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FIFTEENTH ASIA-OCEANIA METEOROLOGICAL SATELLITE USERS' CONFERENCE
THE JOINT 2025 FENGYUN SATELLITE USER CONFERENCE

Lightning Climatology and Hotspots over Bangladesh Observed by FY-4A LMI, TRMM-ISS LIS, WWLLN, ENTLN, and GLD360 Networks



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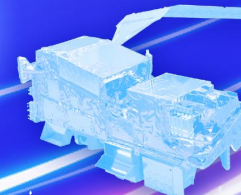
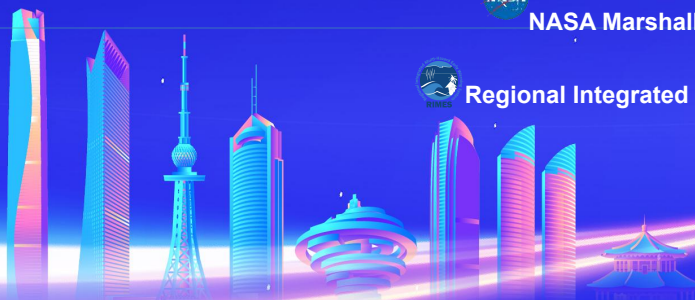
Daniel J. Cecil

NASA Marshall Space Flight Center, Huntsville, AL, United States



Nazmul Ahasan

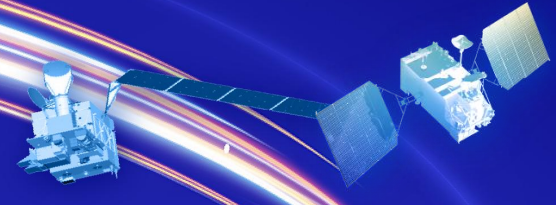
Regional Integrated Multi-Hazard Early Warning System, Dhaka, Bangladesh





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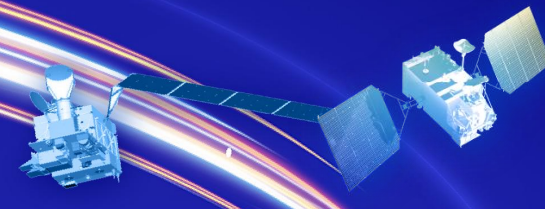
Objective

To identify the lightning hotspots over Bangladesh



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Article Type: Research Article

Where Are the Lightning Hotspots on Earth?

Rachel I. Albrecht, Steven J. Goodman, Dennis E. Buechler, Richard J. Blakeslee, and Hugh J. Christian

Print Publication: 01 Nov 2016

DOI: <https://doi.org/10.1175/BAMS-D-14-00193.1>

Top 500 flash rate density (FRD, fl km⁻² yr⁻¹)

105	82.95	25.25	89.85	Sherpur	Bangladesh	Asia
272	62.11	24.25	90.95	Bājītpur	Bangladesh	Asia
410	54.17	24.15	89.55	Shāhzādpur	Bangladesh	Asia



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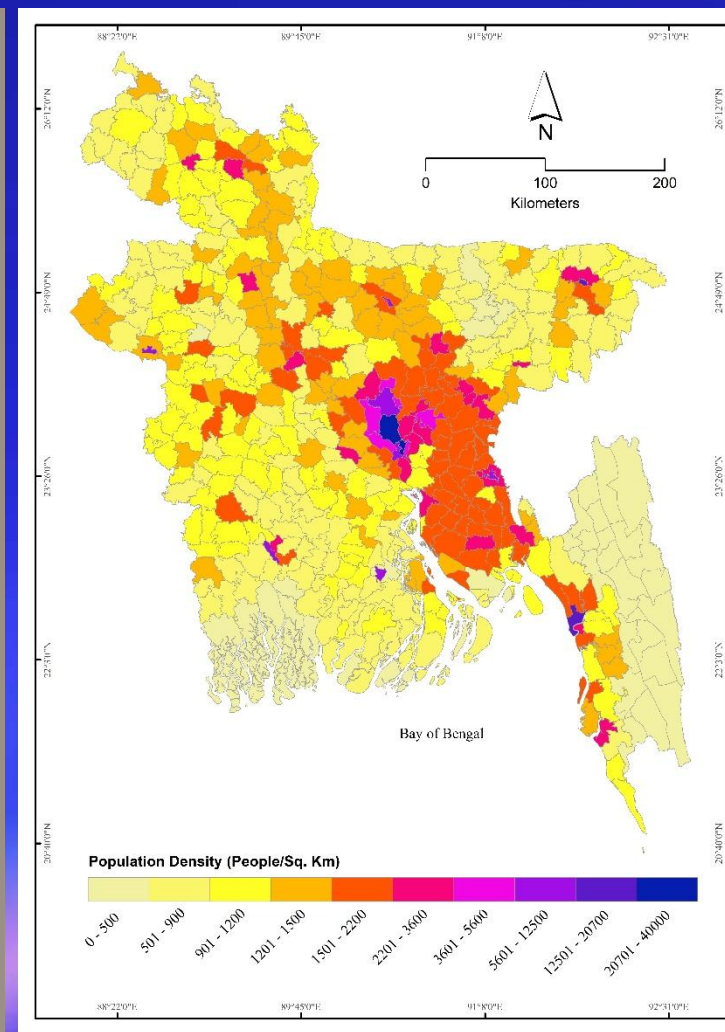
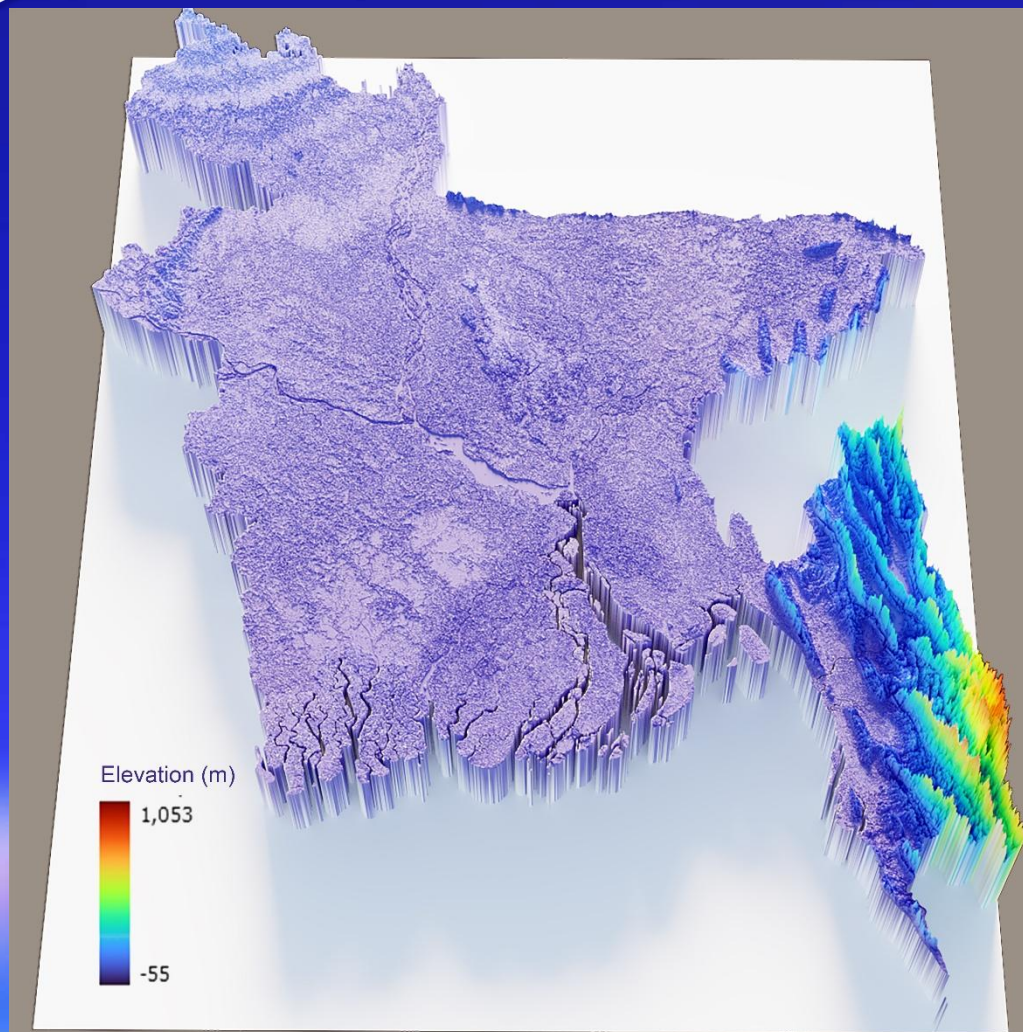


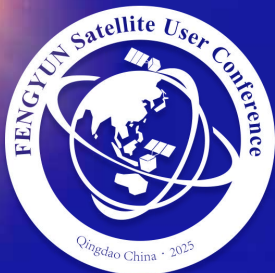
Where Are the Lightning Hotspots in Bangladesh?



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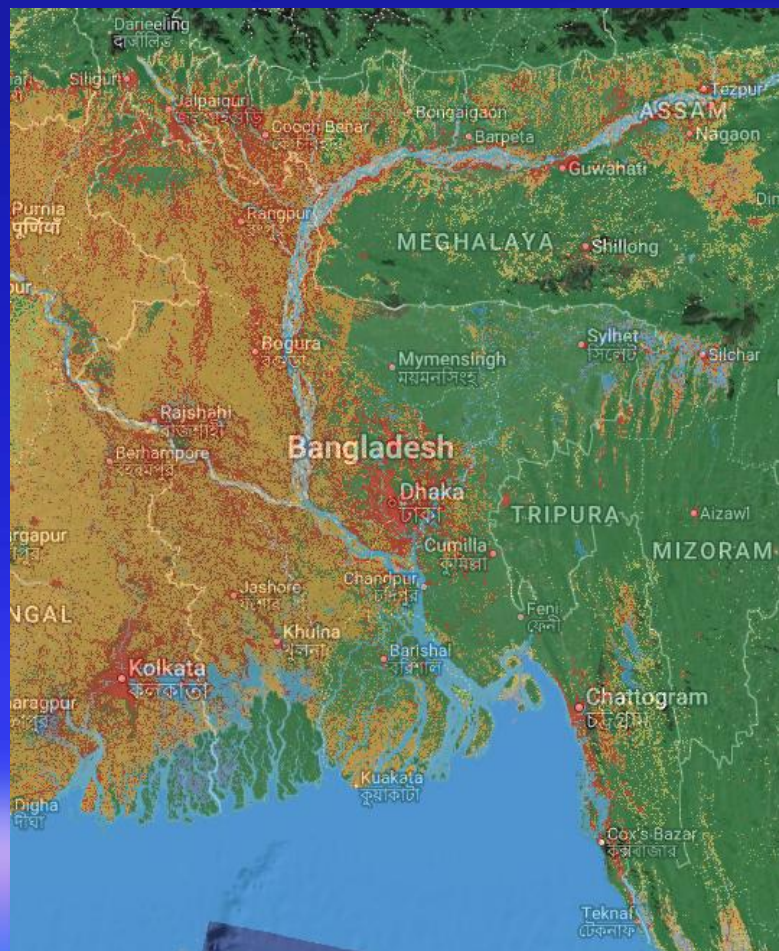
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Four Seasons:

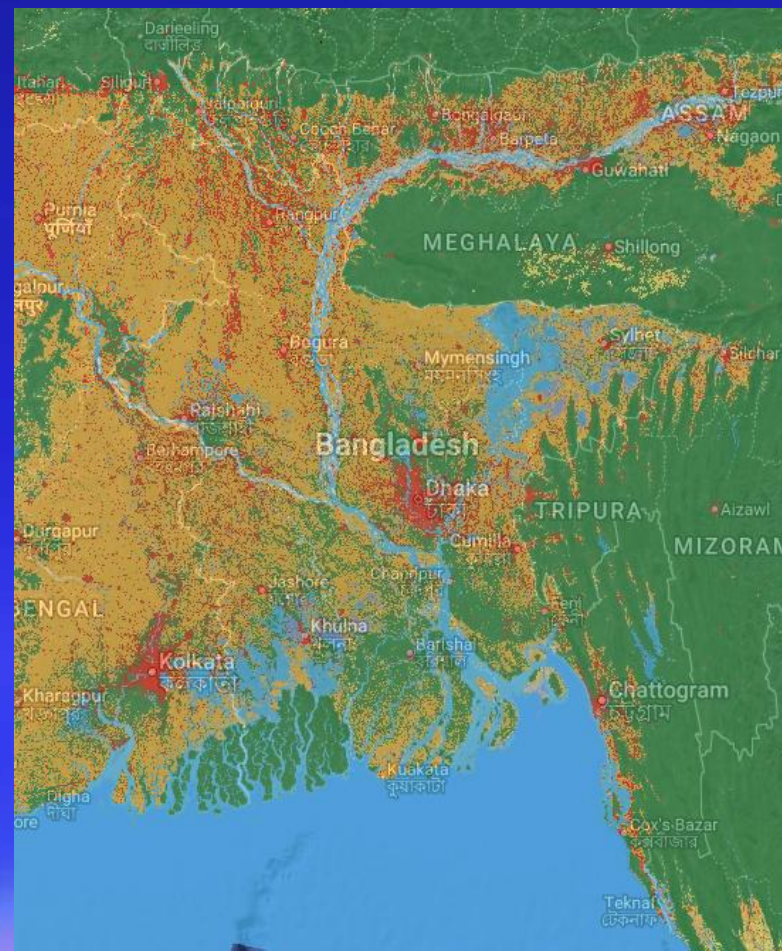
1. Winter (December-February)
2. Pre-monsoon (March-May)
3. Monsoon (June-September) (SW Summer Monsoon)
4. Post-monsoon (October-November)

Primary Lightning Systems:

1. Pre-monsoon Thunderstorm/NorWester (March-May)
2. Southwest Summer Monsoon (June-September)
3. Western Disturbance (Winter)
4. Cyclones (Pre & Post Monsoon)



Pre-monsoon (March-May)



Monsoon (June-September)

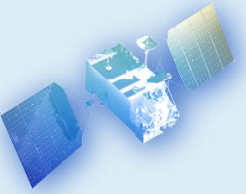
LEGEND

- Water
- Trees
- Grass
- Flooded vegetation
- Crops
- Shrub and scrub
- Built
- Bare
- Snow and ice

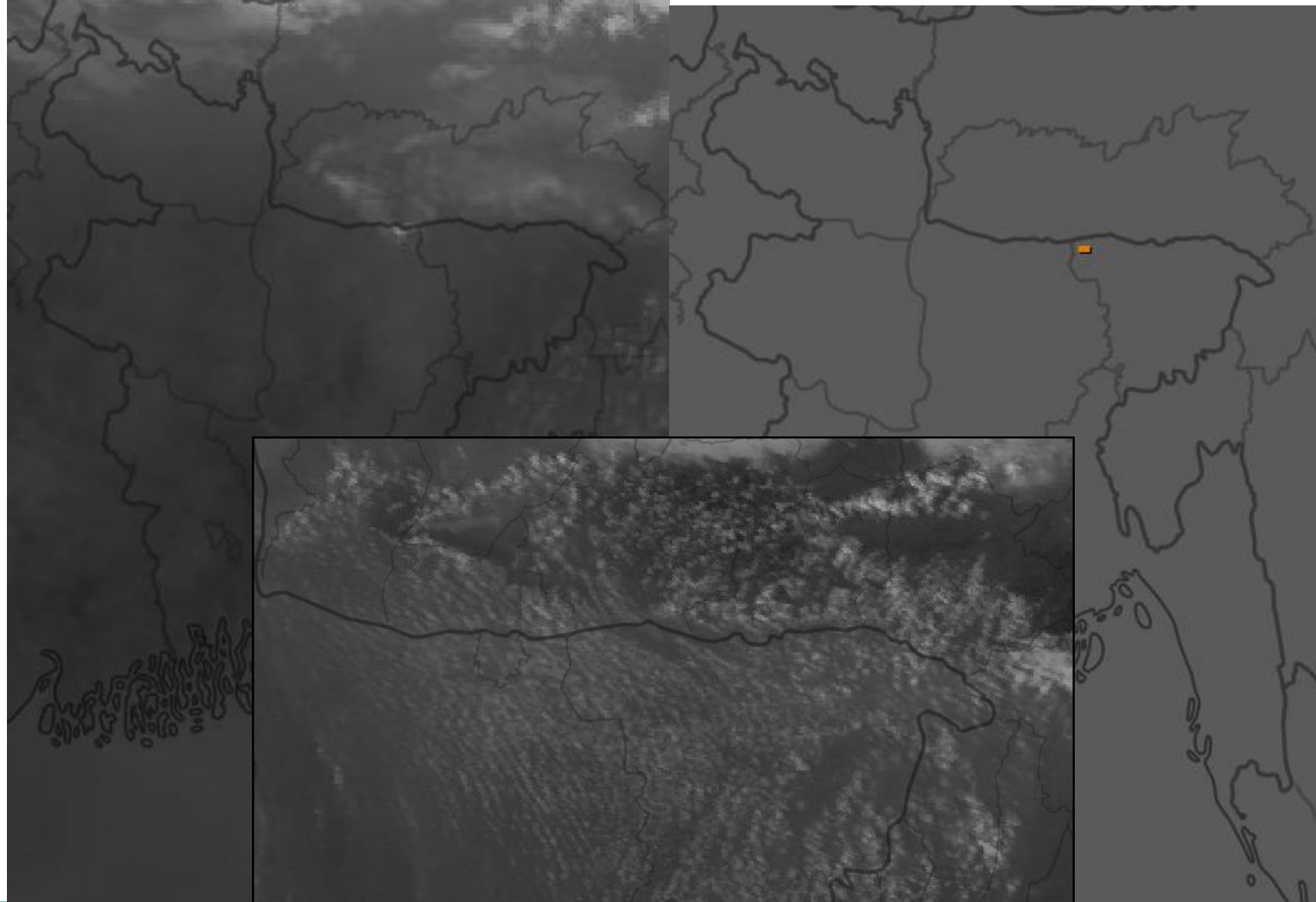


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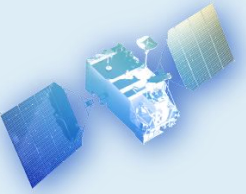
13 March 2025



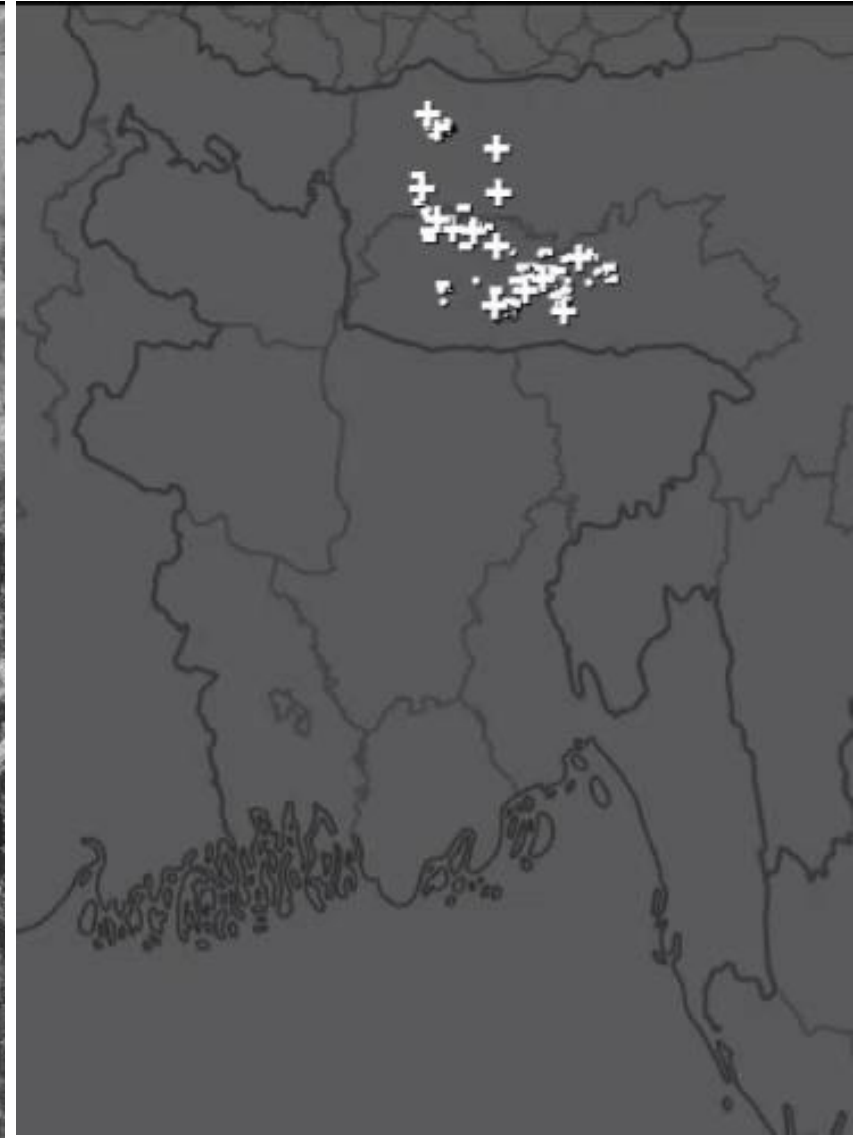
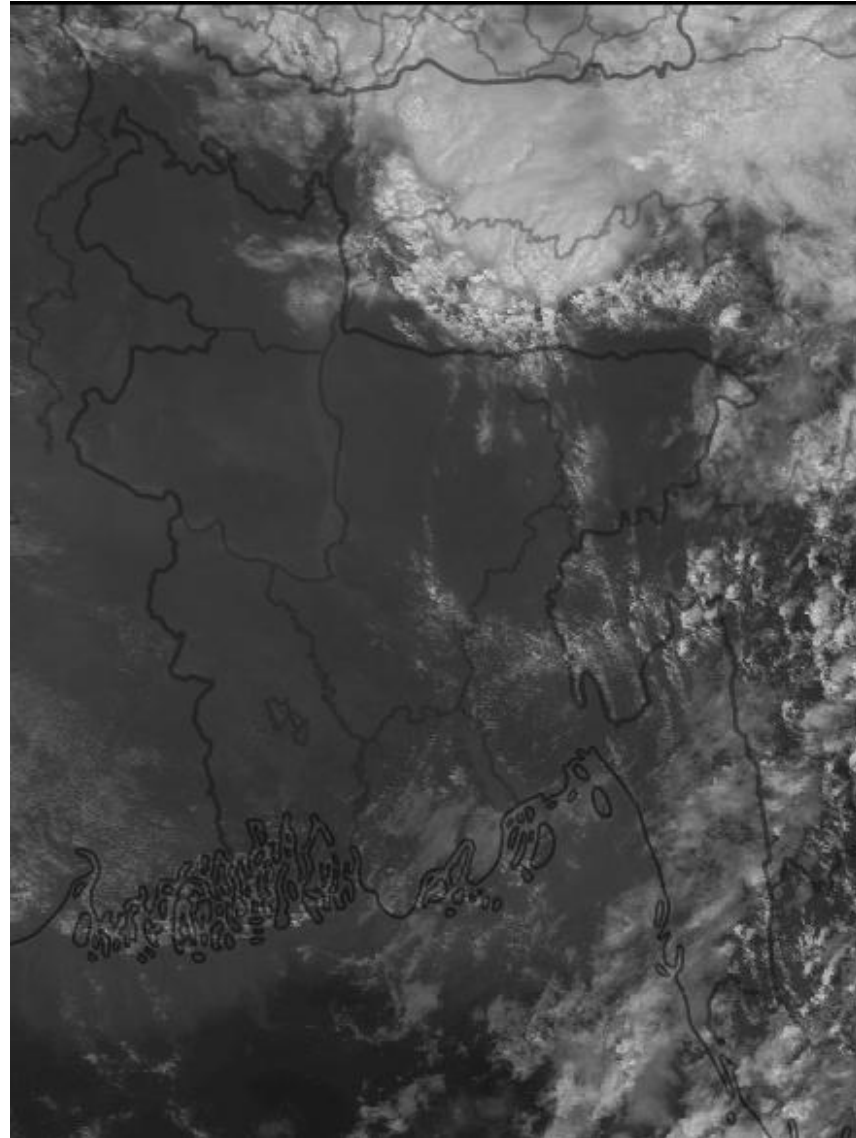


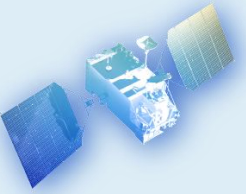
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1 May 2025



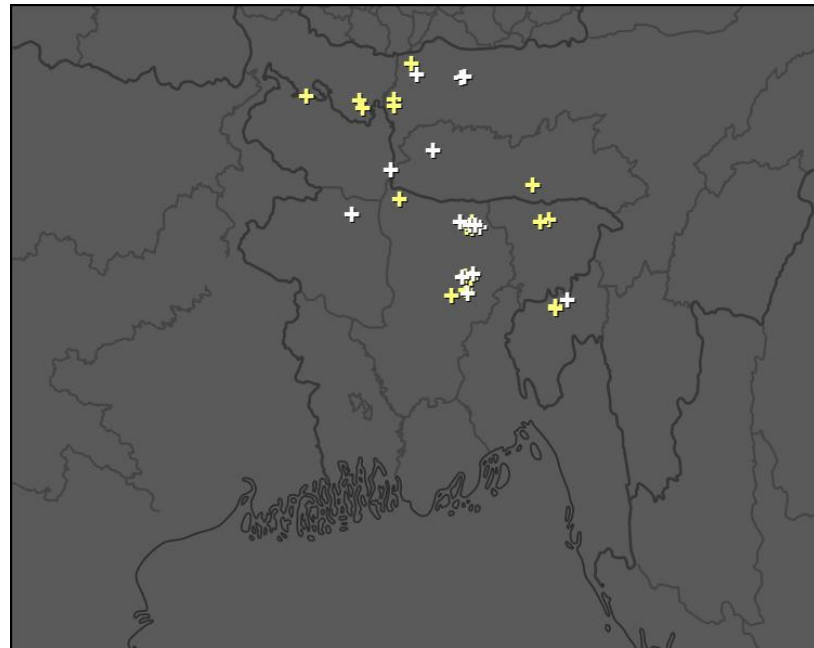
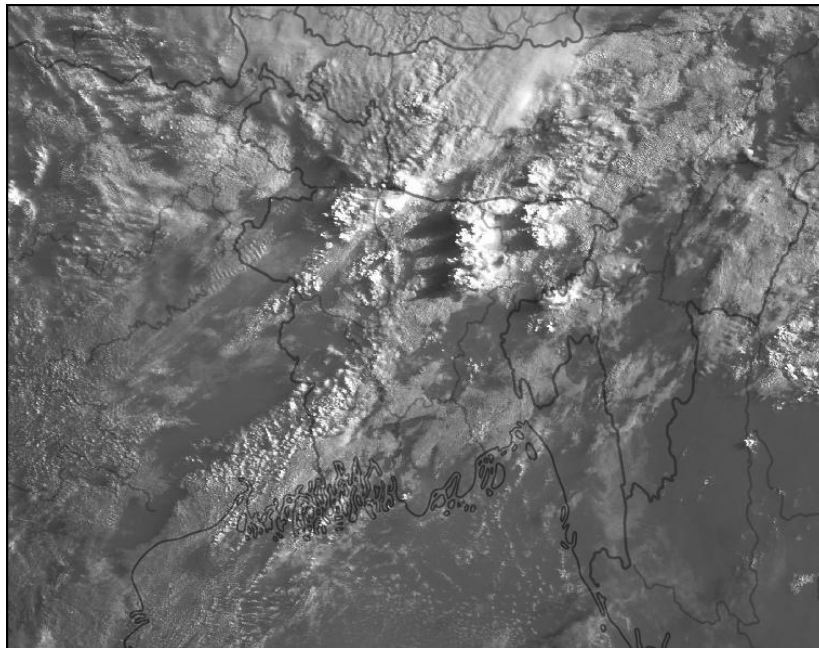


28 April 2025

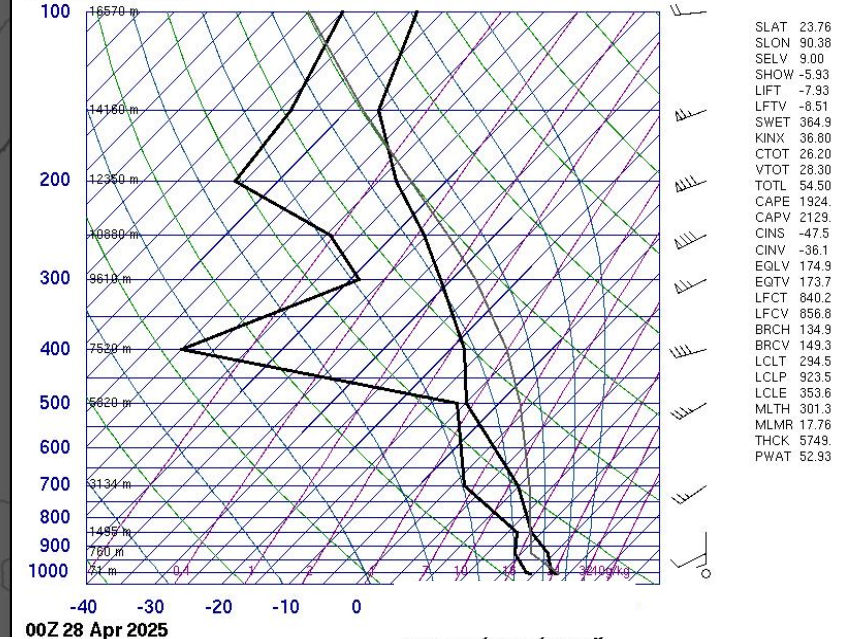
Home » Country » 12 killed in lightning strikes in 7 dists

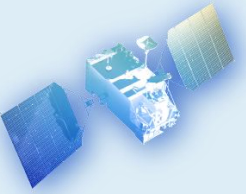
12 killed in lightning strikes in 7 dists

Staff Correspondent ☒ 28 April, 2025, 16:39



41923 VGTJ Dhaka



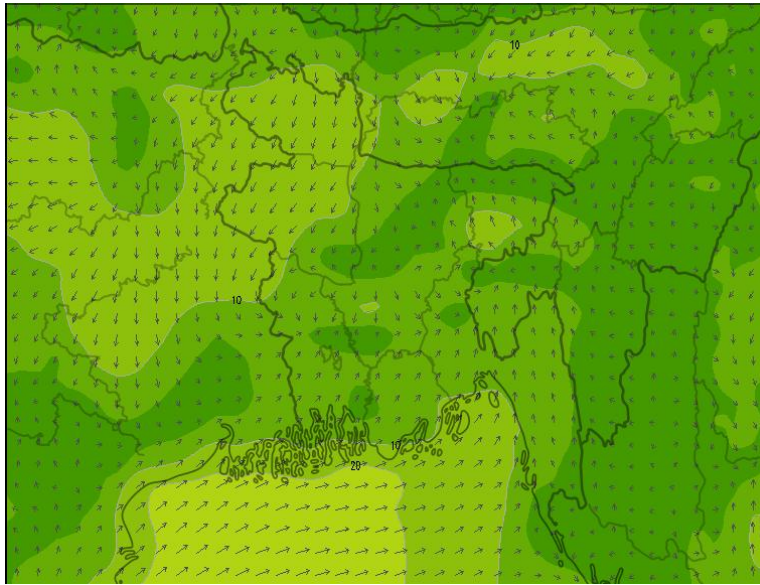


28 April 2025

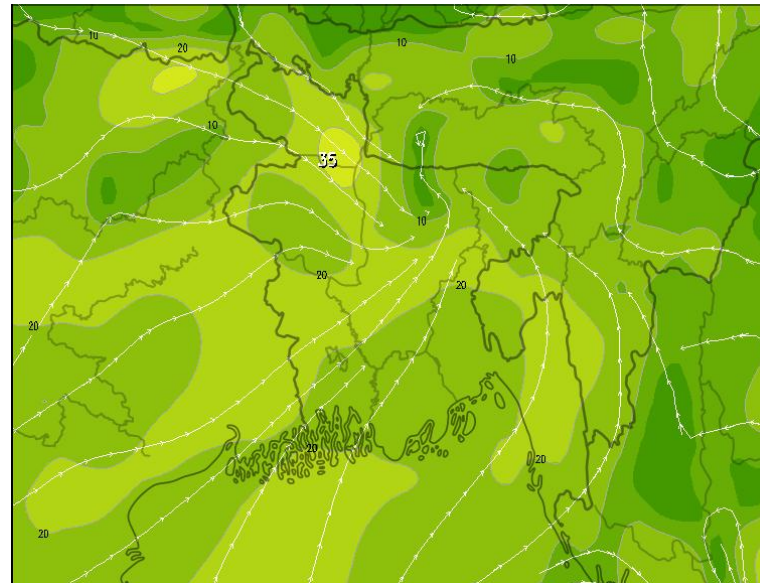
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12 killed in lightning strikes in 7 dists

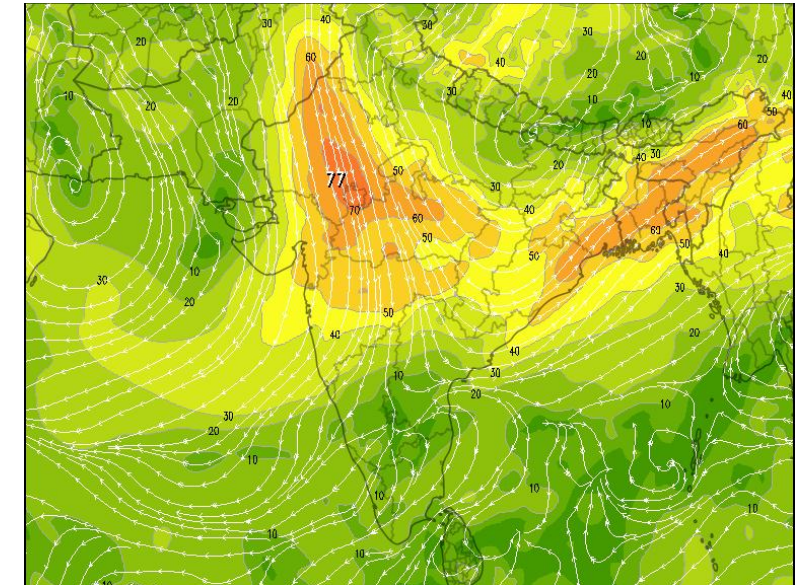
Staff Correspondent ☒ 28 April, 2025, 16:39



Wind direction and mean wind speed (kph)
Reanalysis for
Mon 04/28/2025, 06:00am GMT+06



Wind speed and streamlines, 850hPa (kph)
Reanalysis for
Mon 04/28/2025, 06:00am GMT+06

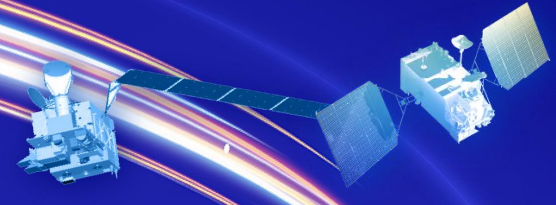


Wind speed and streamlines, 500hPa (kph)
Reanalysis for
Mon 04/28/2025, 06:00am GMT+06



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Mishra et al. (2025) reported that Bangladesh experiences the highest number of fatalities per 1000 sq. km among South Asian countries.

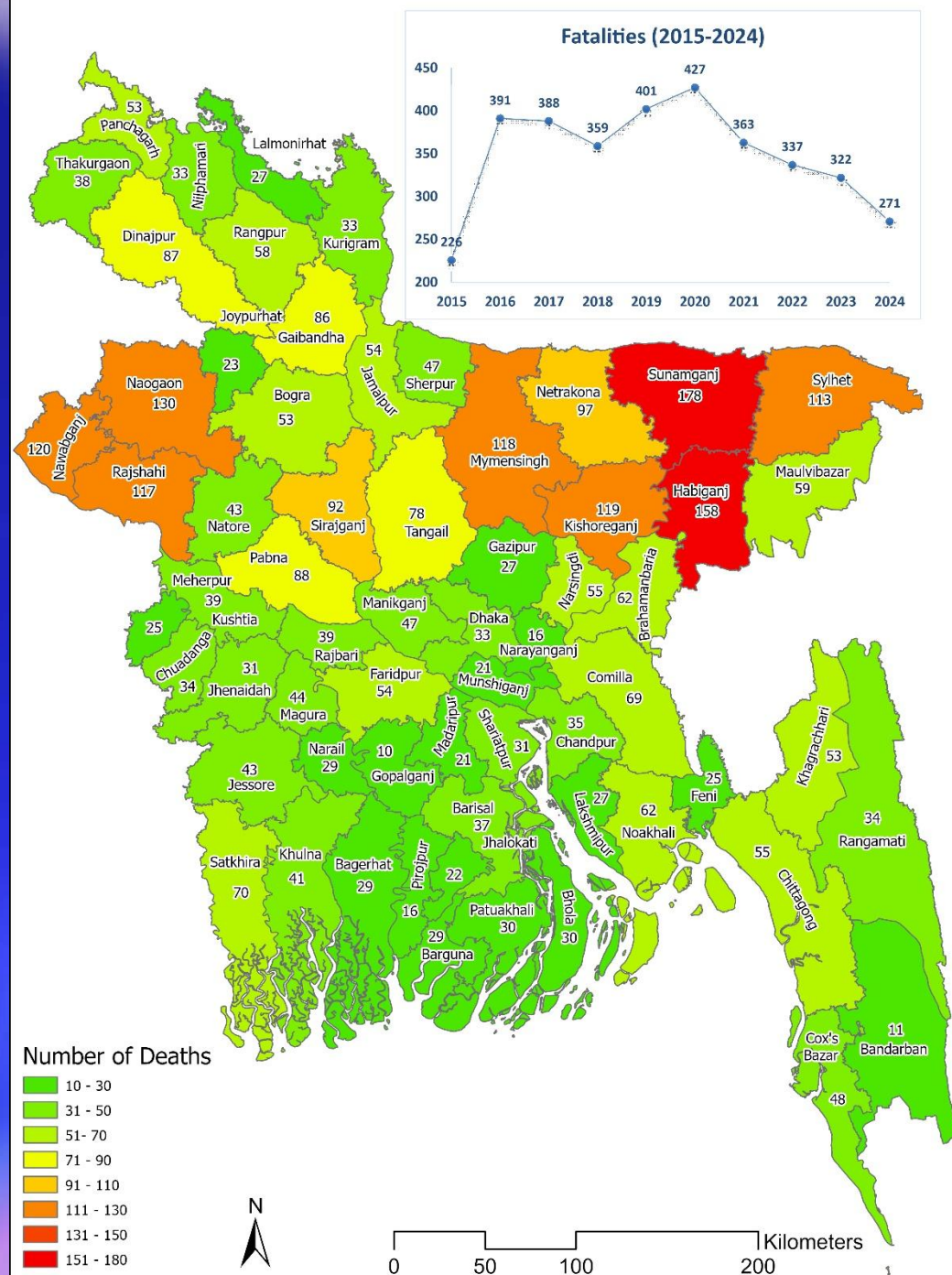


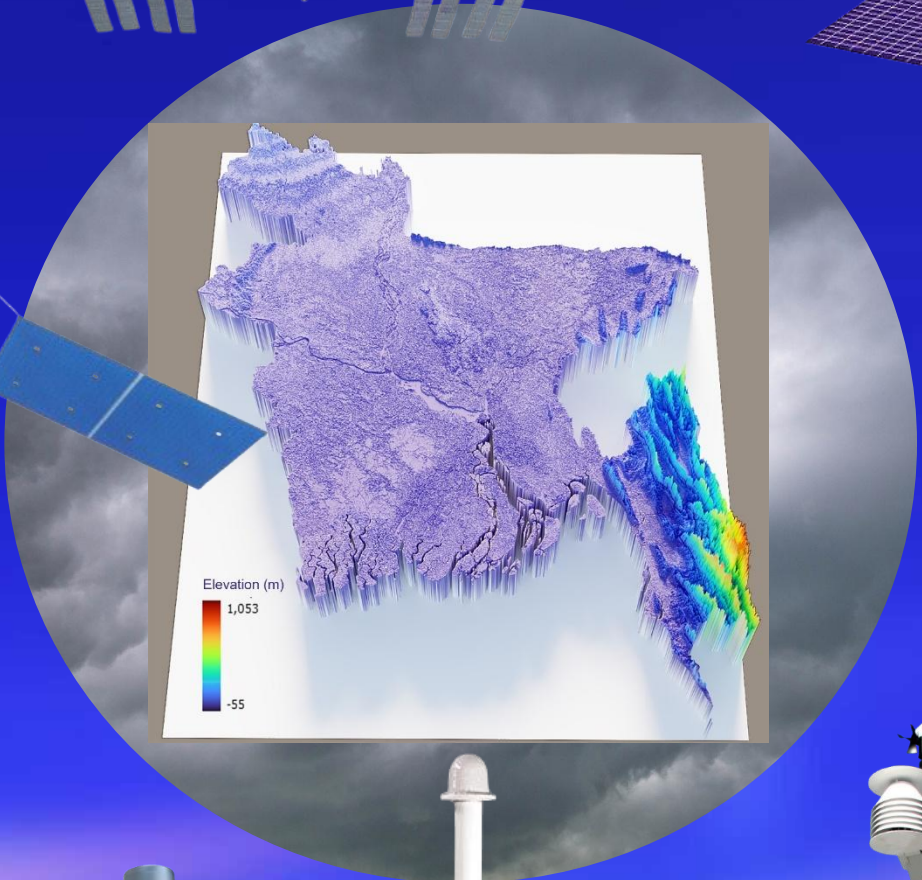
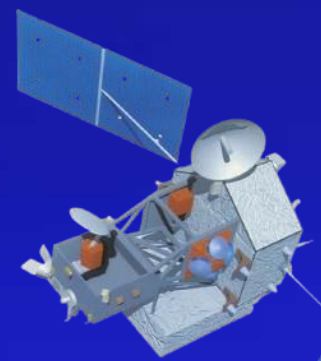
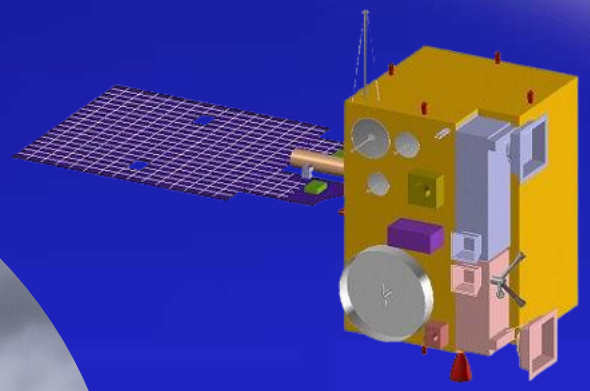
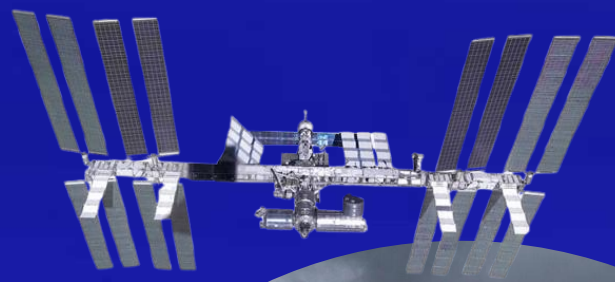
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Lightning Deaths during 2015-2024 based on
Department of Disaster Management, Bangladesh

~350 lives every year

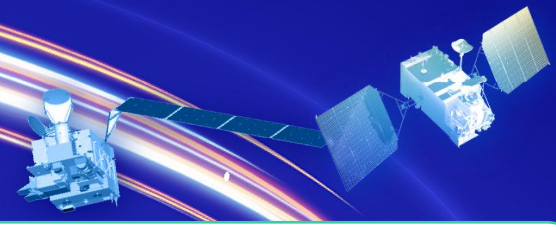






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Characteristics of lightning datasets used

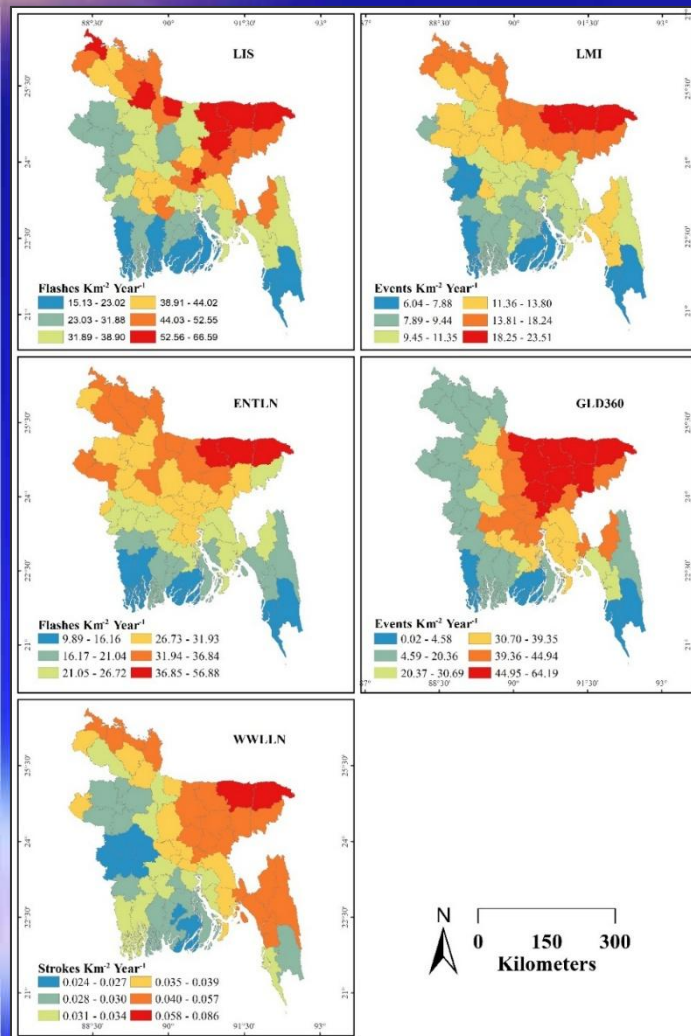
Dataset	Platform type	Lightning type	Detection Efficiency	Years
FY-4A	Geostationary Orbit	CG+IC flashes	Unknown for Bangladesh	2018-2021
WWLLN	Ground network	CG strokes	>50%, accounted for in climatology	2010-2023
ENTLN	Ground network	CG, IC strokes	70-88% in South Asia	2018-2022
GLD360	Ground network	CG strokes	Unknown for Bangladesh	2018-2022
LIS	Low-Earth Orbit	CG+IC flashes	60-70%, accounted for in climatology	1998-2015; 2017-2023



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Ranking based on lightning flash rates at district level



Rank	Districts					
	LMI	LIS	ENTLN	WWLLN	GLD360	Averaged
1	Sunamganj	Sunamganj	Sunamganj	Sunamganj	Sunamganj	Sunamganj
2	Netrokona	Sylhet	Sylhet	Sylhet	Netrokona	Sylhet
3	Sylhet	Kishoreganj	Netrokona	Netrokona	Narayanganj	Netrokona
4	Sherpur	Narayanganj	Lalmonirhat	Habiganj	Sherpur	Kishoreganj
5	Habiganj	Panchagarh	Rangpur	Maulvibazar	Sylhet	Narayanganj
6	Nilphamari	Netrokona	Kurigram	Kishoreganj	Mymensingh	Sherpur
7	Mymensingh	Gaibandha	Nilphamari	Rangamati	Kishoreganj	Panchagarh
8	Thakurgaon	Sherpur	Kishoreganj	Panchagarh	Narsingdi	Habiganj
9	Panchagarh	Khagrachhari	Sirajganj	Chittagong	Gazipur	Mymensingh
10	Lalmonirhat	Munshiganj	Sherpur	Lalmonirhat	Habiganj	Gaibandha

3,340,000
Flashes/Year

33%
CG

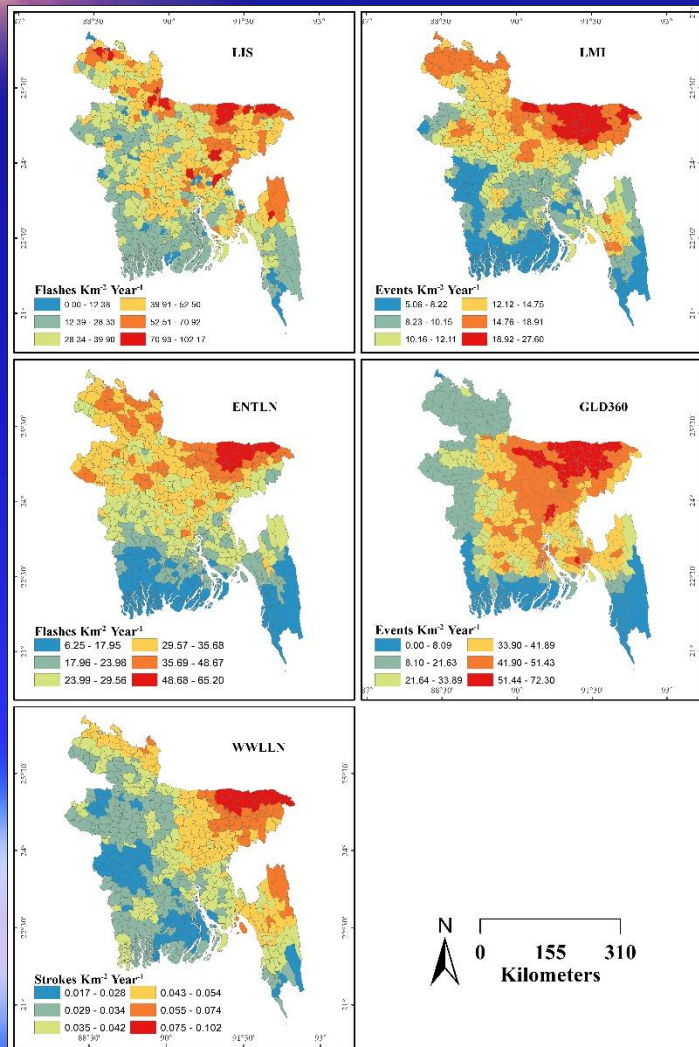
62%
April-June



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Ranking based on lightning flash rates at sub-district level

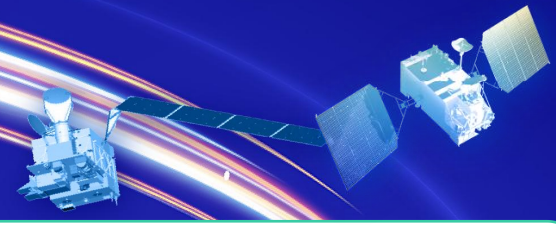


Rank	Sub-Districts					
	LMI	LIS	ENTLN	WWLLN	GLD360	Averaged
1	Jamalganj	Jamalganj	Companiganj	Gowainghat	Jamalganj	Jamalganj
2	Haluaghat	Bakshiganj	Sunamganj Sadar	Sunamganj Sadar	Tahirpur	Sunamganj Sadar
3	Dera	Companiganj	Tahirpur	Bishwambarpur	Sunamganj Sadar	Gowainghat
4	Jagannathpur	Tahirpur	Dowarabazar	Shantiganj	Shantiganj	Tahirpur
5	Sulla	Mohanganj	Bishwambarpur	Jamalganj	Dharampasha	Bishwambarpur
6	Shantiganj	Sreebardi	Gowainghat	Companiganj	Mohanganj	Shantiganj
7	Barhatta	Gowainghat	Jamalganj	Dowarabazar	Bishwambarpur	Companiganj
8	Khaliajuri	Mahalchhari	Shantiganj	Jaintiapur	Khaliajuri	Dowarabazar
9	Dharampasha	Dowarabazar	Dharampasha	Kanaighat	Sulla	Mohanganj
10	Osmaninagar	Bishwambarpur	Chhatak	Tahirpur	Kabirhat	Bakshiganj

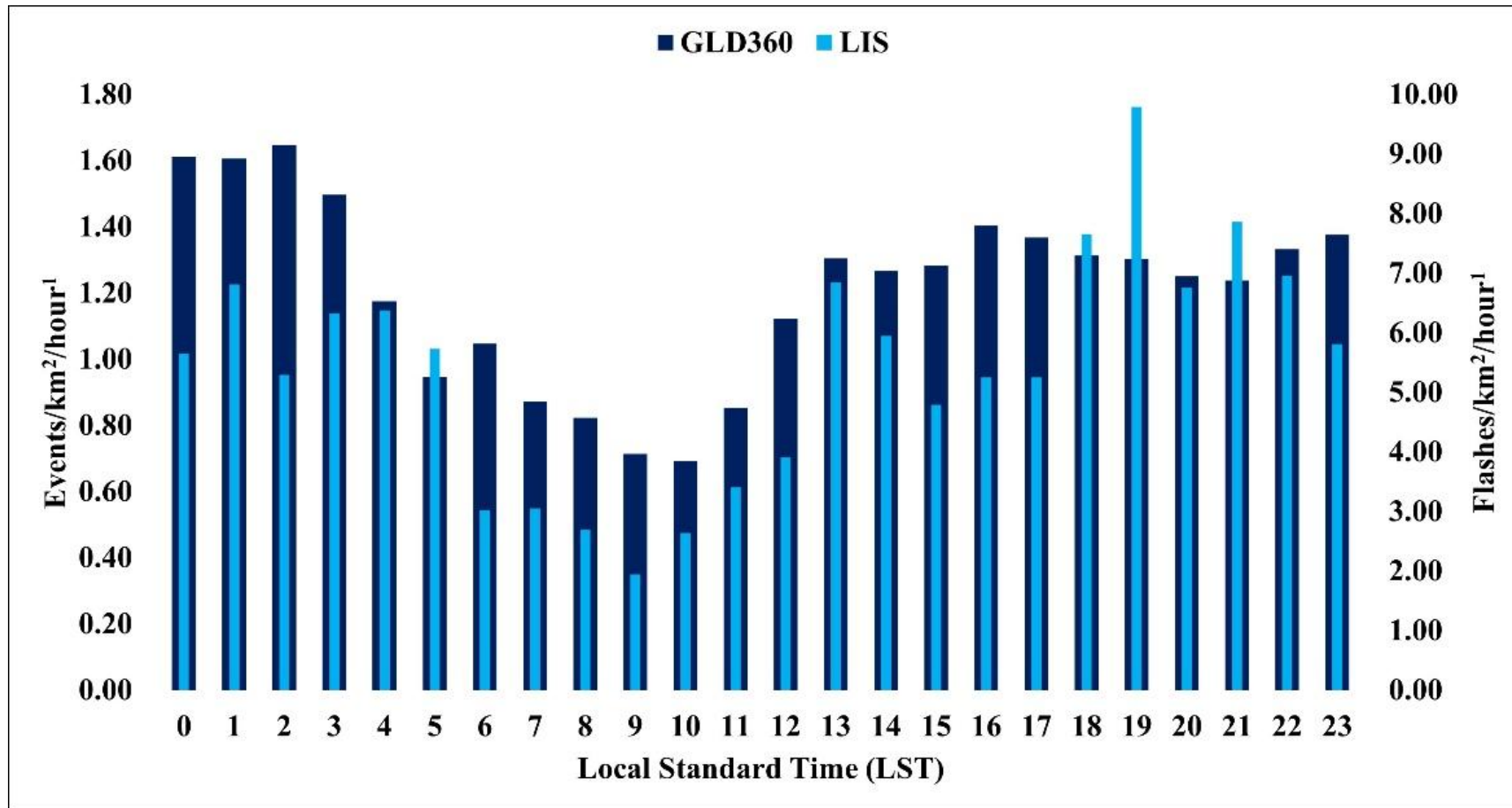


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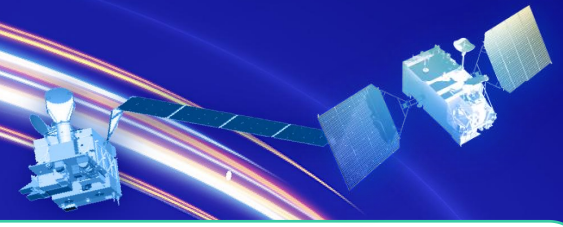
Diurnal variations of lightning densities over Bangladesh



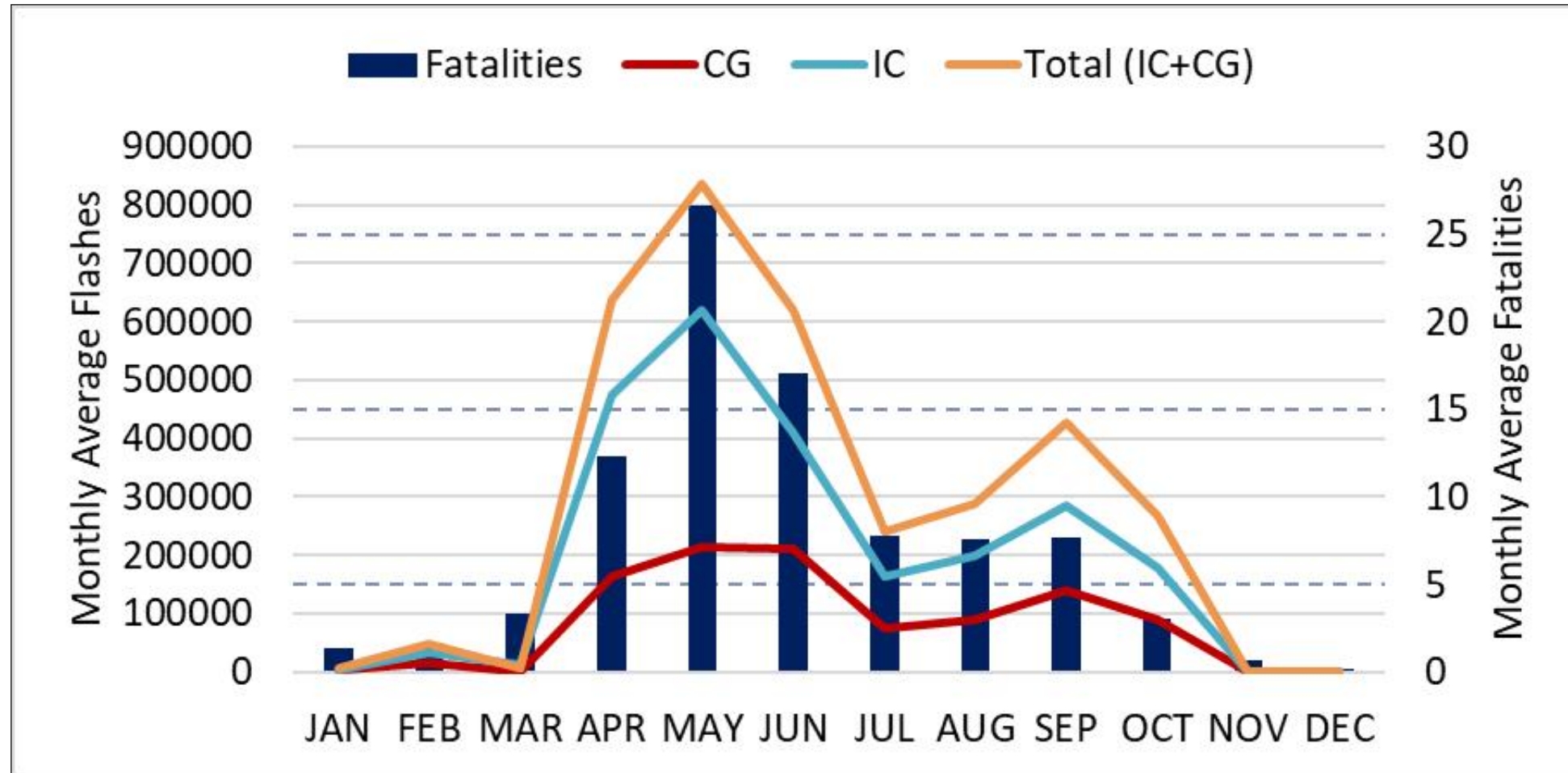


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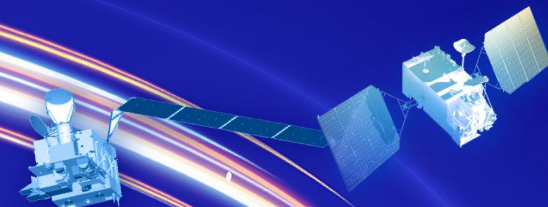
Monthly variation of lightning flashes and associated fatalities over Bangladesh



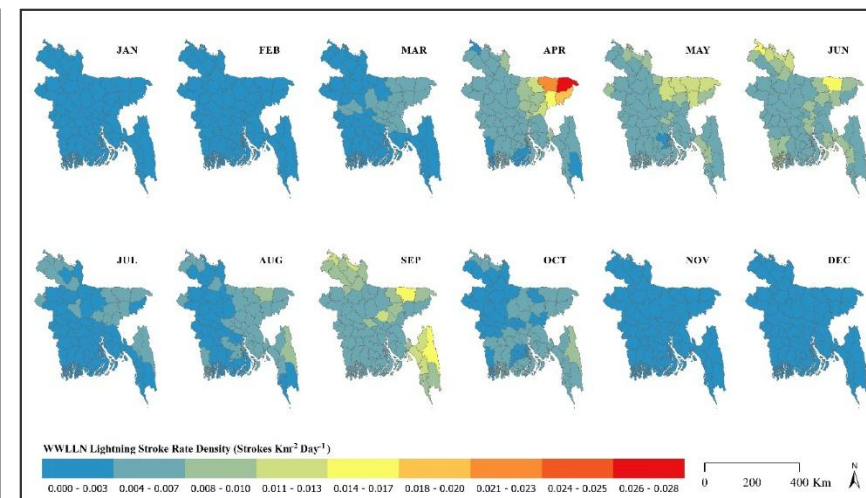
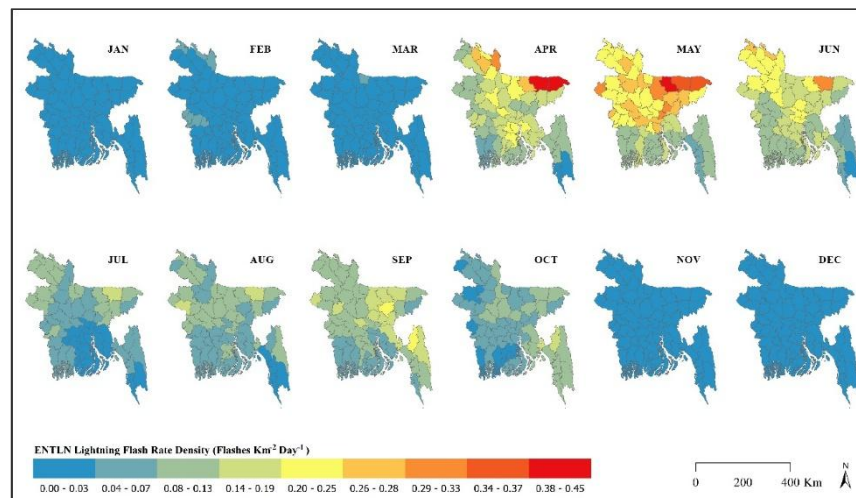
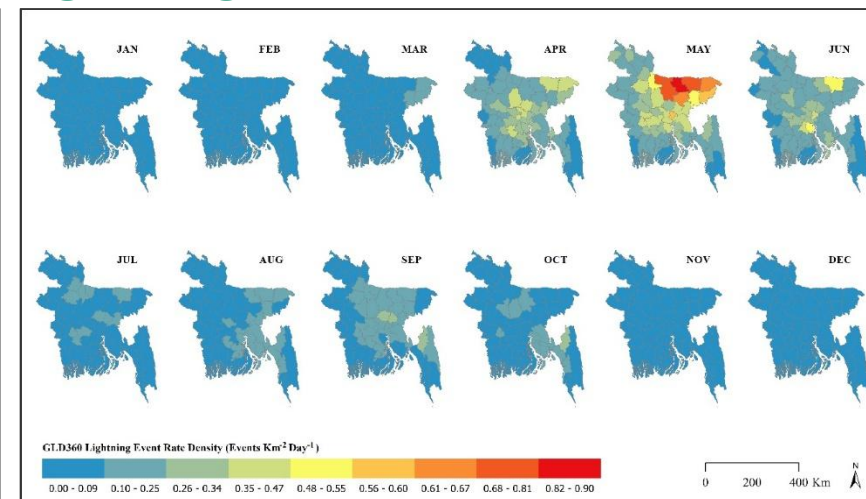
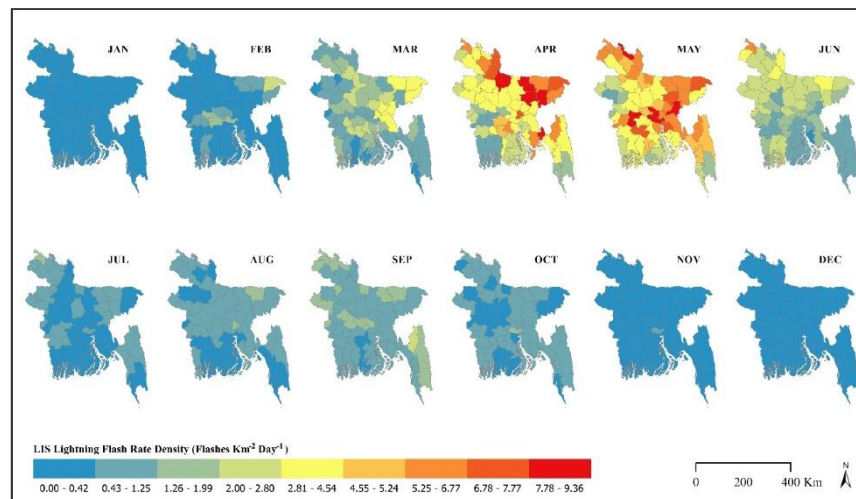
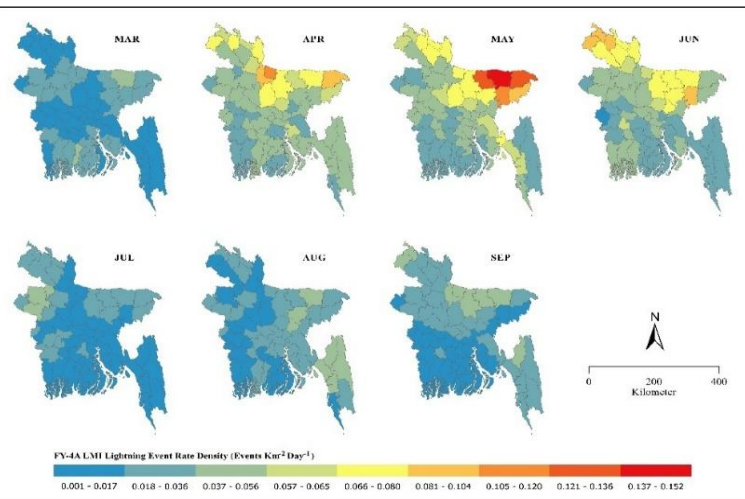


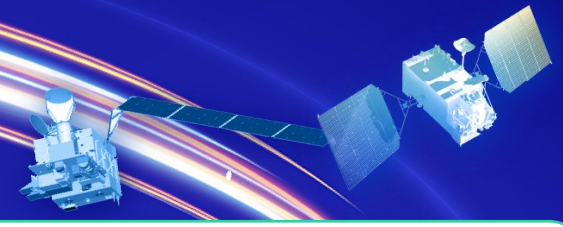
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Monthly variation of lightning flashes





Hotspots & Coldspots using Getis-Ord G_i^* statistics (ArcGIS Pro)

- ❑ Getis-Ord G_i^* statistics is produced to compare the local mean value to the global mean
- ❑ The local sum of a specific district and sub-district is then compared to the sum of all district and sub-district lightning values.
- ❑ High z score and low p values would give more statistically significant (99% confidence level) hotspots result whereas a negative z score with low p value reflects statistically significant coldspots.
- ❑ The Getis-Ord local statistic is given as:

$$G_i^* = \frac{\left(\sum_{j=1}^n w_{i,j} x_j\right) - \bar{X} \left(\sum_{j=1}^n w_{i,j}\right)}{S \sqrt{\frac{n \sum_{j=1}^n w_{i,j}^2 - \left(\sum_{j=1}^n w_{i,j}\right)^2}{n-1}}}$$

where, x_j is the attribute value for feature j , the spatial weight between feature j and i is denoted by $w_{i,j}$, n is the total number of features and:

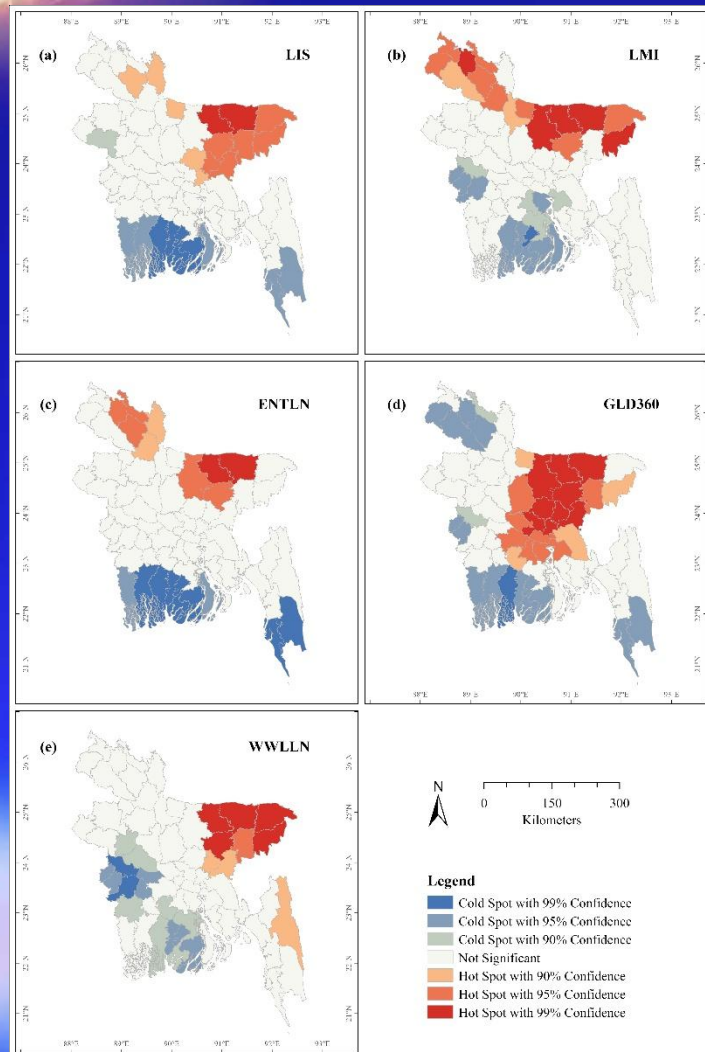
$$\bar{X} = \frac{\sum_{j=1}^n x_j}{n} \quad \text{and} \quad S = \sqrt{\frac{\sum_{j=1}^n x_j^2}{n} - (\bar{X})^2}$$



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Ranking of the lightning hotspots at district level



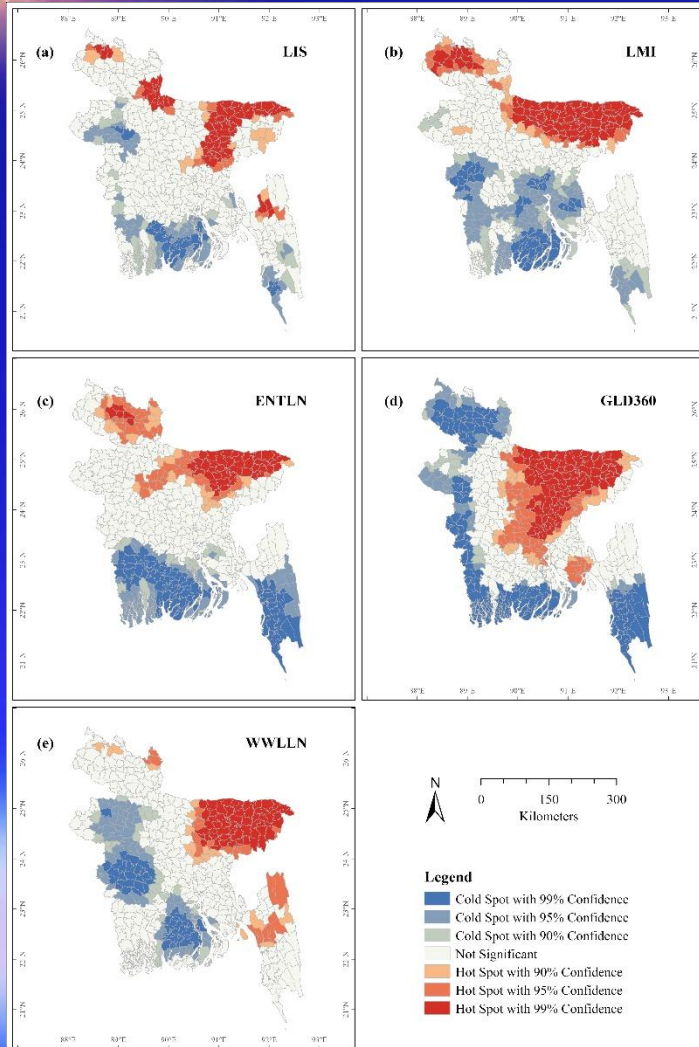
Rank						
	LMI	LIS	ENTLN	WWLLN	GLD360	Averaged
1	Netrokona	Netrokona	Sunamganj	Sunamganj	Netrokona	Netrokona
2	Sunamganj	Sunamganj	Netrokona	Netrokona	Kishoreganj	Sunamganj
3	Mymensingh	Brahmanbaria	Rangpur	Maulvibazar	Dhaka	Kishoreganj
4	Maulvibazar	Narsingdi	Lalmonirhat	Sylhet	Gazipur	Maulvibazar
5	Nilphamari	Kishoreganj	Mymensingh	Kishoreganj	Narayanganj	Mymensingh
6	Sylhet	Maulvibazar	Kishoreganj	Habiganj	Narsingdi	Sylhet
7	Sherpur	Habiganj	Nilphamari	Brahmanbaria	Sunamganj	Narsingdi
8	Panchagarh	Sylhet	Gaibandha	Narsingdi	Brahmanbaria	Brahmanbaria
9	Thakurgaon	Narayanganj	Kurigram	Rangamati	Mymensingh	Narayanganj
10	Kishoreganj	Kurigram	Dinajpur	Khagrachhari	Munshiganj	Nilphamari



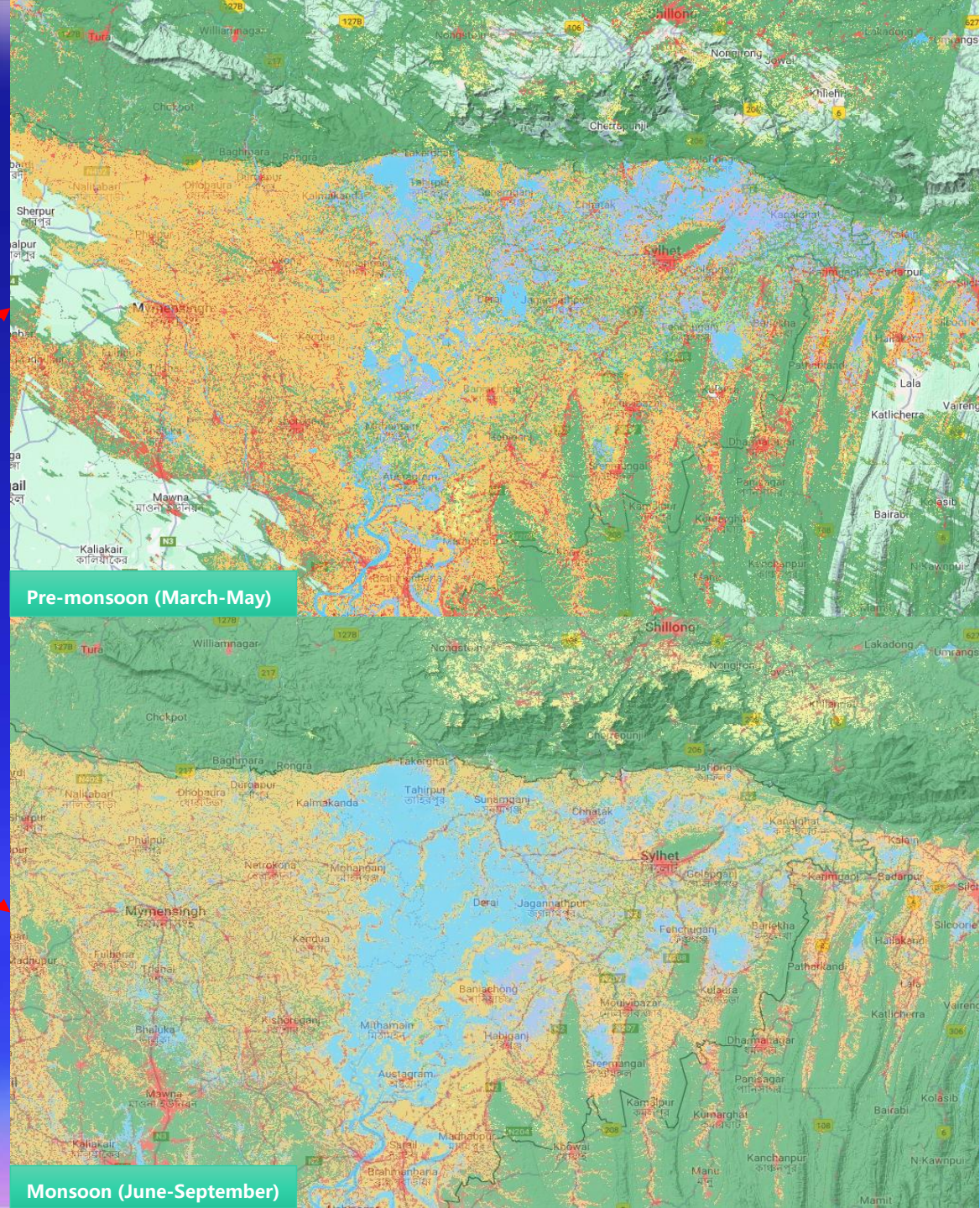
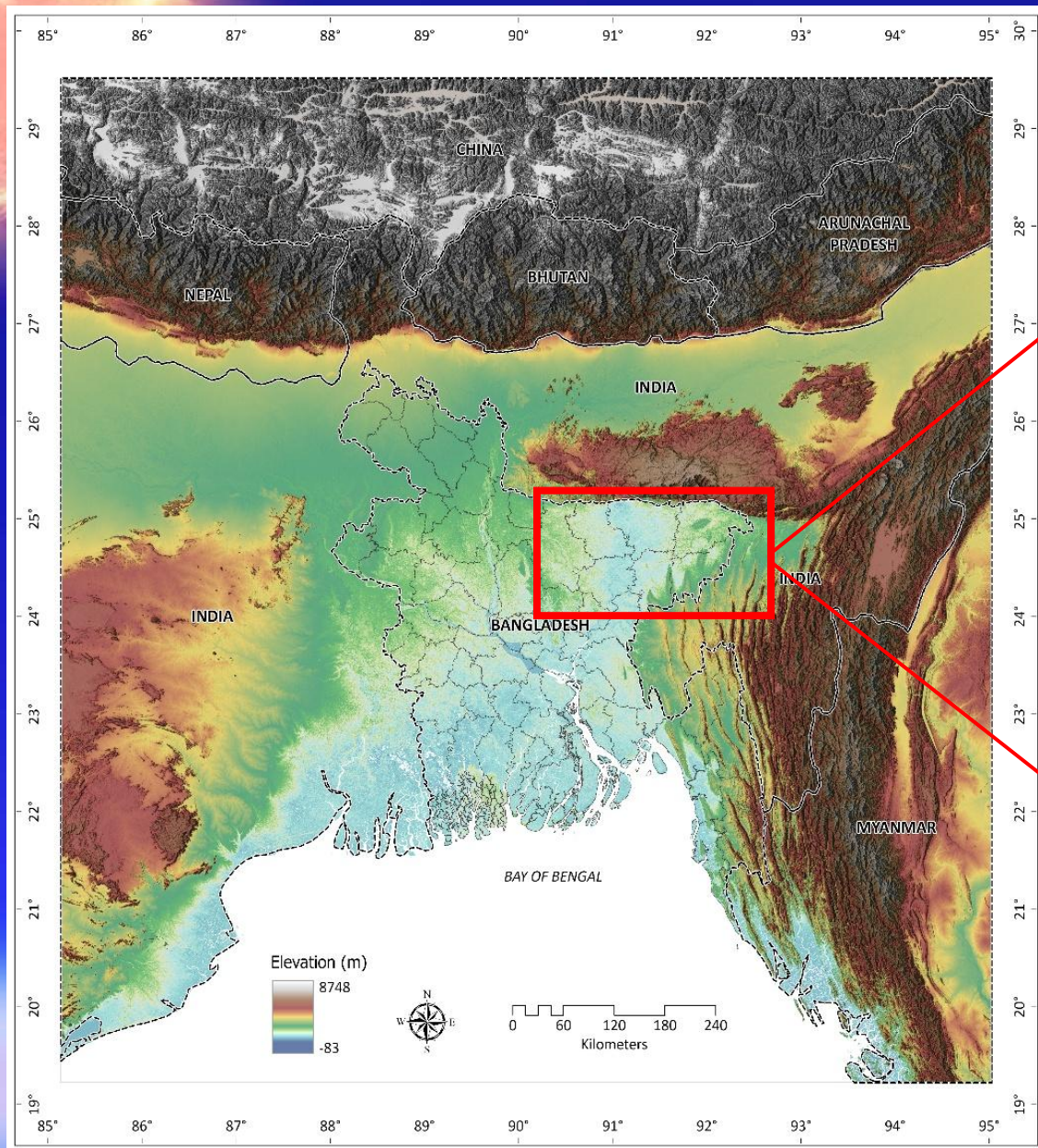
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Ranking of the lightning hotspots at sub-district level



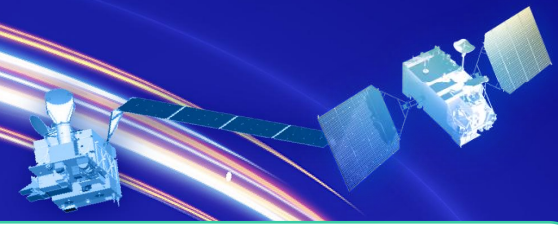
Rank						
	LMI	LIS	ENTLN	WWLLN	GLD360	Averaged
1	Deraï	Jamalganj	Sunamganj Sadar	Shantiganj	Jamalganj	Jamalganj
2	Mohanganj	Bishwambarpur	Jamalganj	Sunamganj Sadar	Sunamganj Sadar	Sunamganj Sadar
3	Shantiganj	Tahirpur	Bishwambarpur	Chhatak	Shantiganj	Bishwambarpur
4	Jamalganj	Dharampasha	Shantiganj	Jamalganj	Mohanganj	Shantiganj
5	Jagannathpur	Sunamganj Sadar	Dowarabazar	Bishwambarpur	Bishwambarpur	Tahirpur
6	Khaliajuri	Bakshiganj	Chhatak	Dowarabazar	Tahirpur	Dharampasha
7	Sulla	Dewanganj	Tahirpur	Comaniganj	Deraï	Mohanganj
8	Ajmiriganj	Mohanganj	Comaniganj	Sylhet City Corporation	Dharampasha	Chhatak
9	Chhatak	Char Rajibpur	Dharampasha	Gowainghat	Chhatak	Deraï
10	Dharampasha	Bajitpur	Mohanganj	Tahirpur	Dowarabazar	Dowarabazar





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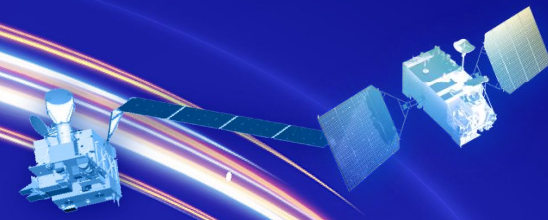
Ranking of the lightning coldspots at sub-district level

Rank										
	LMI	LIS	ENTLN	WWLLN	GLD360	LMI	LIS	ENTLN	WWLLN	GLD360
1	Jhalokati	Jhalokati	Pirojpur	Jhenaidah	Bagerhat	Patuakhali Sadar	Barguna Sadar	Ramu	Bakerganj	Barguna Sadar
2	Pirojpur	Pirojpur	Bagerhat	Kushtia	Nilphamari	Amtali	Bamna	Maheshkhali	Rajapur	Amtali
3	Patuakhali	Bagerhat	Jhalokati	Chuadanga	Bandarban	Barguna Sadar	Mathbaria	Rupsa	Dumki	Betagi
4	Barguna	Patuakhali	Barguna	Rajbari	Cox's Bazar	Mirzaganj	Rampal	Terokhada	Kanthalia	Bamna
5	Bagerhat	Barguna	Patuakhali	Jhalokati	Barguna	Dashmina	Bhola Sadar	Phultala	Nalchity	Mathbaria
6	Jhenaidah	Bandarban	Bandarban	Magura	Patuakhali	Dumki	Amtali	Dumuria	Shailkupa	Patuakhali Sadar
7	Chuadanga	Cox's Bazar	Cox's Bazar	Meherpur	Jhalokati	Bauphal	Bauphal	Chakaria	Bauphal	Chandanaish
8	Meherpur	Khulna	Khulna	Pirojpur	Pirojpur	Lalmohan	Patharghata	Abhaynagar	Mirzaganj	Patharghata
9	Shariatpur	Satkhira	Satkhira	Patuakhali	Rangpur	Betagi	Burhanuddin	Dighalia	Patuakhali Sadar	Mirzaganj
10	Bhola	Bhola	Bhola	Barguna	Khulna	Galachipa	Patuakhali Sadar	Khulna City Corporation	Barisal City Corporation	Bandarban Sadar



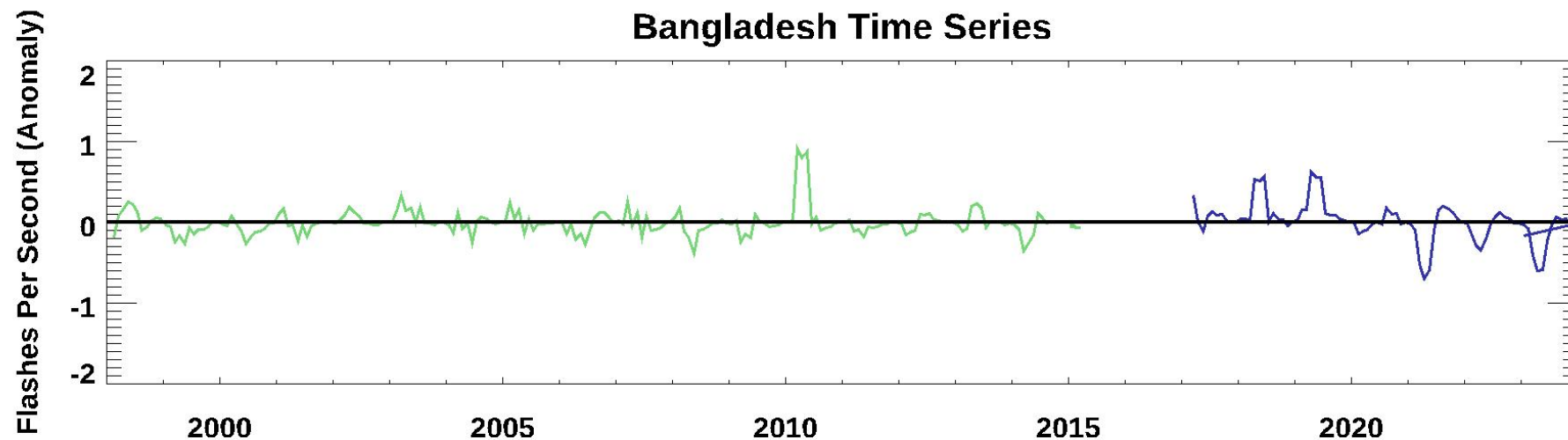
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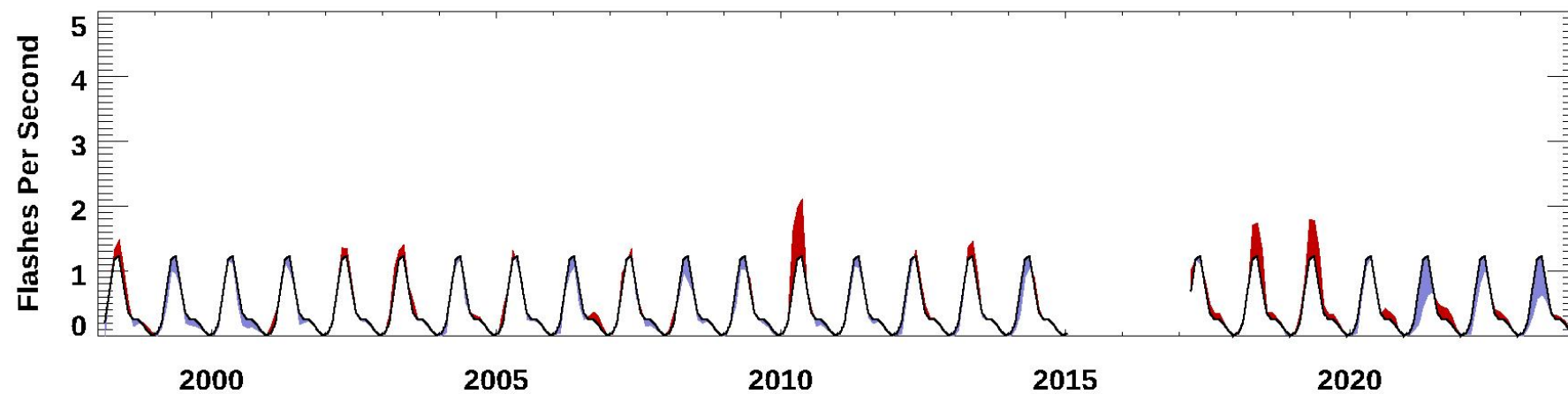


OTD+LIS Data

Bangladesh Time Series



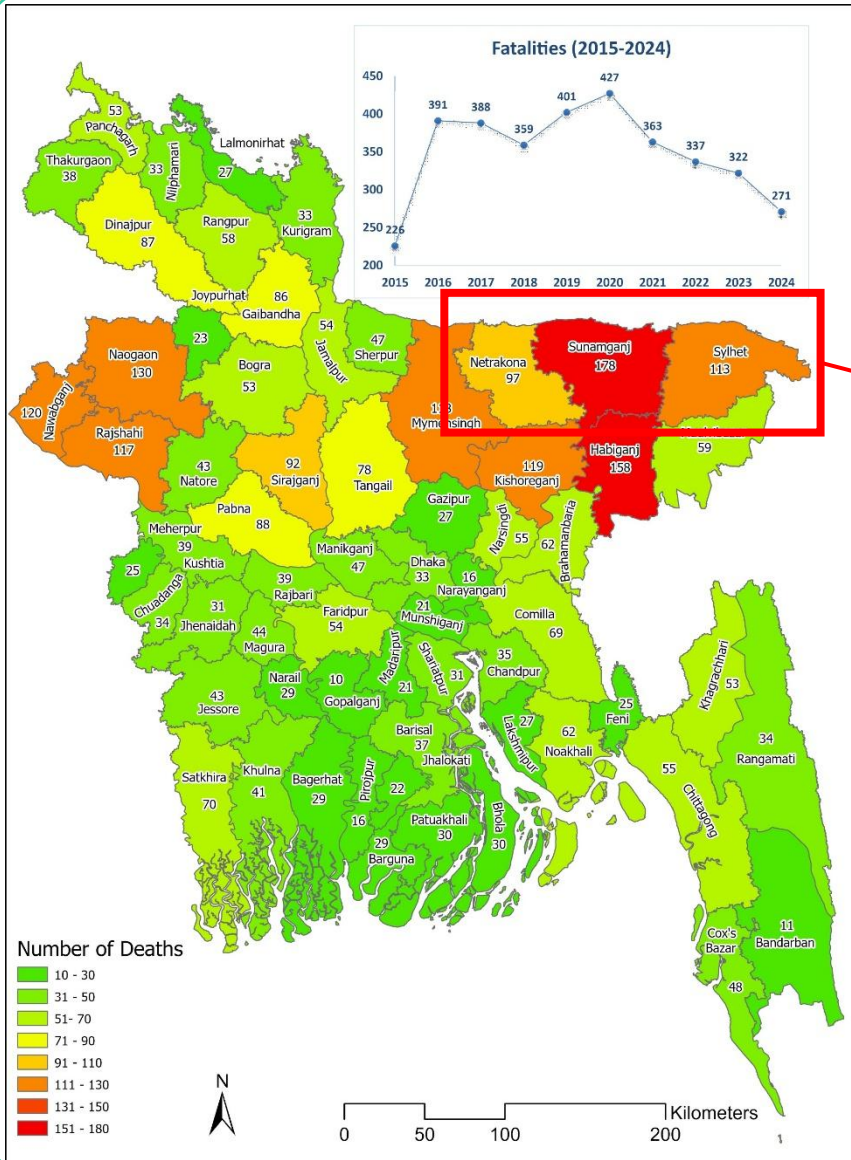
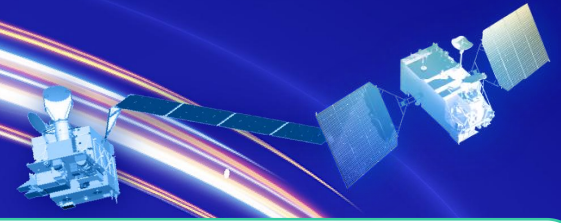
Bangladesh Time Series





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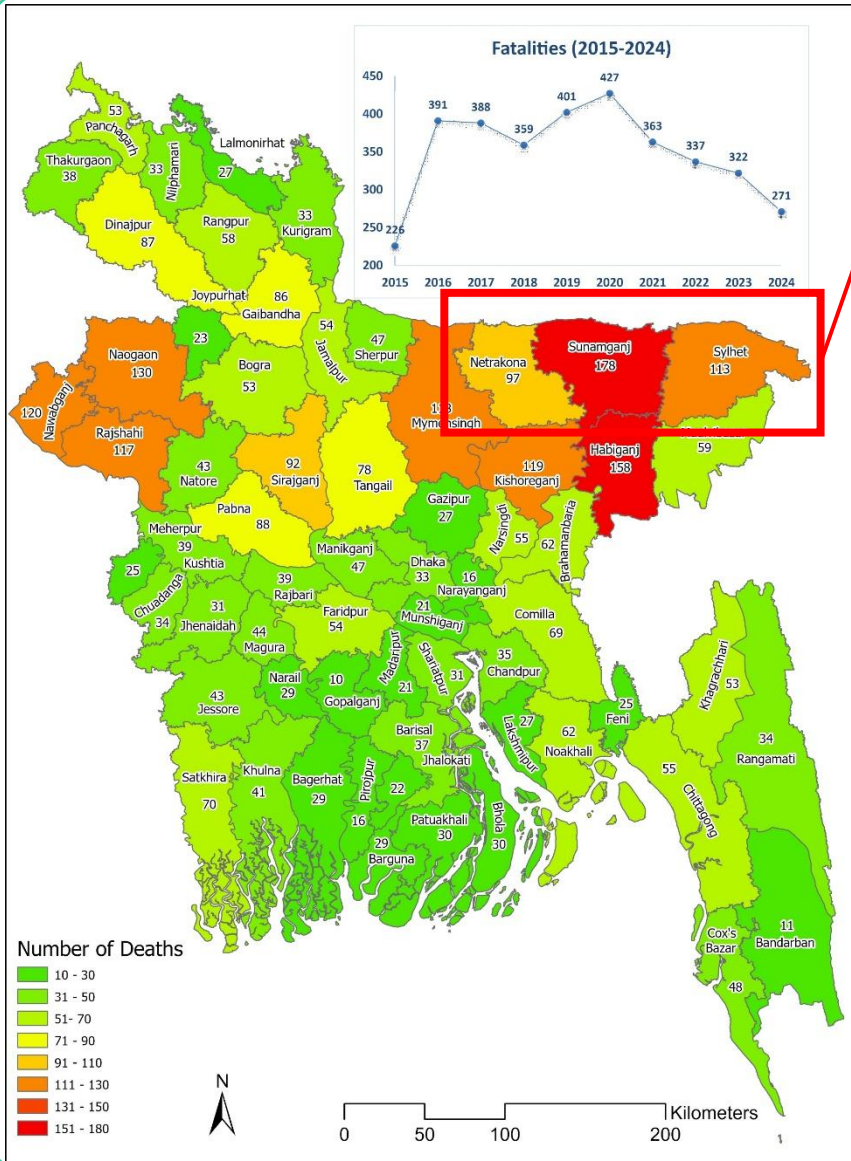
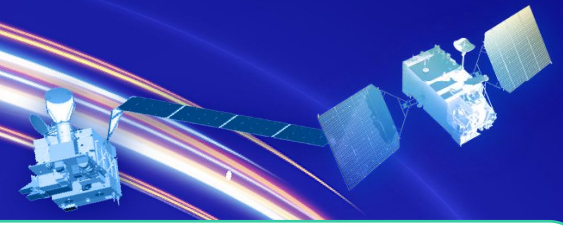
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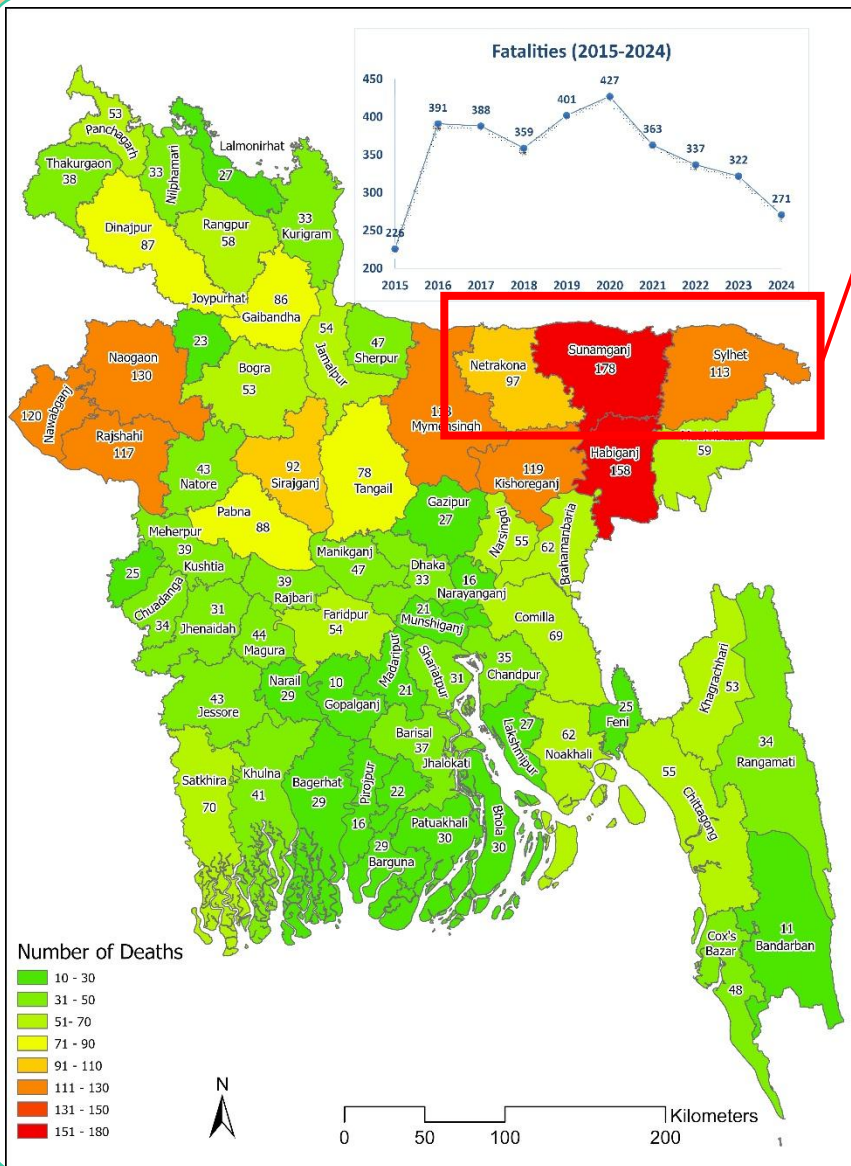
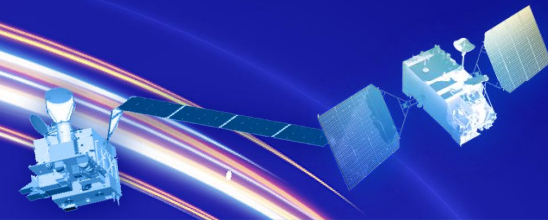
COMMON MISCONCEPTIONS

- Many believe that mobile phones attract lightning.
- Some believe that lightning activity increased after the theft of British-era land survey pillars, which were thought to possess magnetic properties.
- It is commonly believed that rubber-soled shoes or plastic-handled umbrellas can prevent lightning strikes.
- Some people believe it is unsafe to touch someone who has been struck by lightning.



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COMMON BUT UNSAFE PRACTICES

- Farmers continue working in the fields during thunderstorms,
- Fishermen keep fishing even under overhead thunderstorm and some rush to catch more when they see a storm approaching
- Youngsters play outdoor games or fly kites during nearby storms.
- People seek shelter under trees or open sheds.
- Some believe that staying at a certain distance from a tree makes them safe from lightning.
- Some people get stuck while riding cattle during thunderstorms, and others get caught while trying to bring cattle back home.
- In almost all lightning strike cases, victims do not receive CPR or emergency treatment, as community members in rural areas generally lack CPR training and basic first aid knowledge.



Lightning Awareness Program with 3000+ Farmers, Students and others



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Lightning Awareness Program with Students



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বজ্রপাতের মৃত্যু কমানোর জন্য কি কি ব্যবস্থা গ্রহণ করা উচিত?

- বজ্রপাতের মৃত্যু কমানোর জন্য সবচেয়ে গুরুত্বপূর্ণ বিষয় সচেতনতা।
- দেশব্যাপী বিভিন্ন শিক্ষাপ্রতিষ্ঠানে ও কৃষকদেরকে নিয়ে বিভিন্ন সচেতনতামূলক কার্যক্রম পরিচালনা করতে হবে।
- পাঠ্যপুস্তকে বজ্রপাতের সচেতনতামূলক তথ্যসমূহ অন্তর্ভুক্ত করতে হবে।
- ঘরবাড়িতে বিভিন্ন ভবনে দুপূর্ণ যায়গায় বজ্রনিরোধক বসবসাতে হবে। তবে, বজ্রনিরোধক যন্ত্রসমূহ সাধারণত প্রায় ১০০ মিটার বা তার বেশি দূরত্ব থেকে কাজ করে। তাই বাড়িঘর এই যন্ত্রের চেয়ে গুরুত্বপূর্ণ সচেতনতা বৃদ্ধি করা।
- চারদিকে খোলা নয়। বজ্রপাতের সময় খোলা জায়গায় থেকে দূরে সরে আসতে হবে। চারদিকে খোলা এমন আশ্রয়কেন্দ্র বাঁধা।
- বজ্রপাতের পূর্বাভাস। বজ্রপাতের পূর্বাভাস জানতে মানুষের কাছে পৌঁছে দিতে এর সাথে সংশ্লিষ্ট অধিদপ্তর ও প্রতিষ্ঠানে এ আলাদা।
- বজ্রপাতের মৃত্যুর। বজ্রপাতের মৃত্যুর প্রতি বছর কমপক্ষে এপ্রিল থেকে জুন মাস পর্যন্ত জরুরী কার্যক্রম ঘোষণা করা। বজ্রপাতের মৃত্যুর প্রতি বছর কমপক্ষে এপ্রিল থেকে জুন মাস পর্যন্ত জরুরী কার্যক্রম ঘোষণা করা। বজ্রপাতের মৃত্যুর প্রতি বছর কমপক্ষে এপ্রিল থেকে জুন মাস পর্যন্ত জরুরী কার্যক্রম ঘোষণা করা।
- সারা বিশ্বের সাথে মিলে। সারা বিশ্বের সাথে মিলে।

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International Lightning Safety Day
28 June 2025



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Thank You