

Specialized Applications of Lightning Data: Tropical Cyclones and Volcanoes

Chris Vagasky

20 May 2021

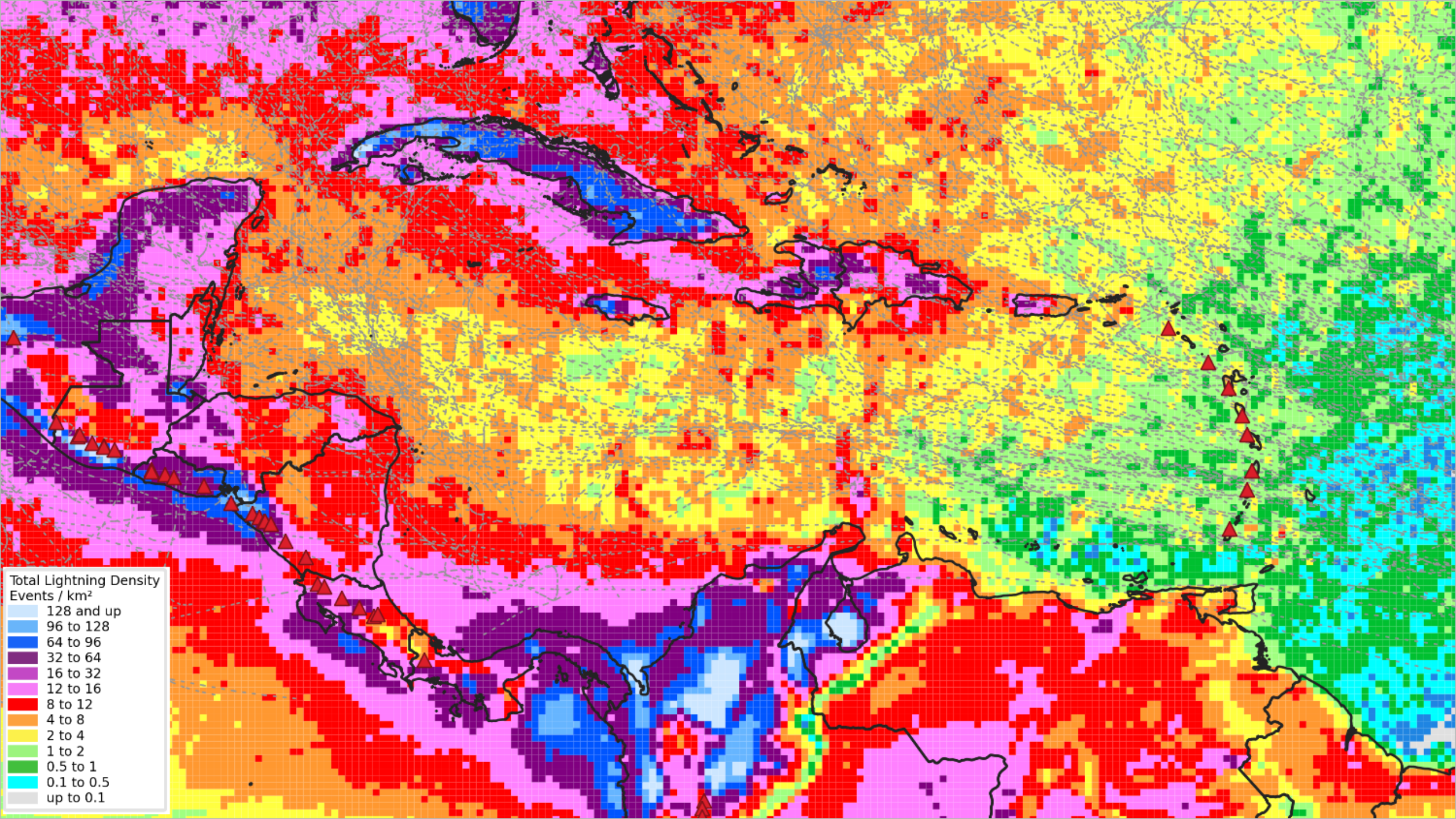
CMO/WMO Symposium on Lightning and Lightning
Safety Awareness

Why detect lightning?

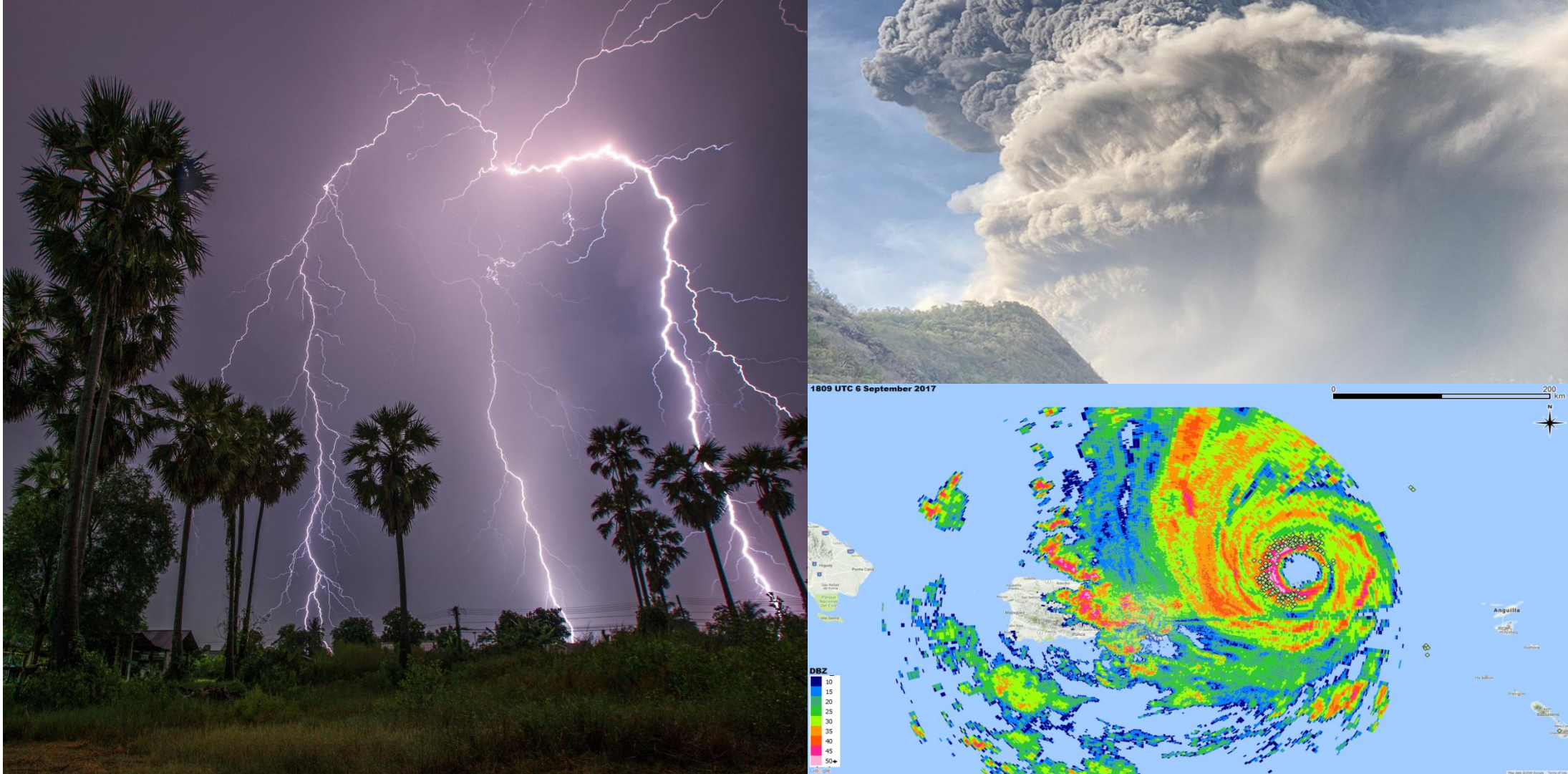
- Severe weather monitoring
- Protection of life and property
- Improve management of operations
- Reduce costly downtime
- Improve operations & efficiency



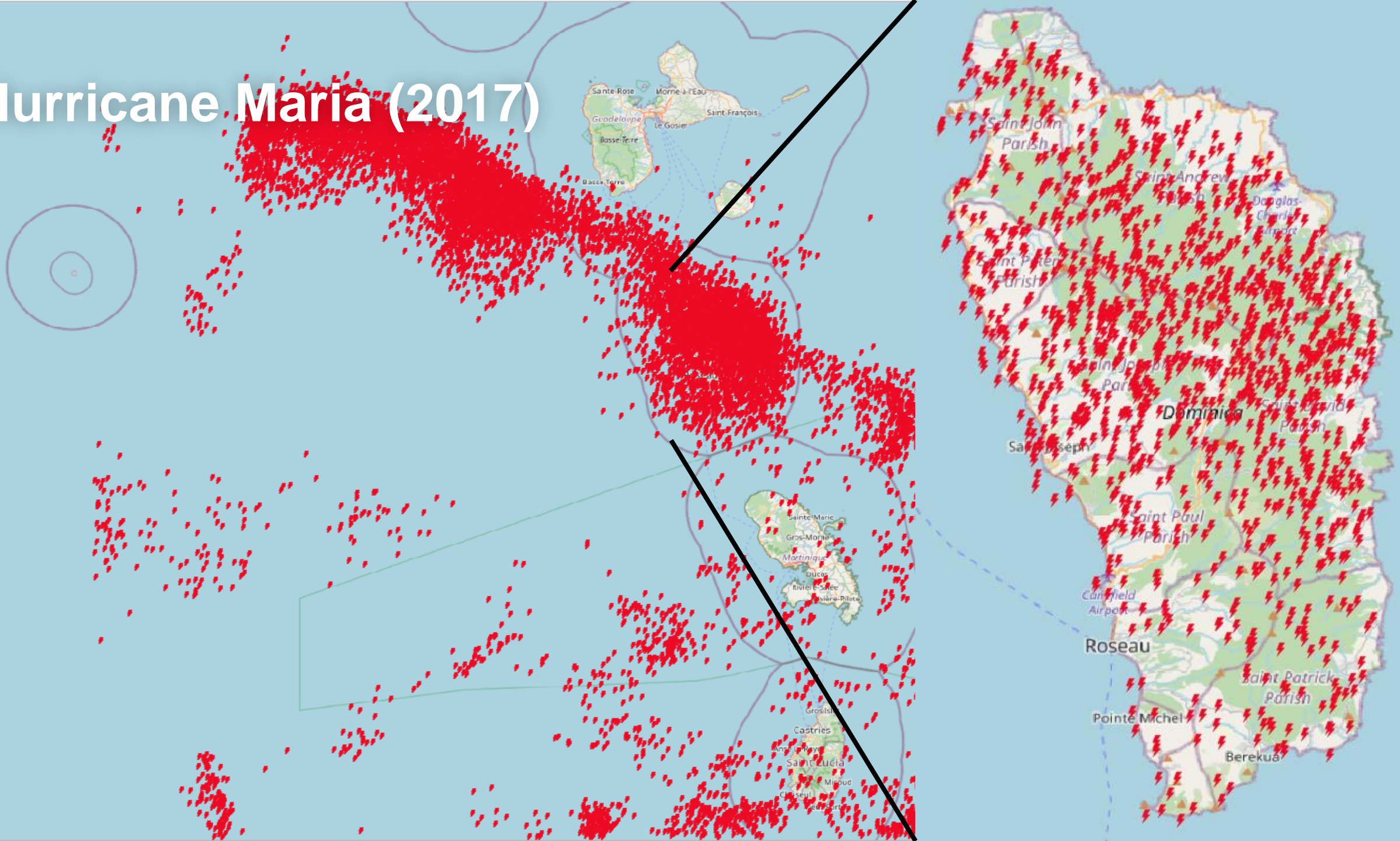
You could teach a semester's long course on this subject, so this is more of an overview



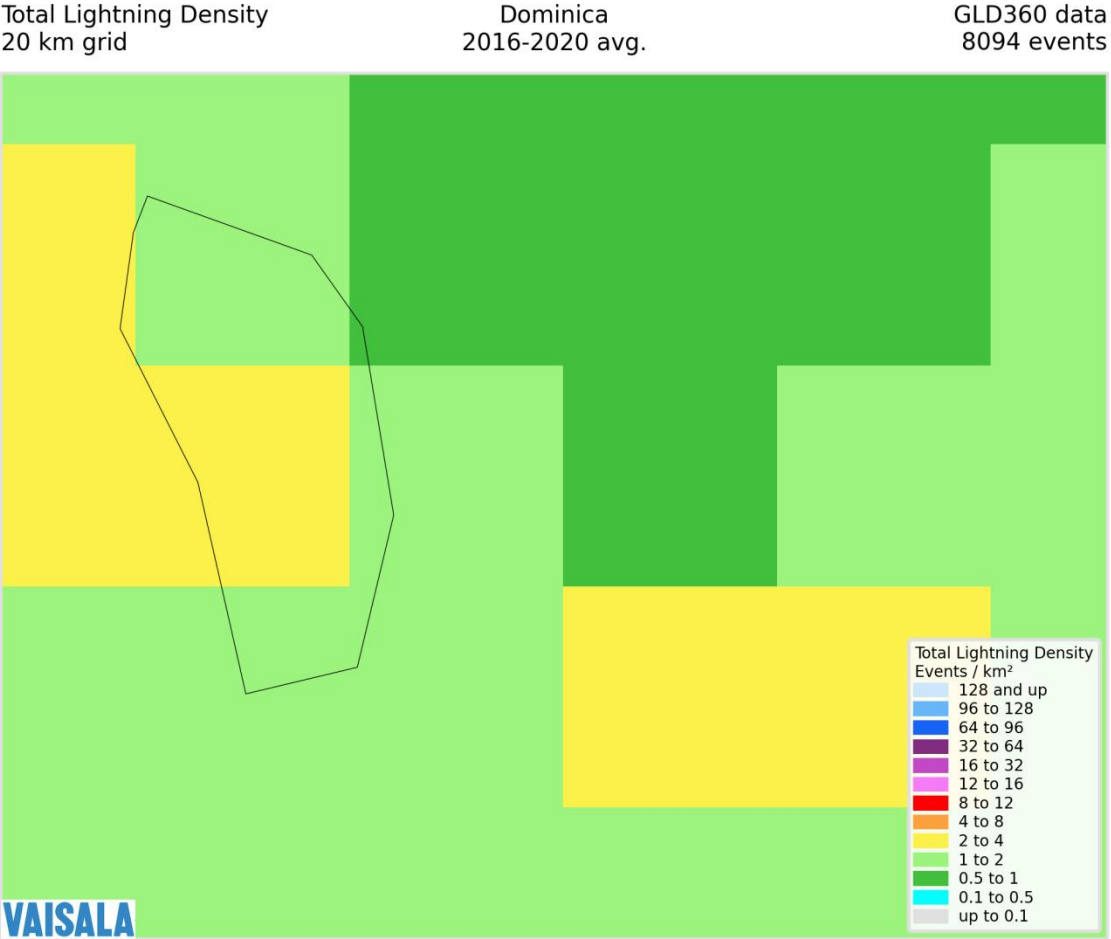
The Caribbean and Central America has a lot of:



Hurricane Maria (2017)



Dominica

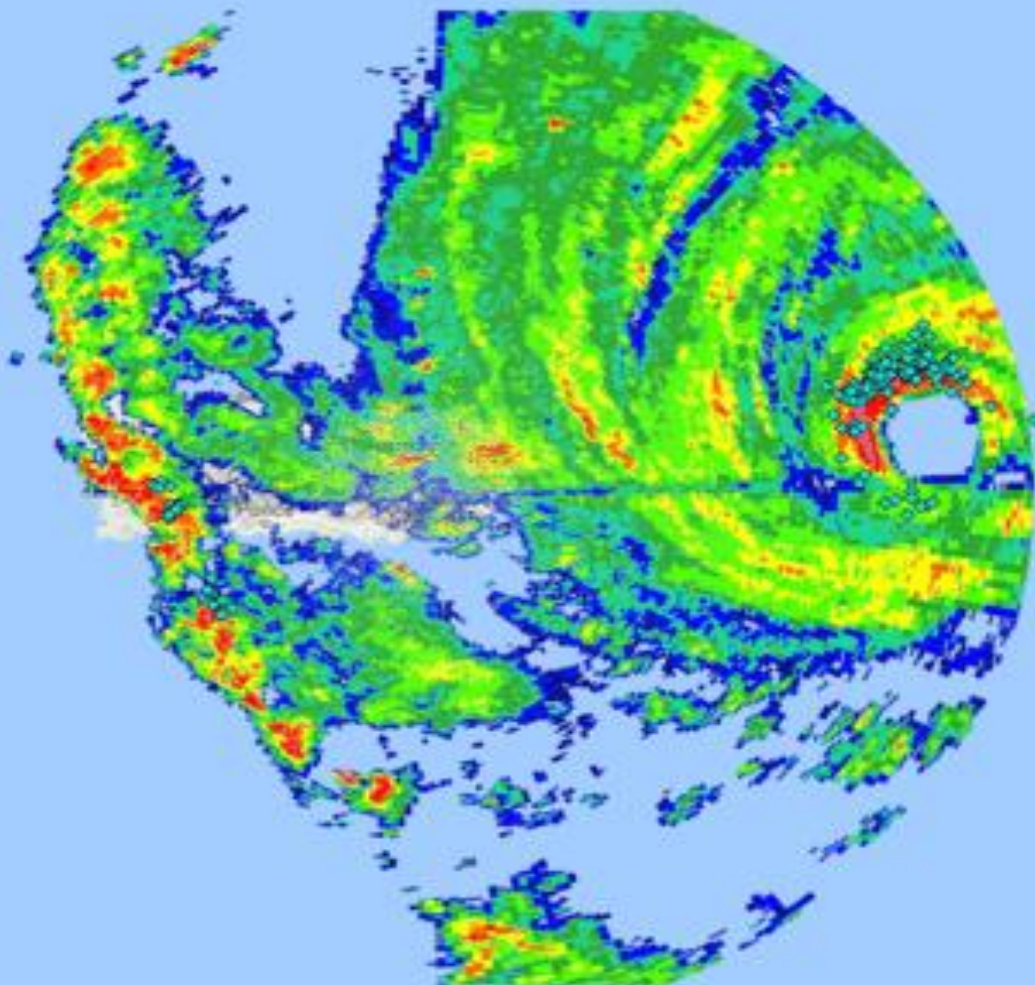


- Average 1600 lightning events per year
- In just 16 hours during Hurricane Maria, 1139 lightning events detected
- Almost a year's worth of lightning in less than a day!

Lightning is related to stronger convection in the system

- Tropical waves with more lightning are more likely to develop
- Lightning location is critical to understanding the structure of the system
- Inner core and rainband lightning can be related to intensity changes
- Lightning helps identify regions in the rainbands with heavier rain, stronger wind, and possible tornadoes

Enveloped Eyewall Lightning



Enveloped Eyewall Lightning is a special case of tropical cyclone lightning

- The EEL Signature is persistent lightning wrapping the eyewall of strong tropical cyclones for a minimum of 6 hours
- Typically found in Category 4 and 5 hurricanes, with their peak intensity occurring when the EEL Signature is present
- Hurricanes with the EEL Signature tend to be stronger than hurricanes without
- Journal of Operational Meteorology article:
<https://doi.org/10.15191/nwajom.2017.0514>

La Soufrière Eruption

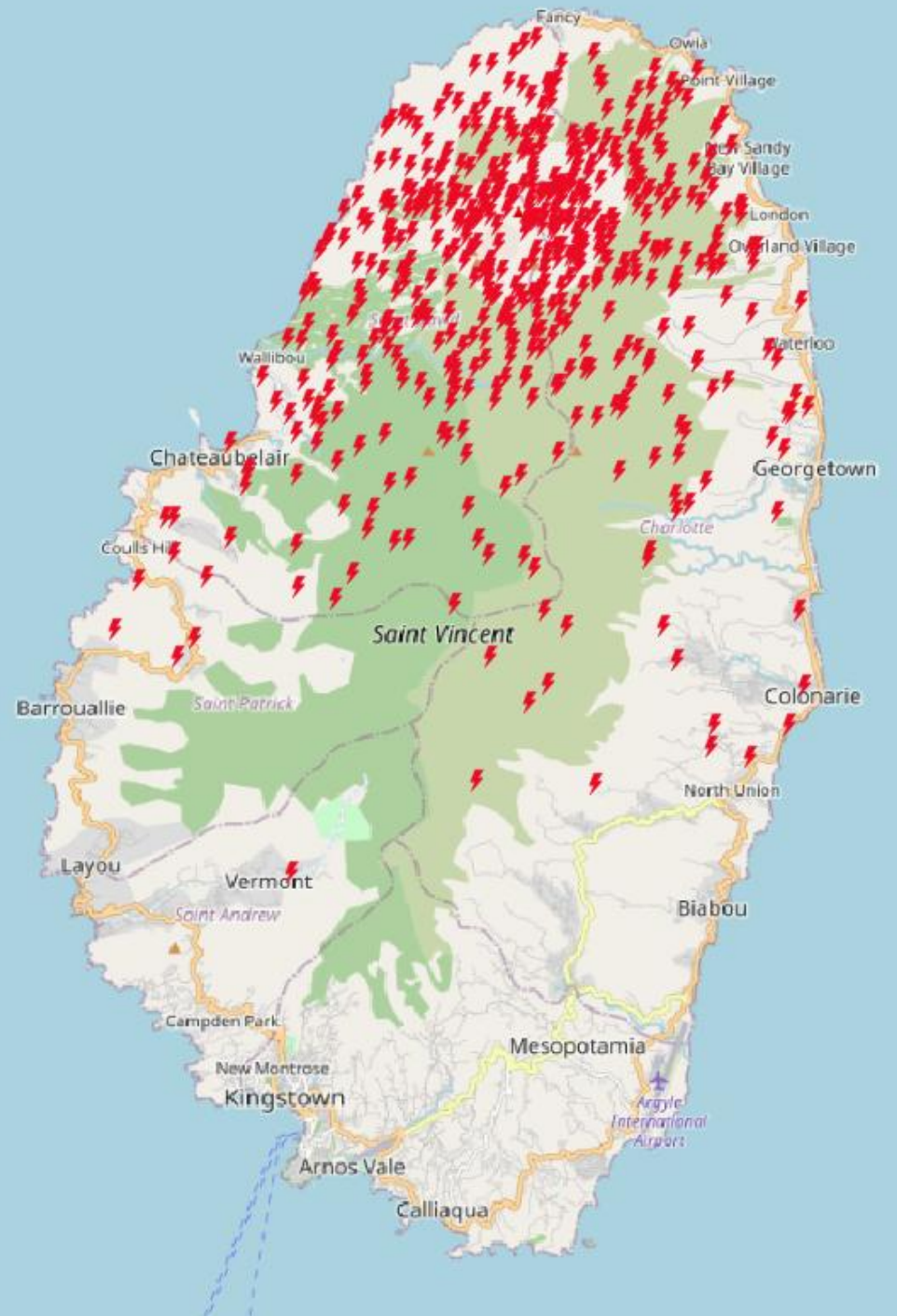
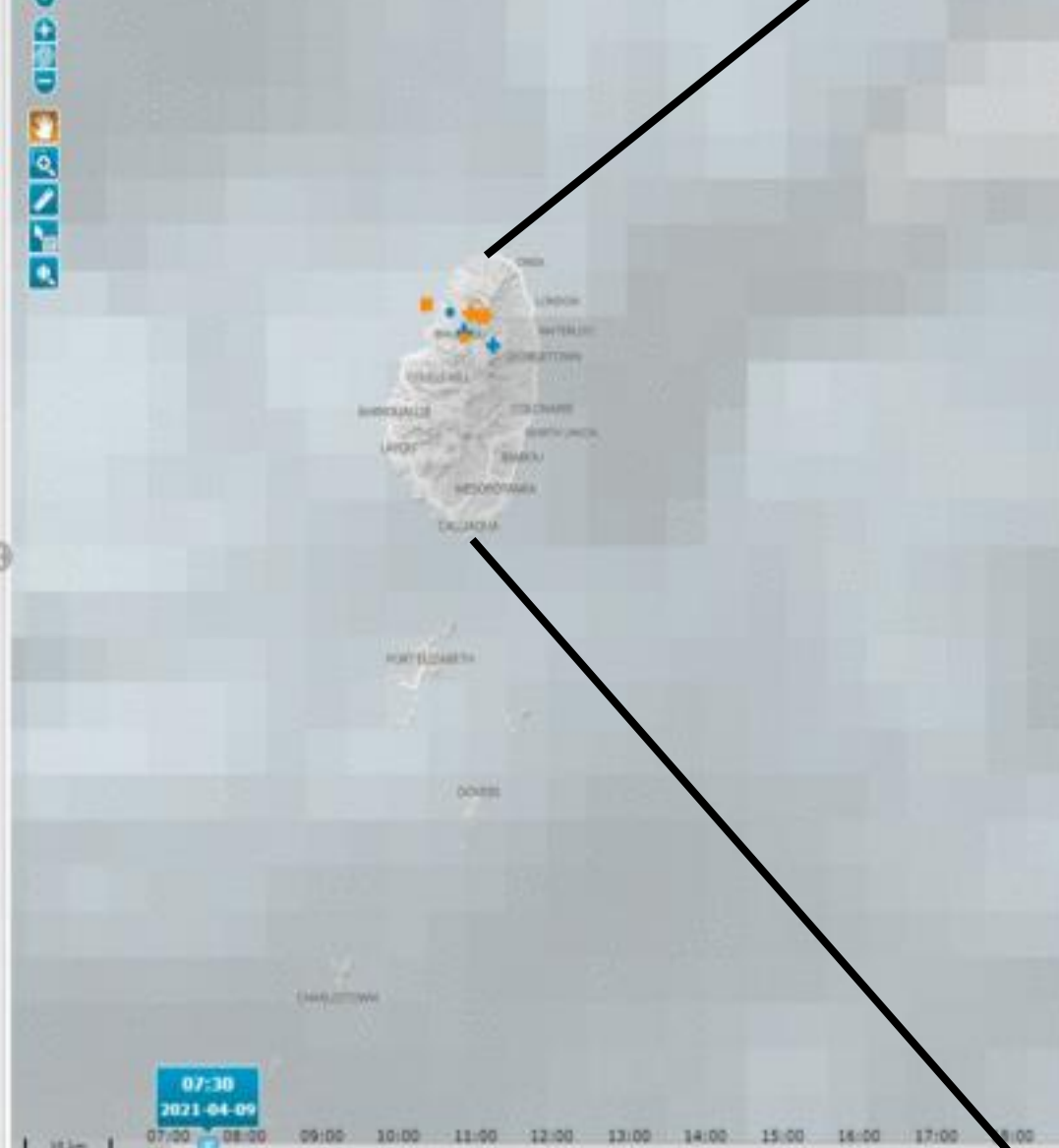
Layer All Lightning

Opacity 10 40 70 100

- 0 min to 15 min
- 15 min to 30 min
- 30 min to 60 min
- 60 min to 90 min
- 90 min to 120 min

- Positive
- Negative
- Cloud

- Storm Intensity
- Lightning Threat Zone
- METAR
- Weather Hazards
- US Radar
- Foreca Radar
- Satellite

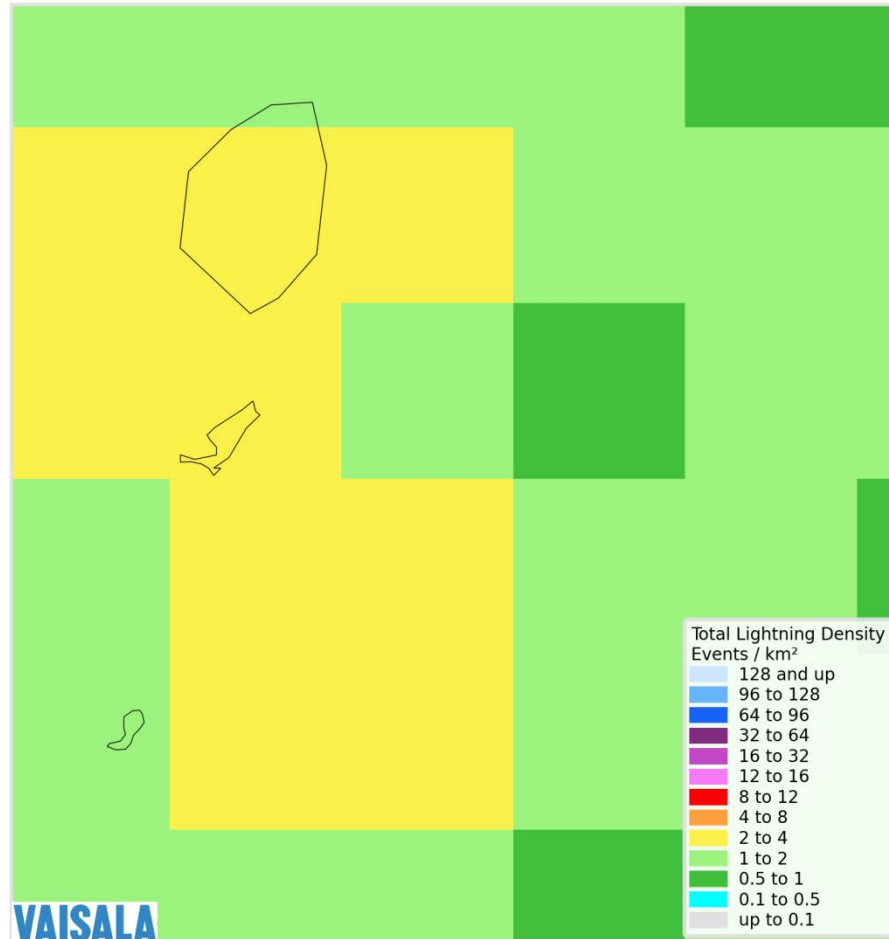


Saint Vincent

Total Lightning Density
20 km grid

St. Vin. and Gren.
2016-2020 avg.

GLD360 data
5813 events



- Average 1200 lightning events per year
- During weeklong eruption, more than 500 lightning events on the island
- 1400 lightning events near the island
- A year of lightning in a week

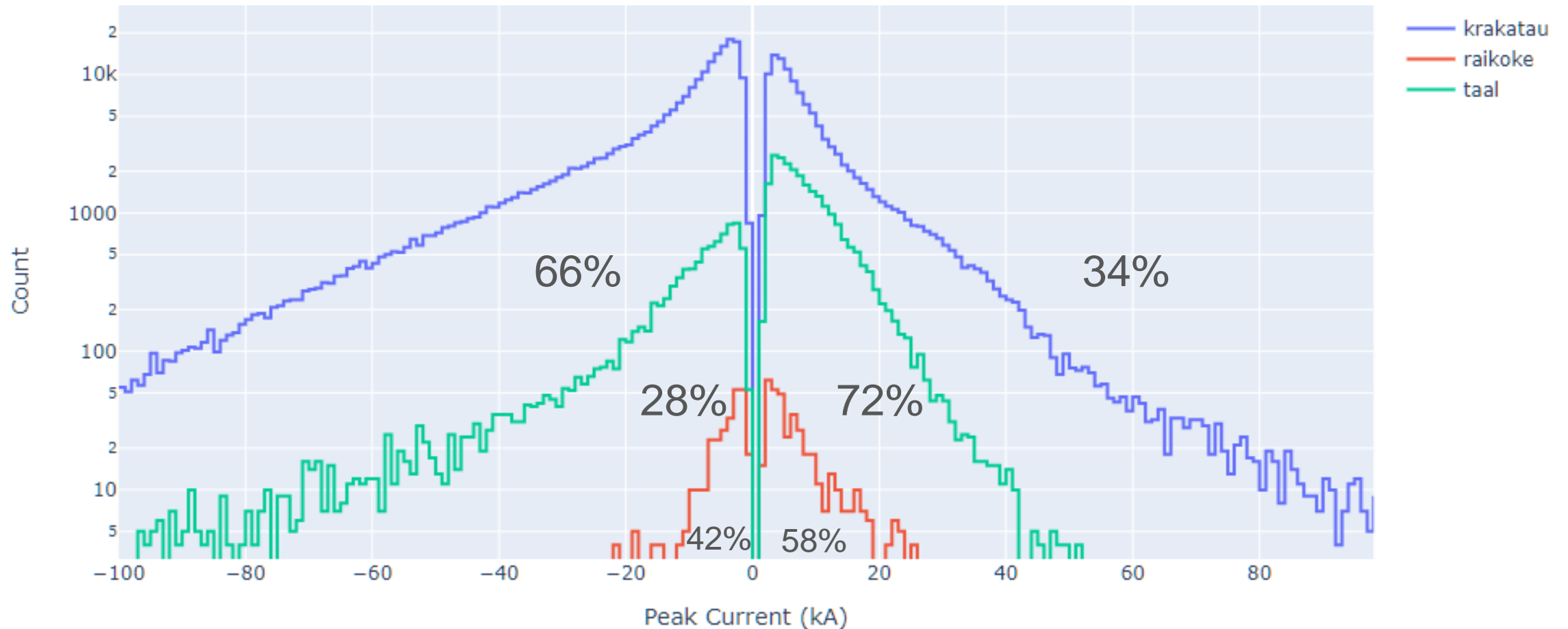
Volcanoes bring an assortment of hazards

- Tephra and ash can damage infrastructure, crops, and transportation systems
- Lahars cause destruction to infrastructure and environmental damage
- Pyroclastic flows destroy nearly everything in their path

Lightning data is an additional tool for monitoring volcanoes

- In the La Soufrière eruption, each explosive event produced lightning that was detectable by GLD360
- Real-time lightning data is available within 35 seconds of lightning being detected
- Most satellite data updates at 1, 5, or 15 minute intervals
- At least 25 seconds more lead time for volcanic eruptions that produce lightning

Each volcanic lightning event is a little different from the previous one



Summary

- The Caribbean and Central America are no strangers to lightning, tropical cyclones, and volcanoes
- These events can produce a lot of lightning in a short period of time, adding a secondary hazard
- Real-time lightning data supports hurricane forecasting operation and post-storm analysis
- Real-time lightning data is an additional tool for volcanic eruption monitoring and geological analysis

Email: chris.vagasky@vaisala.com

Phone: 720-304-4421