COMMENTS

Daily Precipitation Grids for South America

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We are pleased to see the development of new daily precipitation databases, such as that of Liebmann and Allured (2005, hereafter LA2005). Precipitation information at daily resolution is vital for many applied research topics in climatology, ecology, and hydrology. The development of a new database for South America is particularly welcome, because this important region has received limited attention with regard to precipitation databases (Cook et al. 2003). Still, we are troubled that daily precipitation continues to be gridded using approaches that filter out important spatial and probabilistic information. The new database produced by LA2005 as well as the Climate Prediction Center's Unified Raingauge Dataset (URD; Higgins et al. 2000) for the contiguous United States use spatial operators that smooth spatial patterns of precipitation and drastically alter the daily precipitation probability distribution. Below, we i) discuss the essential problems with filtered daily precipitation products, ii) illustrate these problems by using an example from the midwestern United States, and iii) present solutions that overcome many of these problems.

As noted in their section on "Quality of gridded data," LA2005 acknowledge some of the problems with the spatial averaging of daily precipitation. What LA2005 refer to as "singularities" or "noise," however, is what many scientists refer to as an important climatological or hydrological event. Knowing more about the spatial distribution and historical probabilities of these events is essential to understanding their causes and impacts. By using averages of daily precipitation data within grid circles (LA2005) or the Cressman spatial filter (Higgins et al. 2000), much of the information that is important at the daily time scale has been removed. Smoothed daily precipitation is perhaps more useful for modeling applications, but a high-resolution gridded product that has realistic spatial and probabilistic information can be smoothed and transferred to a model grid of any size.

To illustrate the problems with the simple averaging and smoothing of daily precipitation data, we have applied the methods of LA2005 to data from south-central Indiana (a grid point centered on 39°N, 86°W; precipitation observations from the U.S. Daily Historical Climate Network). When daily precipitation data are averaged or smoothed, a grid point that has precipitation occurring at *any* nearby precipitation will have a precipitation value. As a result, precipitation frequency is vastly altered by the averaging process. For the south-central Indiana example, precipitation station observations produce frequencies that range from 24% to 35% (i.e., precipitation occurs on 24%–35% of the days), depending on season and location. A 1° grid point with simple averaging of nearby precipitation produces precipitation frequencies of around 45%–52%. Larger grids are even worse, due to more stations being averaged. When using simple averaging, a 2.5° grid point in south-central Indiana produces precipitation frequencies of 57%–66%. Due to the damping nature of the spatial averaging process, the entire precipitation probability distribution is shifted toward more frequent, smaller precipitation events. As a result, extreme precipitation events (such as those associated with 10- or 50-year return periods) are vastly smaller when data are gridded using averaging.

The following two approaches are available to remedy the problems of excessively smoothed daily precipitation grids: i) simulation-based approaches and ii) unconventional spatial interpolation methods. An example of a simulation-based approach is a stochastic weather generator, as used in the VEMAP2 database (Kittel et al. 2004). The advantage of a simulation-based approach is that the precipitation probability distribution is preserved; however, the simulation does reduce the utility of the database as a historical record (actual daily precipitation events

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are not faithfully reproduced). Unconventional spatial interpolation methods that are designed for daily precipitation are perhaps the best solution. These methods use a two-part method that first estimates precipitation occurrence (spatially) and then estimates precipitation amount. For instance, a method such as indicator kriging can be used to "interpolate" precipitation occurrence (Jolly et al. 2005). In essence, indicator kriging interpolates the occurrence ("1") and nonoccurrence ("0") of precipitation. Then, grid locations with a value over some critical level can be assigned a precipitation amount. An appropriately sampled spatial probability distribution would be a flexible solution to determining the precipitation amount at a given location.

In summary, alternatives to the simple interpolation or averaging of daily precipitation can provide improved gridded databases of daily precipitation. In particular, careful attention to approaches that preserve spatial and probabilistic information is critical.

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