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LIGHTNING STRIKE DENSITY

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As our society becomes more and more technology dependent, we are becoming more vulnerable to inclement weather. Utilities, telecommunication, agriculture and transportation are all adversely impacted by lightning. However, no good lightning climatology is available. Most presentations show the annual number of "thunderstorm days" observed at weather stations.

In a 1984 study by D. MacGorman, M. Maier and W. Rust for the Nuclear Regulatory Commission, it was noted that thunderstorm day information is a poor indicator of lightning strike probability because it does not take into account the duration of lightning activity. Days having a few minutes of lightning activity are treated the same as days having long-lived storms.

In an effort to compensate for this, MacGorman, Maier and Rust analyzed thunderstorm data from 450 14-hour aviation observing sites. Their chart of thunderstorm days (Fig. 1) agrees with other climatologies. (Note, no attempt was made in this chart to "adjust" data to account for effects of topography.)

A more interesting chart was obtained by using recorded thunder start and stop times to compute the mean annual thunderstorm duration (Fig. 2). This chart differs from the thunderstorm day chart in that the values of thunderstorm duration fall faster as one moves westward through the western states, and there are larger relative maxima in north central Arizona, northeastern New Mexico, southeastern Texas, and from eastern Kansas and western Missouri through eastern Arkansas. These differences arise both from differences in the average duration of thunderstorms (from over two hours in the mountains of Arizona and New Mexico to less than 30 minutes along the northwest Pacific coast) and from variations in the number of thunderstorms (126 at Ft. Myers, Florida to two at several places along the California coast).

Examination of lightning detection data during one summer in Florida and during a spring in Oklahoma showed that there is a correlation between the density of lightning flashes (number of ground strikes per square kilometer) and thunderstorm duration. The equation of best fit is:

$$N_S = 0.054\ H^{1.1}$$

where

N_S is stroke density

H is thunderstorm duration in hours.

By applying this equation to the data of Fig. 2, a chart estimating lightning hazard was obtained (Fig. 3). A strong maximum is found to lie along the Gulf coast. Maxima are also found in the mountains of New Mexico and Arizona. In the Central Region, a local maximum of 12 strikes per square kilometer per year is found in eastern Missouri and western Kansas. In contrast, western Wyoming receives less than two strikes/km^2 every year.

It must be emphasized that these are only estimates of the hazard. Besides the obvious problems of representativeness and validity of the thunderstorm duration data, the conversion of these data to lightning strike density is based on a small lightning detection data base collected from two locations for only portions of a year.

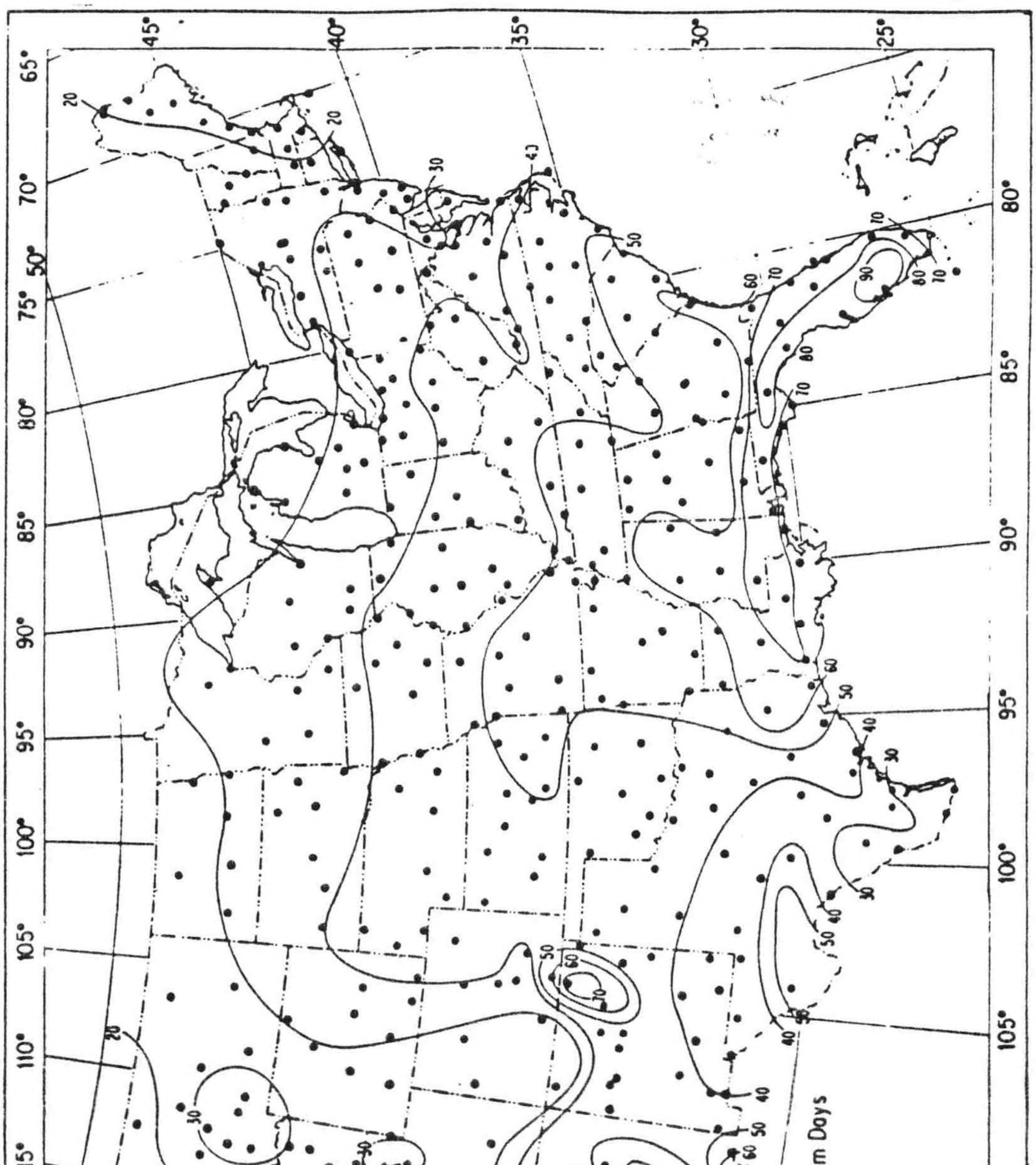

Fig. 1. Contour map of mean annual thunderstorm day.

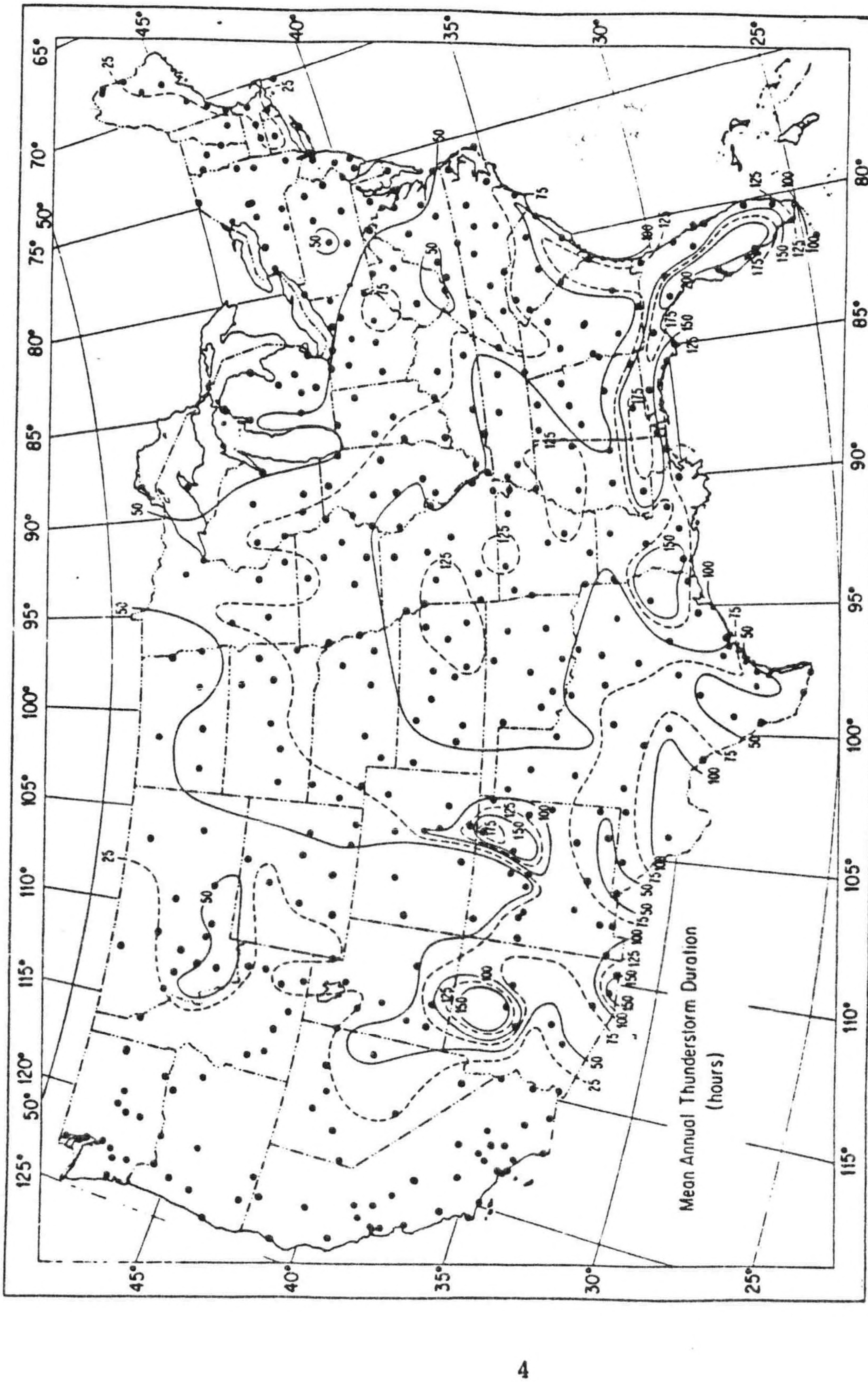

Fig. 2. Contour map of mean annual thunderstorm duration.

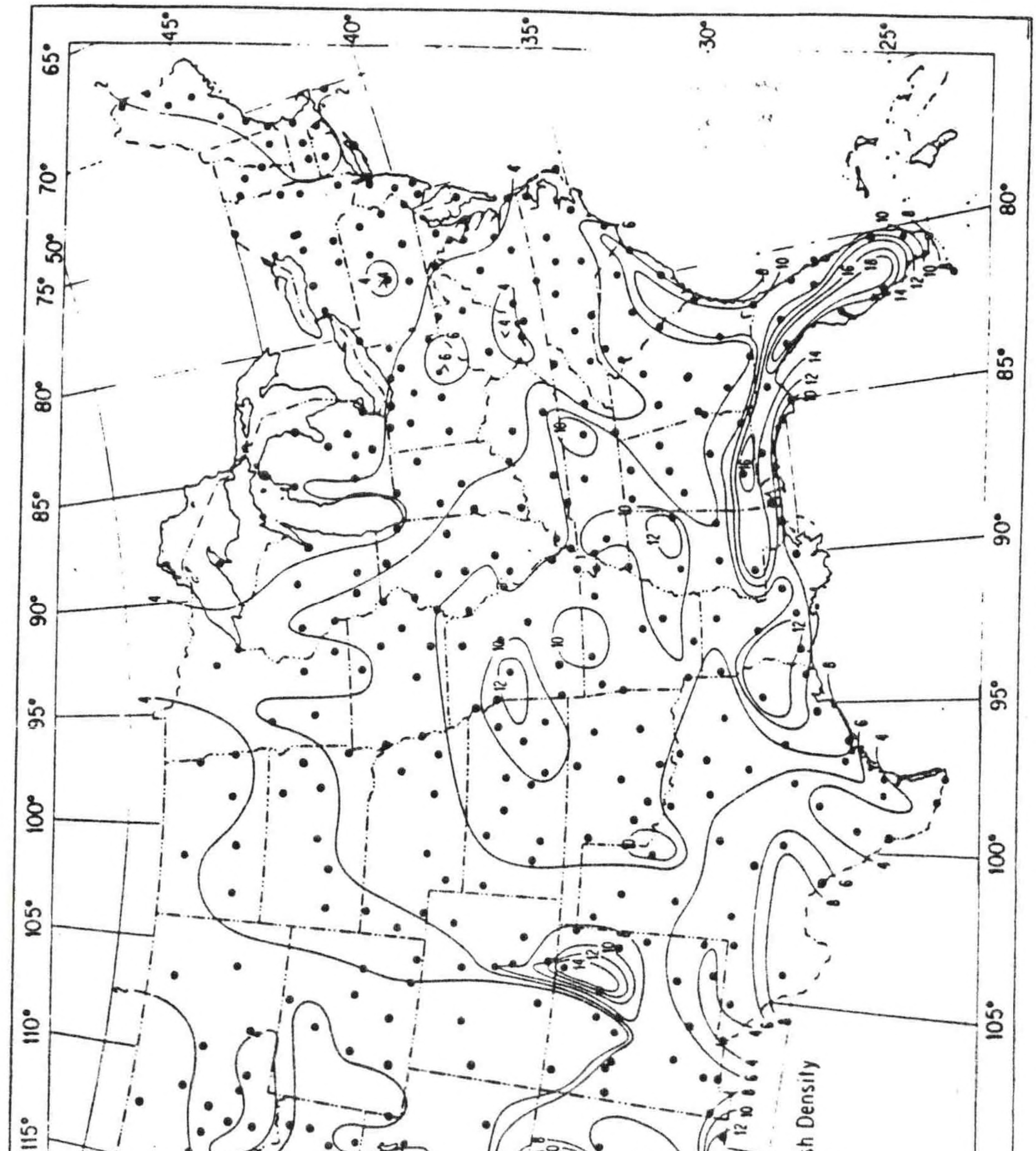

Fig. 3. Contour map of mean annual lightning strike density.