Science and Applications from LIS Lightning

**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.

**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 LIS as Hugh Christian prefers) 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**

**LIS Flight Heritage**

- Optical Transmitter Detector
  - Launched: April 1997
  - Data: May 3951 - April 2000
  - Orbit: 170 x 1715 km (inclination = 75°)
  - End of life: 2001

- LIS Lightning and Background Images
  - Super Storm Sandy October 28, 2012

**LIS Integration as Hosted Payload on STP-H5**

- LIS is one of thirteen instruments on the STP-H5 payload manifest.
- LIS will be installed on ISS in an Earth viewing (nadir) position.
- Payload built to allow robotic installation on ISS.

**LIS Launch, Installation and Operation on ISS**

- Launch on a Space X rocket with Dragon cargo vehicle in January 2016.
- Robotically installed on an external truss (ELC-1) in position shown.
- Operated for 2 years, but will seek mission extension from NASA.

**LIS Performance Parameters**

**LIS in Calibration**

- Field of View: 1250 x 1250 km
- Data: May 1995 - April 2000
- Launched: April 1995

**LIS Hardware (Heritage and New)**

- **Sensor Unit**
  - Optical Assembly
  - 128x128 CCD Focal Plane
  - Lightning and Background detection

- **Electronics Unit**
  - Real Time Event Processor and Background removal
  - Control & Data Handling (C&DH)
  - Power conversion and control

- **Interface Unit**
  - Power conversion
  - 1 PPS Time Signal
  - C&DH Formatting
  - ISS Interface

**LIS Launch**

- 1997 Launch
- TRMM time series observations: 1997 - 2000

**LIS Hardware**

- **(heritage)**
  - Imaging
  - 4 x 4 cm
  - Spatial resolution: 1 km at nadir
  - Angular resolution: 3°

- **(new)**
  - Imaging
  - 8 x 8 cm
  - Spatial resolution: 1 km at nadir
  - Angular resolution: 1°

**Unique Science Contributions from ISS Platform**

- **Lightning coverage at higher latitude missed by TRMM**
  - TRMM LIS missed up to 30° in Hemisphere summer
  - 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
  - Temporal, spatial, energetic and intercalibration (idding)
  - Lightning system validation, hurricane rapid intensification (volcanic eruptions)
  - Desired by NASA and strongly endorsed by NOAA partners

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

**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-borne vantage point, such as provided by ISS LIS, still remains an ideal location to obtain total lightning observations on a global basis.

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