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EVALUATION OF SIMULATING DAILY AIR TEMPERATURE WITH THE NORMAL DISTRIBUTION: IMPLICATIONS FOR GEM

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Weather simulation models are commonly 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 if long-term measured data are not available, measured data contain missing records, collection of actual data is cost or time prohibitive, or when necessary to simulate impacts of future climate scenarios. Most weather generators are capable of producing one or more components of weather such as precipitation, temperature, solar radiation, humidity, and wind speed. This study focused on one generation component, the procedure commonly used by weather simulation models to generate daily maximum and minimum temperature. The normal distribution is used by most weather generators (including: USCLIMATE, WXGEN, LARS-WG, CLIMGEN, and CLIGEN) to generate daily maximum and minimum temperature values. The objective of this study was to analyze the adequacy of generating temperature data from the normal distribution. To accomplish this objective, the assumption of normality in measured daily temperatures was evaluated by testing the hypothesis that daily minimum and maximum temperature are normally distributed for each month. In addition, synthetic temperature records generated with the normal distribution were compared to measured temperature records. Based on these analyses, it was determined that measured daily maximum and minimum temperature are generally not normally distributed in each month but often are 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.

A continuation of this effort will examine other distributions and/or procedures to improve the temperature generation procedures in a weather generator under development, the Generation of weather Elements for Multiple applications (GEM) model. In contrast to this study, analysis of the temperature routine in the GEM model (which has the necessary serial and cross correlation structure in place) will allow evaluation of properties such as: frost free period, length of cold and hot spells, first freeze, etc. These important features, which impact climate change and crop simulation modeling, must be realistically represented by temperature routines in weather generators.

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