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# Drought Monitoring by Time Series Analysis of Satellite Land Surface Temperature

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With the development of remote sensing in the last thirty years massive satellite data have been accumulated by different satellite sensors. These continuous satellite data record the information on changes in land surface conditions. The research on the information retrieving from satellite time series data is of great significance, including applications to climate change research, identification of phenology, hydrological modeling, ecosystem and drought monitoring, etc. In this paper a methodology is presented for drought early warning by analyzing the time series of MODIS Land surface Temperature (LST) product.

LST, representing the thermal properties of land surface and in turn canopy water stress conditions, is a vital parameter in the drought monitoring. The continuous increasing of LST relative to the historical average implies that drought might be happening. The proposed methodology is to use the satellite time series data to retrieve the trend in LST changes for drought monitoring. Missing observations always exist in the satellite time series due to cloud cover, which affects the reliability of the information retrieved from the time series. The first problem to solve when using such incomplete time series data is, therefore, to evaluate the quality of the time series and reconstruct a new time series without gaps. We have designed a set of criteria to classify the time series quality by taking into account the percent of the missing observations in the time series, the length of the gap in the series, and the retrieval quality of the parameter. A modified version of HANTS (Harmonic ANalysis of Time Series) is implemented to reconstruct the time series. The modification on HANTS is made to fit the rapidly changing character of LST time series. Then the time series of the LST anomaly relative to the historical average is calculated. Based on the time series of the LST anomaly an index to depict the accumulated temperature anomaly and its changing direction is designed. This index is capable of describing drought evolution and drought severity. To process the massive satellite data in time for quasi-real time monitoring, an algorithm is designed and coded to implement a tool for drought early warning through procedures including dataset management, image mosaic and resampling, image degradation, time series reconstruction, calculation of historical average, calculation of anomaly, and generation of drought severity index, etc.

We have chosen China mainland as the study area to implement the developed method for drought monitoring. The MODIS daily (MOD11A1) and 8-day (MOD11A2) LST products are collected to construct the time series of satellite data. Then we applied the above methodology over the whole China in particularly to analyze the severe drought event occurred in Sichuan-Chongqing in 2006.