THE FLORIDA STATE UNIVERSITY
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DEVELOPING STATISTICAL GUIDANCE FOR AFTERNOON LIGHTNING ACTIVITY IN PORTIONS OF TWO SOUTH FLORIDA COUNTIES

By

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ABBREVIATIONS AND ACRONYMS

BLR	Binary Logistic Regression
CAPE	Convective Available Potential Energy
CG	Cloud-to-ground
CSI	Critical Success Index
FAR	False Alarm Ratio
FP&L	Florida Power and Light Corporation
FSL	Forecast Systems Laboratory
GEM	Global Environmental Multiscale
GPS	Global Positioning System
HLGF	Hosmer and Lemeshow Goodness of Fit
hPa	hectoPascal
IMPACT	Improved Accuracy from Combined Technology
in	inch
IPWV	Integrated Precipitable Water Vapor
kA	kiloampere
km^2	square kilometer
KSC	Kennedy Space Center
LI	Lifted Index
LT	Local Time
MDF	magnetic direction finder
MDR	manually digitized radar
$m\ s^{-1}$	meter per second
NCDC	National Climatic Data Center
NGM	Nested Grid Model
NLDN	National Lightning Detection Network
NMC	National Meteorological Center
Q1	Quartile One
Q2	Quartile Two
Q3	Quartile Three
Q4	Quartile Four
SPSS	Statistical Package for the Social Sciences
TOA	time-of-arrival
UTC	Universal Coordinated Time

ABSTRACT

Statistical guidance equations are developed to determine the probability of noon to midnight lightning activity (the occurrence or non occurrence of at least one flash) in eastern Miami-Dade and Broward Counties during the warm season (May-September). The guidance assumes that the sea breeze provides the dominant forcing for afternoon convective and lightning activity. The guidance product is developed to assist personnel at Florida Power and Light Corporation in deciding whether extra line crews will be needed after normal business hours.

Fourteen years (1989-2002) of warm season lightning data from the National Lightning Detection Network and 1200 UTC Miami radiosonde data are used to develop and test the guidance equations. The lightning data document whether lightning occurred within the areas of interest during the noon to midnight period. The radiosonde data are used to calculate fifty-four potential predictors, including wind, moisture, stability and temperature parameters. Two persistence variables (the previous day's afternoon activity and the current day's morning activity) also are included as potential predictors.

Binary logistic regression is used to relate the noon to midnight lightning activity to the pool of potential predictors. A stepwise screening procedure is used to build separate models for each month during the warm season for each county. Deriving separate monthly models is found to improve forecast skill compared to a single warm season model. Each monthly model generally contains persistence and the wind, moisture, and stability parameters which are known to influence the strength and movement of the sea breeze and convective development.

A cross-validation procedure is used to test the models on independent data and to determine the stability of the models. The cross-validation process reveals that the models are statistically stable and perform well when tested on independent data. The

probability of detection, calculated from the independent testing, ranges from ~67% during May to ~90% in August, while false alarm rates range from ~30% during May to only 15% in August.

Results from independent testing of the models also show that they improve on forecasts based solely on persistence. For example, the threat score for the guidance equations is ~69% versus ~61% for persistence alone. Furthermore, the hit rate improves from ~71% to ~77%. Although persistence is a powerful predictor of lightning activity in South Florida during the warm season, the guidance equations provide superior results.

Days when the models produced an incorrect forecast are examined. When no lightning was forecast but occurred anyway, quartiles of lightning activity are considered. The percent of incorrect forecasts decreases from low activity days (i.e., 1st quartile days, 1-7 afternoon flashes) to high activity days (4th quartile days, >125 afternoon flashes). Thus, incorrect forecasts are least likely on the most important days. Fewer days with lightning occurrence are incorrectly forecast during July and August than during May. A similar trend is observed on days when no noon to midnight lightning was observed but had been forecast.