Space Weather Impacts on VIIRS Instrument: A hypothesis on VIIRS Sync-loss Occurrence

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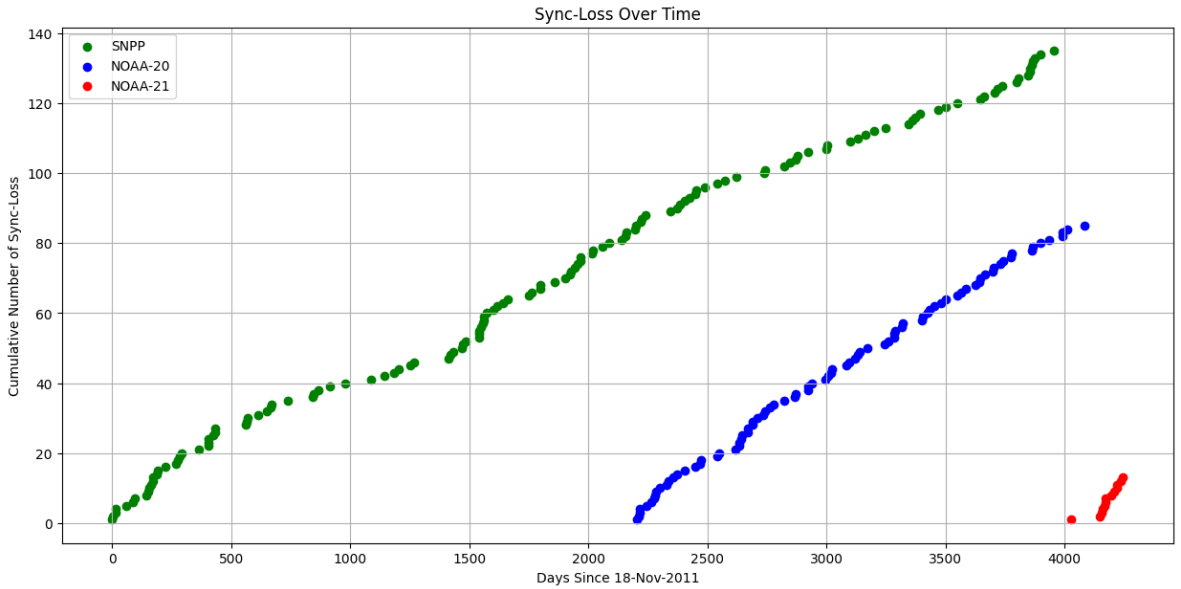
Background

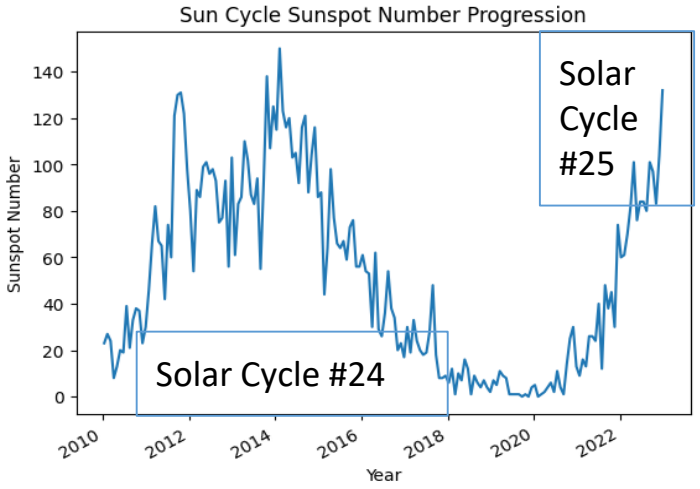
- During geomagnetic storms, energetic electrons originating from the solar wind or the Earth's magnetic tail can be precipitated along the magnetic field lines into the Earth's polar region
- When conditions are right, these energetic electrons can charge spacecraft surfaces, build up electric potentials, cause Electrostatic Discharges (ESD), and sensor anomaly
- VIIRS on SNPP and NOAA-20/21 all experienced sync-loss

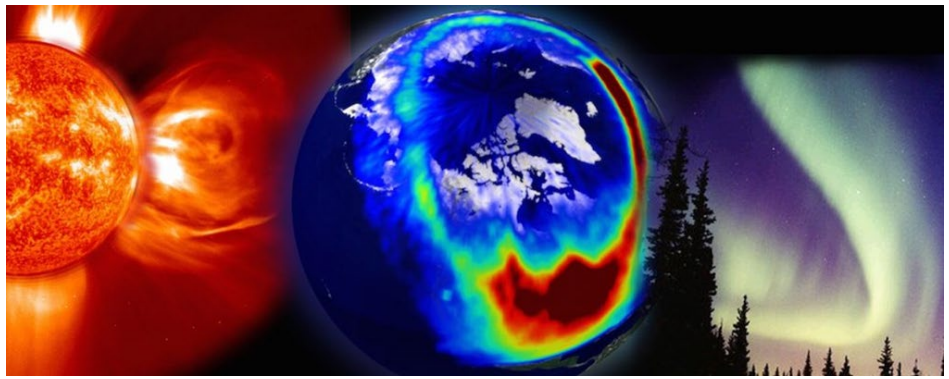
What I Learned

- ESD can cause phantom commands, synchronization losses, and loss of data
- We are entering the maximum of the 25th solar cycle so the increased intensity of geomagnetic storms will likely affect the occurrence of sync-losses for NOAA-21 VIIRS.

VIIRS Sync-Loss







Analysis of SNPP/NOAA-20/NOAA-21 Sync-Loss Occurrences

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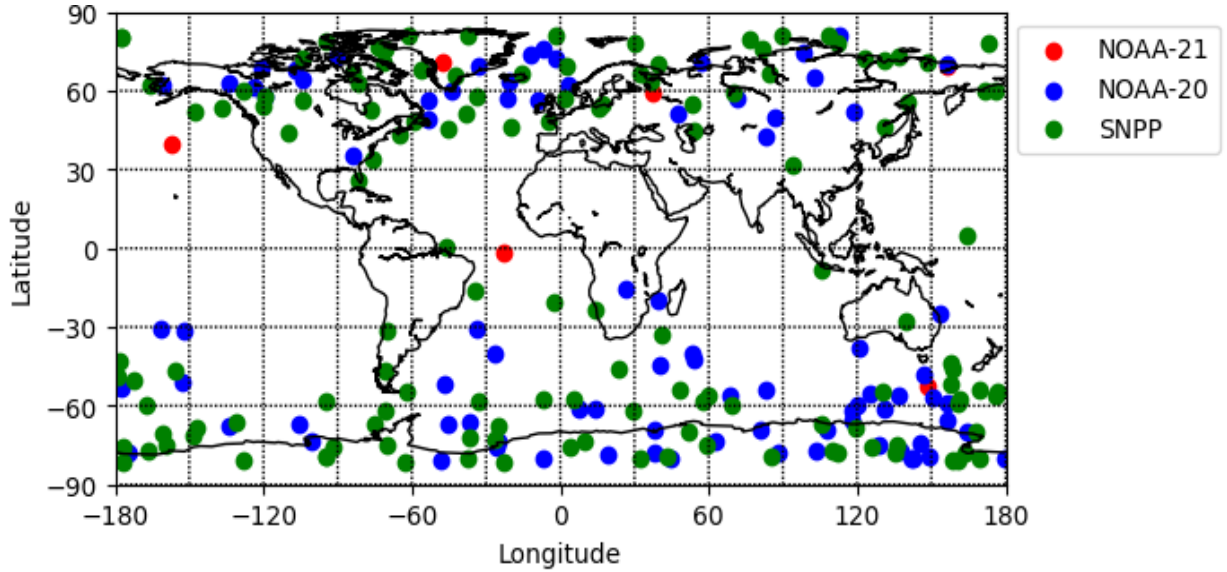
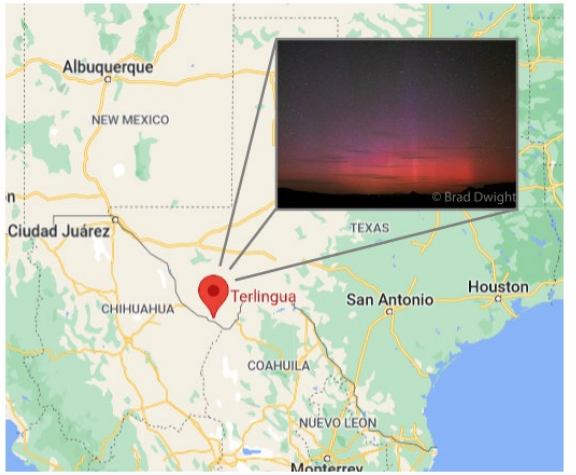
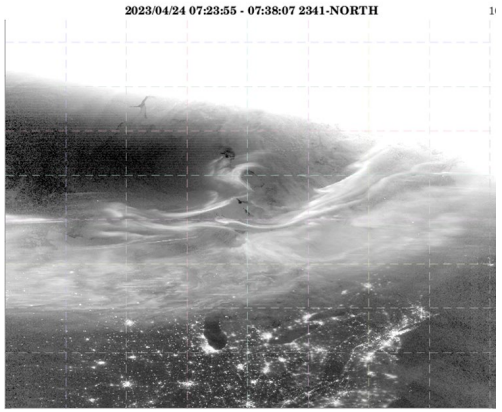
Sync-Loss Locations



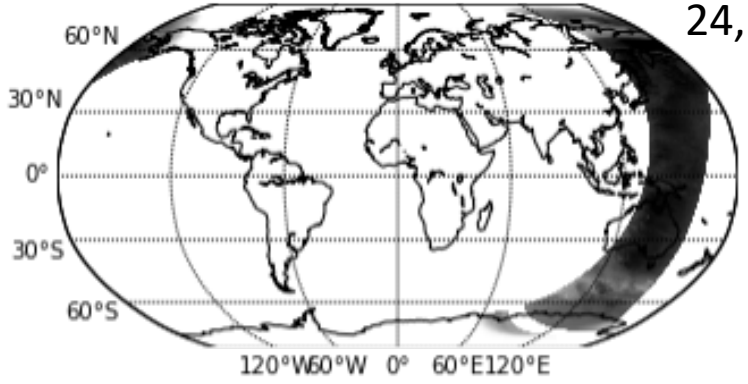
Presence of Aurora

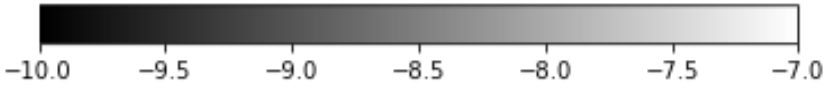




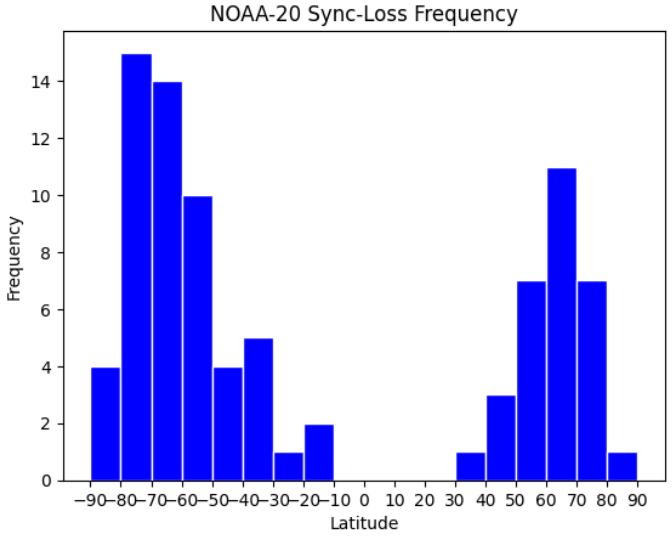
Top Left: Aurora over Texas and Arizona (Apr. 24)

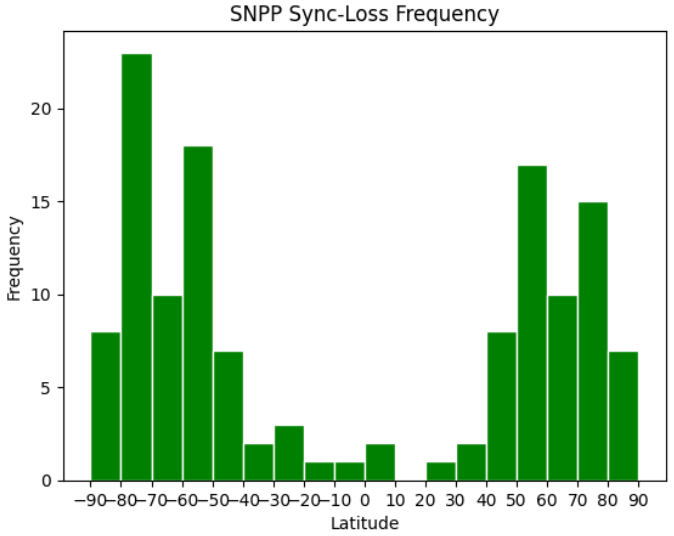
Top Right: DNB April 24, 2023





Bottom: DNB September 28, 2017
scale: (log[radiance])





A Hypothesis on the Aging Instrument Impacts on VIIRS Sync-loss Occurrence Frequency

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Background

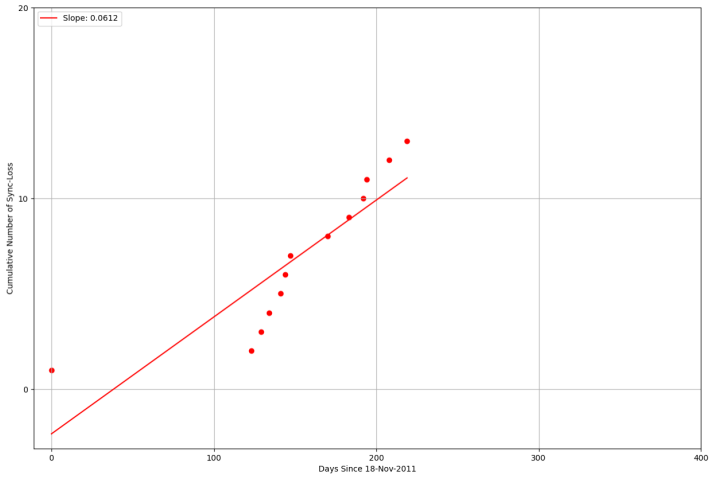
- Electron charging favors to crowd around sharp metal tips or sharp corners to build up the electric potential.
- The frequent discharging may corrode these sharp tips and structures such that the charging surface is more conductive.
- As the instrument becomes old, the occurrence of electronic switching anomalies such as sync-loss can be less

What I Learned

- The slopes for SNPP and NOAA-20 for the beginning of sync-loss occurrence are similar to that of NOAA-21.
- The sync-loss occurrence for SNPP and NOAA-20 have slowed down recently, possibly due to instrument aging.

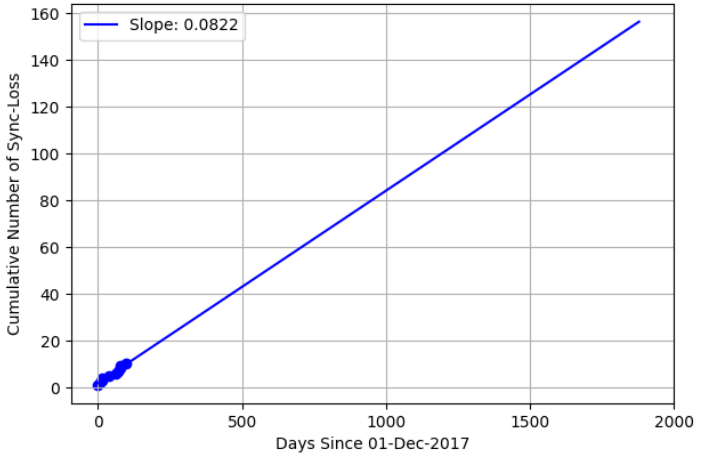
Comparing Early Sync-Loss

NOAA-21



NOAA-21 First 13 Events:
Slope = 0.0612
About 1 occurrence every 14 days
NOAA-20 First 10 Events:
Slope = 0.0822
About 1 occurrence every 12 days
SNPP First 20 Events:
Slope = 0.0611
About 1 occurrence every 14 days

NOAA-20



SNPP