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Cloud-to-ground Lightning over the Indian Subcontinent

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MOTIVATION

- We examine cloud-to-ground lightning stroke densities over the entire Indian subcontinent using data from the GLD360 for the 2012 – 2016 period. This is the first climatology of cloud-to-ground lightning using lightning network data over this region, to the best of our knowledge.
- A large loss of life due to cloud-to-ground lightning is reported in this region, especially during agricultural activities (Holle 2016).
- India averages 2,234 deaths per year from lightning (Selvi and Rajapandian 2013).
- Bangladesh averages 280 deaths per year from lightning (Dewan et al. 2017); 64 people were killed there in two days in May 2016 (Holle and Islam 2017).

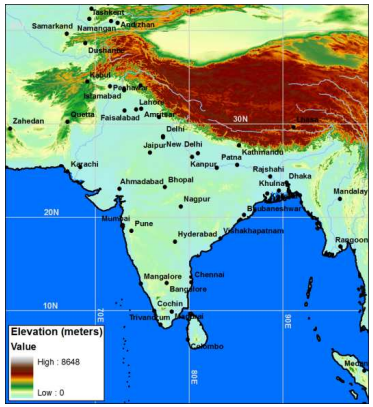
GOAL

Characterize the location, intensity, and time of day and year of the cloud-to-ground lightning threat over the Indian subcontinent to aid in understanding:
--Where to focus safety education to reduce lightning fatalities and injuries,
--Impacts of lightning on power utilities and other infrastructure,
--The meteorological conditions leading to cloud-to-ground lightning.

DATA CHARACTERISTICS

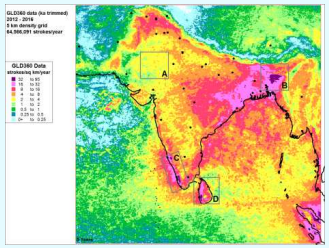
- Strokes with estimated peak currents between -10 kA and +15 kA were excluded from this analysis as they are more likely to be cloud pulses.
- The flash detection efficiency of the GLD360 in this region is expected to be between 60% and 45% during this period. No correction for less than perfect detection efficiency was applied to the data used in this study.
- Location accuracy: 5 to 8 km (Said et al. 2013; Said and Murphy 2016).

STUDY DOMAIN



ANNUAL CLOUD-TO-GROUND STROKE DENSITY

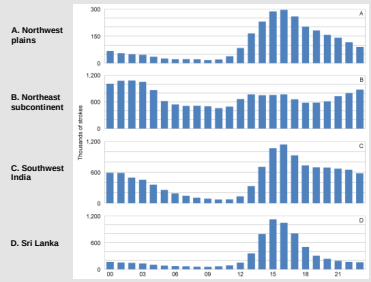
2012-2016



Annual conclusions

- Largest stroke densities are in the northeast subcontinent (included in Region B), southwest India (included in Region C), western Sri Lanka (included in Region D), and the northwest base of the Himalayas
- Very sharp cutoff to the north of the Himalayas
- Extensive lightning over the northern Indian Ocean

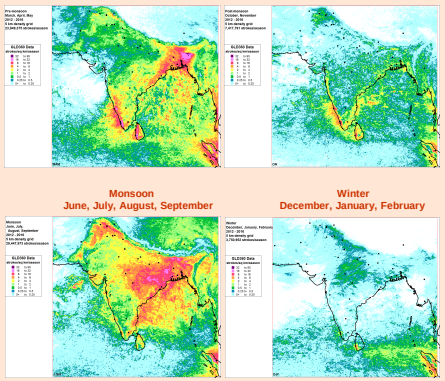
DIURNAL VARIATIONS



Diurnal conclusions

- Most lightning is between late morning and late afternoon
- The northeast subcontinent lightning is widely spread across all hours, with minor maxima in the afternoon and during the night compared with stronger afternoon peaks at the other three locations

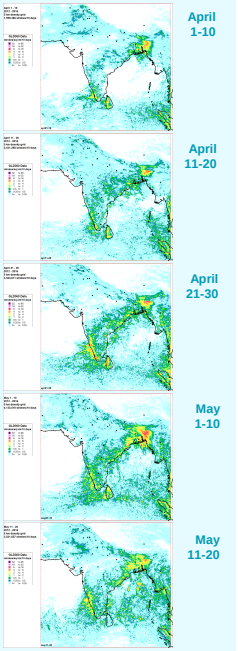
SEASONS



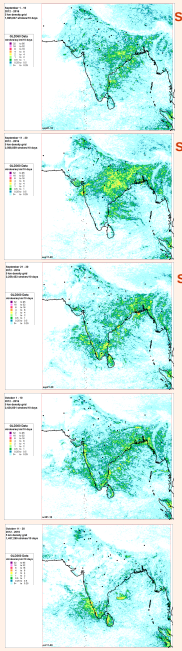
Seasonal conclusions

- The largest coverage of moderate cloud-to-ground lightning is during the monsoon season
- Significant lightning is occurring in the south and east during the pre-monsoon months
- Winter has the least lightning although westerly disturbances may bring widespread rain (Selvi and Rajapandian 2016)

PRE-MONSOON MIGRATION



MONSOON RETREAT



Monsoon migration conclusions

Pre-monsoon

Lightning spreads northwest and grows in intensity, but is present through the period in northeast

Post-monsoon

Sporadic retreat but lightning continues along coastlines into October

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