Evaluating the Adequacy of Simulating Maximum and Minimum Daily Air Temperature with the Normal Distribution

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Publication Request at a Glance

Publication: Journal Of Applied Meteorology
Publication Request Approval Date: April 26, 2001

Interpretive Summary: Many local, state, and federal agricultural agencies use weather programs to produce weather data for use in studies of crop growth, soil erosion, and water quality. These programs use mathematical equations and relationships to attempt to produce data that match actual weather data reasonably well. However, improvements are needed in several of the processes used to produce temperature data. Our results show that the relationship used to produce temperature data may need adjustment to adequately reproduce actual measured temperature values. Based on this finding and recommended changes, weather generators should be able better represent temperature data, which will allow agencies to better study agricultural conditions and problems.

Technical Abstract: Weather simulation models (or weather generators) are often used to generate synthetic daily weather for use in studies of crop growth, water quality, water availability, soil erosion, climate change, etc. Synthetic weather sequences are needed when long-term measured data are not available, measured data contain missing records, or collection of actual data is cost or time prohibitive. Weather generators are capable of producing synthetic values of precipitation, temperature, solar radiation, humidity, and wind speed. In this study, we focused on the generation procedure for daily maximum and minimum temperature. Most weather generators, including, USCLIMATE, WXGEN, LARS-WG, CLIMGEN, and CLIGEN use the normal distribution to generate daily maximum and minimum temperature values. Our objective was to analyze the assumption of normality in daily maximum and minimum temperature. To accomplish this objective, we examined how well the normal distribution fit measured temperature data and evaluated the appropriateness of generating random temperature data from the normal distribution. Based on this analysis, we determined that measured daily maximum and minimum temperature are not generally normally distributed in each month but are often slightly skewed which contradicts the assumption of normality used by most weather generators. In addition, generating temperature from the normal distribution resulted in several physically improbable values.