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Soil moisture estimation using a slope indicator between land surface temperature and net surface shortwave radiation

X. Song (1), P. Leng (1), Z. Li (2,3), B. Tang (2), X. Li (4), J. Ma (1), and F. Zhou (1)

(1) College of Resources and Environment, Graduate University of Chinese Academy of Sciences,Beijing,China (songxn@gucas.ac.cn), (2) Key Laboratory of Water Cycle and Related Land Surface Processes, Institute of Geographical Sciences and Natural Resources Research, Chinese Academy of Sciences, Beijing, China (lizl@igsnrr.ac.cn), (3) TRIO/LSIIT (UMR7005 CNRS)/ENSPS, Bld Sebastien Brant, BP10413, 67412 Illkirch, France (lizl@igsnrr.ac.cn), (4) Remote Sensing Center, China Institute of Water Resources and Hydropower Research, Beijing, China (lxtsxn@126.com)

Regional drought can be monitored by remote sensing based soil moisture indictors in thermal infrared and optical wavelengths. According to previous studies, only single temporal remotely sensed data is participated in the calculation of those instantaneous soil moisture indictors, and some of which require observed meteorology parameters. The present study proposes a novel soil moisture indicator that theoretically developed with multi-temporal LST (Land Surface Temperature) and NSSR (Net Surface Shortwave Radiation). To assess the validity of this indictor, deduction of the linear relationship between LST and NSSR has been conducted based on the earth's surface energy budget, and the slope K of the linear relationship was found probably to be a promising soil moisture indictor. In addition to the deduction, LST and NSSR have been simulated with different underlying surfaces and atmospheric conditions by CoLM (Common Land Model). Based on the simulated data, the linear relationship between LST and NSSR was proved to be correct. Further study showed that the variation of average surface soil moisture in the morning and slope K of the linear relationship kept consistent, and the correlation coefficient was nearly 0.8 with each different atmospheric condition, which indicated that slope K is capable of determining surface soil moisture. Finally, two MODIS data were used to map regional K and then used to classify the drought grade of Anhui province during a serious drought. Results showed that the drought monitored by slope K was corresponded with the meteorology statistics. Further, synchronous TVDI were also acquired to test and verify K in regional scale, results showed that the correlation coefficients of the linear fitting between K and TVDI reached 0.93 and 0.88 for the two time phases, respectively, which has also demonstrated that K is capable of monitoring drought. This study can provide a novel method to monitor drought in the none-observation area. Even though the indictor is theoretically developed with multi-temporal LST and NSSR, it remains feasible with the polar orbiting satellites data with some reasonable assumptions, which has also expanded the application with the proposed indictor.