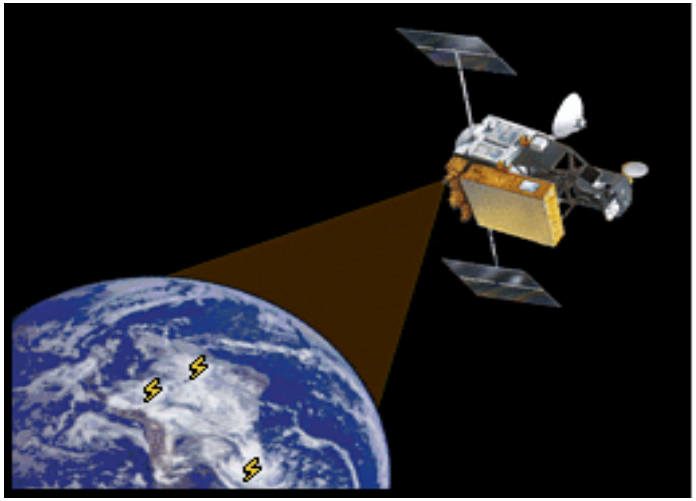
INDICATORS DERIVED FROM TRMM/LIS SATELLITE LIGHTNING OBSERVATIONS



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PROJECT OBJECTIVES

1. Apply LIS to Get Entire Picture:

➢ Lightning observations from the Tropical Rainfall Measuring Mission (TRMM) satellite Lightning Imaging Sensor (LIS) will be used to obtain important lightning-based indicators for the National Climate Assessment (NCA).

➢ Complement and expand upon a NCA effort already in progress by the PI (Koshak) that employs national ground-based lightning data to track various characteristics of cloud-to-ground (CG) lightning, and its impacts. LIS detects CG & cloud flashes.

➢ Provide a more comprehensive assessment of the co-evolution of global temperature, lightning, and adverse lightning-caused impacts on the US. [According to a conservative estimate in the literature, a 40 ± 14 % increase in total lightning is anticipated per 1^{o}C average land wet-bulb temperature change.]

2. Combine Lightning/Rainfall: Increasing global temperatures have the potential to produce not only more thunderstorms, but more intense thunderstorms (floods, hail, tornadoes). Conversely, lightning with little rain can produce wildfires. So, we will look at indicators involving lightning & rainfall amount (derived from national radar mosaic).

3. Monitor Regional LNOx Changes: Lightning nitrogen oxides (LNOx) influences climate since it controls [O_3] and [OH], and since it is the most important source of nitrogen oxides in the upper troposphere. So, we will trend LNOx using the NASA/MSFC Lightning Nitrogen Oxides Model (LNOM) and we will examine LIS flash area/brightness data (which are proportional to LNOx).

INDICATORS

1. Lightning Frequency Indicator:

$$\mathrm{LFI} = N$$

$N =$ Number of flashes in a region/period

2. Lightning NOx Indicator:

$$\mathrm{LNI} = \sum_{i=1}^{N} A_i B_i$$

$A_i = i^{th}$ flash optical area

$B_i = i^{th}$ flash optical brightness

3. Intense Convection Indicator:

$$\mathrm{ICI} = MR$$

$M =$ Number of CG strokes (from NLDN data).

$R =$ Rainfall (in mm)

4. Dry Lightning Indicator:

$$\mathrm{DLI} = \begin{cases} M/R\ , & R \le R_o \\ 0, & R > R_o \end{cases}$$