/time
- Match GLM and LIS data to reference networks using spatial/temporal windows:
 - Flash: 200 ms, 50 km
 - Group: 4 ms, 25 km (LIS) or 50 km (GLM)

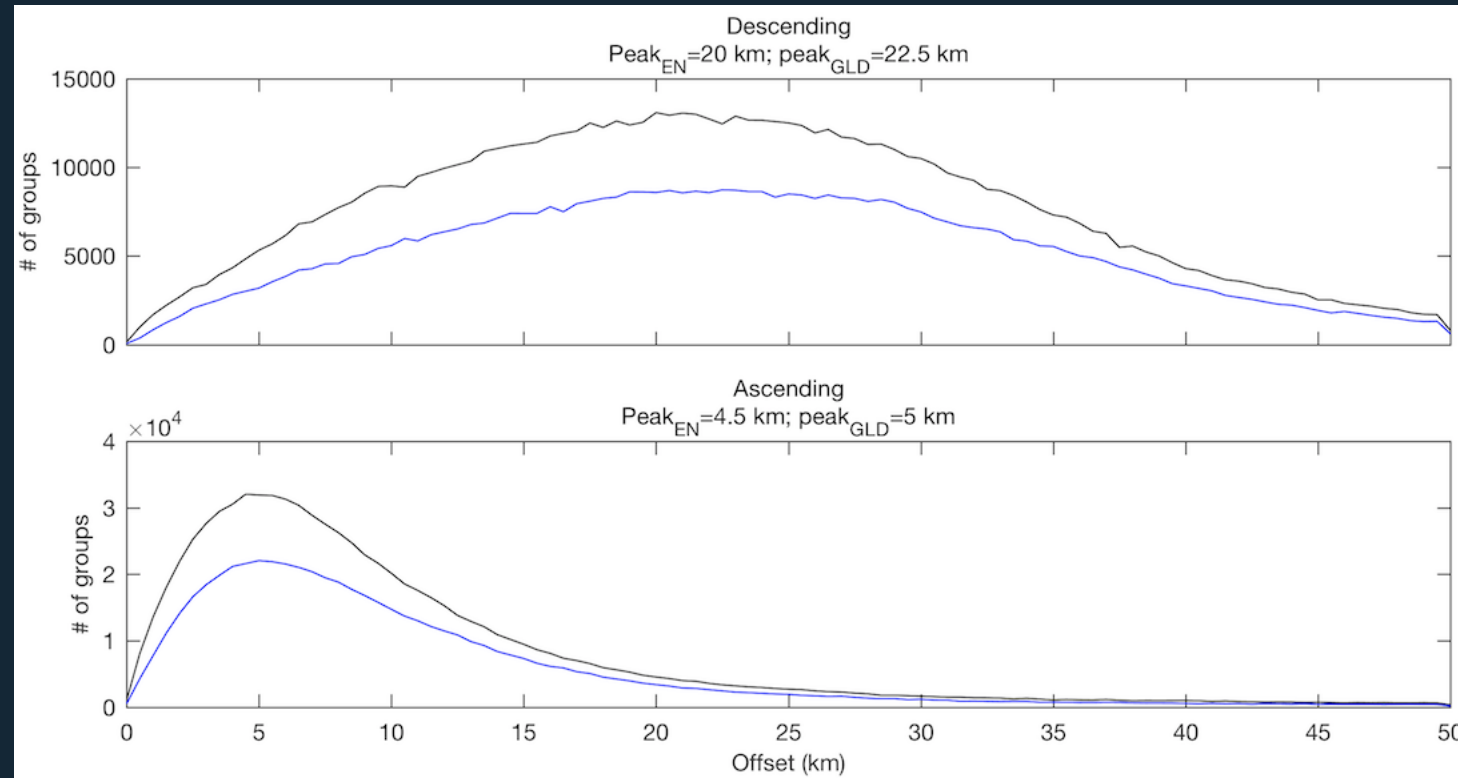
LIS Timing Accuracy



LIS Location Accuracy (this time last year)

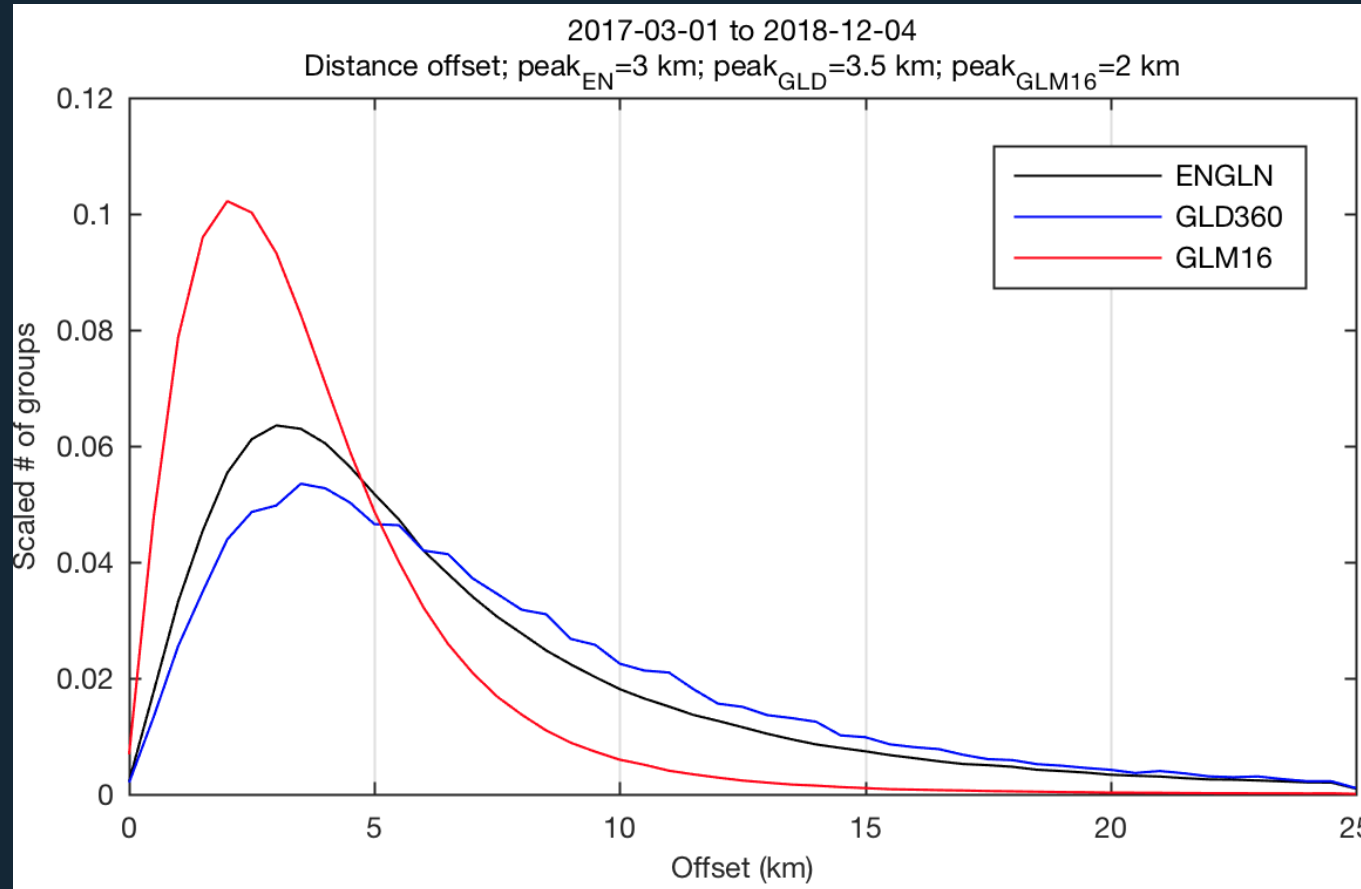


LIS Location Accuracy (this time last year)



- ISS pointing variations throughout its orbit
- Extensive tuning against GLM-16 and ground-based networks

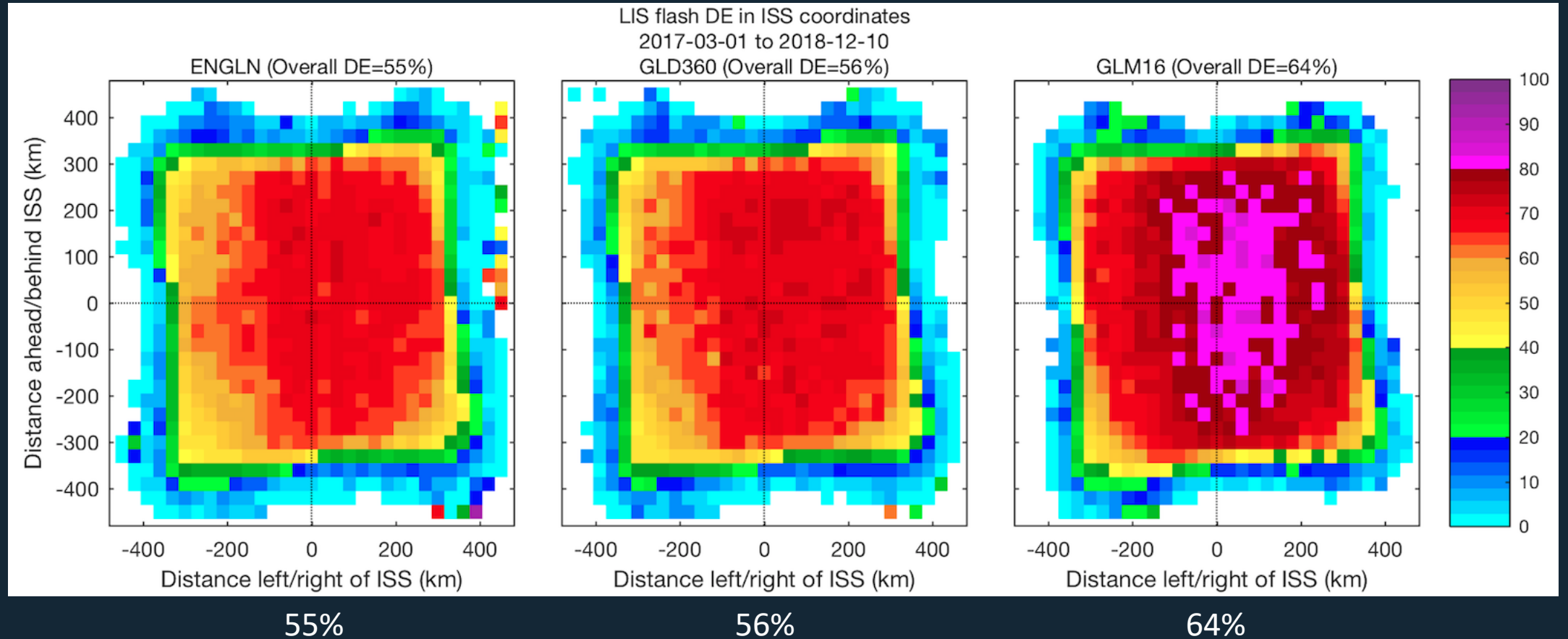
LIS Location Accuracy (now)



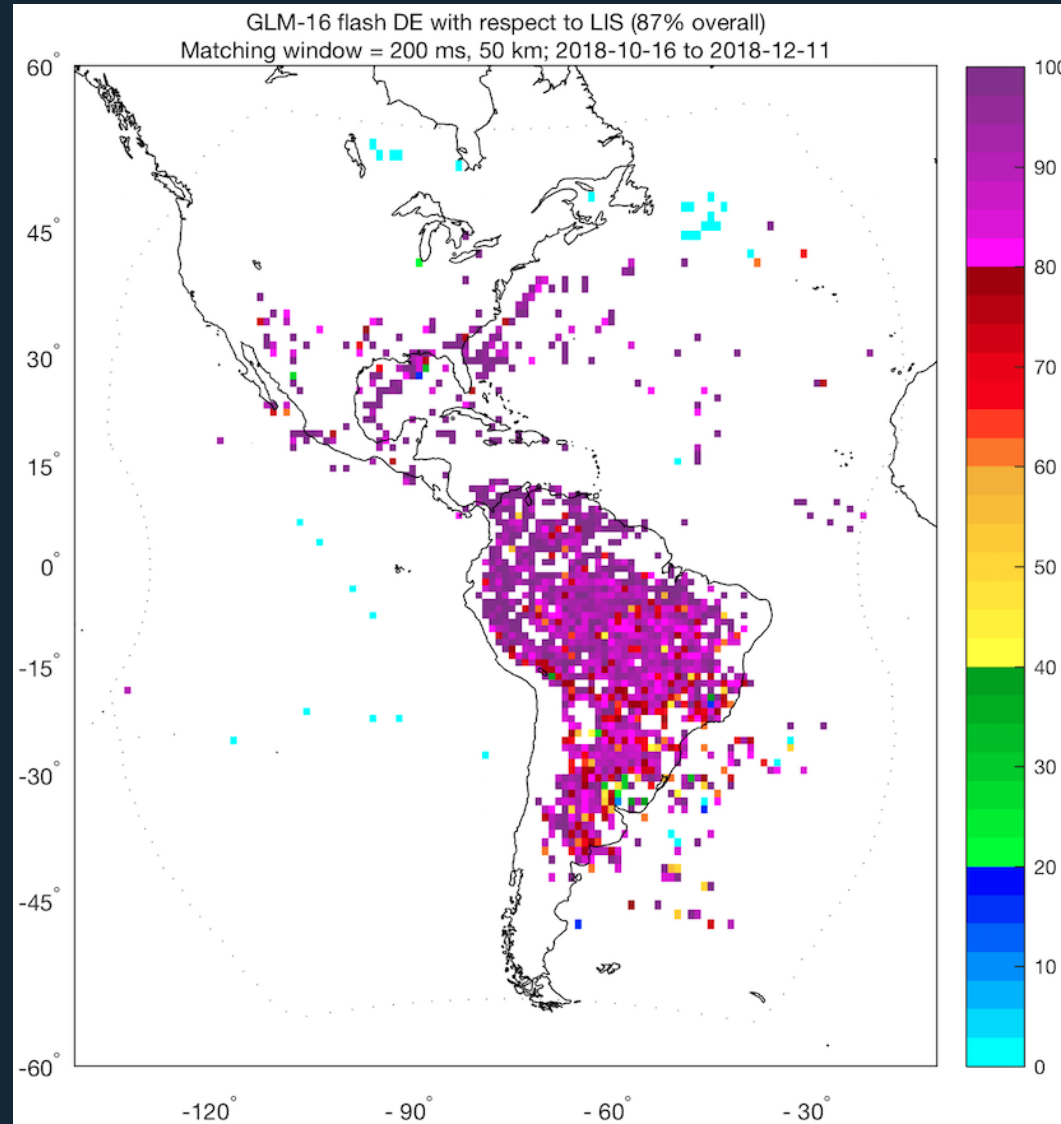
Full ISS-LIS dataset reprocessed as of June 2018 (P0.2)

LIS Flash Detection Efficiency

ISS direction of flight ↑

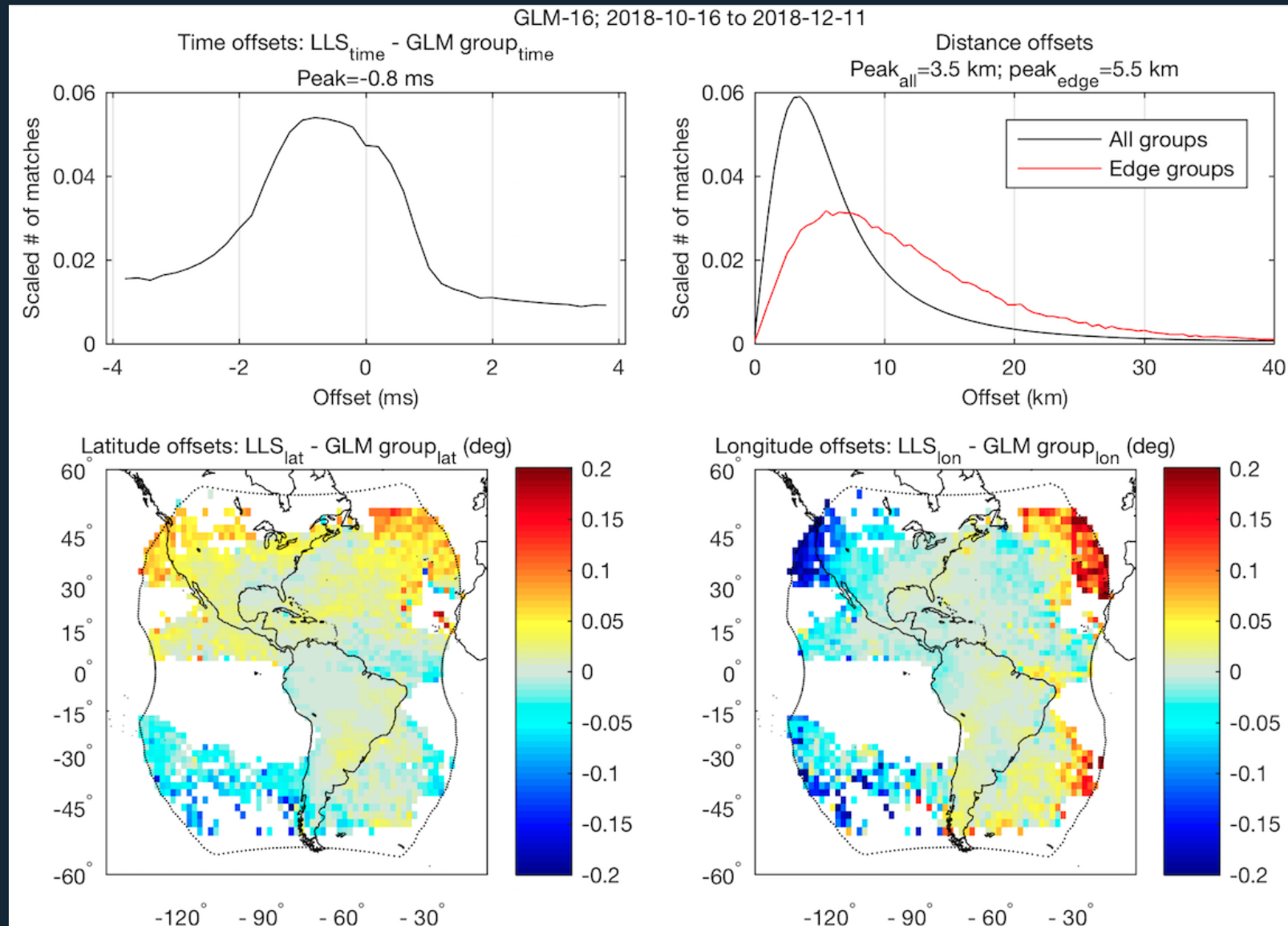


GLM-16 Flash Detection Efficiency w.r.t. ISS-LIS



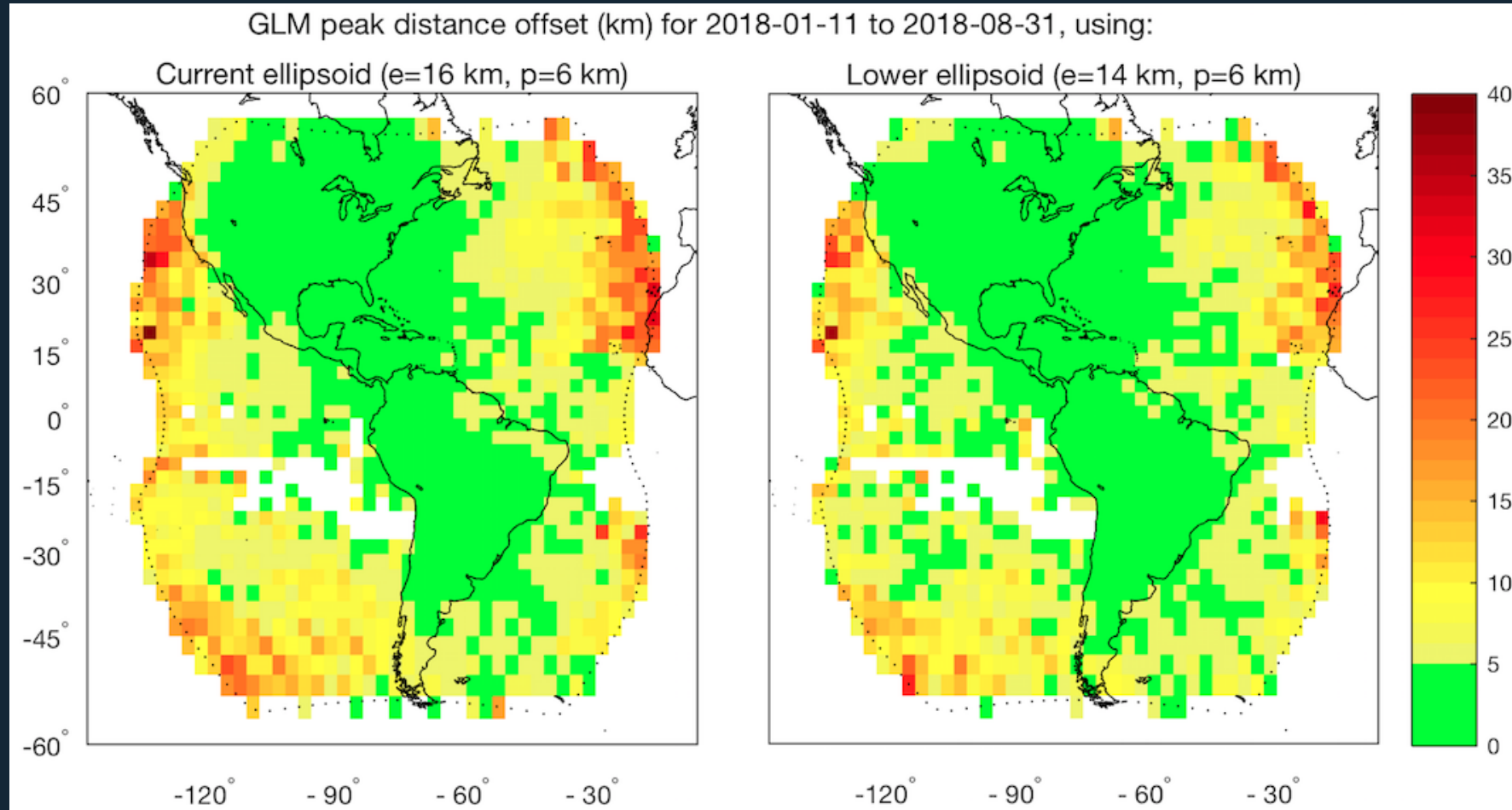
87%

GLM-16 Time/Location Accuracy w.r.t. Ground Networks

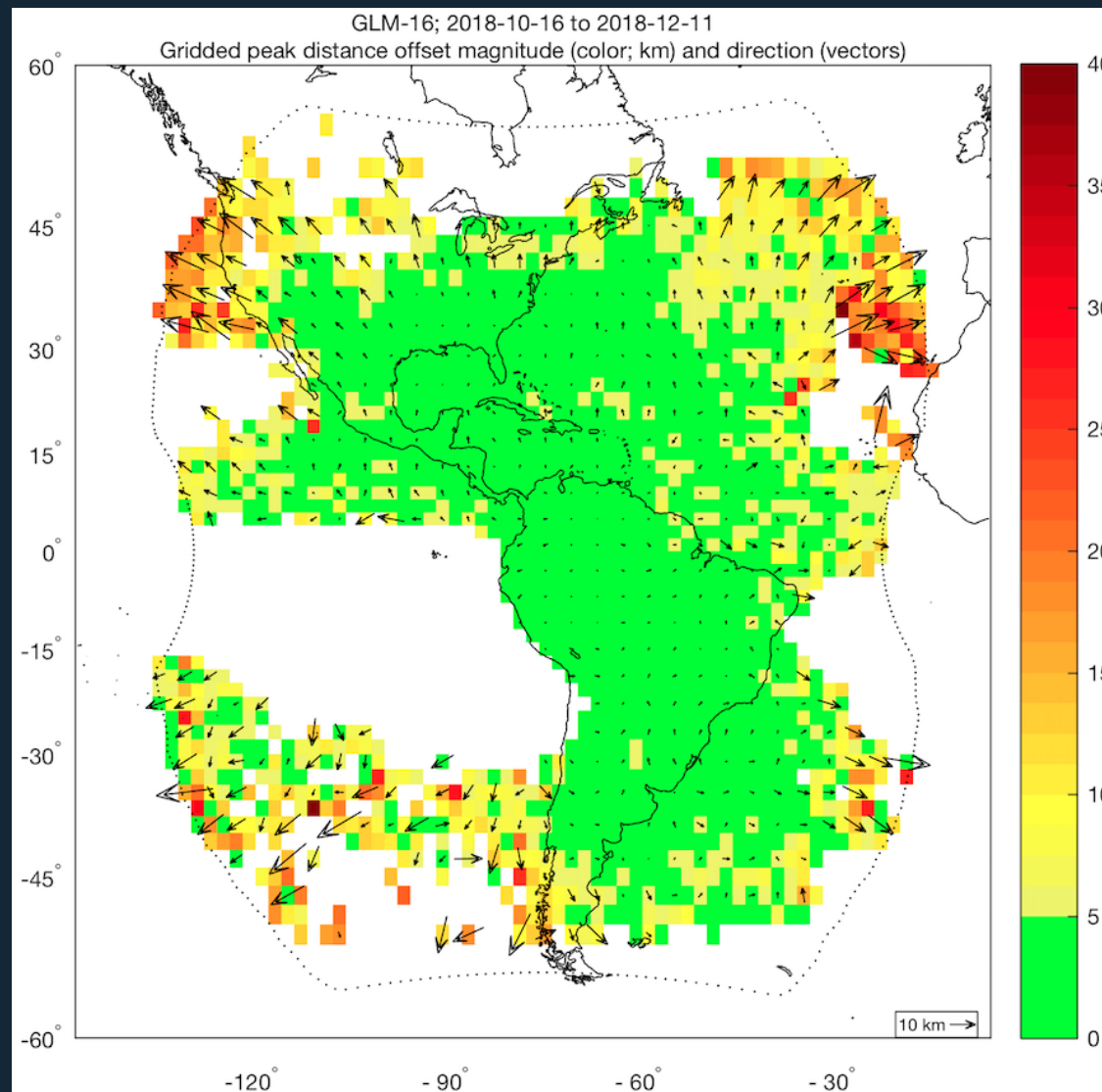


Lower Ellipsoid Improves Location Accuracy

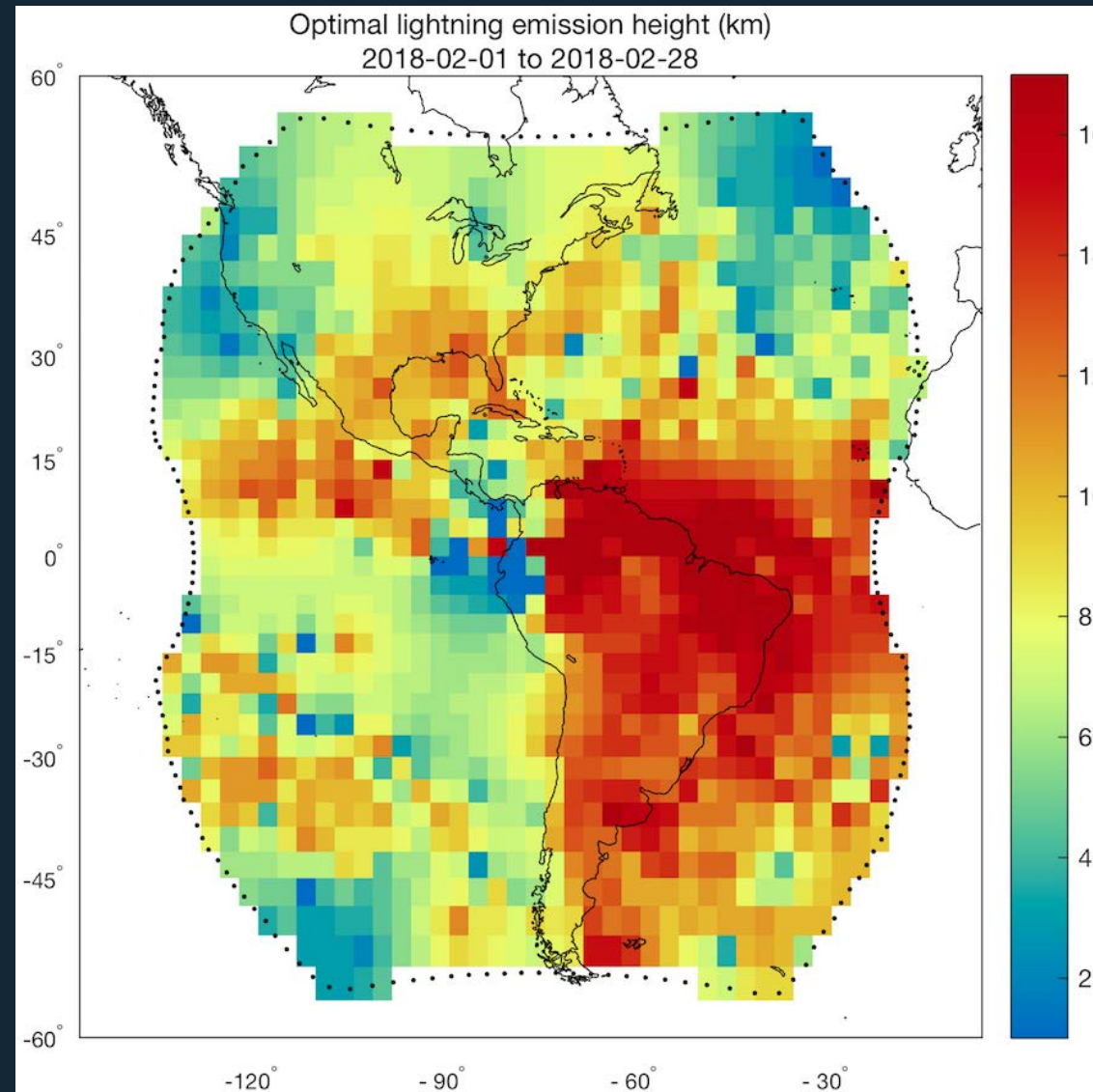
Implemented 15 October 2018 (GLM-16) and
3 December 2018 (GLM-17)



Systematic Inward Shift Near Limb



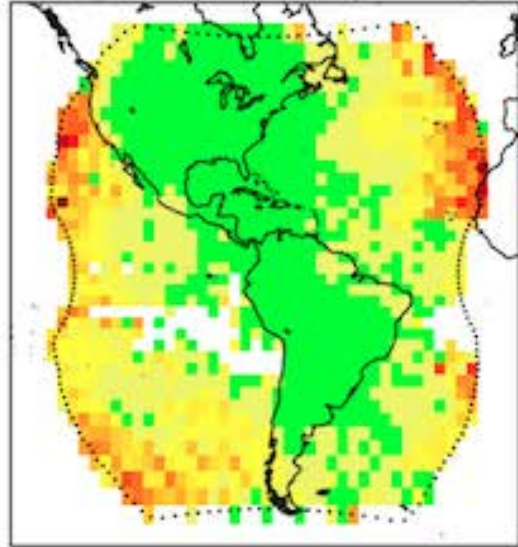
Optimal Lightning Emission Height (February 2018)



Optimal Lightning Emission Height Further Improves Location Accuracy

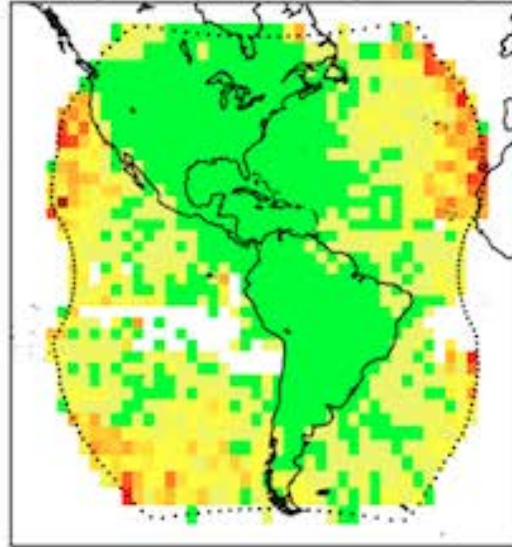
GLM peak distance offset (km) for 2018-01-11 to 2018-08-31, using:

Ellipsoid (e=16 km, p=6 km)



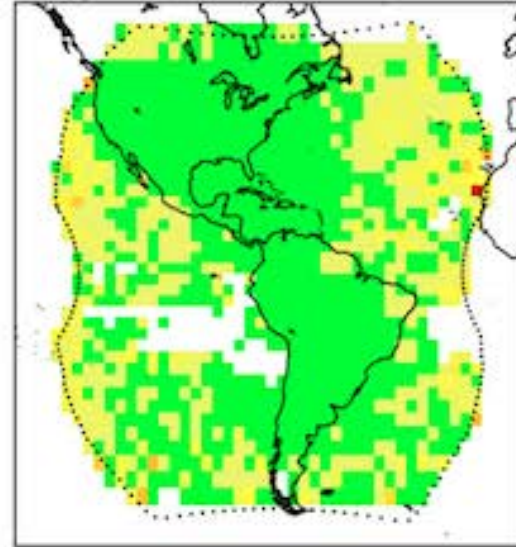
-120° -90° -60° -30°

Ellipsoid (e=14 km, p=6 km)



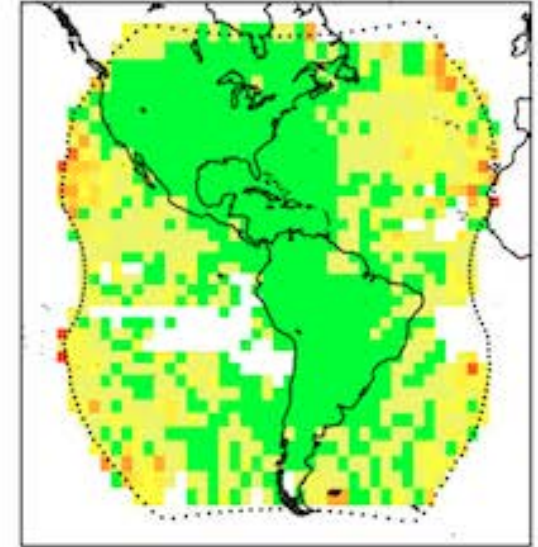
-120° -90° -60° -30°

Optimal h for current month



-120° -90° -60° -30°

Optimal h for month +/-1



-120° -90° -60° -30°



Conclusions

- LIS
 - Tuning has significantly improved location accuracy; now ~2-2.5 km (sub-pixel) with respect to GLM
 - Sub-ms timing accuracy
 - Flash DE ~65% with respect to GLMs, ~55% with respect to ground networks
 - Provisional data available at <https://ghrc.nsstc.nasa.gov/pub/lis/iss/data/science/nqc/>
- GLM-16
 - Peak distance offsets ~3-4 km (sub-pixel)
 - Sub-ms timing accuracy
 - Flash DE >85% with respect to ISS-LIS
 - Lower lightning ellipsoid improves location accuracy, particularly near the limb
 - Application of optimal lightning emission height further improves location accuracy (implementation in ground system TBD)