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Cotton Yield Assessment Using Remotely Sensed Drought Indices

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Agricultural drought is a natural hazard having direct impacts to crop yield. One major application of remote sensing to agriculture is crop monitoring and assessment of vegetative stress, whereas satellite derived indices have been extensively used for identifying stress periods in crops. In this paper, two remotely sensed indices are used in order to quantify agricultural drought impact to cotton growth and estimate the final yield. In specific, Vegetation Condition Index (VCI) and Temperature Condition Index (TCI) are used to monitor agricultural drought and estimate cotton yield. VCI and TCI characterises the moisture and thermal conditions of vegetation, respectively. VCI has excellent ability to detect drought, whereas TCI can identify thermal stresses that have direct impact in vegetation's health. The two indices are computed for 20 hydrological years, from October 1981 to September 2001, from NOAA/AVHRR ten –day composite images with 8x8 Km spatial resolution. VCI and TCI are correlated with yield data in order to identify the critical ten-day showing the highest correlation coefficient with the final yield. Two approaches are tested for deriving the empirical model for estimating cotton yield. The first uses VCI values and yield for developing the empirical relationship. The second incorporates VCI and TCI values along with yield data in a multiple regression analysis. In order to test the derived models on independent dataset, the period 1981-1996 is used for developing the empirical models, whereas the years 1997-2000 are used for validation. The study area is the Prefecture of Thessaly, the largest lowland formation of Greece and the country's largest agricultural centre, located in Central Greece. The critical ten-days for cotton yield regarding the values of the two indices are the 2nd and 3rd of July for VCI and TCI, respectively, corresponding to blooming to bolls open phenological stage. The two approaches gave similar results denoting the significance of VCI to crop yield estimation and the importance of moisture conditions to the final cotton yield in Greece. In all cases, results present that model's estimating accuracy is above 95%, with a Mean Absolute Difference (MAD) of 2% between the estimated and the real yield values. The results show that an early estimation of the cotton yield is feasible by the use of the VCI, three months prior to harvest.