NOAA Atlas 14 rainfall for Midwest and Southeast states

Compiled by William Merkel and Helen Fox Moody, updated April 29, 2015

Statistics for NOAA Atlas 14 100-year 24-hour rainfall by state and county

Background

NOAA released volumes 8 and 9 of Atlas 14 for the midwest and southeast United States respectively on Monday April 22, 2013. Precipitation-frequency data are available from NOAA Atlas 14 for both annual and partial duration series at the NWS website http://hdsc.nws.noaa.gov/hdsc/pfds/. GIS data for the 100-year 24-hour partial duration rainfall were downloaded and prepared. State and county maps were overlayed on the GIS to derive statistics on a county basis. The GIS Spatial Analyst command Zonal Statistics as Table was used to generate minimum, maximum, range (difference between maximum and minimum), mean, and standard deviation of the 100-year 24-hour rainfall.

Considerable study of the NOAA 14 data (2006) for the Ohio Valley and neighboring states has been completed both by the Water Quality and Quantity Technology Development Team and by hydraulic engineers in the respective state offices and some procedures have been developed to prepare rainfall databases for the WinTR-55 and EFH-2 computer programs and for developing rainfall distributions to replace the Types II and III which were used in the past. Similar procedures are expected to be used in the midwest and southeast states (which border the Ohio Valley NOAA 14 area) due to similar climatic and topographic characteristics.

Instructions

Preparation of rainfall databases

The midwest and southeast states covered by NOAA Atlas 14 volumes 8 and 9 (except for Colorado) have rainfall data included in the WinTR-55 rainfall database by county or by parish in Louisiana. These same data are also included in rainfall data files used with the EFH-2 computer program. One option for users of these computer programs is to visit the NOAA 14 web site and download data at specific project sites. To save user's time and considering that users may not have internet access at all times, rainfall databases and data files are expected to be developed for these states. Whereas the current files are generally based on TP-40 (1961), data from NOAA Atlas 14 will be substituted.

The first step in this process is to develop maximum, minimum, range, and mean of the 100-year 24-hour rainfall by state and county or parish. This has been done by Bill Merkel and Helen Fox Moody . In states where there is enough topographic relief to product orographic effects in the rainfall amounts, such as Virginia, 100-year 24-hour rainfall could vary by up to 5 inches in a single county. To address this situation, if the rainfall varied more than 1.5 inches within a county, the county was split in two or more parts, each having a set of rainfall values in the rainfall database.

Some of the midwest and southeast states have all counties with less than 1.5 inch variation. Other states have several counties with more than 1.5 inches of variation.

If a county is to be split, use the following procedure:

- Split the county along some boundary such that the range of the 100-year 24-hour rainfall of each part is less than 1.5 inches.
- Start with a state/county GIS shapefile and digitize the boundary.
- In split counties, generate the statistics for each part (min, max, range, and mean).
- Select a representative point location in each county or part of split counties. Find a point in the county (or part of county) where the 100-year 24-hour rainfall is equal (or within 0.05 inch) of the mean county value. Record this latitude and longitude.
- Open the NOAA Atlas 14 web site and download the csv (comma separated variable) file for that location. Use the 1-year through 100-year 24-hour rainfall values at this location in the WinTR-55 rainfall database and the EFH-2 rainfall data file. A GIS layer will be developed with the set of locations in each state.
- Bill and Helen will assist any state with these steps if requested.

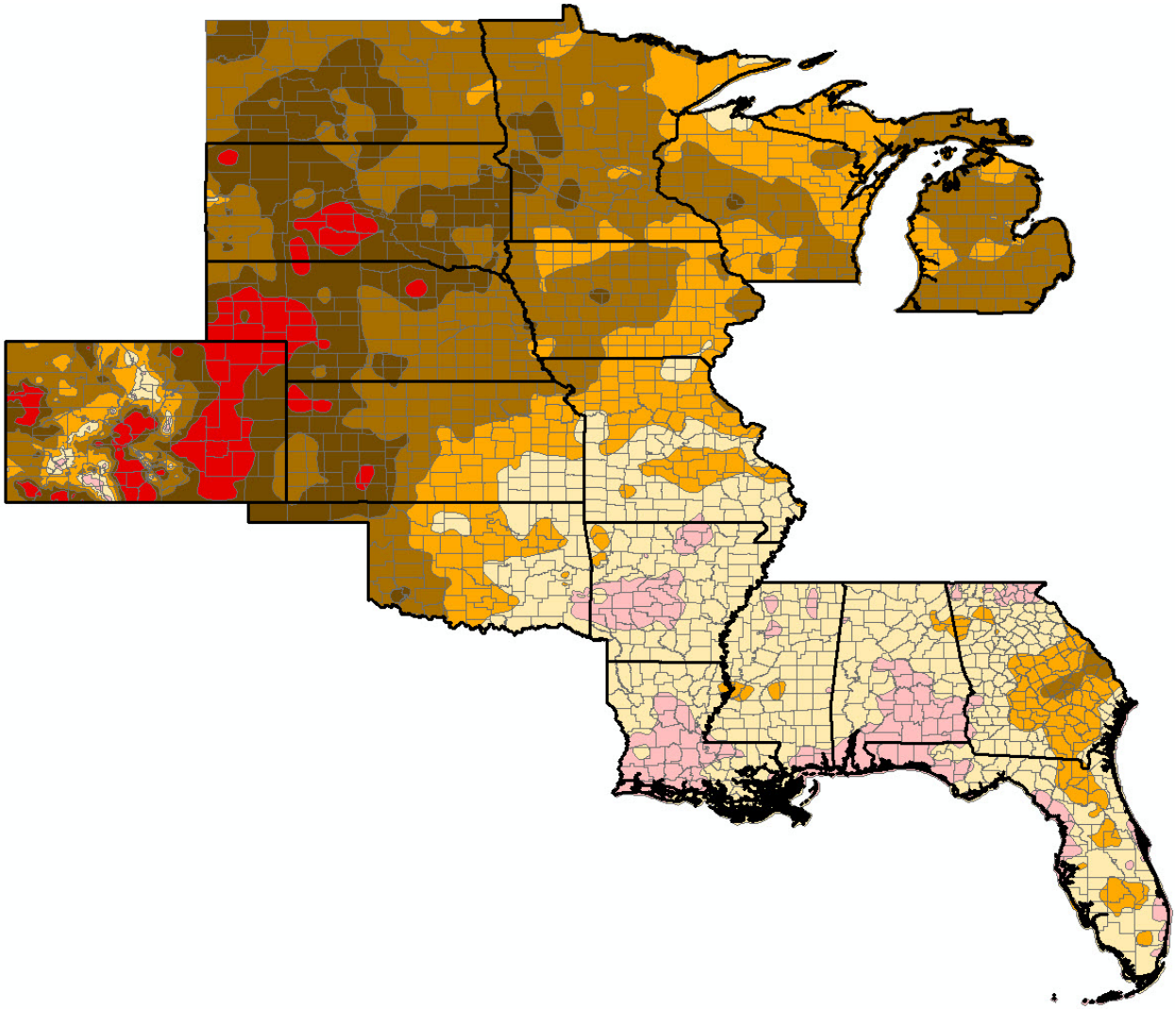
Development of rainfall distributions

The latest draft of Part 630 Chapter 4 Storm Rainfall and Distribution includes the procedures that will be used to develop rainfall distributions for the midwest and southeast states. The purpose of the rainfall distribution is to include all the rainfall amounts at shorter durations in the 24-hour rainfall distribution. For example, for a 25-year 24-hour storm, the 25-year 5-minute rainfall, 25-year 10-minute, rainfall, etc are included within the 24-hour distribution. This is accomplished by placing the 5-minute rainfall in the center (12 hours) and each larger duration being centered at 12 hours. The 60-minute rainfall is located between 11.5 and 12.5 hours. The 2-hour rainfall is located from 10 to 12 hours, etc.

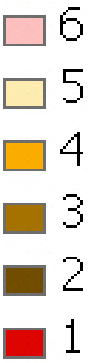
A map has been generated with the ratio of the 60-minute rainfall to the 24-hour rainfall for the 25-year values. In preliminary analyses, this ratio varies from a low value of 0.32 to a high value of 0.75. A rainfall distribution map has 6 rainfall distributions. Based on this ratio, areas within a range of values will be included as a rainfall distribution region. They are named MSE 1, MSE 2, through MSE 6 (MSE is abbreviated from midwest/southeast states). The range of ratio of 60-minute to 24-hour rainfall is in the following table.

Rainfall Distribution Name	Minimum 60-min/24-hour	Maximum 60-min/24-hour
MSE 1	0.58	0.75
MSE 2	0.53	0.58
MSE 3	0.48	0.53
MSE 4	0.43	0.48
MSE 5	0.38	0.43
MSE 6	0.32	0.38

For reference, the 60-minute to 24-hour ratio for the Type II rainfall distribution is 0.45 and the ratio for the Type III is 0.40. Based on the NOAA Atlas 14 data, rainfall distributions less intense, of similar intensity, and more intense than the Types II and III are being used.



Tentative rainfall distribution regions (based on GIS analysis).



Distribution region 1 has the most intense rainfall distribution and region 6 has the least intense rainfall distribution. In preliminary tests, regions 1 and 2 have peak discharges similar to the New Mexico 60 and 65 rainfall distributions (significantly higher than the Type II). Region 4 has peak discharges similar to the Type II rainfall distributions. Region 5 has peak discharges similar to the Type III rainfall distribution. Region 6 has peak discharges less than the Type III rainfall distribution.

Some may question whether to drop the Type II, Type III, and New Mexico rainfall distributions based on these preliminary conclusions. The Type II does not have any documentation remaining on specifically how it was developed and what data were used to develop it. We do not have documentation on the New Mexico rainfall distributions (there may be some documentation saved in the New Mexico state office). The Type III has significant documentation remaining and is based on data from TP-40 and NWS Hydro-35 report. The tentative rainfall distributions (map above) above are based on NOAA 14 data and similar procedures were used to develop rainfall distributions for the Ohio Valley and New York/New England states.

The map above is based entirely on the GIS data and does not consider state or county boundaries. When adjusting the map to fit state desires, the boundaries may be adjusted to follow county/parish boundaries. It is simpler for the field office staff to use a single rainfall distribution in a county. Two general choices have been used in states. One is to select the rainfall distribution that makes up the largest percentage of land area. The other choice is to select the more conservative rainfall distribution that is present in a county. For example, if a county is divided between rainfall distribution MSE 3 and MSE 4, then assign rainfall distribution MSE 3. Whichever choice is made, it is recommended to be consistent for all counties in a state.

Yet several states have chosen to follow the rainfall distributions as defined on the map above. This means that a single county may have more than one rainfall distribution and the user must read the map to determine which rainfall distribution to use.