



Central Florida Flow Regime Based Climatologies of Lightning Probabilities



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PRIMARY OBJECTIVES

- Update the probability of lightning climatologies using individual cloud-to-ground (CG) lightning strike data instead of gridded data and use updated wind flow regimes as in Lambert et al. (2007) for 1-, 3- and 6-hr intervals in 5-, 10-, 20-, and 30-NM radius range rings around the Kennedy Space Center (KSC) Shuttle Landing Facility (SLF) and eight other airfields in the National Weather Service in Melbourne, Florida (NWS MLB) county warning area (CWA), to include the Orlando International Airport (MCO).
- Present the climatologies to the forecasters in a graphical user interface
- Add three years of data to the period of record (POR)

BACKGROUND

- The threat of lightning is a daily concern during the warm season in Florida
- Forecasters at the Spaceflight Meteorology Group (SMG) at Johnson Space Center in Houston, Texas consider lightning in their landing forecasts for Space Shuttles at the SLF
 - Lightning detected within 30 NM of the SLF violates weather Flight Rules for Shuttle landing operations
- Forecasters at NWS MLB consider lightning in their Terminal Aerodrome Forecasts (TAFs) for eight airports in the NWS MLB CWA
 - The NWS MLB also creates a daily CG lightning threat index map for their CWA that encompasses all of their TAF locations
- The 45th Weather Squadron (45 WS) forecasters include a probability of lightning occurrence in their daily 24-Hour and Weekly Planning forecasts
 - The probability of lightning occurrence is used by personnel involved in determining the possibility of violating launch commit criteria, and planning for daily ground operations on KSC and Cape Canaveral Air Force Station (CCAFS)



DATA

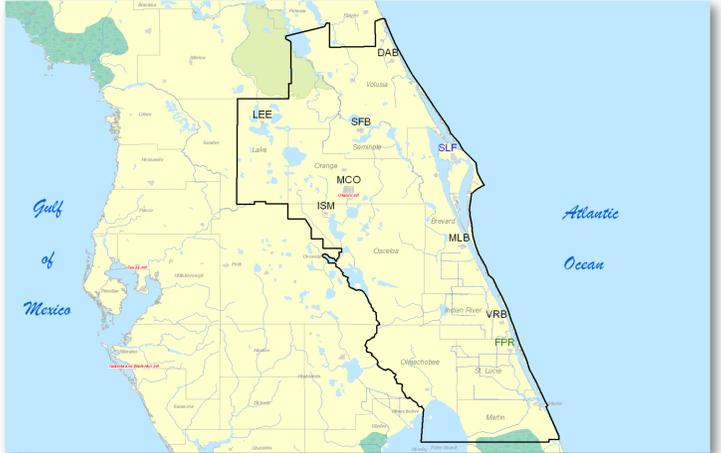
- Period of Record
 - Warm season months of May through September in the 19-year period 1989-2007
- Two types of data were needed for this work:
 - Individual CG lightning strike data from the National Lightning Detection Network (NLDN)
 - NLDN data were provided to the 45 WS by the 14th Weather Squadron (14 WS) in Asheville, North Carolina
 - The NLDN database contained lightning strike data provided to the 14 WS by Vaisala Inc. in Tucson, Arizona
 - The 14 WS provided data that included the date, time, latitude and longitude, polarity and strength of every strike within a 30 NM radius of each site for the entire period of record (POR)
 - Flow Regime Information
 - Used the mean wind direction in the 1000–700 mb layer from the Jacksonville (JAX), Tampa (TBW), and Miami (MFL) 1200 UTC soundings. Based on Lambert (2007), the 1000 UTC CCAFS (XMR) sounding was used to determine the flow regime when it could not be classified by using the combined wind directions from the other three 1200 UTC soundings.



The plus signs on the map show the locations of the soundings used to determine the flow regimes on each day in the POR

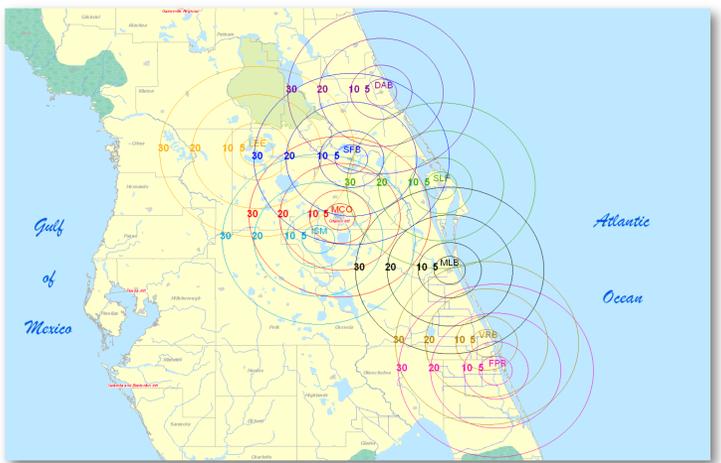
This table contains the names of each flow regime as reclassified in Lambert (2007) from Lericos et al. (2002), a brief definition of each flow regime, and the number of days in each regime during the warm seasons in 1989–2007

AMU Naming Convention	Flow Regime Definition	# Days in the Regime
SW-1	Subtropical ridge south of MFL. Southwest flow over KSC/CCAFS.	331
SW-2	Subtropical ridge north of MFL, south of TBW. Southwest flow over KSC/CCAFS.	682
SE-1	Subtropical ridge north of TBW, south of JAX. Southeast flow over KSC/CCAFS.	486
SE-2	Subtropical ridge north of JAX. Southeast flow over KSC/CCAFS.	262
NE	Northeast flow over Florida, likely from a stronger-than-average subtropical ridge north of JAX extending into southeast U.S., at times forming a closed high pressure center.	363
NW	Northwest flow over Florida, likely from a stronger-than-average subtropical ridge south of MFL extending into Gulf of Mexico.	367
Other	When the layer-averaged wind directions at the three stations did not fit in defined flow regime.	339
All	Non-flow regime based (e.g., all days from all years in the warm season included)	2830



Map of central Florida showing the location of the SLF (blue text), the seven current NWS MLB TAF sites (black text), possible future NWS MLB TAF site (green text) and the NWS MLB CWA (heavy black outline area).

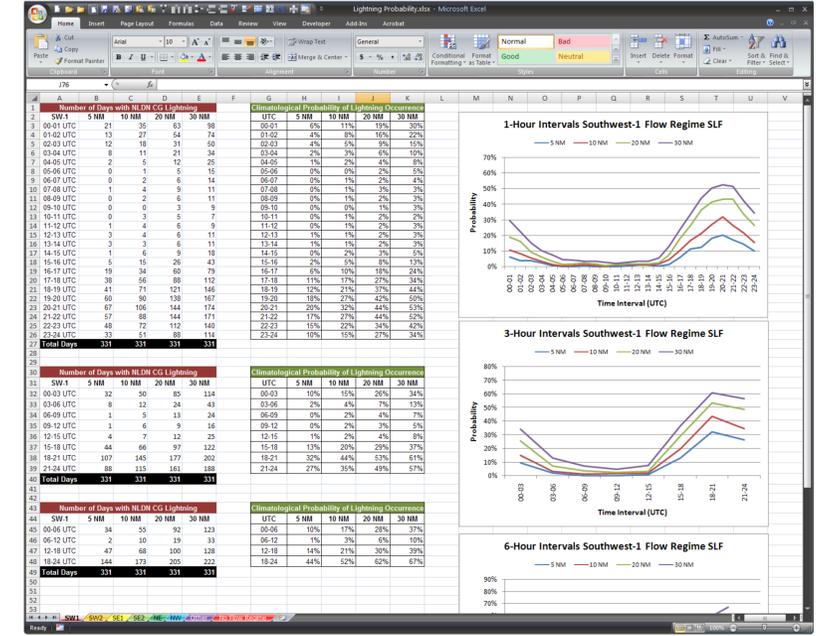
- Climatologies were developed for the SLF, MCO, Daytona Beach (DAB), Leesburg (LEE), Sanford (SFB), Kissimmee (ISM), Melbourne (MLB), Vero Beach (VRB) and Fort Pierce (FPR) in east-central Florida



Map of central Florida showing locations of nine sites in the NWS MLB CWA surrounded by 5-, 10-, 20- and 30-NM radius range rings

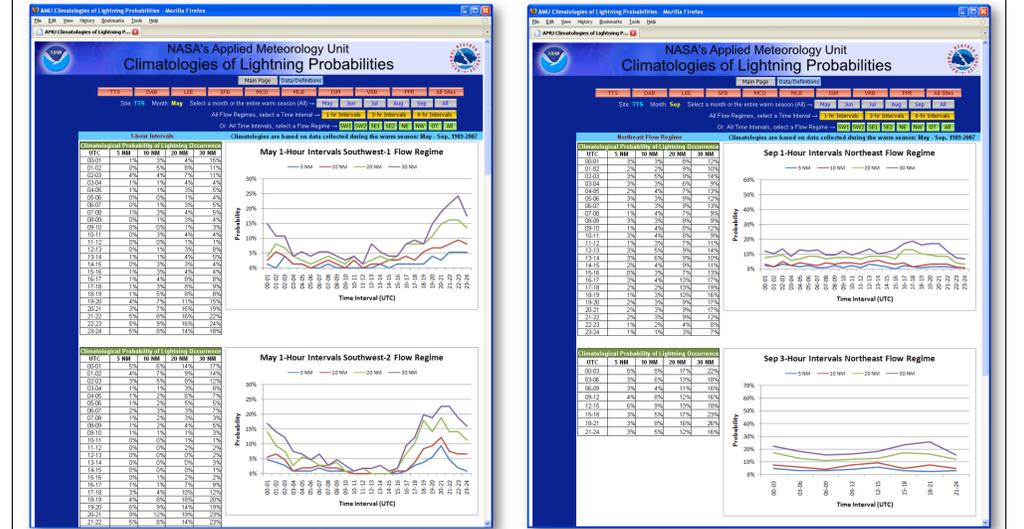
GRAPHICAL USER INTERFACE

- The data was initially processed in S-PLUS® software (Insightful Corporation 2007) and then transferred to Microsoft Excel™ 2007 to develop clean looking tables and graphs
 - Each site's six Excel workbooks contained 120 probability tables and 120 corresponding charts resulting in a total of 2,160 tables and charts contained within 54 Excel workbook files. Although navigable in Excel, it would be cumbersome for the operational forecasters to move among the different sites, flow regimes and time intervals



The SLF Excel workbook showing the worksheet for Southwest-1 flow. Tables showing the number of days with lightning and climatological probability of lightning are on the left and center, respectively. The charts corresponding to the probability tables are on the right.

- Developed a web-based HyperText Markup Language (HTML) GUI that can be used with most web browsers on computers with popular operating systems such as Windows, Mac and Linux



CONCLUSIONS

- Flow regime based climatologies of lightning strike probabilities have been improved by using individual CG lightning strike data, employing revised wind flow regimes, and extending the POR by three years
- Provided the climatologies to the forecasters in an HTML GUI
 - SMG uses the GUI as a briefing tool to mission managers (NASA Flight Directors)
 - NWS MLB uses the climatologies to deliver more accurate convective forecasts for area TAFs, and to create daily lightning hazard graphics for the public

REFERENCES

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