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Model for Predicting Rainfall by Fuzzy Set Theory Using USDA Scan Data

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Abstract Text:

This research presents the development of a fuzzy inference model for predicting rainfall with data from USDA Soil Climate Analysis Network Station at the Alabama A & M University (AAMU) Campus for the year 2004. The model was developed with Fuzzy variables which were selected based on the degree of association of different factors with various combinations causing rainfall (RF). Variables TP denoting the drop of temperature and WS denoting rise of wind speed between ith and (i-1)th day gave the highest value of R2. Therefore, TP and WS were used for the antecedent part of the production rules to predict rainfall (RF). Results of the model showed better performance after introducing the threshold values of (1) Relative Humidity and solar radiation of ith day, (2) Humidity increase while compared between ith and (i-1)th day, and (3) product of temperature drop (TP) and wind speed (WS) rise while compared between ith and (i-1)th day. Errors between actual and calculated amount of rainfall were 1.20, 2.19, and 9.60 percentages when using USDA scan data from AAMU campus for the years 2003, 2004 and 2005, respectively. The improved model was tested for WATARS and Bragg farm to check the applicability of the model. The errors between the actual and calculated amount of rainfall were 3.20, 5.90, and 1.66 percentages using USDA scan data from WATARS for the years 2003, 2004, and 2005, respectively. Similarly, percentages of errors were 10.37, 11.67, and 25.52 when using scan data from Bragg for the years 2004, 2005, and 2006, respectively.

Impact Statement:

Prediction of rainfall is a complicated task because in the field of agro-meteorology decisions are heavily intertwined in the visage of uncertainty associated with the weather systems. Rainfall prediction has so far been done using probability theory. Statistical approach as the dominant method that enabled modeling of imprecision and uncertainty of any system or phenomenon, ended due to the introduction of fuzzy logic. Moreover, fuzzy inference model has been proved to be very powerful tool to solve a problem involved with any ambuguities or vague assumptions. Fuzzy model can yield more precise results compared to any other traditional method for rainfall prediction.