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Climate Divisions: To Use or Not to Use?

One of the most frequent responses to some of the climate products we send out each month is that they are not spatially specific enough—that is, they may give you an idea of what has happened or is likely to occur in your general area, but are not at a fine enough resolution to use in decision making. Part of the reason for the lack of spatial specificity is that many climate information products are based on climate divisions. This article will explain what the climate divisions are, why they are used, and the advantages and disadvantages of their use for different applications.

Climate divisions have been through a great many changes since the U.S. Department of Agriculture's Weather Bureau first categorized the nation into 12 climatological districts in 1909 based on the nation's principal drainage basins. The divisions were intended to be useful to agriculture, irrigation, transportation, forestry, and engineering; actually reflecting climatic similarities was a far lesser concern (1).

The divisions were redrawn in the 1950s, based partially on climatic considerations, but also to reflect geography, river districts, and/or forecast areas of responsibility. Despite more recent changes, divisional boundaries still tend to be structured along county lines, drainage basins, or major crops and thus in some instances reflect economic and political considerations more than climatological ones (1).

Today, the total area of each of the 48 contiguous states has been divided into between one (Rhode Island) and 10 climate divisions (many larger states), for a total of 344 divisions. Each division contains multiple temperature and precipitation monitoring stations; for example, the Western Regional Climate Center (WRCC), which reports individual station data, lists 224 stations for Arizona and 203 for New Mexico (although all stations may not be active) (2). Over 5,000 weather stations report daily temperature and precipitation to the National Climatic Data Center, which has compiled divisional datasets of temperature and precipitation averages on a monthly and yearly basis, stretching back to 1895. Climate divisions also have been established and datasets compiled for Alaska, Hawaii, Puerto Rico, the U.S. Virgin Islands, and Pacific trust territories, although not all go back as far in time.

Divisional averages form the backbone of many climate information products, such as the Drought Monitor. The averages are simple unweighted arithmetic means of monthly data from all stations within a given division that are thought to reflect the general climatic characteristics of the division (therefore excluding outliers such as stations on mountaintops). To calculate them, temperature and precipitation data from 1931 to 1982 were averaged and linear regression equations were used to fill in missing data points. Other techniques were used to fill in data based on the different climatic divisions that existed at earlier time frames. However, in some areas (Arizona in particular), stations were few and far between in sparsely settled areas of the state and clumped together in more populated areas. Statisticians have had to correct the biases that these factors introduced to the averages (1).

Statistically based climate forecasts, many of which are produced by NOAA's Climate Prediction Center (CPC), rely on data derived from climate divisions; however, as analyses by Robin Webb and Klaus Wolter have shown, divisional data are often inaccurate for regions with complex topography such as mountain ranges. For example, the 60 stations within a single Colorado climate division range in elevation from 1,500 to 3,200 meters and hence reflect a very wide variability of precipitation and temperature

continued on page 4

Climate Divisions, continued

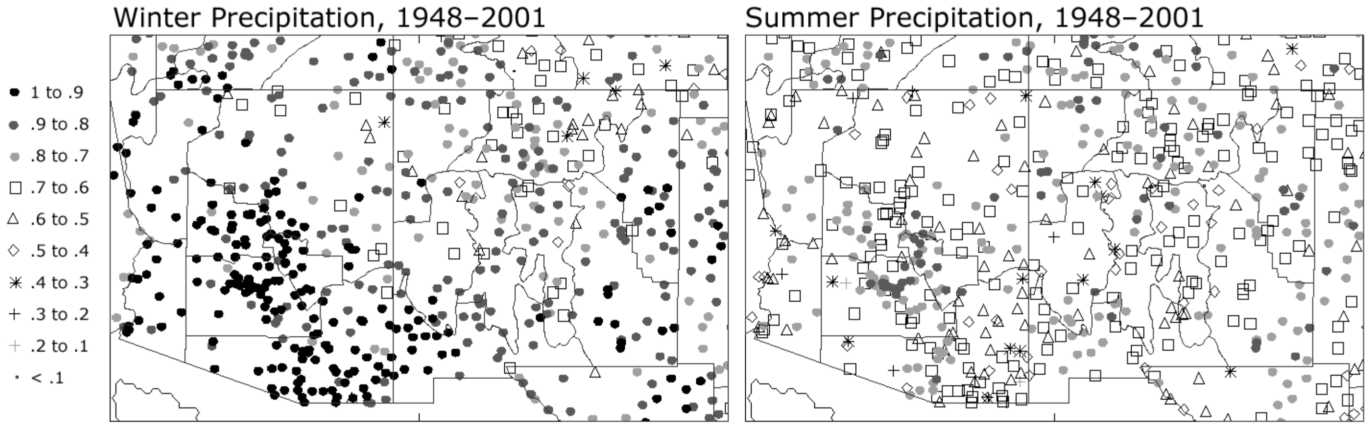

Figure 1. Climate Division Data Accuracy. Climate divisions in Arizona and New Mexico are depicted by the lines within the states. The maps depict the correlations between individual stations and NOAA climate division data for winter (December through February; left) and summer (June through August; right) precipitation. The higher percentage of dark dots in the image on the left, particularly in southern and central Arizona, indicates better winter season correlation between climate division and individual station precipitation; the larger number of squares, triangles, and diamonds on the right shows weaker summer season precipitation correlations. These figures bolster arguments for creating improved U.S. climate divisions.

readings (1). Webb's research indicates that in Arizona and New Mexico divisional data are fairly accurate during the winter months, but problematic during the summer because they do not capture the spatial variability of monsoon rainfall (as many END InSight participants have remarked).

If climate divisions often do not reflect actual conditions in particular locations, why are they so widely used? In part, climate divisions are a holdover from a time when computing capacity was far lower and agencies would have been hard-pressed to calculate and map temperature and precipitation variations from thousands of individual stations. Although the computing capacity to map individual station data does exist today, many forecasting tools are based on divisional data and it would require a major investment of resources and time to make them more spatially specific.

There are other reasons that division-scale data may be more useful for some applications. As Robin Webb notes, climate division data are commonly used to monitor current and evolving climate conditions, to create and verify forecasts and seasonal outlooks, and to conduct analyses of patterns of climate variability. Climate division data are most useful for tracking large-scale climatic features or anomalies over long periods of time. Despite the fact that each climate division may encompass widely varied terrain, large-scale anomalies such as the droughts of the 1930s, 1950s, and 1980s, as well as the cold winters of the 1970s, are easy to discern. Climate division data are also more complete than data from particular stations may be, due to the use of regression analyses that have been conducted to fill in blanks left in the climatic records of individual stations. In addition, in keeping with the original goal of reflecting crop growing regions or other economic areas, they are in some cases more useful for planning for crop-growing belts, river drainage basins, electric power grids, numerical model grids, geopolitical regions, etc.

(1) Guttman, N. and R. Quayle, 1996. A historical perspective of U.S. climate divisions. *Bulletin of the American Meteorological Society* 77(2):293–304.

(2) Data for individual climate stations are available from the Western Regional Climate Center, via the Internet at http://www.wrcc.dri.edu/climsum.html.

About END InSight

END InSight is a year-long project to provide stakeholders in the Southwest with information about current droughkt and El Niño conditions. As part of the Climate Assessment for the Southwest (CLIMAS) project at the University of Arizona, END InSight is gathering feedback from stakeholders to improve the creation and use of climate information.

The *END InSight Newsletter* is published monthly and includes background and topical climate information. All material in the newsletter may be reproduced, provided CLIMAS is acknowledged as the source. The newsletter is produced with support from the National Oceanic and Atmospheric Administration (NOAA).

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