APPLICATION OF TWO SHORTWAVE INFRARED WATER STRESS INDICES TO DROUGHT MONITORING OVER NORTHWESTERN CHINA*

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ABSTRACT

Drought is a harmful and headachy natural disaster in the world, which has caused considerable loss to agricultural production and economy per year with high frequency, it is therefore very important and necessary for drought monitor over large scales by remotely sensed techniques. Certain studies have reported that the shortwave infrared (SWIR) reflectance (1300-2500 nm) on satellite were sensitive to variation of vegetation/soil water (Fensholt and Sandholt, 2003; Chen et al, 2005;Qin et al, 2008). The NIR band (858 nm) has been identified as a good choice for reference band that suitable for normalization due to it is relatively insensitive to vegetation/soil water content changes in comparison with the longer wavelengths of NIR and SWIR bands. In order to establish physically meaningful water stress index, the SWIR bands with strong water absorption features are used in this study, thereby the shortwave infrared water stress indices (SIWSI) are constructed using NIR and SWIR bands. Although these indices were usually adopted to estimate vegetation water content, vegetation water generally is supplied by soil water, thus these SIWSI should also be sensitive to soil moisture. Based on the above analysis, a representative arid and semi-arid region over northwestern China, Ningxia region, which droughts occur frequently, is selected to evaluate the drought status using two indices of $SIWSI_{6,2}$ and $SIWSI_{7,2}$ derived from NIR channel 2 (858 nm) and SWIR channel 6 (1640 nm) or 7 (2105-2130 nm) of MODIS sensor, combining with ground truth measurement data of soil moisture observed by the meteorological stations across the whole study area.

The fitted regressions of negative logarithmic curves indicate that both indices have significantly correlated with the *in-situ* measurements ($P<0.01$), the greater of the indices, the drier of the land. The $SIWSI_{6,2}$ performs slightly

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better than the $SIWSI_{7,2}$ (r^2 =0.56 and 0.48). Good performance for drought monitoring would then be anticipated using these indices. Unlike other complex methods of constructing triangle or trapezoid space, for example, the feature space method of land surface temperature (LST)-Normalized Difference Vegetation Index (NDVI) requires the study area cover large enough region to establish dry edge and wet edge, where error occurs easily in this process. Meanwhile, the drought monitor approaches based on NDVI have time lags after droughts occur. Furthermore, compared with TM data that limited by its infrequent coverage and cost, MODIS data is free and available daily (every other day at equator) with narrower bandwidth ranges and wider scan range despite its moderate spatial resolution. Hereby, for just need two bands normalization, the two SIWSI indices demonstrate great potential for drought monitoring simply and quickly using MODIS data over large territories without ancillary data, especially in arid or semi-arid environment, including evaluation of soil moisture or canopy vegetation water.

Key words: Drought; Shortwave infrared water stress index (SIWSI); MODIS.

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