

Shortcommunication

A brief assessment of a weather data generator (CLIMGEN) at Southern African sites

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Abstract

Weather data generators usually consist of two parts - a section that derives site-specific data-generation coefficients, and a routine that creates the actual observations themselves. In this study, the two CLIMGEN routines were integrated into a single PASCAL program, together with a radiation estimator, and then tested at sites in Southern Africa which had more than 50 years of concurrent daily air temperature and rainfall data. Annual figures were compared for all sites, while monthly statistics were compared for "best" and "worst" cases. Additionally, CLIMGEN daily data were used with the crop yield model CERES-Maize. Yield estimates obtained were compared with those using real observations over a similar 25-year period.

CLIMGEN appears to work satisfactorily over much of Southern Africa. Its representation of climatic means and day to day variability are good. However, it requires more testing at places with shorter climatic records. Also, additional research using other crop yield models at other sites would be invaluable.

Introduction

Crop growth simulation models can be used in production risk studies provided sufficient long-term daily weather data are available. Crop models such as CERES-Maize and CERES-Wheat require daily values of at least rainfall, air temperature and solar radiation, although the latter can be estimated from potential surface values (Clemence, 1992a). However, it is common knowledge that long-term records (say 30 years or more) of concurrent daily weather data are scarce in Southern Africa. Thus, provided they are reliable, so-called "weather estimators" (IBSNAT Project, 1989) can play an important role in supplementing weather data records so that adequate climatic risk assessment can take place.

The "Daily Rainfall Model" (Zucchini and Adamson, 1984) is an example of a locally developed weather estimator. The author has tested the model informally, and it appears to work well at a number of sites here. However, it lacked the ability to generate concurrent air temperature observations, and hence investigation into this estimator was abandoned at an early stage.

Weather estimators usually work by computing certain probability/variability coefficients from existing real data. These coefficients are then used to generate the required data sequences. Provided sufficient real data have been used to create these, generated weather data from simulators such as TAMSIM (McCaskill, 1990a) and WGEN (Richardson and Wright, 1984) can emulate reality quite successfully over longer periods such as a month or more (Meinke et al., 1993). The latter authors do warn that because of the stochastic element present in estimators such as WGEN and TAMSIM, they are not recommended for the infilling of small gaps in weather data records. This is owing to the possibility of the occasional introduction of extreme events.

The CLIMGEN model (Campbell, 1993) is a modification of the well-known WGEN (Richardson and Wright, 1984) weather estimator. However, it is simply presented in the universal

computer language PASCAL, which means the user can adapt the program and its input and output formats at will.

Method

To test the Campbell estimator in this study, weather stations with suitably lengthy concurrent records of at least rainfall and air temperature were selected. "Suitably lengthy" climatic records for a place were thought to be in the order of 30 years, especially if the climate of semi-arid areas was to be adequately represented (Lynch and Dent, 1990). However, to avoid auto-correlation, the period of real data used to evaluate the synthetic weather values had to be separate from that used to create the parameter files. In other words, at least 60 years of real, concurrent weather data were considered necessary for a station to be included in this test. Of the 430 odd weather stations for which daily records are kept on the PC-based weather data bank of the Grain Crops Institute (GCI) (Clemence, 1992b), only about 12 had concurrent records of air temperature and rainfall of 60 years or more. The stations selected appear in Table 1, and, fortunately, represented a wide variety of climates.

Next, parameter files of coefficients were created for each station, using the CLIMPAR routine of the CLIMGEN program. These were based on 30 years of data in each case, except for Newcastle and Jan Kempdorp. Each parameter file was then used to generate a 30-year record of synthetic daily data. These data sets were summarised statistically into monthly means and standard deviation values for certain weather elements. Since the key to realistic weather data estimation is the assessment of variability, extremes of daily air temperature were determined for each month, as was extreme high and low mean monthly rainfall. The mean monthly number of rain days were also computed, as rainfall distribution is important in crop growth simulation modelling.

The next aspect of the testing was to compare crop yield model outputs using both real and synthetic data. For this the CERES-Maize crop yield estimator (Ritchie et al., 1986) was used with 25 years of daily weather data at Cedara. A Hutton soil was assumed. Planting day was set at 327, the cultivar assumed

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