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A Newly Global Drought Index Product Basing on Remotely Sensed Leaf Area Index Percentile Using Severity-Area-Duration Algorithm

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Drought is one of the typical natural disasters around the world, and it has also been an important climatic event particular under the climate change. Assess and monitor drought accurately is crucial for addressing climate change and formulating corresponding policies. Several drought indices have been developed and widely used in regional and global scale to present and monitor drought, which integrate datasets such as precipitation, soil moisture, snowpack, streamflow, evapotranspiration that deprived from land surface models or remotely sensed datasets. Vegetation is a prominent component of ecosystem that modulates the water and energy flux between land surface and atmosphere, and thus can be regarded as one of the drought indicators especially for agricultural drought. Leaf area index (LAI), as an important parameter that quantifying the terrestrial vegetation conditions, can provide a new way for drought monitoring. Drought characteristics can be described as severity, area and duration. Andreadis et al. has constructed a severity-area-duration (SAD) algorithm to reflect the spatial patterns of droughts and their dynamics over time, which is a progress of drought analysis. In our study, a newly drought index product was developed using the LAI percentile (LAIpct) SAD algorithm. The remotely sensed global GLASS (Global LAnd Surface Satellite) LAI ranging from 2001-2011 has been used as the basic data. Data was normalized for each time phase to eliminate the phenology effect, and then the percentile of the normalized data was calculated as the SAD input. 20% was set as the drought threshold, and a clustering algorithm was used to identify individual drought events for each time step. Actual drought events were identified when considering multiple clusters merge to form a larger drought or a drought event breaks up into multiple small droughts according to the distance of drought centers and the overlapping drought area. Severity, duration and area were recorded for each actual drought event. Finally, we utilized the existing DSI drought index product for comparison. LAIpct drought index can detect both short-term and long-term drought events. In the last decades, most of the droughts at global scale are short-term that less than 1 year, and the longest drought event lasts for 3 year. The LAIpct drought area percentage consist well with DSI, and according to the drought severity classification of United States Drought Monitor system, we found the 20% LAIpct corresponds to moderate drought, 15% LAIpct corresponds to severe drought, and 10% LAIpct corresponds to extreme drought. For some typical drought event, we found the LAIpct drought spatial patterns agree well with DSI, and from the aspect of temporal consistency, LAIpct seems smoother and fitter to the reality than DSI product. Although the short period LAIpct drought index product hinders the analysis of global climate change to some extent, it provides a new way to better monitor the agricultural drought.