Questions & Answers Session A

Please type your questions in the Question Box. We will try our best to get to all your questions. If we don't, feel free to email Amita Mehta (amita.v.mehta@nasa.gov) or Timothy Lang (timothy.j.lang@nasa.gov).

Question 1: Is data only available for visualization?
Answer 1: Data are available for visualization as well as detailed quantitative analysis. The data are available in standard formats such as NetCDF.

Question 2: Can we find any current data for higher latitudes?
Answer 2: TRMM only goes to +38 and -38 degrees latitude. OTD (+/-75 deg) and ISS LIS (+/-55 deg) fill in for higher latitudes.

Question 3: What is the best tool or resource to plot the movement of a storm in order to assist and/or improve the detection of probable forest fires caused by electrical discharges?
Answer 3: Real time and near-real time data is the best data for that. Geostationary Lightning Mapper (GLM) products help to cover the Western Hemisphere. Commercial data providers (Vaisala, EarthNetworks) among others (e.g., WWLLN) provide information as well. Some commercial data providers allow use of their data free of charge for scientific purposes, otherwise the data will incur a charge.

Question 4: Are Terrestrial Gamma-ray Flashes (TGFs) dangerous?
Answer 4: Maybe. There are not a lot of close up TGF observations, though we did get some recent data in ALOFT that should help to answer this question. There is a possibility that TGFs are dangerous, but the severity of the danger is not known. If an aircraft is already flying that close to a TGF, there is already an inherent risk of other storm-based dangers.

Question 5: How can we identify the lightning/thunderstorm using change in electric field, as the electric field can be changed by various factors?
Answer 5: If you are making a measurement using an electric field sensor, it is important to know your background measurements along with possible interference from other sources. Analyze your data before and after the storm as well.

Question 6: How can we download data for analysis?
Answer 6: You can go into the web-based file manager to download files for analysis such as NetCDFs. NASA Earthdata Search is a good tool to obtain data.

Question 7: Suppose I have a study area somewhere in the world (~20 km^2) and I want to find all occurrences of ISS data that pertain to that area over a 4 year period. What's the most efficient way to approach this search?
Answer 7: In reference to Question 6, NASA Earthdata search is a good tool to help isolate data for this application. There is some isolation work that may need to be done for your particular use case.

Question 8: What format is GHRC data in, and is it of sufficient spatial resolution to map a region with sparse sub-orbital lightning detection equipment like Southern Africa?
Answer 8: There are two formats GHRC data come in, being HDF and NetCDF. NetCDF is more beginner friendly and easier to work with. As lightning data is variable, it helps to broaden your research area as well. There is a 10-km product from TRMM LIS that can help as well in an area such as Southern Africa.

Question 9: Do TRMM LIS and ISS LIS need similar algorithms to be treated? Which type of detection would be used (NDVI, NDWI, etc.) for the specific wavelength of triple 7, and what about Terrestrial Gamma-ray Flash specific algorithm, lasso type sparsity?
Answer 9: TRMM and ISS LIS have similar data structures. In terms of detection, that is already accounted for in the data. There is no need to develop your own algorithm. You do need a separate detector for gamma rays.

Question 10: Could there be a correlation between regions with higher lightning occurrence, potentially indicative of elevated aerosol levels in the atmosphere, and increased vulnerability of coral reefs to environmental stressors such as climate change and pollution?
Answer 10: There is a possibility that aerosols can invigorate convection which could lead to additional lightning flashes. This is an active area of research. Moisture in the lower atmosphere along with heating can also lead to triggering lightning as well. Enhanced sea surface temperatures (SSTs) can also lead to enhanced thunderstorm activity.

Question 11: When working with LIS data and other few lightning datasets in the past, I found lack of proper Python or any other scripts available to start working with. Any Jupyter notebooks on these datasets available to do the visualization and processing is really appreciated.

Answer 11: GHRC does have a few data recipes to look into. Using the xarray Python module to read in the NetCDF data can help as well. The lack of scripts we agree is an issue and if there are any additional questions regarding this you can contact us.

Question 12: Could it be that the areas of more lightning on Earth are related to some kind of mineral deposits, and have there been any investigations related to this?

Answer 12: Yes, this is possible. I know of a location in New Mexico that is one of the most frequently struck locations in the state. In addition to it being mountainous, it is also a known region with lots of iron ore. So it is possible that a mountain with more metallic mineral composition could be struck more often. However, additional research needs to be done.

Questions & Answers Session B

Please type your questions in the Question Box. We will try our best to get to all your questions. If we don't, feel free to email Amita Mehta (amita.v.mehta@nasa.gov) or Timothy Lang (timothy.j.lang@nasa.gov).

Question 1: Does view time tracking require a human reviewer?
Answer 1: The view time is computed using an algorithm and available in LIS data, but it is not fully binned and gridded. The end user needs to do that using tools like scipy's binned_statistic_2d function.

Question 2: You mentioned different resolutions of different datasets, etc. What is the best resolution you currently are working with and what would be the resolution you'd wish for? There are machine learning methods that can help (superresolution, U-nets. etc.).
Answer 2: The native resolution of the LIS instrument is about 4km x 4km. Since lightning is a volatile observation, binning to coarser resolutions is necessary when developing climatologies. With CubeSpark, we are looking to improve the resolution to 1 to 2 km.

Question 3: With the increased urbanization, what are the possible lightning disaster mitigation strategies, both in terms of rural and urban areas?
Answer 3: In the United States, we have lowered the amount of casualties due to lightning due to improvements in education, warnings, and infrastructure. In other regions, lightning fatalities are a bigger issue. Urbanization in certain ways can help with protection from lightning due to the large amount of built-up area and especially if certain buildings have lightning protections in place, such as lightning rods.

Question 4: Can atmosphere and aerosol interaction affect lightning?
Answer 4: Most likely yes. This is an active area of research.

Question 5: Are there live lightning observations sources?
Answer 5: There are real-time lightning products. The Geostationary Lightning Mapper (GLM) covers the Western Hemisphere, and the Meteosat Third Generation Lightning

Imager covers Europe and Africa. Certain commercial data such as WeatherBug and AccuWeather also provide information as well.

Question 6: Can setting up lightning arrester arrays country-wide mitigate lightning risk in a whole country? Is it feasible financially?

Answer 6: In high value areas, it can prove to be valuable. Many modern buildings in the US and other countries do have these protections built into modern building codes. Education and emergency management can also be valuable as well.

Question 7: Is there any warning system for lightning similar to a cyclone warning system?
Answer 7: Tools such as smartphone apps and text alerts can help with notifying people of an impending storm. Outdoor sirens also help as well, but this is dependent on your area.

Question 8: Is there any region where positive polarity lightning outperforms negative polarity?
Answer 8: There are areas where positive polarity outperforms negative polarity such as the Upper Great Plains of the US (Minnesota, North & South Dakota, Kansas and Eastern Colorado). With the Cubespark mission, we want to try to measure lightning altitude and how it varies throughout the world.

Question 9: Drones are planned to be used extensively in the near future (like parcel deliveries, traffic monitoring), do you think they are prone to lightning strikes?
Answer 9: With any airborne object, it is more likely that they will be prone to lightning strikes. There will also most likely be measures in place that make it so drones do not fly in inclement weather. Other aircraft such as airplanes do have fail safes in the event of a lightning strike.

The homework assignment will be posted during Part 3 of the training series (April 2).

Question 10: Would a study of lightning intensity related to biological dispersion in ecosystems be viable?

Answer 10: Small biological substances/species (like bacteria, pollen, etc.) can serve as aerosols, which as we discussed may help to modulate convection and perhaps lightning. So understanding how aerosol variability due to biological cycles may feed back onto clouds and convection is a very interesting topic, worthy of further research. In addition, certain species of trees, especially in the tropics, have adapted themselves to lightning strikes. These interrelationships between the biosphere and the atmosphere are the subject of at least one ongoing research project that I know of.