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Drought monitoring and prediction by time series analysis of greenness and thermal anomalies at large scale

L. Jia (1), J. Li (1), and M. Menenti (2)

(1) Alterra, Wageningen University and Research Centre, 6708BP Wageningen, The Netherlands (Li.Jia@wur.nl), (2) Department of Earth Observation, Delt University of Technology, Delft, The Netherlands

Drought is the result of insufficient water supply from either precipitation or from surface/ground water for a certain period so that the vegetation and the soil are eventually under extreme water stress. Vegetation will respond to drought by changing spectral properties and by increasing thermal emission since the photosynthesis and transpiration activities are reduced by insufficient water supply.
A drought monitoring and prediction technique is developed by generating and analyzing cloud-free time series of greenness and thermal properties of the land surface expressed by vegetation index (VI) and land surface temperature (LST) respectively.
HANTS (Harmonic Analyze of Time Series) was modified to deal with the steep slope due to fast growth as observed in vegetation index or resulted by large thermal contrast observed as large amplitude in the LST time series. A modification was also done allowing gradually increasing and decreasing weighing coefficients, and a moving-window implementation to make prediction of the signal possible.
The study shows that the vegetation index anomaly develops as a smooth function of time, thus suggesting an easier prediction of trends and anomalies at different moments through the growing season. A weighted moving-window time-series of the vegetation index anomaly relative to the historical average was calculated both for detection and for prediction.
A case study was done by time series analysis of LST and vegetation index using linear interpolation and the modified HANTS during the severe drought events occurred in China in 2006. The LST anomaly anticipated the appearance of the vegetation index anomaly by a few weeks, but it was smaller throughout the period of drought occurrence in 2006. The LST anomaly once it appeared, it did not disappear, thus providing additional and useful information on the impending drought event, well in advance of the time of peak-severity. The VI anomaly showed large magnitude and lasted longer time.