4.5 DEVELOPMENT OF LIGHTNING CLIMATOLOGY INFORMATION OVER THE WESTERN U.S.

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1. PROJECT OBJECTIVES

Between 1990 and 2000, depending upon the region, our analyses of fire occurrence data indicates that between 50% and 75% of all fire starts in the western United States on Bureau of Land Management (BLM) land were caused by cloud-to-ground (CG) lightning strikes. It would be desirable to have a better understanding, therefore, of when and where these lightning strikes occur historically so that fire managers and planners can allocate their resources more effectively. Also, this information is necessary in analyzing climate factors related to seasonal fire activity (Brown and Hall 2000). Since 1990, the National Lightning Detection Network™ (NLDN) has been recording information about CG lightning strikes across the U.S. The objective of this project was to develop CG lightning strike climatologies over the continental western U.S. for various time periods, including the annual average, monthly average, and hourly by month average number of lightning strikes.

2. DATA

Cloud-to-ground lightning strike data for the period 1990 through 2000 were obtained from the National Lightning Detection Network™ maintained by Global Atmospherics, Inc. (GAI). The data set used for the analysis consists of the date, time, latitude, and longitude of the strike. For further information about NLDN, see Cummins et al. (1998).

3. METHODS

Climatologies for each time period of interest (i.e., annual, monthly, hourly by month) were computed by dividing the total number of lightning strikes within a grid for the time period by the total number of years (11). The area along the U.S.-Canada border includes three years (1998 – 2000) comprising strike data from Canadian lightning sensors. Eleven years is a relatively short period of record for developing a climatology given the occurrence of decadal and longer climate regimes. Also, with such a short record it is possible that a single thunderstorm that produced an “unusually” large amount of lightning strikes could heavily influence the climatology.

A 0.5 degree spatial grid was used across the western U.S. for each climatological time period. This grid size is somewhat of an arbitrary choice, but it does resolve some coarse terrain features and allows for identifying coherent regions of lightning activity. Annual correction values for 1990-1998 were applied to each grid to improve the climatology counts. These values attempt to correct for known detection efficiency issues across the network during those years based on an algorithm recently developed at GAI (Cummins 2001). Though the correction values are based on annual number of strikes, it is believed that these values can also be applied to the monthly and diurnal climatologies. For the last step of the climatology development, the gridded values were contoured using a Cressman analysis scheme (Cressman 1959). The 0.5 degree resolution combined with the contouring technique creates a smoothing effect which results in a more generalized, but hopefully representative climatology of an area.

4. PRODUCTS DEVELOPED

Individual plots and animations for each climatological time period are available at the Desert Research Institute Program for Climate, Ecosystem and Fire Applications web site (http://www.dri.edu/CEFA).

Specific products include:

- Individual plots of –
  - Annual climatology
  - Monthly climatologies (see Figures 1a, b)
  - Hourly-by-month climatologies (see Figures 2a-d)

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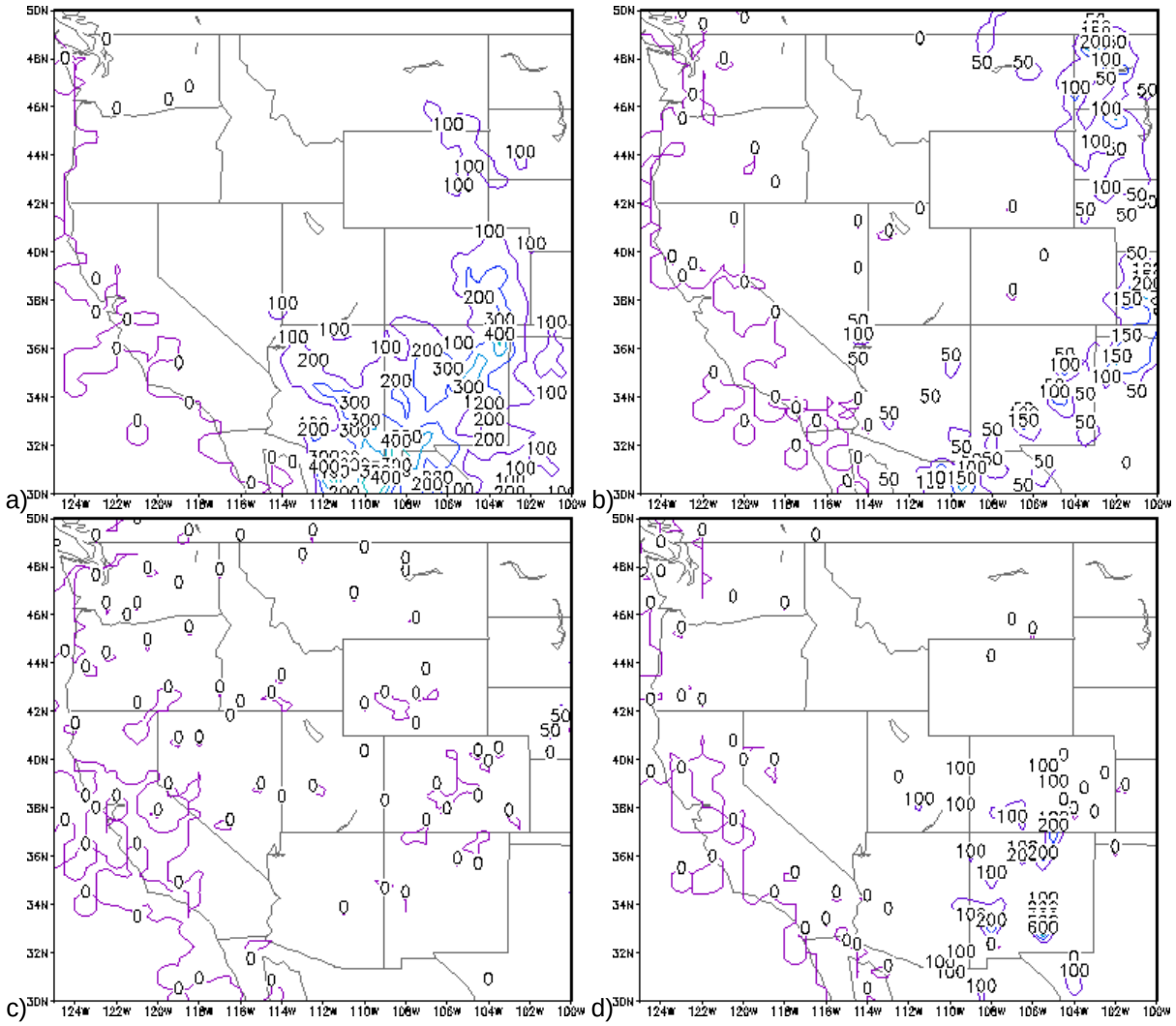

Figure 2: Hourly NLDN lightning strike climatologies (1990 – 2000) for July a) 00, b) 06, c) 12, and d) 18 UTC. Contours represent average number of strikes for each respective hour.

- Animations of –
    - Monthly climatologies throughout a year
    - Hourly climatologies (diurnal cycle) through a month

However, due to the proprietary nature of these data, access to the plots is currently limited to wildfire agencies. Individuals or organizations interested in obtaining lightning data should contact GAI directly.

Figure 1 shows an example contoured plot of monthly NLDN lightning climatologies for a) April and b) August based upon the 1990-2000 period. Note the scale change in the contour intervals. Figure 2 shows an example of NLDN hourly lightning climatologies in July for a) 00 UTC, b) 06 UTC, c) 12 UTC and d) 18 UTC. Increases in counts are especially apparent at 00 and 18 UTC.

5. REFERENCES

Brown, T.J., and B.L. Hall, 2000: *Nevada 1999 Wildland Fire and Climate Season Assessment*. CEFA Report 00-04, 26pp. Available at http://www.dri.edu/CEFA/Publications/publications_index.htm.

Cressman, G., 1959: An operational analysis system. *Mon. Wea. Rev.,* **87**, 367-374.

Cummins, K.L., 2001: *Personal communication.*

Cummins, K.L., M.J.Murphy, E.A. Bardo, W.L. Hiscox, R.B. Pyle, and A.E. Pifer, 1998: A combined TOA/MDF technology upgrade of the U.S. National Lightning Detection Network. *J. Geophys. Res.*, **103**, 9035-9044.

6. ACKNOWLEDGEMENTS

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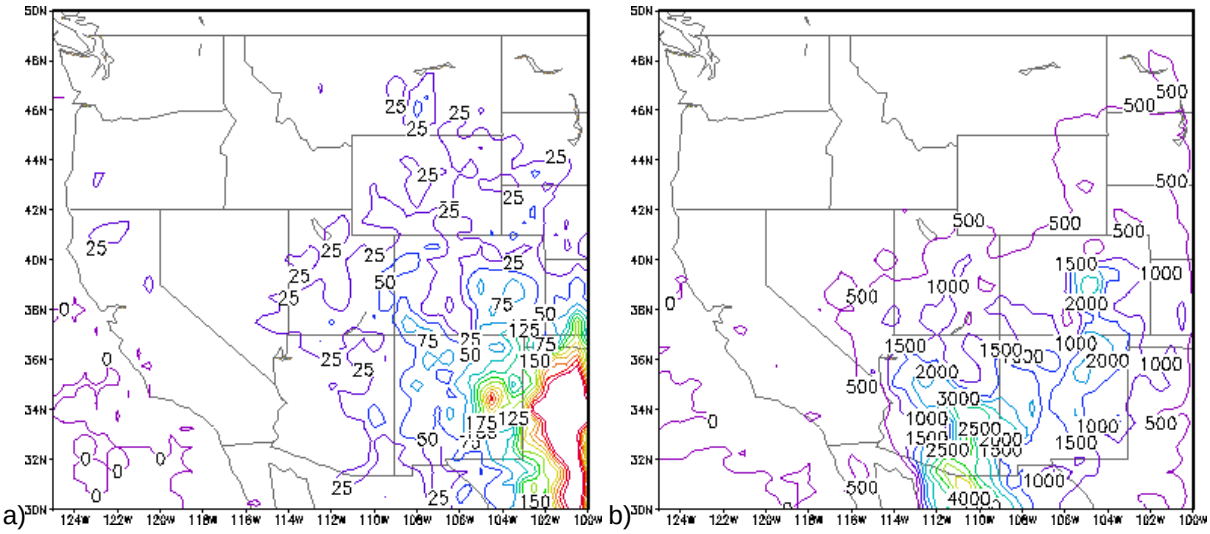

Figure 1: Monthly NLDN lightning strike climatology (1990-2000) for (a) April and (b) August. Contours represent average number of strikes for each respective month. Note the change in contour interval scale for each month.