AN IMPROVED TWO-DIMENSIONAL SPECTRAL SPACE BASED MODEL FOR DROUGHT MONITORING AND ITS APPLICATIONS[1]

Qiming Qin, Chuan Jin, Ning Zhang

Institute of Remote Sensing and Geographic Information System, Peking University, Beijing, 100871, China

Corresponding author: Qiming Qin. Tel: +86-10-62751965. Fax: +86-10-62751962.

E-mail address: qmqin@pku.edu.cn.

ABSTRUCT

Remote sensing is an effective tool to achieve surface information with its macro-observation, objectiveness, promptness and low-cost. It plays an important part in the real-time monitoring of temporal and spatial variation of crop moisture content, soil moisture, pests and diseases and can provide the farmland drought information in a large and worldwide scale [1-8]. As a result, research on monitoring of agricultural drought by remote sensing has great practical significance on the promotion of agricultural production and regional sustainable development.

Based on the analysis of the features of two-dimensional spectral space, we promote an improved model named DDI (Distance Drought Index) against Perpendicular Drought Index (PDI) method [9,10].The main points are as follows: The humid areas are generally found in the lower left corner of the moisture triangle scatter diagram in the Red-NIR spectral space. For pure water body, it can be taken as blackbody and its reflectance should be zero in Red-NIR band. The distribution of points in the scatter diagram varies with different water conditions and vegetation conditions in the two-dimensional spectral space. If appropriate coefficient is employed to eliminate the vegetation influence, the surface water condition indicator is available. Therefore, the distance between each point and the extreme point in the left bottom corner can be used as a drought monitoring indicator. As shown in figure 1, line CO represents the distance between point C and the moisture saturated area. $1+NDVI$ stands for the influence of vegetation. And the DDI of point C is calculated by the following equation:

$$DDI\_c = \frac{|CO|}{1+NDVI} \qquad (1)$$

[1]Thanks to the R&D Special Fund for Public Welfare Industry of China (Meteorology): (GYHY200806022), the National Natural Science Foundation of China (40771148), and the High-Tech Research and Development Program of China (2009AA12Z128 and 2008AA121806-04) for funding.

Generally speaking, the moisture condition is better in the vegetation flourished area with higher NDVI value, which will reduce the value of DDI and shows a sign of less severe drought. The added 1 is to avoid the zero vale of NDVI. Thus, the smaller the distance is, the less arid it represents; the greater the distance is, the more severe the drought is. The model not only takes the vegetation impact into account and at the same time simplifies the model processing.

The validation is taken on the remote sensing images of experimental area in Ningxia Hui Autonomous Region on April 18th, 2004. Combined with the analysis of the soil moisture data, we come to the conclusion that DDI achieves a better result on drought monitoring with R^2 equals to 0.5598 than that of PDI with R^2 equals to 0.4632.

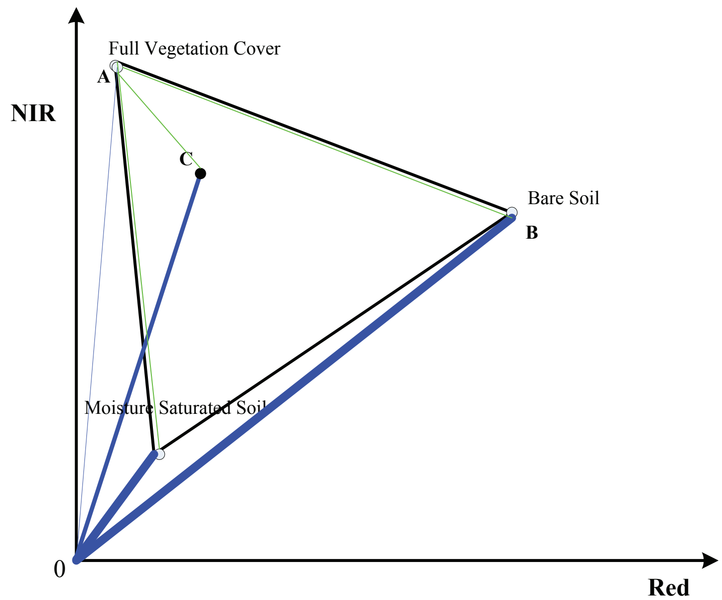

Figure 1 the sketch map of DDI

REFERENCES

[1] F. Baret, G.Guyot, D.J. Major, "TSAVI: a vegetation index which minimizes soil brightness effects on LAI and APAR estimation." Proceedings of the 12th Canadian Symposiµm on Remote Sensing, Vancouver, Canada, pp.1355-1358, 1989.

[2] T.N. Carlson, R.R. Gillies, E.M. Perry. "A method to make use of thermal infrared temperature and NDVI measurements to infer surface soil water content and fractional vegetation cover," Remote Sensing Review, pp.45-59,1994

[3] R.E. Burgan, "Use of remotely sensed data for fire danger estimation." EARSeL Advances in Remote Sensing, pp.1-8,1996.

[4] R.R.Gillies, T.N.Carlson, J.Cui, W.P. Kustas, and K.S. Hµmes, "A verification of the 'triangle method for obtaining surface soil water content and energy fluxes from remote measurements of the normalized difference vegetation index (NDVI) and surface radiant temperature." International Journal of Remote Sensing, pp. 3145-3166,1997

[5] Unganai, L.S. and Kogan F.N. "Drought monitoring and corn yield estimation in Southern Africa from AVHRR data,"Remote Sensing of Environment, pp.219-232, 1998

[6] Calson et al. "The impact of land use-land cover changes due to urbanization on surface microclimate and hydrology: a satellite perspective." Global and Planetary Change, pp.49-65,2000

[7] N.H. Broge and E. Leblanc,"Comparing prediction power and stability of broadband and hyperspectral vegetation indices for estimation of green leaf area index and canopy chlorophyll density", Remote Sensing of Environment, pp.156-172,2000.

[8] H.Fang, S.Liang, M Chen., C. Walthall et al. "Statistical comparison of MISR, ETM+ and MODIS land surface reflectance and albedo products of the BARC land validation core site, USA." International Journal of Remote Sensing, PP. 409-422, 2004.

[9] A. Ghulam, Q. Qin , Z. Zhan, "Designing of the perpendicular drought index." Environmental Geology. pp. 1045-1052,2006.

[10] Q. QIN, A. GHULAM, L. ZHU, L. WANG, J. LI and P. NAN. "Evaluation of MODIS derived perpendicular drought index for estimation of surface dryness over northwestern China," International Journal of Remote Sensing, pp. 1983 - 1995, 2008