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Dataset of Typical Drought Disaster and its Impacts on the Terrestrial Vegetation in the Southwest China (2009−2010)

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Abstract: In order to study the impacts of typical drought disaster on terrestrial vegetation, we selected the drought event in the Southwest China that occurred from June 2009 to April 2010 based on the standard precipitation evapotranspiration index (SPEI). And then we got the datasets by analyzing the Global Land Surface Satellite (GLASS) leaf area index (LAI) and the Fraction of Absorbed Photosynthetically Active Radiation (FAPAR) data. The dataset includes: (1) the drought degree data, LAI anomalies, FAPAR anomalies from June 2009 to April 2010 in the Southwest China and the drought severity index, the accumulation of LAI anomalies, the accumulation of the FAPAR anomalies during the drought periods. The data has a spatial resolution of 0.01° and a temporal resolution of 1 month; (2) the monthly LAI anomalies, FAPAR anomalies at different land covers and the 3-month scale SPEI from 2001 to 2014 in the area; (3) the multi-year (2001−2014) monthly average data of LAI anomalies, FAPAR anomalies of different vegetation and 3-month scale SPEI in the region; (4) the border file of this region. The dataset is archived in .tif, .xlsx, and .shp formats. The results showed that, the impacts of a drought disaster on vegetation was closely related to the drought severity, the LAI and the FAPAR declined more compared with the average level; the response of different vegetation to the drought was different, and croplands and woody savannas were more easily be affected by the drought compared with the mixed forest.

Keywords: drought; vegetation; LAI anomalies; FAPAR anomalies; SPEI; the Southwest China

1 Introduction

Drought has great impact on terrestrial vegetation, and the response of different vegetation to drought varies among different vegetation[1−2]. We analyzed the influences of one typical drought disaster on different vegetation occurred in the Southwest China from 2009 to 2010 based on the standardized precipitation evapotranspiration index (SPEI)[3], emergency events database (EM-DAT, https://www.emdat.be/) and the LAI and FAPAR product of GLASS[4]

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[2] Wu, J. J., Yang, J. H. The dataset of drought degree and its impact on vegetation in the southwest of China (2009−2010) [DB/OL]. Global Change Research Data Publishing & Repository, 2017. DOI: 10.3974/geodb.2017.04.01.V1.

and got the dataset of typical drought disaster and its impacts on terrestrial vegetation.

The Southwest China includes the southeastern part of the Qinghai-Tibet Plateau, the Sichuan Basin and most of the Yunnan-Guizhou Plateau. The climate types in the region are complex. The scale, severity, and frequency of drought in the Southwest China have increased over the past 60 years due to the effect of global climate change[5].

2 Metadata of Dataset

The metadata of the dataset of drought degree and its impact on vegetation in the southwest of China (2009–2010)[6] are summarized in Table 1. It includes the dataset full name, short name, authors, year, temporal resolution, spatial resolution, data format, data size, data files, data publisher, and data sharing policy, etc.

Table 1 Metadata summary of the dataset of drought degree and its impact on vegetation in the southwest of China (2009–2010)

Items	Description
Dataset full name	The dataset of drought degree and its impact on vegetation in the southwest of China (2009–2010)
Dataset short name	DroughtVegSWChina2009_2010
Authors	Wu, J. J. Q-1391-2017, Faculty of Geographical Science, Beijing Normal University, jjwu@mail.bnu.edu.cn Yang, J. H. N-3427-2018, Faculty of Geographical Science, Beijing Normal University, yangjh15@mail.bnu.edu.cn
Geographical region	Southwest China Year 2001–2014
Temporal resolution	0.01 ° Spatial resolution 1 month
Data format	.tif, .shp, .xlsx
Data size	81.9 MB (after compression)
Data files	The dataset includes: (1) boundary shp folder: store the vector border file of the study area, the data format is .shp (2) drought degree folder: store the drought degree data from June 2009 to April 2010 of the study area, the data format is .tif, the time resolution is 1 month, the spatial resolution is 0.01 °, the invalid value is −99, and the numbers 1−5 represent extreme drought, severe drought, mild drought, moderate drought and no drought (3) LAI anomaly folder: store the monthly LAI anomaly data from June 2009 to April 2010 of the study area, the data format is .tif, the time resolution is 1 month, the spatial resolution is 0.01 °, the invalid value is 255, and the scale factor is 0.1 (4) LAI anomaly accumulated value folder: store the accumulation of the LAI anomalies at the drought period in this region, the data format is .tif, the spatial resolution is 0.01 °, the invalid value is 255, and the scale factor is 0.1 (5) FAPAR anomaly folder: store the monthly FAPAR anomaly data from June to April in 2007 of the study area, the data format is .tif, the time resolution is 1 month, the spatial resolution is 0.01 °, the invalid value is 255, and the scale factor is 0.1 (6) FAPAR anomaly accumulated value folder: store the accumulation of the FAPAR anomalies at the drought period in this region, the data format is .tif, the spatial resolution is 0.01 °, the invalid value is 255, and the scale factor is 0.1 (7) .xlsx file: store the statistic information of different land cover's response to the drought disaster, the data format is .xlsx
Foundation(s)	Ministry of Science and Technology of P. R. China (2016ST0010)
Data publisher	Global Change Research Data Publishing & Repository, http://www.geodoi.ac.cn

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Items	Description
Address	No. 11A, Datun Road, Chaoyang District, Beijing 100101, China
Data sharing policy	***Data*** from the Global Change Research Data Publishing & Repository includes metadata, datasets (data products), and publications (in this case, in the *Journal of Global Change Data & Discovery*). ***Data*** sharing policy includes: (1) ***Data*** are openly available and can be free downloaded via the Internet; (2) End users are encouraged to use ***Data*** subject to citation; (3) Users, who are by definition also value-added service providers, are welcome to redistribute ***Data*** subject to written permission from the GCdataPR Editorial Office and the issuance of a ***Data*** redistribution license, and; (4) If ***Data*** are used to compile new datasets, the 'ten percent principal' should be followed such that ***Data*** records utilized should not surpass 10% of the new dataset contents, while sources should be clearly noted in suitable places in the new dataset [7]

3 Methods

3.1 Algorithm

We identified the drought events based on the SPEI, and then we calculated the LAI anomalies and FAPAR anomalies to study the impacts of drought disasters on vegetation. The vegetation anomalies were calculated by the follow formula:

$$VIAN_i = VI_i - \overline{VI} \tag{1}$$

$$\overline{VI} = \sum_{i=1}^{n} VI_i / n \tag{2}$$

Since drought is a continuous process, the drought severity index can reflect the overall severity of drought. Drawing lessons from the calculation methods of the drought severity index[8–9], the accumulation of LAI anomalies and the accumulation of FAPAR anomalies are defined and calculated as indicators of the cumulative effects of drought events on terrestrial vegetation. The cumulative value of vegetation index anomalies is calculated as follows:

$$VIAN\_Accumulation = \sum_{i=t_1}^{i=t_2} VIAN_i \tag{3}$$

3.2 Technical Workflow

First of all, we identified the drought event based on the SPEI, then the LAI anomalies and FAPAR anomalies were calculated, and lastly we calculated the accumulations of LAI anomalies and the accumulations of FAPAR anomalies during the drought periods (Figure 1).

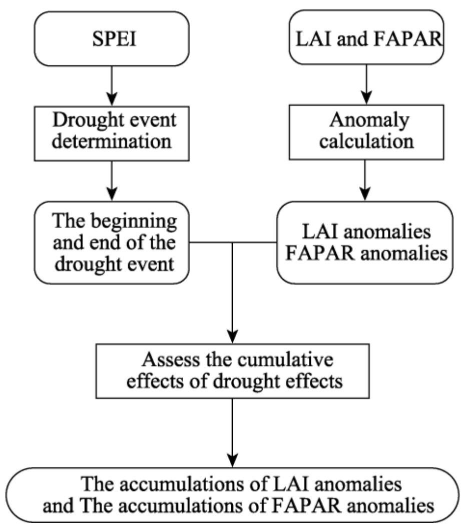

Figure 1 Workflow of the dataset development

4 Results and Validation

4.1 Data Products

The published dataset includes six folders and one

Excel file. We can analyze the trend of vegetation remote sensing parameters (LAI and FAPAR) anomalies through the drought disaster statistic information datasets of this region (Figures 2–3). The sub-folders named with "the LAI anomalies" and "the FAPAR anomalies"

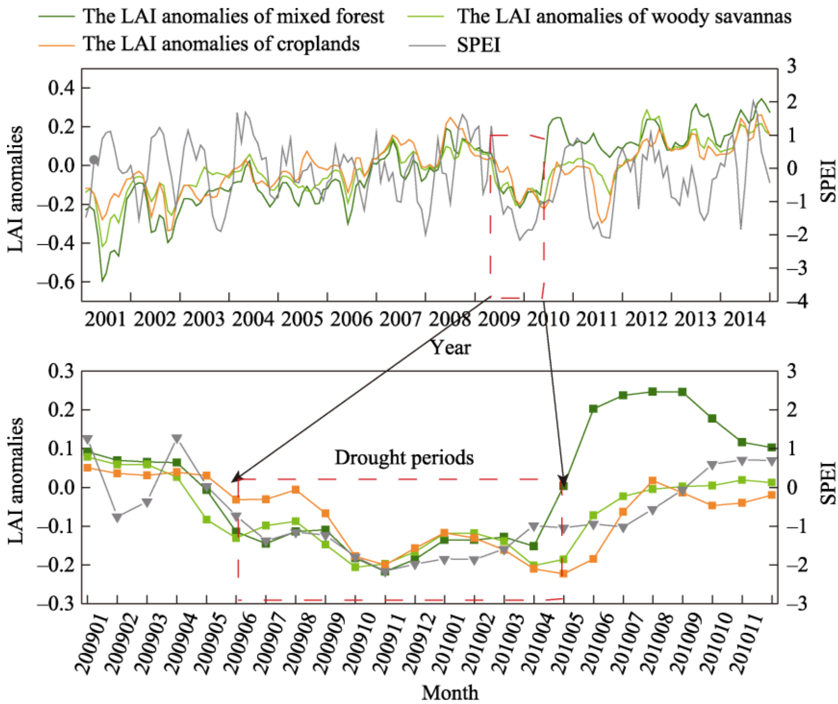

Figure 2 LAI anomalies of different vegetation in the Southwest China from 2001 to 2014

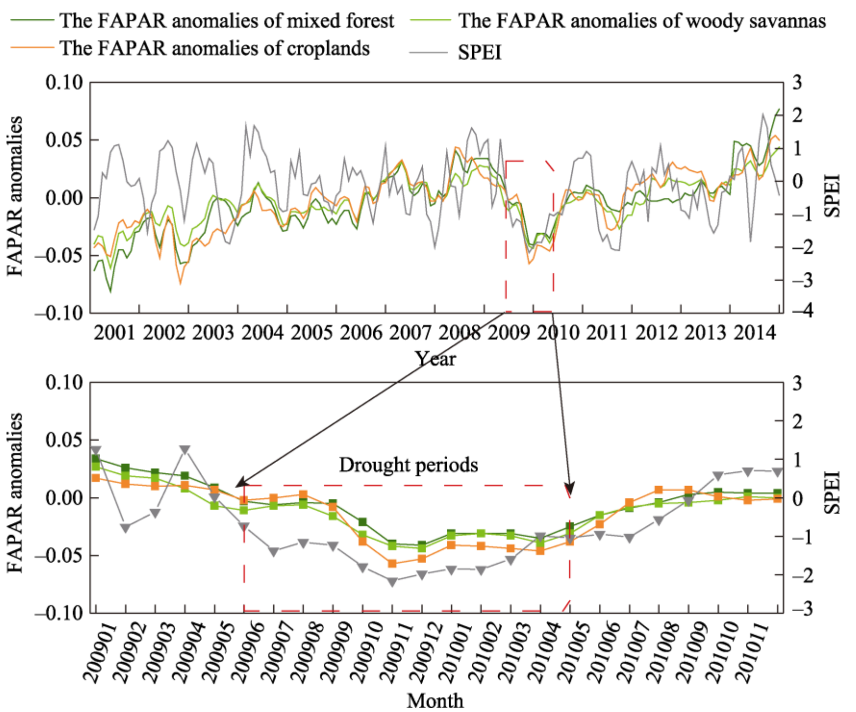

Figure 3 FAPAR anomalies of different vegetation in the Southwest China from 2001 to 2014

are used to store the vegetation remote sensing anomalies files, the LAI anomalies and FAPAR anomalies can be displayed in space with the help of ArcMap (Figures 4–5). The other three sub-folders named "Drought Severity", "the Accumulations of LAI anomalies" and "the Accumulations of FAPAR anomalies" are used to store the drought severity index file, the accumulations of LAI anomalies file and the accumulations of FAPAR anomalies file, the above three files can be showed in space by the ArcMap as well (Figure 6).

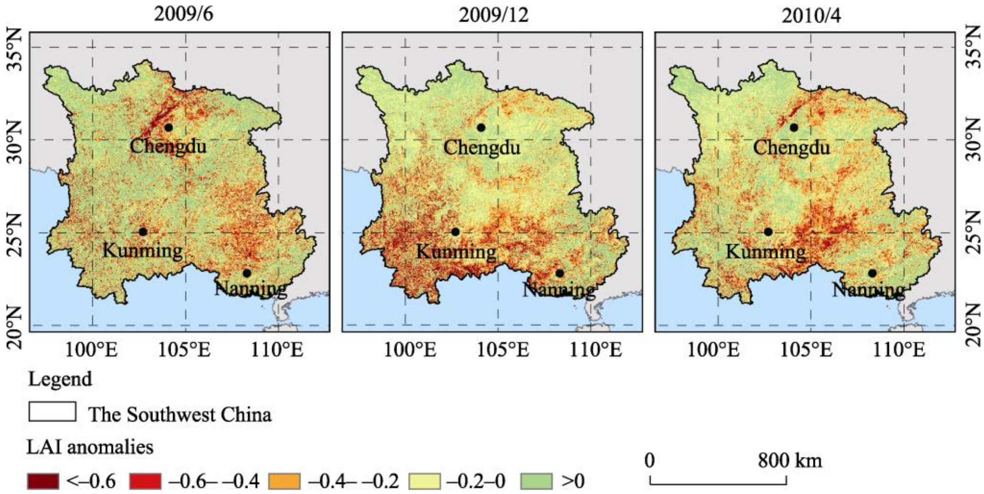

Figure 4 Spatial characteristics of LAI anomalies in different months in the Southwest China

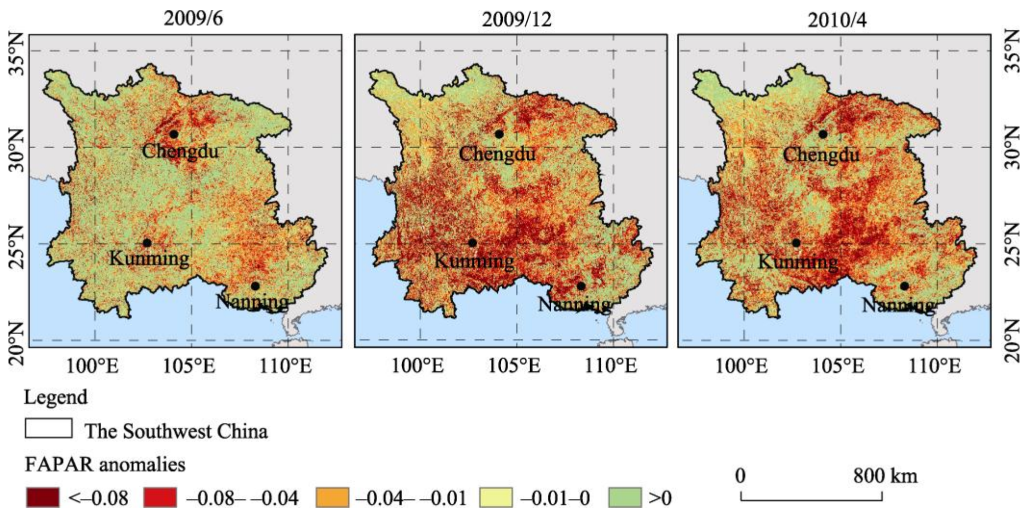

Figure 5 Spatial characteristics of FAPAR anomalies in different months in the Southwest China

4.2 Validation

The GLASS LAI products and FAPAR products is spatially complete and temporally continuous[10]. Kim *et al*. explored the impacts of severe drought on vegetation in Yunnan, and they considered the GLASS LAI could be used as an effective indicator for assessing the vegetation response to drought[11].

The literature studies suggest that our conclusions drawn from our dataset are consistent with the existing research results. Zhang *et al*. studied the impacts of the drought event on vegetation based on MODIS EVI product, and they found cropland was the most sensitive to drought, followed by grassland and then woodland[12]. Yan *et al*. analyzed the response of vegetation to the drought, they also found cropland and grassland were more easily effected by drought[13]. We are able to get the consistent conclusions (Figures 2–3). Wang *et al*. found the area of vegetation ecosystem that suffered from this disaster in Yunnan, Guangxi, and Guizhou accounted for more than 80% of the total area of the vegetation ecosystem in these three administrative regions. Farmland vegetation was seriously damaged, resulting in large areas of crops dying off, at the same time the effect on natural vegetation was obvious and the growth was apparently suppressed[14]. This is consistent with the spatial analysis results of our dataset (Figures 4–6).

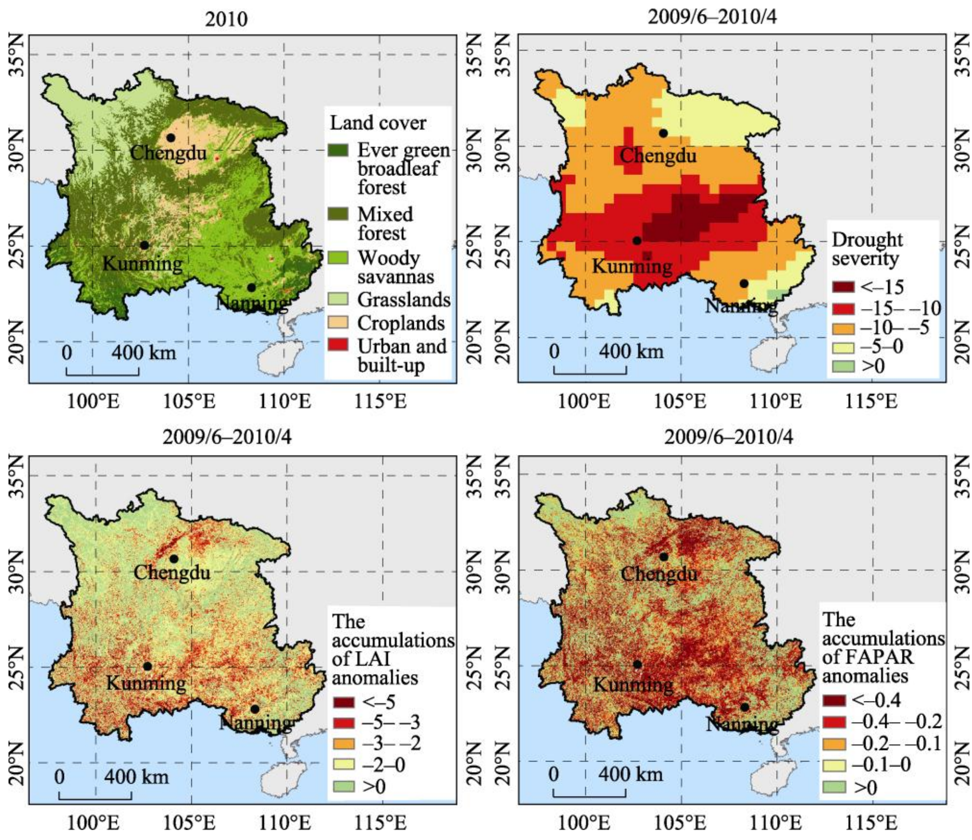

Figure 6 Spatial distribution of vegetation type, drought severity, and the accumulations of LAI and FAPAR anomalies in the Southwest China

5 Discussion and Conclusion

The dataset was developed based on the GLASS LAI and FAPAR by the anomaly analysis in 0.01° pixels and monthly frequency. At the same time, the conditions of different land cover influenced by the drought were analyzed combined with the MODIS land cover product[15–16]. It was found that the impact of drought on vegetation was closely related to the drought severity. The effects of drought on vegetation were also related to vegetation types, croplands and grasslands were more susceptible to drought. Most of the Sichuan Basin was non-irrigated croplands, which had lower FAPAR anomalies compared with other regions experiencing similar drought severity (Figure 6).

With the development of a drought event, the drought severity in one region will go from light to heavy and then go from heavy to light, thus it is important to quantify the overall condition of one region's vegetation affected by a drought event. Based on the run theory, this paper proposed the accumulations of vegetation remote sensing parameters (LAI and FAPAR) anomalies to quantify the cumulative effects of major drought events on vegetation. And this method has been used to study the influences of drought on terrestrial vegetation in China[17], providing a methodological reference for studying the comprehensive impacts of drought disasters on vegetation. The datasets can provide a reference for analyzing the effects of drought disasters on vegetation.

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