Lightning Observations from the International Space Station (ISS) for Science Research and Operational Applications


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Mission

- Fly a space-qualified, flight-spare LIS on ISS to take advantage of unique capabilities provided by the ISS (e.g., high inclination, real time data).
- Integrate LIS as hosted payload on DoD Space Test Program Houston 5 (STP-H5) mission and launch on Space X rocket in January 2016 for a minimum 2 year mission.
- Well established processing, archival, and distribution systems assure ISS LIS data will be quickly placed into the hands of the science user community.

Measurement

- NASA, the University of Alabama in Huntsville (UAH) and their partners developed and demonstrated effectiveness and value of space-based lightning observations as a remote sensing tool.
- LIS measures total lightning (amount, rate, radiant energy) during both day and night, with storm scale resolution, milliseconds timing, and high, uniform detection efficiency.
- LIS globally detects TOTAL (both cloud and ground) lightning with no land-ocean bias.

Need and Benefit

- Lightning is quantitatively coupled to both thunderstorm and related geophysical processes, and therefore provides important science inputs across a wide range of disciplines (e.g., weather, climate, atmospheric chemistry, lightning physics).
- ISS LIS (or a LIS as Hugh Christian prefers LIS) will extend TRMM time series observations, expand latitudinal coverage, provide real time data to operational users, and enable cross-sensor calibration.

Science and Applications from LIS Lightning

- Lightning is strongly coupled to severe weather hazards (transient luminous events, solar storms, thunderstorms, tornadoes, hail, wild fires) and can improve forecast models.
- Lightning provides critical daytime lightning to better understand mechanisms leading to terrestrial gamma-ray flashes (TGFs) and Transient Luminous Events (TLEs).
- Lightning NOx also impacts ozone, an important greenhouse gas.
- Lightning is strongly coupled in a quantitative way to thunderstorm processes and responds to updraft velocity and atmospheric forcing. ISS LIS will:
  - Extend 16 year time series of TRMM LIS, expand to higher latitudes.
  - Monitor the occurrence and changes in extreme storms.
  - Provide much desired cross-sensor calibrations between platforms.

Chemistry: ISS LIS will help improve estimates of lightning produced NOx for climate and air quality studies.

Other: Complementary ISS LIS observations will help unravel the mechanisms leading to terrestrial gamma-ray flashes (TGFs) and Transient Luminous Events (TLEs).

Unique Science Contributions from ISS Platform

- Lightning coverage at higher latitude missed by TRMM
  - TRMM LIS missed up to 30% lightning in NH Hemisphere summer
  - Enhance regional and global weather, climate, and chemistry studies
  - Provide CONUS coverage (needed for National Climate Assessment)

- Real time lightning using ISS for operational applications
  - Provide real time lightning in data sparse regions, especially oceans
  - Lightning can improve convective precipitation estimates.
  - Lightning NOx also impacts ozone, an important greenhouse gas.

- Enable simultaneous / complementary observations with other ISS and other ISS payloads
  - Provide critical daytime lightning to better understand mechanisms leading to TGFs and TLES

- Support cross-sensor calibration and validation activities
  - Inter-calibrate ISS LIS, TRMM LIS, GOES-R GLM and MTG LI for improved science and applications

Summary

- There exist several core science applications of LIS lightning observations, that range from weather and climate to atmospheric chemistry and lightning physics due to strong quantitative connections that can be made between lightning and other geophysical processes of interest.
- The space-base vantage point, such as provided by ISS LIS, still remains an ideal location to obtain total lightning observations on a global basis.