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NWS Complementary Use of the Geostationary Lightning Mapper (GLM) and Lightning Imaging Sensor (LIS)

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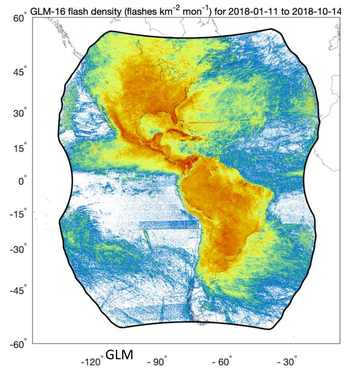
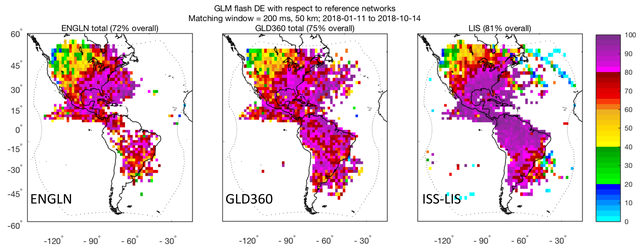
Introduction





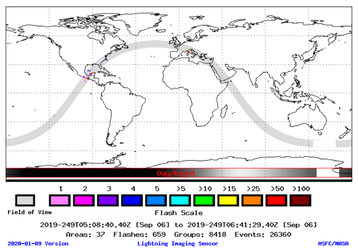
GLM flash density (top) and Detection Efficiency (DE) comparison with three reference data sets (bottom) from ENGLN, GLD360, and ISS-LIS for the period 2018-01-11 to 2018-10-14. Black dots outline the nominal GLM field of view. We find reduced GLM DE in the northwest US at large telescope boresight angle from both GOES-16/17. The ISS-LIS, having a nadir view and higher spatial resolution at nadir, detects lightning not as well observed by GLM.

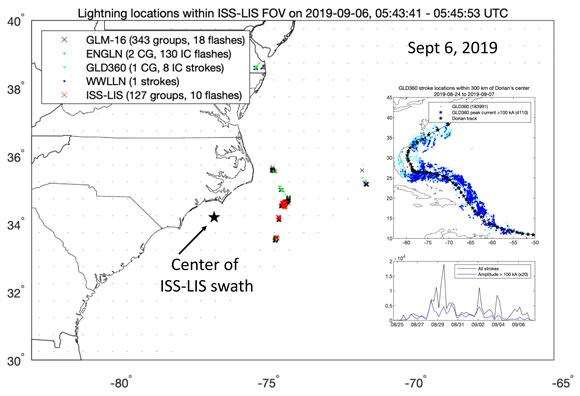
The Lightning Imaging Sensor (LIS) on the International Space Station (ISS) continuously observes the amount, rate, and radiant energy of lightning within its field-of-view (**https://lightning.nsstc.nasa.gov/isslisib/isslisnrt.html**) as it orbits the Earth. The coverage extends to 55 degrees latitude with a latency < 1 min, and thus provides complementary observations towards the edge and outside the field of view of NOAA's GOES-16/17 Geostationary Lightning Mapper (GLM). Such capabilities envision the future of NESDIS best science "Enterprise Algorithms", where multiple sensors, multiple platforms (space, ground) are inputs to a well characterized and validated lightning measurement. GLM products are updated at: **https://vlab.ncep.noaa.gov/web/geostationary-lightning-mapper).**

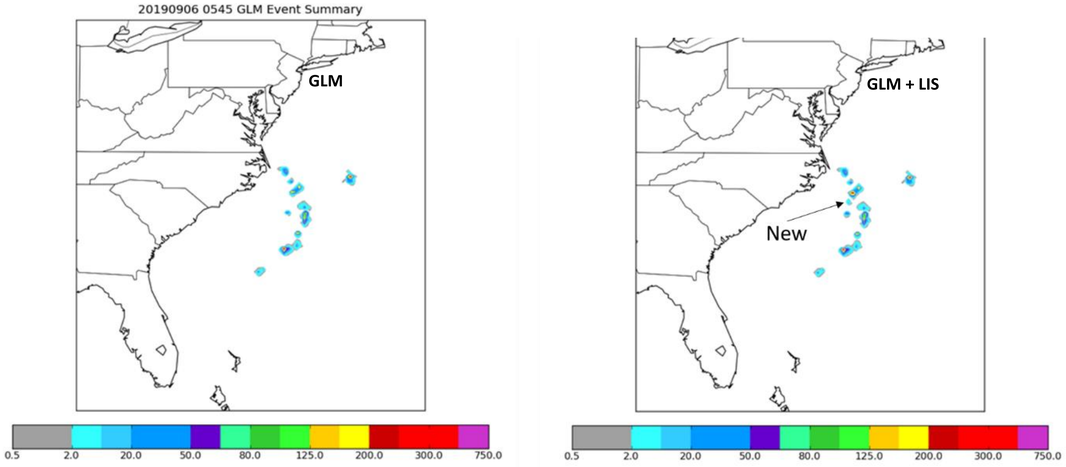
ISS-LIS and GLM provide total lightning observations that will complement lightning data already available to NWS forecasters in AWIPS. One of the unique contributions provided for the first time from LIS is the capability to transmit and disseminate total lightning data in near real-time, especially for operational applications in data sparse regions such as over ocean regions to contribute to storm warnings, nowcasts, oceanic aviation and international Significant Meteorological advisories (SIGMETs).

Oceanic/Offshore Observations

(Below and Right). LIS, GLM, and the ground network group/stroke/flash counts for 2019-09-06, Hurricane Dorian and its Extra-Tropical transition.

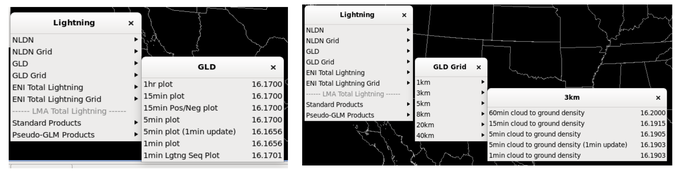






(Left) GLM-only lightning density during the ISS-LIS overpass. (Right) new thunderstorm with lightning density observed by ISS-LIS (storm indicated by arrow in right panel), but not by GLM during the Extra-tropical transition of Dorian as viewed at the NWS Aviation Weather Center. AWC creates Gempak GLM density grid files that can be disseminated to other forecast offices.

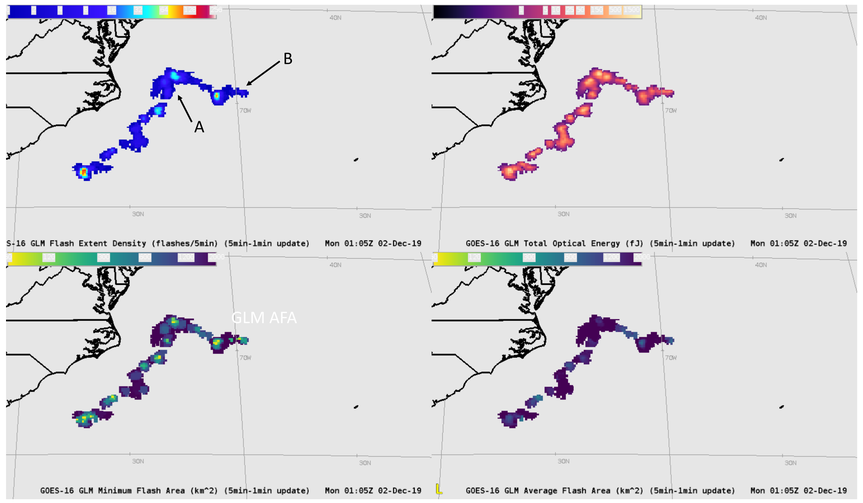
NWS Lightning Products



AWIPS operational lightning product menu (NLDN-Vaisala National Lightning Detection Network), GLD360 – Global Lightning Data from Vaisala, and ENI- Earth Networks Total Lightning. Pseudo-GLM is a GLD360 gridded product resampled to the 8 km x 8 km resolution of the GLM (in preparation for GLM data).

December 1-2, 2019 Nor'Easter responsible for high wind advisories and more than two feet of snow in its wake before it moved out to sea (above) where the OPC is responsible for marine warnings. Previous studies have shown lightning in storms passing over the Gulf Stream can have considerable lightning. GLD360 lightning for this event with 431,535 lightning strokes, 37 of which had very large peak currents >300 kA (Superbolts?) with a max of 475 kA. Such large peak currents are not uncommon in winter and oceanic storms having extensive electrified clouds extending over hundreds of kilometers.

Date	Time	Lat	Lon	Radiant Energy (fJ)	Area (km²)	# Events	# Groups	Duration (s)	kA (GLD)
(A) 2019-12-02	01:03:17.7726	35.6245	-73.1371	531	1.91E+03	37	21	0.3795	-347
(B) 2019-12-02	01:06:11.7616	31.636	-76.985	73	1.98E+02	20	12	0.3461	-407



December 1-2, 2019 Nor'Easter . AWIPS-2 display of candidate GLM Level 3 gridded products. (FED, Upper left) Flash Extent Density. (TOE, Upper right) Total Optical Energy. (MFA, Lower left) Minimum Flash Area. (AFA, Lower right) Average Flash Area. A and B indicate possible Superbolts in the gridded products above. FED indicates where lightning activity is most concentrated (loops indicate trends), TOE indicates flash radiance (GLM analog to kA), and AFA- small values depict compact flashes indicating convective initiation while large values indicate extended flashes observed propagating through stratiform rain during upscale growth of mesoscale convective systems. The combined and complementary information from the satellite mappers and ground-based networks provide a more complete characterization of lightning properties. These GLM products will undergo further evaluation throughout NWS during 2020.

Summary and Conclusions

We present the ISS LIS space-based lightning observations as complementary to GLM and ground-based networks to provide a more complete characterization of lightning activity in near real-time. As ISS LIS detects total lightning (near globally) with high DE, it can therefore fill gaps in the depiction of lightning activity of interest to NWS forecasters over land and ocean areas. At present NWS is developing the capability to integrate the relatively new space-based lightning observations into their AWIPS-2 workstations for operational decision-support.

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