

NOAA ROSES Semi-Annual Report

Reporting Period: September 2020 – February 2021 (1st report)

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Project Title: Downscaling of GLM Lightning Observations Using ISS-LIS Data

Executive Summary

The report summarizes the three components of the project: 1) using the Tropical Rainfall Measuring Mission Lightning Imaging Sensor (TRMM-LIS) data to evaluate the performance characteristics of the International Space Station Lightning Imaging Sensor (ISS-LIS); 2) building GLM and ISS-LIS coincidence datasets and preliminary intercomparison analysis; and 3) using Fly's Eye GLM Simulator (FEGS) data for GLM and ISS-LIS calibration. In the following we provide a summary of the work performed to date for this project, including analysis results, data development, as well as future work.

Progress toward FY20 Milestones and Relevant Findings

1. ISS-LIS Evaluation Study

A detailed characterization and performance evaluation of the ISS-LIS were conducted. The ISS-LIS data from 2017-2019 were used to compare with its counterpart sensor – the historical TRMM-LIS. Probability distribution functions and statistics of the optical lightning signatures including radiance amplitudes (energy density), illuminated cloud-top area, and geometric parameters for events, groups and flashes, and the temporal and spatial characteristics of groups within the flashes for both LIS sensors were examined. Although ISS-LIS is a spare flight model for TRMM-LIS, the individual instrument specifications including pixel resolution, sensitivity, and viewing angle are different. Our main conclusions are that the overall ISS-LIS detection performance is similar to that of TRMM-LIS (i.e. the probability distribution of the optical signatures), though differences remain. This work was presented at the 2020 GLM Science Meeting and 2020 AGU Annual Meeting. A manuscript is in preparation for the Journal of Atmospheric and Oceanic Technology.

2. GLM and ISS-LIS Coincidence Intercomparison

In preparation of the further GLM and ISS-LIS intercomparison, we developed a tool that finds the level-2 coincident ISS-LIS and GLM-16 and -17 groups and conducts the first-step intercomparison including the group products as well as derived parameters such as cloud-top energy. The first version of the coincident ISS-LIS and GLM group-level dataset from 2017-2019 has been created, and will be updated whenever an issue was found. The current version of the group-level dataset is archived on our local server and can be acquired upon request. In addition to the group-level dataset, the coincident ISS-LIS and GLM datasets at the process- (or super-group-) and flash-level are currently under development. Both datasets will be physically more

meaningful and operationally more efficient. All these datasets will eventually be transferred to our GLM public domain once the University of Maryland GLM main websites (which is under development with a collaboration of the University of Maryland iSchool program) are functional. Customers will be able to download all the datasets. Some featured flash animation examples will also be displayed on our GLM website. Some of the results from this work was presented at the 2021 AMS Annual Meeting.

3. FEGS Calibration Study

An extension analysis work from the FEGS observation during the 2017 GOES-R post launch validation flight campaign was performed and contributed to the GeoXO-LMX Systems Working Group discussion on the initial performance parameters of the next generation NOAA lightning imager. Time resolved optical waveforms recorded by FEGS were used to estimate how the optical energy collected by a lightning imager varies as the imager integration period duration is reduced. Additionally, the optical pulse measurements recorded by FEGS were statistically combined with measurements by the TRMM-LIS to produce a lightning optical radiance probability density distribution with unprecedented precision. The distribution can be used to correct the optical radiance distribution functions of GLM and ISS-LIS. This work provided the best estimate possible for the low-end sensitivity specifications of the next generation lighting imager.

Plans for Next Reporting Period

- Finish the ISS-LIS full evaluation study and submit the manuscript
- Finish the analysis of the GLM-LIS cloud-top optical products empirical relationships
- Develop the light source illumination model for GLM and ISS-LIS based on our former model for TRMM-LIS
- Develop the automatic GLM and ISS-LIS coincidence datasets at process- and flash-level
- Update the three levels of coincidence datasets in the netCDF format and transfer them to the University of Maryland GLM website once it is functional