7.8 A NEW EFFORT TO UPDATE PRECIPITATION FREQUENCY MAPS FOR THE UNITED STATES

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1. INTRODUCTION

National maps of precipitation intensity (TP-40, and NOAA Atlas 2, for example) are 30-40 years old, and quite outdated. The National Weather Service's Hydrological Design Studies Center (HDSC) has recently teamed with Oregon State University's Spatial Climate Analysis Service (SCAS) to use the PRISM modeling system to update these maps. In the initial effort, precipitation frequency maps will be updated for the Semi-Arid Southwest and Ohio River Basin. Anticipated follow-on work will encompass the remainder of the United States, including Alaska, Hawaii, Puerto Rico, and Virgin Islands. One of the major predictive elements for these maps will be high-quality, peer-reviewed PRISM grids of 1961-90 mean annual precipitation, supported by the USDA Natural Resources Conservation Service.

2. BACKGROUND

PRISM (Parameter-elevation Regressions on Independent Slopes Model) is a knowledge-based system that uses point data, a digital elevation model (DEM), and many other geographic data sets to generate gridded estimates of monthly and event-based climatic parameters (Daly and Neilson 1992, Daly et al. 1994, Daly et al 1997, Daly et al 2002). Originally developed for precipitation estimation, PRISM has been generalized and applied successfully to temperature, among other parameters. PRISM has been used extensively to map precipitation, dew point, and minimum and maximum temperature over the United States, Canada, and other countries.

Most of the modeling performed using PRISM has been at time scales of one month or longer. Examples of products already produced include: (1) monthly and annual average climate maps for precipitation, temperature, snowfall, degree days, and other parameters for the 1961-1990 period; and (2) sequential monthly maps for precipitation and mean maximum and minimum temperature for the period 1895-1997 (Daly et al., 2000). PRISM 1961-1990 mean precipitation maps are certified as the official maps of the USDA. Many new PRISM gridded data sets can be obtained from: http://www.climatesource.com.

3. PRECIPITATION FREQUENCY MAPPING

The first phase of the project involved comparing PRISM maps of 2y24h and 100y24h precipitation for the semi-arid southwestern United States. HDSC has recently completed a manually-drawn draft of 2y24h for this region.

Using station data supplied by HDSC, a PRISM map of 2y24h was created. Doing so required a new approach to mapping, however. It was immediately recognized that the amount of station data available from HDSC for 2y24h was much less than that available for the peer-reviewed PRISM 1961-1990 mean precipitation maps. Missing data included NRCS SnoTel stations, snow courses, short-term COOP stations, storage gauges, and more. It was also recognized that mean annual precipitation (MAP) was an excellent predictor of 2y24h in a local area, much better than elevation, which is typically used as the underlying, gridded predictor variable in PRISM applications. Therefore, the PRISM MAP grids represented a powerful base map, both in its incorporation of so much station data, and in its superior predictive capability for 2y24h.

The most direct use of the MAP grid in the PRISM application to 2y24h was to use it as the underlying predictive grid, in place of the elevation grid. This produced excellent results. The PRISM and HDSC maps agreed closely (within 0.5") over most of the domain. Exceptions were in mountainous areas such as the San Bernadinos, Mogollon Rim, Wasatch and Uintas, where PRISM values were 10-25% higher than those of HDSC.

Using the 2y24h map as a base, HDSC typically derives other maps, such as 100y24h, by applying Regional Growth Factors (RGF). These are multiplicative factors assigned on a regional basis according to the best judgment of the analyst. RGFs were applied to the PRISM 2y24h map to produce a PRISM RGF 100y24h map. As expected, a comparison between the PRISM RGF and HDSC 100y24h maps found small differences that mirrored those found in the 2y24h maps.

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A major drawback to the RGF approach is that it can result in discontinuous spatial products that exhibit “seams” along the edges of RGF regions. In an attempt to alleviate this problem, PRISM was applied to station data for 100y24h directly, again using MAP as the underlying predictor variable. The direct PRISM map was very similar to the PRISM RGF map. However, close scrutiny revealed that differences between the PRISM RGF and direct PRISM maps were found, and were located along the “seams” between RGF regions. This suggests that high-quality 100y24h maps can be made directly with PRISM, with the added benefit of eliminating edge effects caused by the regional boundaries inherent in the RGF approach.

4. CONCLUSIONS

Recent applications have shown the usefulness of the PRISM modeling system as a tool for mapping extreme precipitation. Several maps of multi-day storm events in the Pacific Northwest were created. Performance of PRISM was very good, and the products served as the basis for event assessments by state and federal government. A pilot project was performed with the USDA-NRCS and the NWS-HDSC to compare PRISM-based maps of 2- and 100-year 24-hour precipitation with those created by NWS-HDSC for the semi-arid southwestern US. A new method for applying PRISM was developed; it involved using mean annual precipitation instead of elevation as the underlying predictor variable. Results showed that the PRISM maps were very similar to those of the HDSC. In addition, direct PRISM modeling of 100-year 24-hour precipitation has advantages over the regional growth factor approach taken by the HDSC by eliminating spatial discontinuities among regions. The pilot study led to a project to create new official precipitation frequency maps for the southwest U.S. and Ohio Valley, currently underway.

5. REFERENCES

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