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Early drought detection by time series analysis on land surface temperature and fraction of Absorbed Photosynthetically Active Radiation

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Drought is a complex and widespread natural hazard and a result of water resources shortage, which affects many parts of the world with a substantial impact on environment, agriculture, hydroelectric power, and many other sectors. To better address the risks associated with drought, it is important to shift from following the hydrological cycle and reacting to drought in the post-drought period to risk-based drought mitigation planning. Improved drought early warning is essential for risk-reduction and drought mitigation planning. Comparing to conventional measurements, an important element of the value of a satellite-based drought monitoring and early warning system is the information provided towards advance alert on impending drought events. This study is to assess whether the time series of available observations might be used to predict time and magnitude of anomalies in land surface temperature and vegetation response. Time series of the MODIS data products fAPAR(fraction of Absorbed Photosynthetically Active Radiation) and LST (land surface temperature) are good candidates, because of the combination of relatively high temporal and spatial resolution. One additional requirement is the predictability of the time series, which depends on the inherent memory of the process observed. A case study was done by time series analysis of LST and fAPAR using Fourier transform and linear interpolation during the severe drought events occurred in Sichuan/Chongqing area of China in 2006. The study shows that the fAPAR anomaly develops as a smooth function of time, thus suggesting an easier prediction of trends and anomalies at different moments through the growing season. The example shows that simple extrapolation in time of the observed

signal (up to any given moment) would provide already an usable advance prediction of anomalies. The LST anomaly anticipated the appearance of the fAPAR 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. Moreover, both fAPAR and LST seem to respond consistently to climate forcing (rainfall, air temperature etc.). For instance, it is clear that the observed fAPAR anomaly responds rather well and correctly to the observed rainfall anomaly. This supports the use of fAPAR observations for detection and prediction of drought-related anomalies in the development of vegetation. Finally, it should be noted that anomalies and trends detected with diverse measures of water availability and of the response of terrestrial vegetation do add up to a coherent picture of the developing drought event about 2 months in advance of the time when anomalies reached their peak values in the case of study.