4.4 LIGHTNING DETECTION FOR FORESTRY USE IN FLORIDA

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1. INTRODUCTION

Florida has long-been known as the thunderstorm and lightning capital of the United States (Fig. 1). In a nationwide study of lightning distribution, Orville (1994) showed that Florida led the country in flash densities between 1989 and 1991. Hodanish et al. (1997) documented over 25 million lightning strikes in the state during a 10-year period.

Lightning increases in frequency from March through May, while precipitation tends to remain at a minimum during this period. April is climatologically the driest month of the year. Most of the yearly precipitation in the state is received via convective precipitation in the summer months and more than 50% of the annual precipitation falls during the rainy season from June through September.

The interior region of the peninsula tends to have a higher flash density than other areas (Fig. 2) while the area running between Tampa Bay on the west coast and Cape Canaveral on the east coast exhibits the highest flash density. The distribution of lightning flashes is closely tied to the geography of the state and the tropical air mass in the area. Various sea- (lake-/bay-) breeze boundaries influence the distribution of lightning in the state.

Lightning kills approximately 96 people per year on average across the United States, with an average of 10 in Florida. Another risk associated with lightning is wildfires.

2. LIGHTNING AND FIRES IN FLORIDA

Fire season in Florida typically runs year-round, with the majority of fires occurring from December through July. While there are a higher number of fires in the early part of the year (Fig. 3, 4), more acreage is lost during the spring months (Fig. 5). Most of the fires in the winter are human caused and are relatively small, while fires in the spring and summer are primarily caused by lightning, and can burn large amounts of land (Fig. 6). The winter season is usually relatively wet and leads to smaller fires, whereas April and May are typically dry months. The presence of volatile fuels also contribute to the extreme fire behavior noted in the spring and summer fires.

An example of an extreme fire season was 1998. After an abnormally wet winter (200% above normal), the spring was abnormally dry (50% below normal). The abundance of fuels that grew over the winter and subsequently dried out in the spring lead to a heavy loading of burnable fuels. The onset of lightning activity resulted in a very active fire season. Lightning caused over 30% of fire ignitions and was responsible for more 79% of the total area burned. All told, more than 2300 fires resulted in over half a million acres burned at a cost of more than 620 million dollars.

The ability to detect and suppress lightning induced wildfires in Florida is of critical importance. Left undetected, these fires can spread rapidly and turn into large wildfires with the potential for great losses. In the years since 1998, the Division of Forestry (DOF) had been using data from a provider who supplied daily lightning density maps and reports for DOF pilots who scout for lightning induced fire starts. The cost for this service was reasonable and the field units were satisfied with the product.

These products were recently discontinued and replaced with a predictor of lightning potential. Unfortunately, lightning potential is not an indicator of where lightning induced wildfires have already been ignited. To receive the data that was needed would require a significantly higher cost to the state. As a result it was determined, using relatively inexpensive lightning detectors that the DOF could set up a statewide lightning system of its own. This system would incur no recurring costs once the hardware and software were purchased and all data could be saved for later analysis. This system is in the process of being installed and is hoped to be operational by the

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beginning of next year. It is believed that this system will be unique in the country.

The availability of affordable real-time and archived lightning data is a limiting factor in detection and suppression of lightning induced wildfires. The cost associated with obtaining statewide lightning information, especially strike location data is often prohibitive.

3. EQUIPMENT AND SOFTWARE

The lightning detection system being set up in Florida by the DOF includes 16 Boltek StormTracker lightning detectors. StormTracker consists of an antenna (Fig. 7) connected to a PCI card installed in a personal computer. The antenna can be mounted inside the roof of a wooden building or on top of the roof, providing there are no metal structures close by. StormTracker equipment detects the low frequency radio signals produced by lightning discharge and uses a direction-finding antenna to determine the direction from which the lightning came. Each antenna has a potential range of 300 miles in radius.

There are several software packages available for analyzing and displaying StormTracker lightning information. The software chosen for this project is Nexstorm, produced by Astrogenic Systems. The advantage of this package over the others is the ability of the program to communicate its data to external applications in real-time, thus enabling third-party development.

4. LIGHTNING NETWORK

Once all 16 detectors are installed and are connected to the Internet, the data stream from each lightning detector will be collected at a central web server for processing. This data will be triangulated and plotted on a background map for presentation on the DOF web site. Reports will also be created for each of the field units. These reports will include all the cloud-to-ground lightning strokes reported over the past 12 h in that district, listed with latitude/longitude, time, and polarity of stroke. These reports will then be given to the DOF pilots for routine fire patrols to help locate any lightning induced wildfires that may have been ignited.

A desirable part in the development of this lightning system would be access to lightning data from the National Lightning Detection Network to be used in comparing locations of strikes from both systems. This will help assure the accuracy of the lightning information in the DOF system. The DOF is currently waiting for this information to be made available via the Bureau of Land Management.

The district computer in which the PCI card is installed and running Nexstorm will also have access to live lightning strikes. This information is critical for protecting personnel in the field and for protection of delicate computer and communications devices in the field offices. The ultimate goal of this project is to create a lightning detection system for the DOF that is self-sufficient and affordable yet will be accurate enough to aid in fire detection and prevention. The data obtained from the system would then be used to further study the effect of lightning on wildfires in the state and potentially aid in better lightning prediction.

5. ACKNOWLEGEMENTS

This work is being done with the help of Dr. Scott Goodrick, of the USDA Forest Service, Athens, GA.

6. REFERENCES

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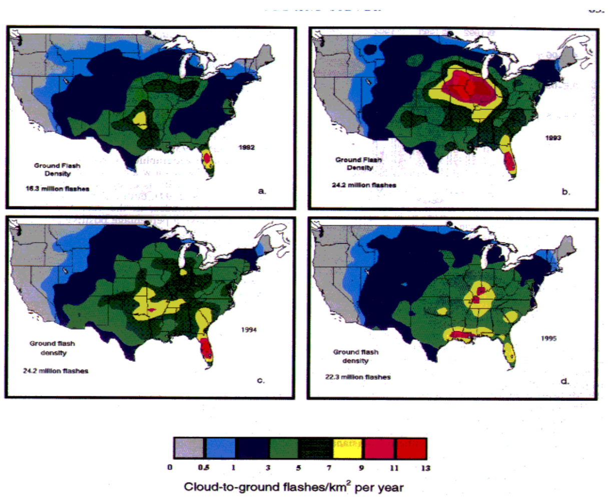

Figure 1. Climatology of cloud-to-ground lightning strikes over the United States (flashes/km^2 per year) during the period 1992-1995. Figure courtesy of Dr. Henry Fuelberg, Florida State University.

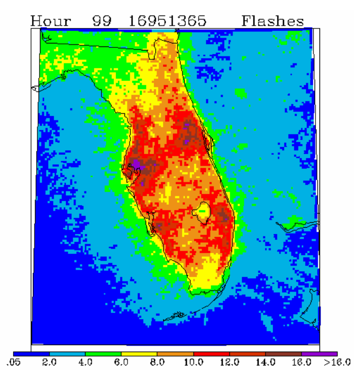

Figure 2. Florida summer climatology of lightning density (flashes/km^2 per 5 months). Figure courtesy of Dr. Henry Fuelberg, Florida State University.

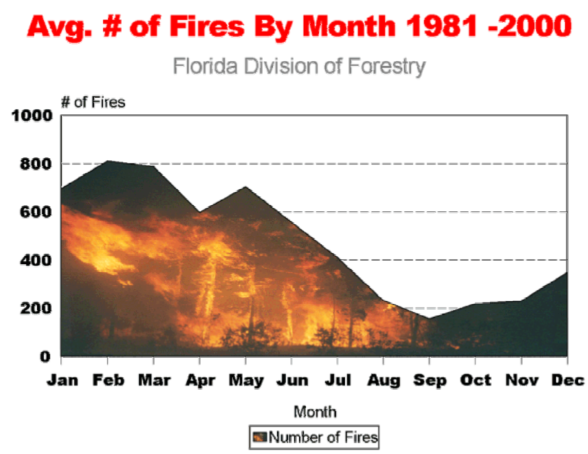

Figure 3. Average number of fires in Florida per month during the period 1981-2000.

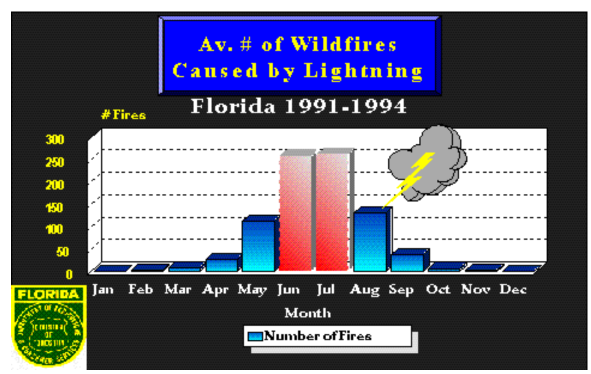

Figure 4. Average number of wildfires caused by lightning in Florida during the period 1991-1994.

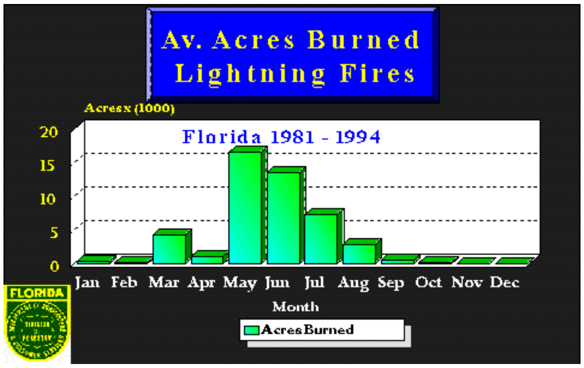

Figure 5. Average number of acres burned in Florida due to lightning fires during the period 1981-1994.

Figure 7. StormTracker antenna.

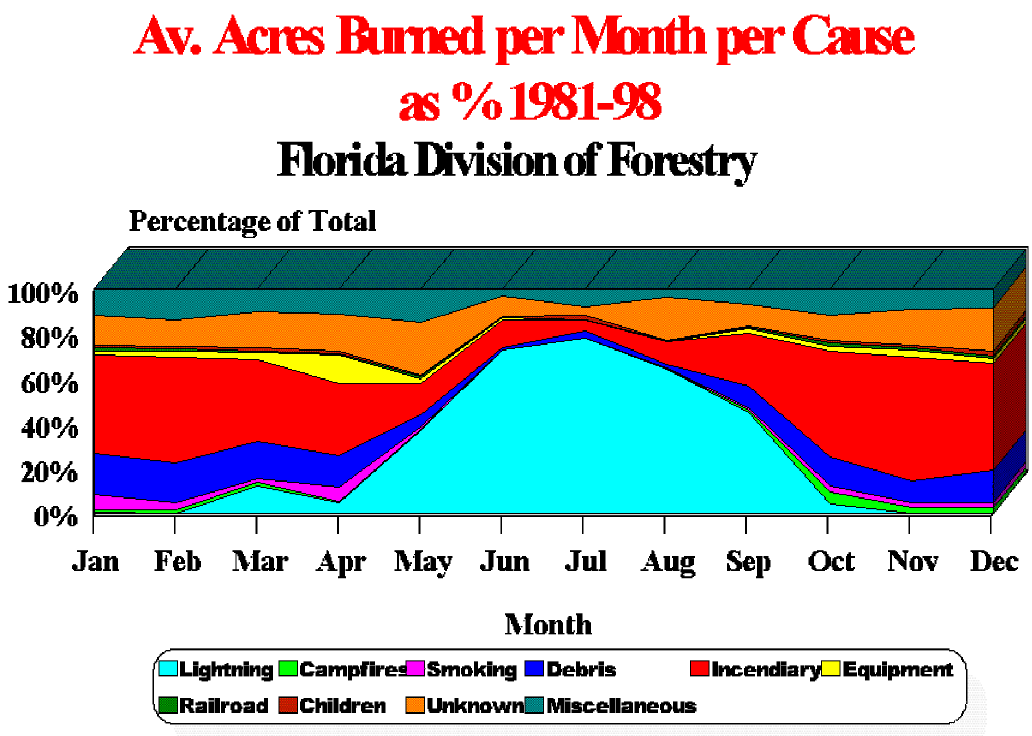

Figure 6. Average number of acres burned in Florida by month and by cause for the period 1981-1994.

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