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Local Estimates of Solar Radiation in North Carolina
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THE NEED

Solar radiation is a driving force for many biological and physical processes such as photosynthesis, and is often described as the main energy source for the atmosphere. This parameter is an essential atmospheric measurement for several agricultural applications, such as crop models and reference evapotranspiration (ET) estimates. However, solar radiation is not widely measured at weather stations across the Southeast US due to the high cost of sensor maintenance and calibration. Thus, an estimation of this parameter is often required. Many empirical models have been developed to estimate solar radiation yet most require local calibration.

Apogee solar radiation sensor

SERVING THE NEED

Two common estimation techniques were studied in North Carolina: Hargreaves and Samani (1985), which utilizes diurnal temperature range as a proxy for cloud cover, and Stull (1988), which uses observations of cloud cover as an input to the equation. Also, Hargreaves and Samani (1985) was locally calibrated for use in North Carolina. The models were validated against solar radiation observations at ECONet stations for the period from 2002 to 2009. According to the five descriptive evaluation techniques utilized, one of the locally calibrated Hargreaves and Samani (1985) models performs best in North Carolina but does not offer much improvement over Hargreaves and Samani (1985) using a constant k coefficient of 0.18. Additional research is being performed to further improve these estimates in North Carolina. For now, it is recommended that Hargreaves and Samani (1985) using a constant k coefficient of 0.18 be utilized on a daily time step to estimate solar radiation in North Carolina. These estimates are then input to crop models or to the reference ET equation.

IMPACT

Use of this guidance is extremely helpful to crop and ecological modelers since solar radiation is a critical parameter for these disciplines. Crop and ecological models require serially complete data sets so this estimation is being used in situations of missing data, and is extremely valuable. Dr. Gail Wilkerson, a well-respected crop modeler, "has struggled with this issue [missing weather data] her whole career". A crop model, such as Decision Support System for Agrotechnology Transfer (DSSAT), will not run without these estimates to fill in the data gaps. Studies show that solar radiation is also a critical input for estimating reference ET, which is an important parameter to agricultural producers and water managers. Thus, Hargreaves and Samani (1985) estimates using a k coefficient of 0.18 are being utilized within the reference ET equation when solar radiation observations are of poor quality or are missing.

PARTNERS & SUPPORT

Climatic data were used in this study, with sources of data including NC ECONet observations and ASOS/AWOS observations. This guidance is offered in close collaboration with faculty in the Crop Science Department at NC State University and the Southeast Climate Consortium (SECC).