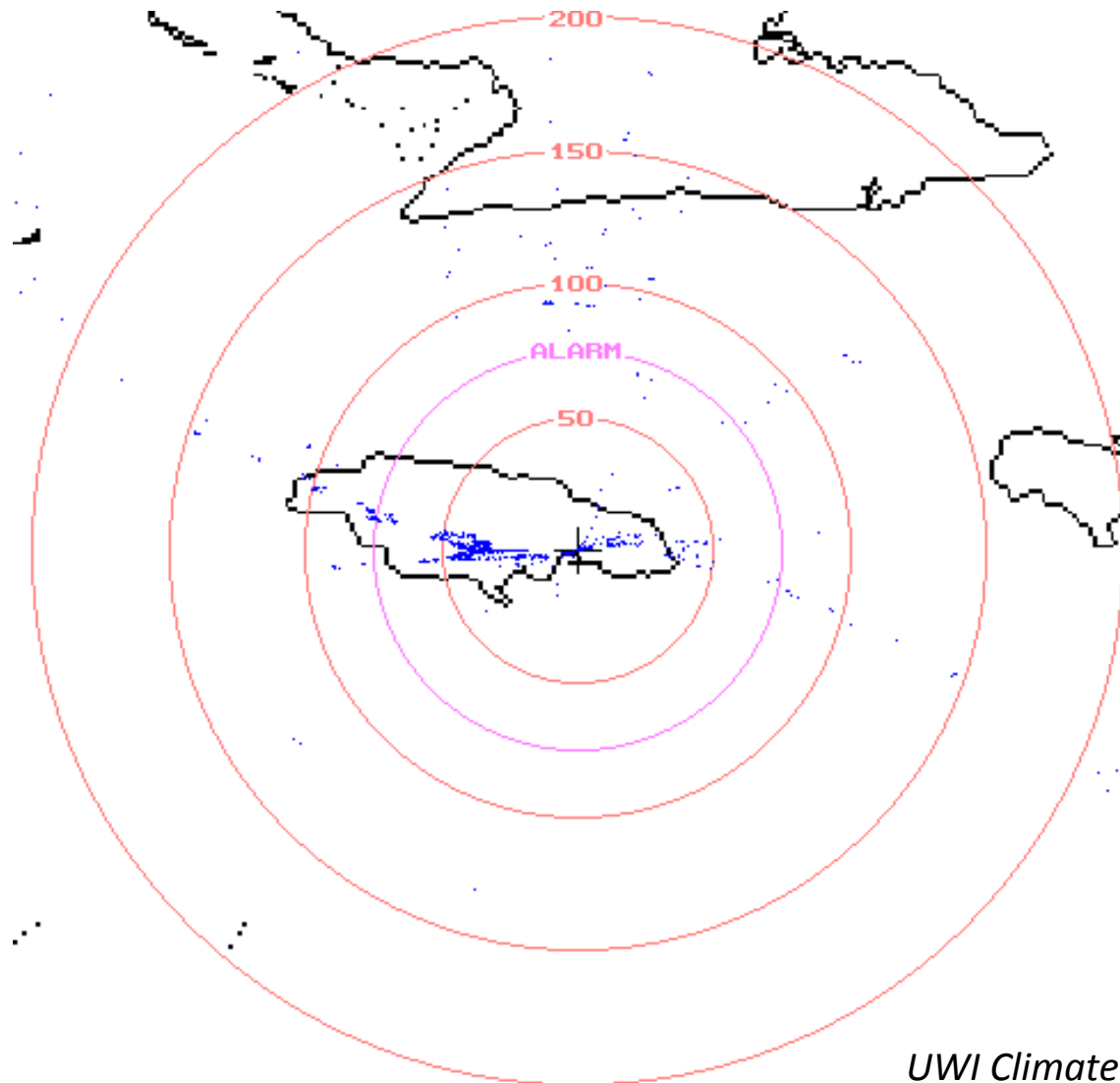


AN INVESTIGATION OF LIGHTNING STRIKES OVER JAMAICA



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D. Walwyn

T. S. Stephenson

UWI Climate Studies Group at Mona

OUTLINE

- Introduction
 - Motivation
 - Objectives
- Data
 - Lightning Data
 - Radiosonde Data
- Data Analysis
 - Temporal and Spatial Lightning Variation
 - Prediction of Lightning Occurrence
- Conclusions
- Next Steps
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WHAT IS LIGHTNING?

- **Introduction**
- **Data**
- **Data Analysis**
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Wind Shear

Instability

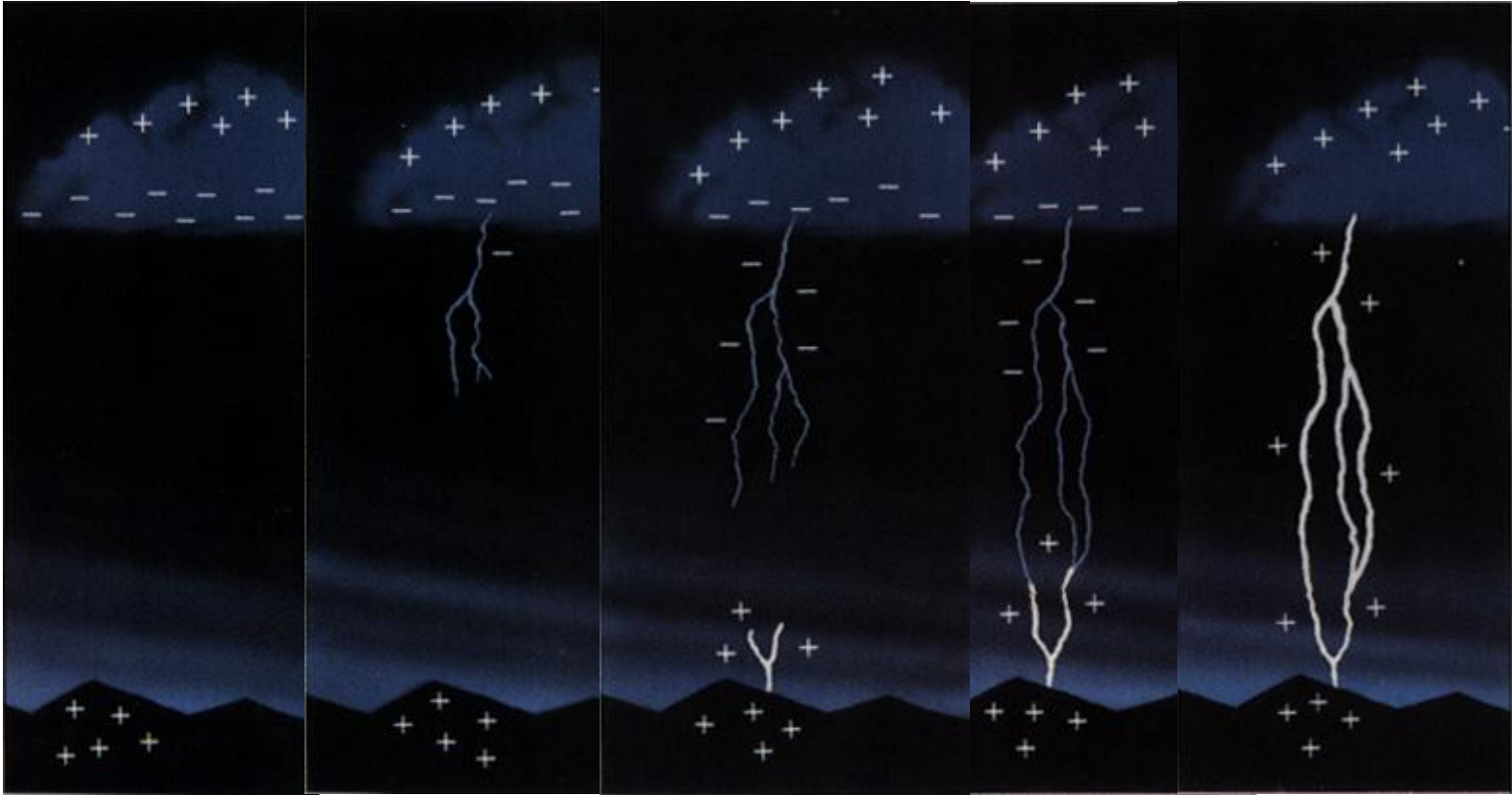
Moisture

Lift



FORMATION OF LIGHTNING

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Motivation

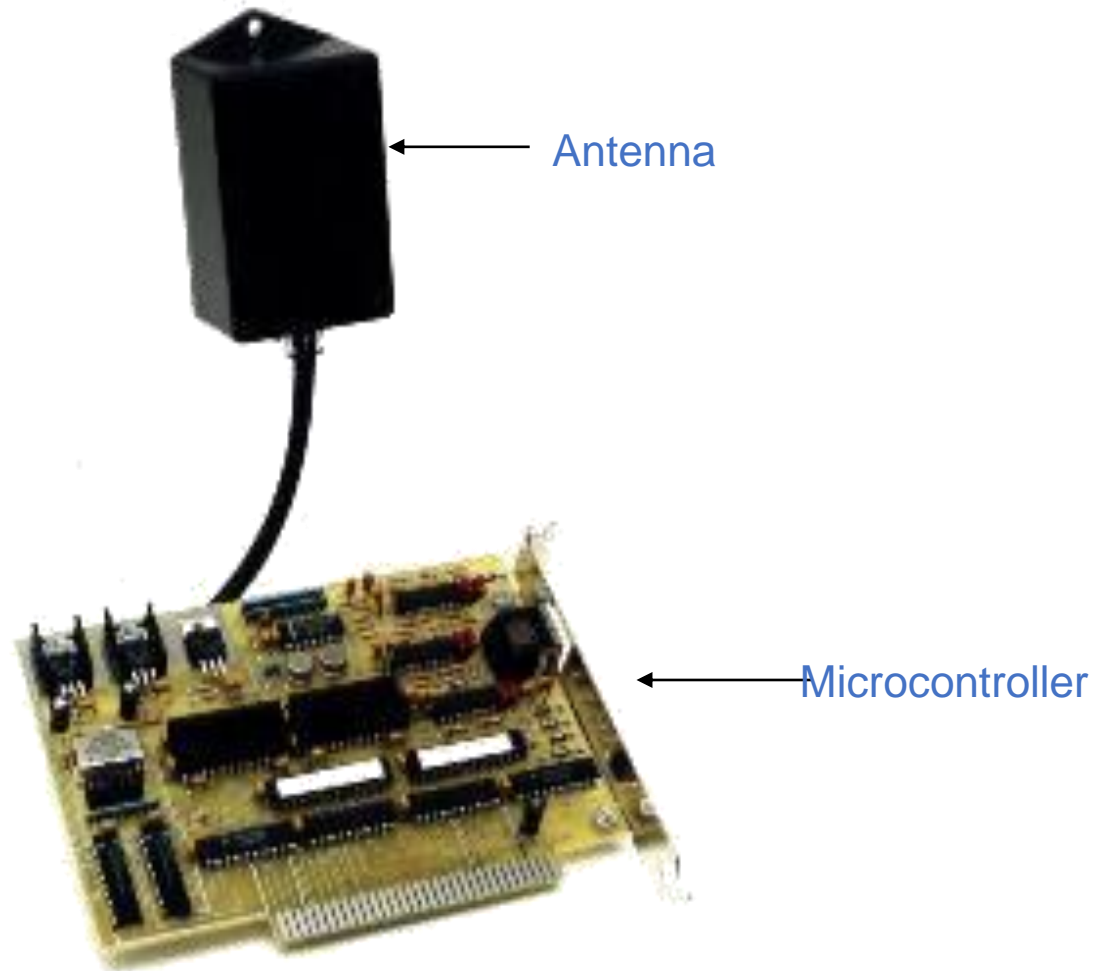
- **Introduction**
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 - **References**
- 78% of global lightning production occurs in the 30°S–30°N band (Christian et al. 2003), which includes Jamaica, located at 18.15N.
 - While lightning events are widely studied throughout the world, there is very little documented work done in the Caribbean.
 - The only recorded study prior to this one with respect to Jamaica was done by Coy in 2001

Objectives

- **Introduction**
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- Determine the **temporal variations** of lightning over the island.
 - Investigate the **spatial variations** of lightning across the island and offshore.
 - Develop predictive models for lightning occurrence over land **up to $2^{1/4}$** days in advance.

Lightning Data

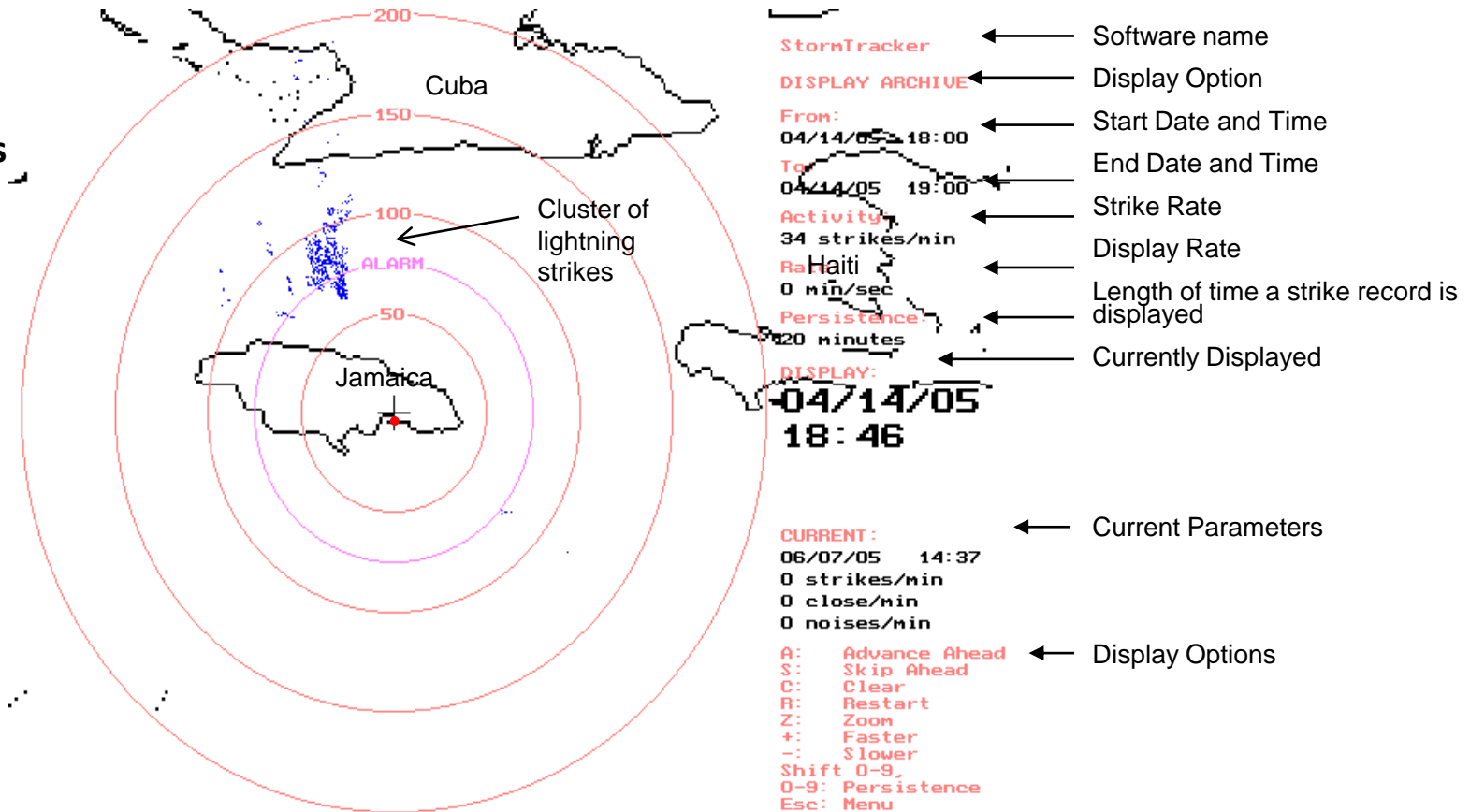
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Storm Tracker

STORM TRACKER DISPLAY

- Introduction
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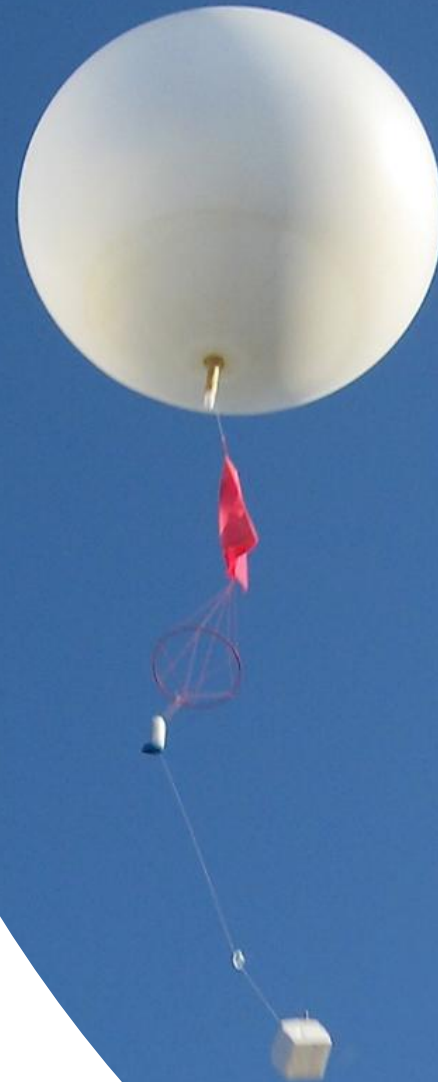


Radiosonde Data

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1200 UTC Soundings from Norman Manley International Airport, Kingston (MKJP)

Convective Indices - thunderstorm potential - Measure lift, moisture, instability, wind shear, e.g., Lifted Index, Convective Available Potential Energy (CAPE), K-Index, Equivalent Potential Temperature



DATA

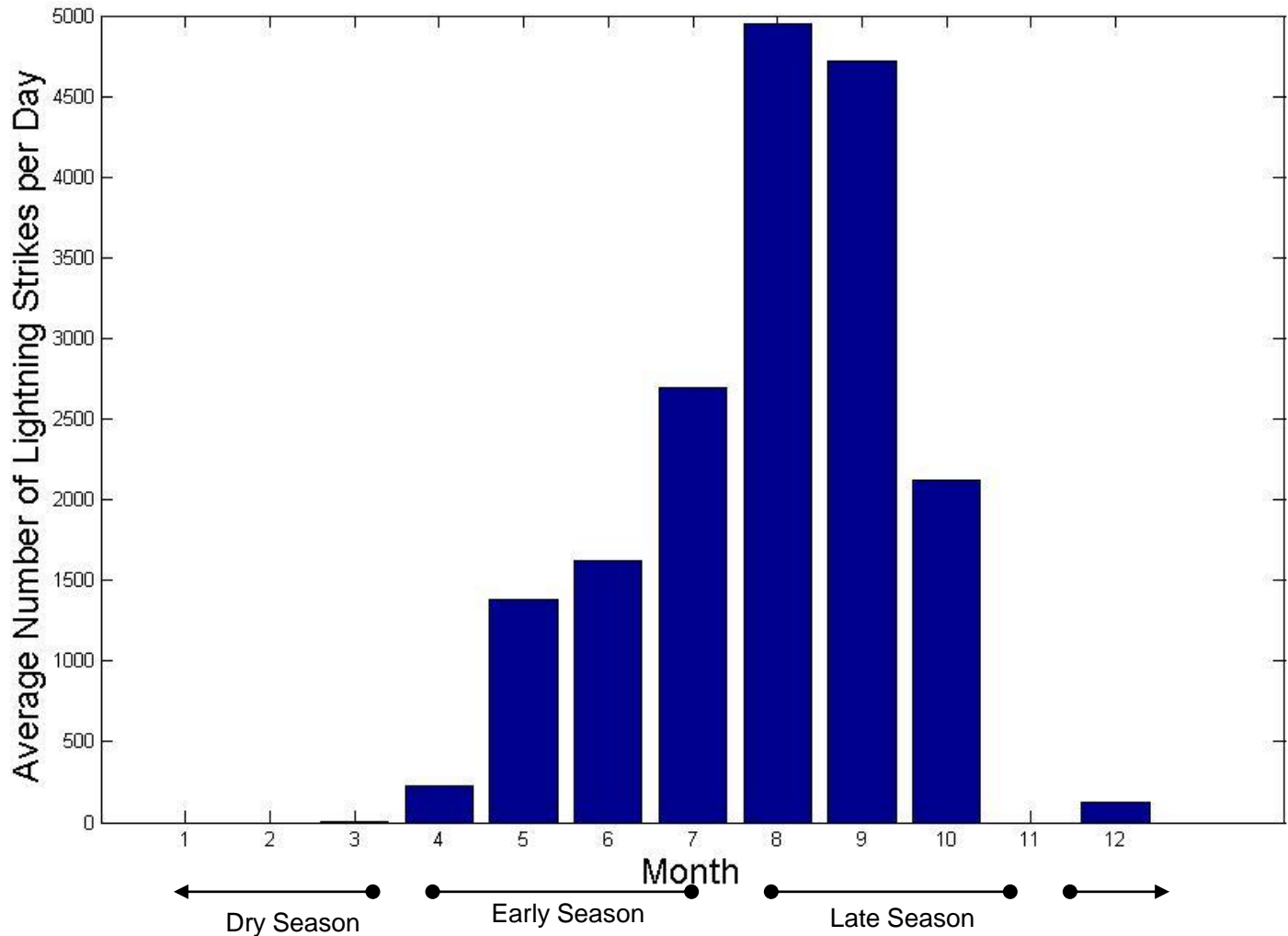
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- **References**

Lightning data and Radiosonde data for the periods

- September 1998 to December 1998
- May 1999 to November 1999
- November 2004 to October 2005

TEMPORAL AND SPATIAL VARIATIONS

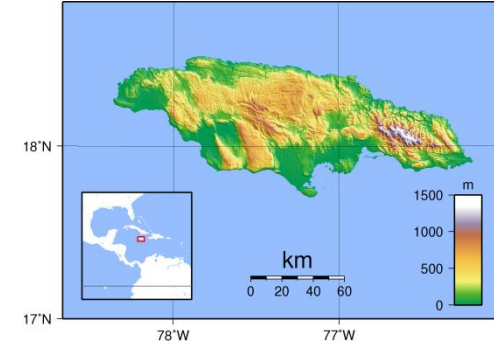
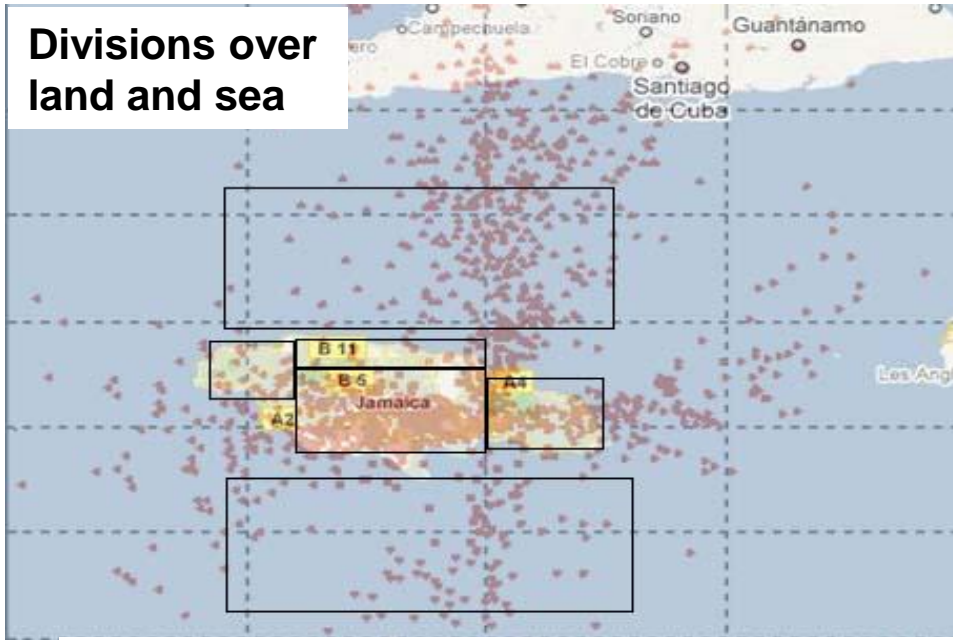
Average number of lightning strikes per day for each month



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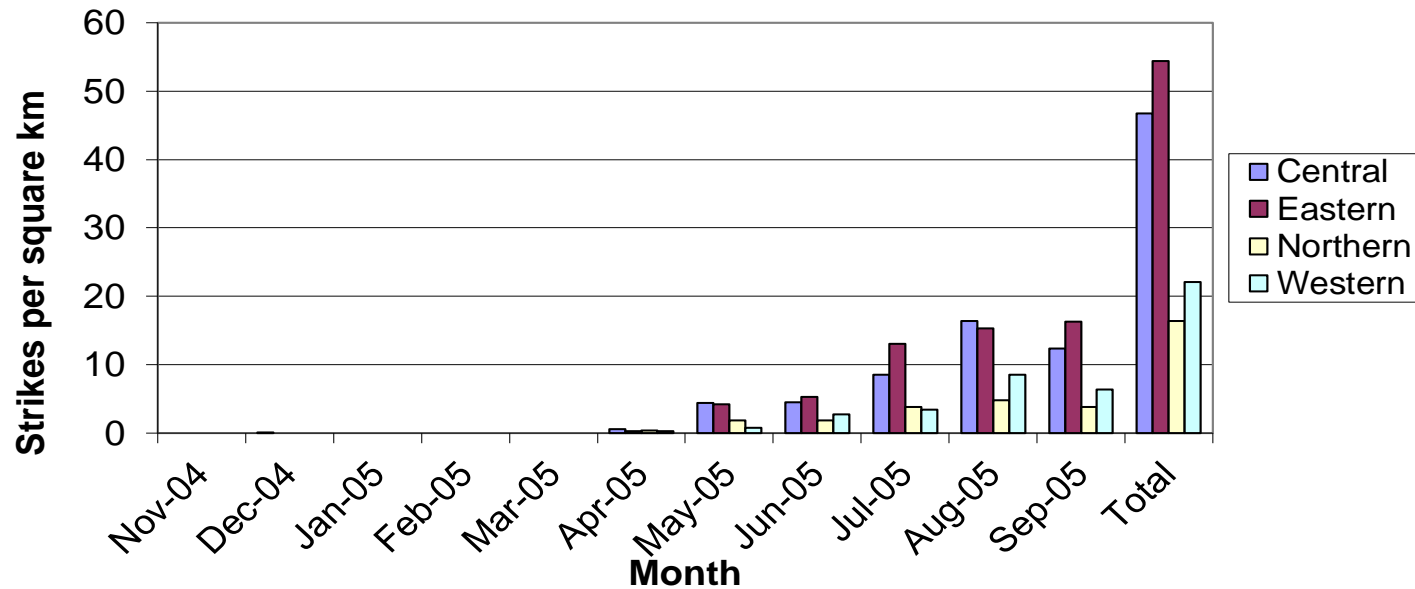
TEMPORAL AND SPATIAL VARIATIONS

Divisions over land and sea



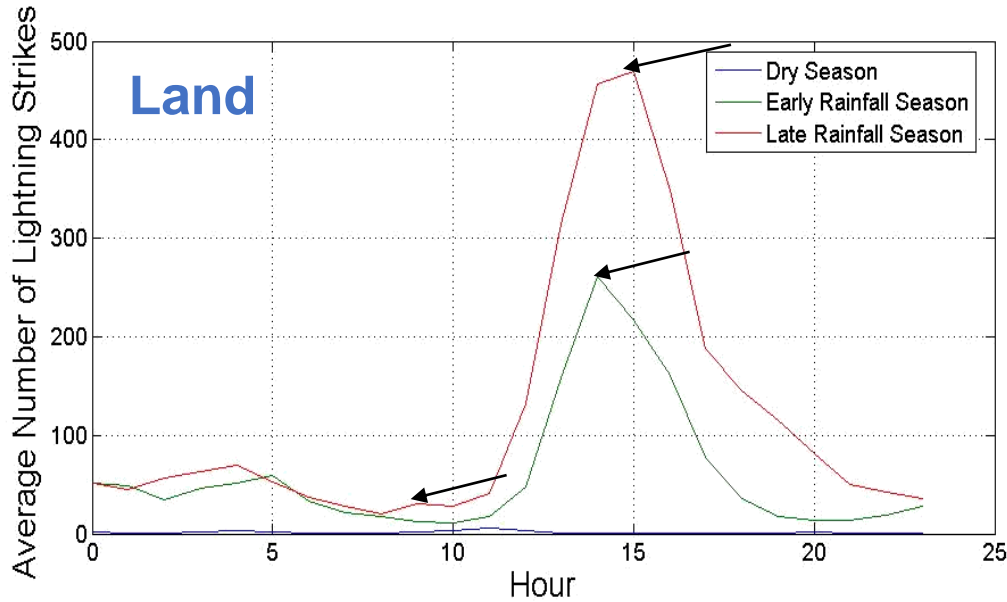
- Introduction
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Strike intensity per square km over land

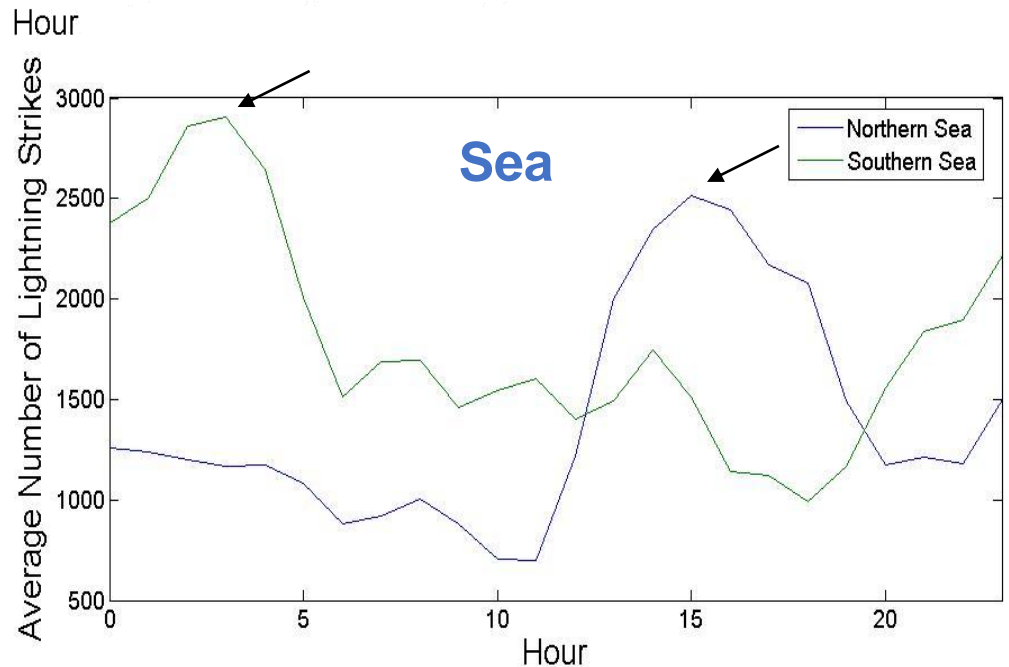


TEMPORAL AND SPATIAL VARIATIONS

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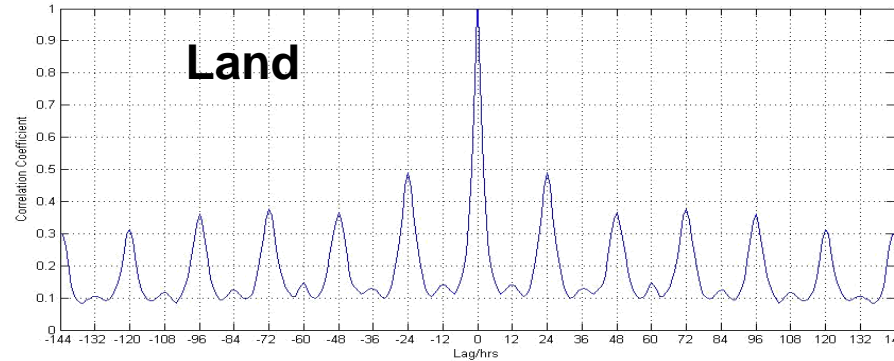


Average number of strikes per hour by rainfall season over land (above) and for each sea division (below)

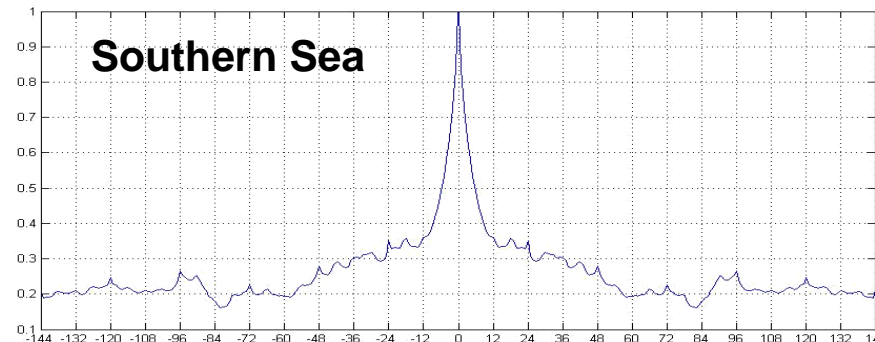
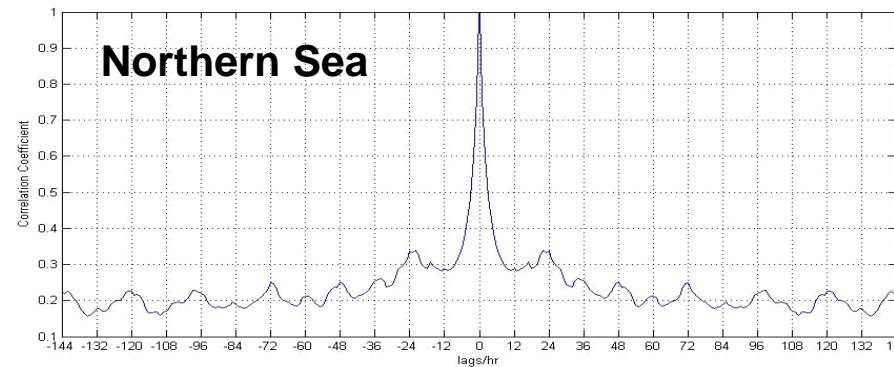


TEMPORAL AND SPATIAL VARIATIONS

Autocorrelation of hourly lightning data from November 2004 to October 2005



Significant correlation for lag of ± 24 hr, repeated every 24hrs

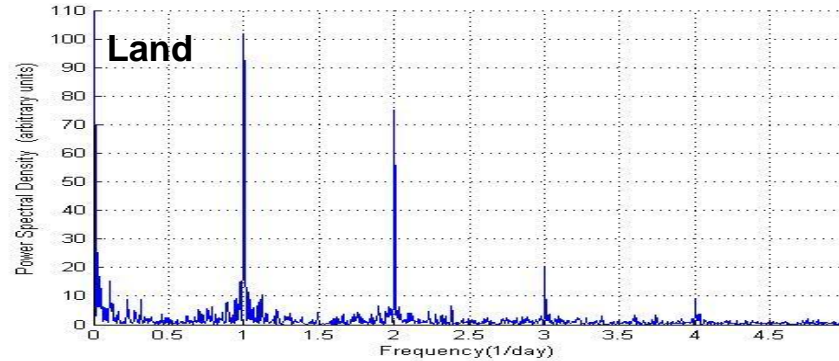


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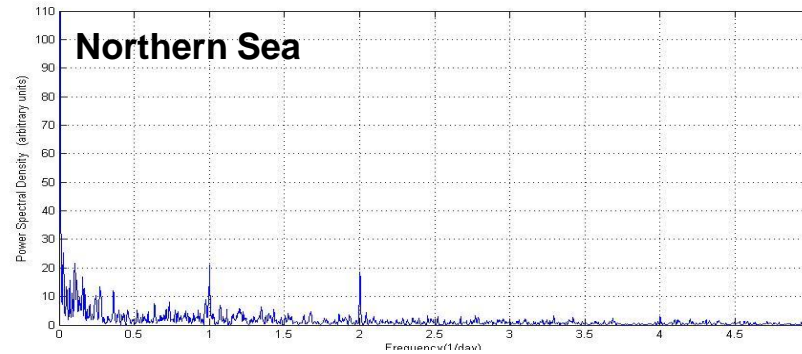
TEMPORAL AND SPATIAL VARIATIONS

Absolute Values of the Fourier Transform for the Autocorrelation of the Hourly Time Data

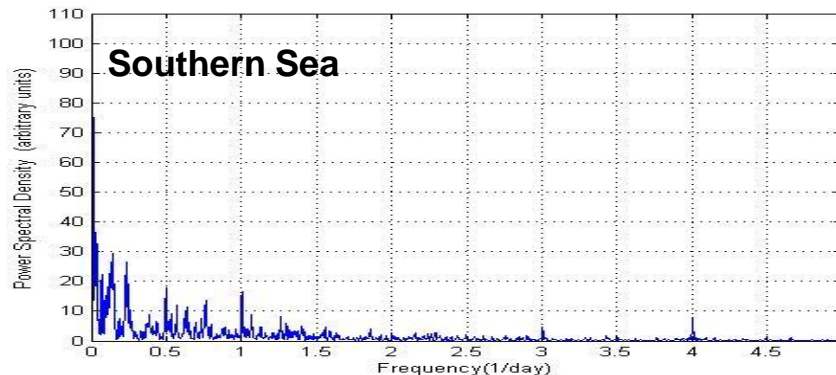
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Strong spectral lines corresponding to 1day, $\frac{1}{2}$ day, $\frac{1}{3}$ day and $\frac{1}{4}$ day



1day and $\frac{1}{2}$ day



Noisy, convection not as predictable day-to-day

PREDICTION OF LIGHTNING OCCURRENCE

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Persistence Variable

>1000	Active	2
1-999	Inactive	1
0	Zero	0



PREDICTION OF LIGHTNING OCCURRENCE

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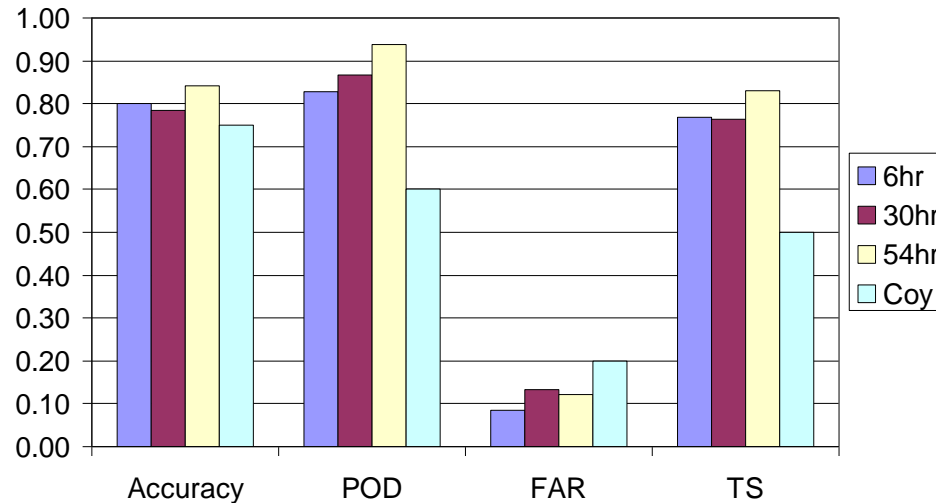
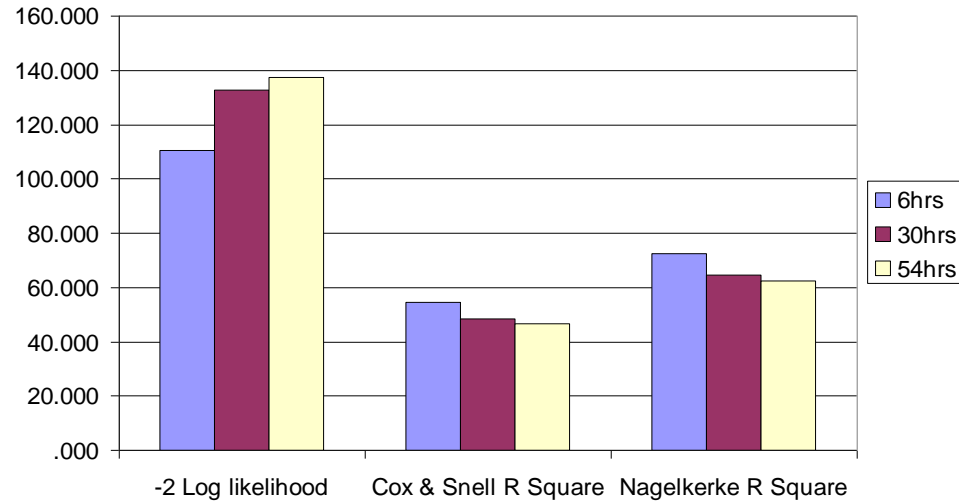
Correlation with Lightning Occurrence

Atmospheric Index	6hrs	30hrs	54hrs
DayPersis012	.770	.653	.653
NightPersis012	.616	.611	.624
LI	-.596	-.586	-.581
CAPE	.501	.418	.490
500DD	-.473	-.472	-.465
850EPT	.465	.493	.433
700EPT	.461	.451	.428
700RH	.453	.453	.409
KI	.441	.488	.414

PREDICTION OF LIGHTNING OCCURRENCE

Variance Explained and Skills scores for validation samples (below)

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Models' skill scores improved relative to Coy study

Conclusions

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- Diurnal variations over land
 - Distinct 12hr and 24 hr cycles were observed.
 - Strike intensity displayed a broad minimum from 1100UTC to 1500UTC (6-10am local) and peaks between 1900UTC and 2100UTC (2-4 pm local).
- Diurnal variations over sea
 - Northern sea division displays an afternoon peak.
 - Southern sea division more characteristically displays a single nighttime peak.
- Seasonal Variations
 - Average daily and hourly lightning activity is greatest during the late rainfall season and least during the dry season.
- Lightning occurs predominantly to the east and centre of the island.

Conclusions

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- The most significant indices for predicting lightning occurrence are:
 - Lifted Index
 - K Index
 - Daytime Persistence of Lightning
 - Nighttime persistence of Lightning
- Persistence improves the performance of the model indicated by an increase in the Critical Success Index from 0.50 for Coy to 0.77 for this study

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MetServiceJA @MetserviceJA · Jul 16

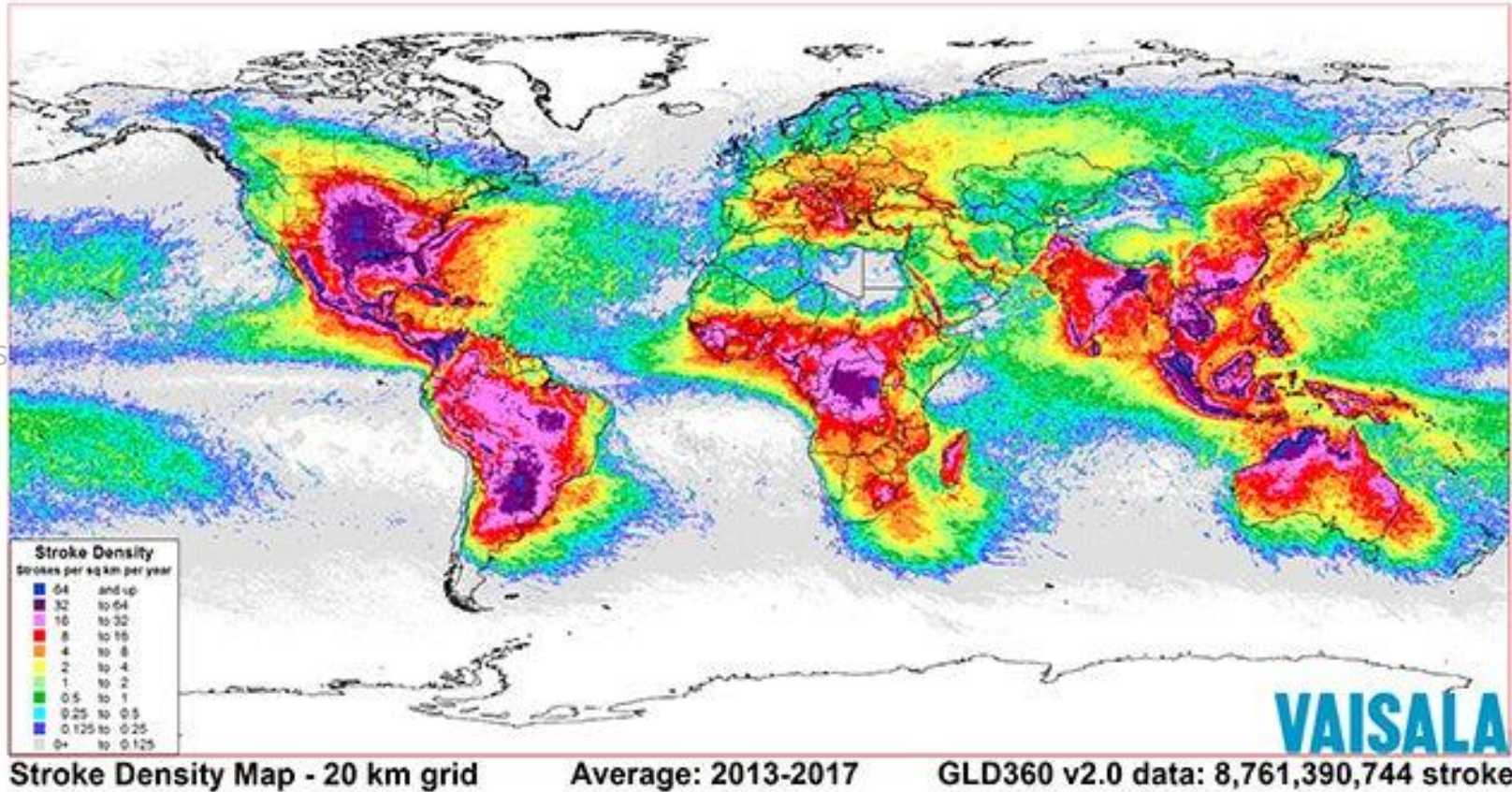
The **#LightningForum**, hosted by the Meteorological Service, raised awareness to the lightning hazard in Jamaica but also looked at the possibility of a lightning detection network for the island. Tyler Buck, Product Manager of Lightning Detection Systems at Vaisala Inc. explains.



MetServiceJA @MetserviceJA · Jul 16

Cherri-Ann Farquharson, Assistant Lecturer in the Faculty of Engineering, UWI, addresses participants at the **#LightningForum** being hosted by the Meteorological Service.





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- Received lightning data for the English Speaking Caribbean for 2014 – 2018 from Vaisala.
- UWI Climate Studies Group at Mona will update work and look for some intersections with lightning activity, climate indices, and forest fires.

Expect More Lightning Strikes With Rising Temperatures, Warn Experts

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Published: Tuesday | October 8, 2019 | 12:06 AM | Judana Murphy/Gleaner Writer



Director of the Meteorological Service of Jamaica, Evan Thompson, has said there are no instruments locally to record lightning activity but from anecdotal evidence, there has been an increase in lightning in recent weeks.

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