2009 CSREES National Water Conference; St. Louis, MO

Improvement of the model for predicting rainfall by fuzzy set theory using USDA scan data

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Abstract:

This paper presents the improvement of the fuzzy inference model primarily developed for predicting rainfall (RF) with data from United States Department of Agriculture (USDA) Soil Climate Analysis Network Station at the Alabama Agricultural and Mechanical University (AAMU) Campus for the year 2004. The primary model was developed with selected Fuzzy variables based on the degree of association of different factors with various combinations causing RF. An increase in wind speed (WS) and a decrease in temperature (TP) when compared between the ith and (i-1)th day were found to have a positive relation with RF. Results of the model showed better performance after introducing the threshold values of (i) Relative Humidity (RH) of the ith day, (ii) Humidity Increase (HI) when compared between the ith and (i-1)th day, and (iii) product (P) of WS and TP when compared between the ith and (i-1)th day. In the improved model, errors between actual and calculated amount of RF were 1.20, 2.19, and 9.60 percent when using USDA scan data from the AAMU campus for years 2003, 2004 and 2005, respectively. The improved model was tested at William A. Thomas Agricultural Research Station (WTARS) and Bragg farm in Alabama to check the applicability of the model. The errors between the actual and calculated amount of RF were 3.20, 5.90, and 1.66 percent using USDA scan data from WTARS for years 2003, 2004, and 2005, respectively. Similarly, percentages of errors were 10.37, 11.67, and 25.52 when using scan data from Bragg farm for years 2004, 2005, and 2006, respectively. The primary model yielded the value of error equaling 12.35 percent using USDA scan data from AAMU campus for 2004. The present model performance has proven to be better than the primary model.

Impact Statement:

Weather forecasting is an important and demanding operational responsibility carried out by meteorological services all over the world. It requires procedures that include numerous specialized fields of knowledge and skill. The task is intricate because in the field of agro-meteorology, decisions are heavily intertwined in the visage of uncertainty associated with weather systems. I addition to other traditional and existing methods, applications of the concept of fuzzy set theory for predicting rainfall and drought would contribute as a trustworthy method for water management issues. Application of fuzzy set theory in soil, crops, water management remain in their infant stages due to the lack of awareness of the superiority and potential of fuzzy set theory in these fields. This model will be useful where the decision on a rainfall is inferred with some verbal and linguistic values which are ambiguous in nature. Hence, this model represents the decision-making process exactly how an expert perceives the situation for inferring either a rainfall or a drought. This model further describes a case by case inference with some production rules. Output of this model will be useful for inferring a rainfall or drought with least error.

Category: Other Water Resource Topics
Type of Presentation: Poster Presentation