International Journal of Wildland Fire **2020**, *29,* 104–119
doi: 10.1071/WF19039_AC

Supplementary material

Current and future patterns of forest fire occurrence in China

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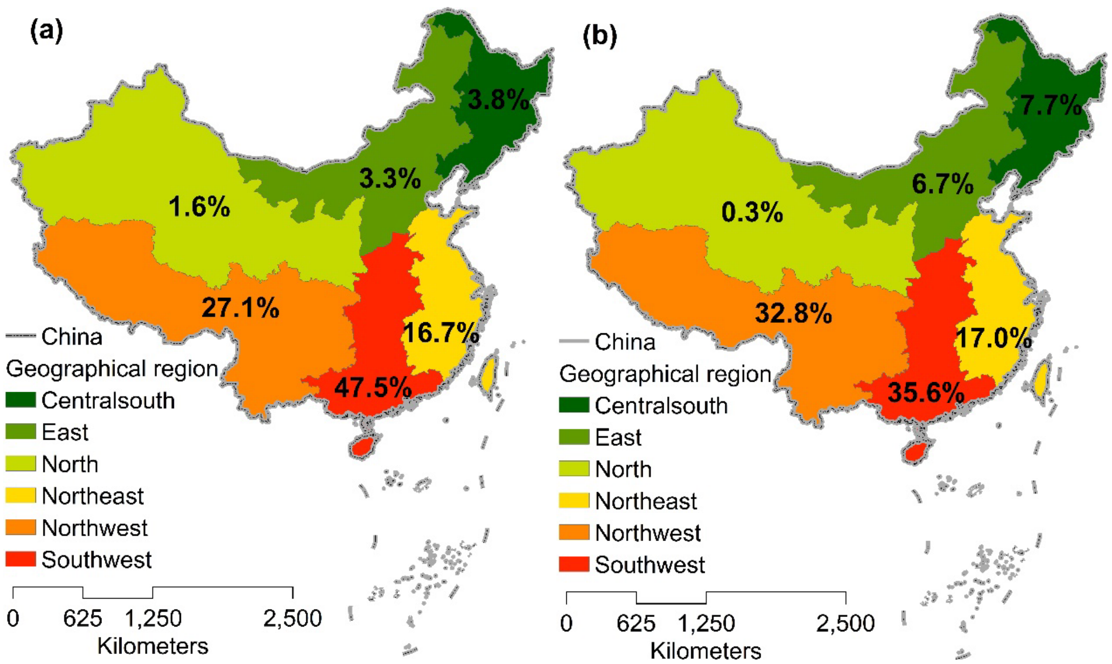
Appendix 1- Comparison of the frequency (fire number), burned area, and spatial patterns of forest fires derived from the China government's fire statistics dataset and the MODIS-based Global Fire Atlas dataset.

We identified 25, 729 forest fires (ignitions) between 2003 and 2015 across China with the MODIS-based Global Fire Atlas dataset, which was less than the number of forest fires recorded in the government's fire statistics dataset (103,711). Some fires may have been small (e.g., short duration) or obscured by smoke, cloud or tree canopy and were undetected by MODIS (Chuvieco *et al.* 2008). By contrast, the forest fire statistics include all forest fires that occur in China (Tian *et al.* 2013). Therefore, we may have underestimated the number of fire occurrences (ignitions) that occur in forested lands of China.

We compared the spatial patterns of fire occurrence between 2003 and 2015 derived from the Chinese government fire statistics dataset and the MODIS-based Global Fire Atlas dataset across geographical regions in China. The spatial distributions of fire occurrence from these two datasets were generally similar. Specifically, both datasets showed that central-southern and southwestern China had the largest percentage of fire occurrence, followed by east, northeast, and north part of China, and northwestern China had lowest fire occurrence.

The mean fire size and total burned area of the 25,729 forest fires derived from the MODIS-based Global Fire Atlas dataset were 147.2 ha and 3,787,050 ha. The mean fire size and total burned area of the 103,711 forest fires derived from the China government's fire statistics dataset were 30.7 ha and 3,200,905 ha. The mean fire size and total burned area derived from the MODIS-based Global Fire Atlas dataset were 79.1% and 15.5% higher than that derived from the China government's fire statistics dataset respectively.



The spatial distribution of percentage of the total number of fires for six geographical regions in China to the total number of fires in the whole country during 2003-2015. (a) Fires derived from the China government's fire statistics dataset; (b) fires derived from the MODIS-based Global Fire Atlas dataset.

Even though the MODIS-based data may underestimate the number of fire occurrences, it can provide general insights into the national patterns of China's fire ignition and variability. A national-level fire data is not always freely available to the public or often incomplete (Lehtomaki *et al.* 2015; Fornacca *et al.* 2017). In contrast, a global earth observation using sensors on space-borne satellites has provided multiple regional or global thematic fire datasets (e.g., the MODIS fire products) (Giglio *et al.* 2010), which are usually available to the public at no cost. Especially in areas such as China where spatially and temporally explicit fire data are lacking or not publicly available. Currently, the MODIS Fire Product has been considered as reliable data source for characterizing fire regimes at large spatial scale (Chuvieco *et al.* 2008; Hantson *et al.* 2013). Therefore, we used the MODIS-based data to characterize fire occurrence patterns in this study.

Appendix 2- Details about the accuracy of the MODIS land cover product (MCD12Q1).

Several land cover products are issued worldwide, such as 1) International Geosphere Biosphere Program Data and Information System's land cover dataset (IGBP- DISCover); 2) University of Maryland land cover dataset (UMD); 3) Global land cover dataset (GLC) from the European Commission's Joint Research Center; 4) Moderate Resolution Imaging Spectroradiometer (MODIS) land cover dataset (MCD12Q1); 5) Global land cover Map (GlobCover) from European Space Agency; 6) Climate Change Initiative land cover dataset (CCI-LC) from ESA; 7) Global Map–Global land cover (GLCNMO) dataset from the International Steering Committee for Global Mapping; 8) Finer Resolution Observation and Monitoring Global land cover dataset (FROM-GLC) from China; 9) the 30 m resolution Global land cover dataset (Globeland30) from National Geomatics Center of China (Yang *et al.* 2017).

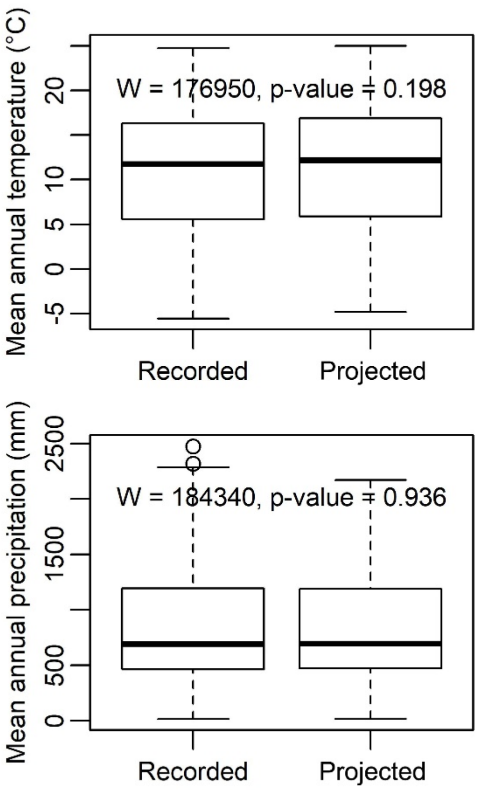
Yang *et al.* 2017 evaluated the accuracy of the seven land cover products (IGBP DISCover, UMD, GLC, MCD12Q1, GLCNMO, CCI-LC and GlobeLand30) over China. They found that when five classes of forests (evergreen needleleaf forests, evergreen broadleaf forests, deciduous needleleaf forests, deciduous broadleaf forests, mixed forests) were aggregated into forests, the overall accuracies of the land cover products ranged from 38.6%-71.98%. Among them, the overall accuracies for CCI-LC and MCD12Q1 were approximately 71.9% and 70.0% respectively over China. And they suggested that if users are interested in land cover maps with more detailed classes, such as including the separation of five classes of forests, the CCI-LC and MCD12Q1 could better match the demand. Considering that fire data and NDVI data in this study were derived from MODIS products, we therefore used the MODIS MCD12Q1 product in this study.

Appendix 3- Comparison between the annual temperature and precipitation of WorldClim 1.4 outputs (projected) and 613 meteorological stations observations (recorded) during 1960-1990 in China

Examinations of whether there is a significant difference between projected “historical” and “recorded” climate from 1960-1990. The “projected” climate variables were extracted from the WorldClim (version 1.4) outputs (1960-1990) based on the spatial location (*longitude* and *latitude*) of 613 meteorological stations in China. The “recorded” climate variables were derived from all 613 meteorological stations from 1960-1990. Comparison was made between the average annual temperature and precipitation of historical outputs (1960-1990) and 613 meteorological stations observations (1960-1990) in China. P values were based on the Mann-Whitney U test.

We found that the annual temperature and precipitation values derived from the WorldClim dataset were close to the observations from 613 benchmark weather stations in China during

1960-1990. Specifically, the mean annual temperature values for the WorldClim and weather station (Mann-Whitney U test, W = 176950, p-value = 0.198) were 11.5±6.7 °C and 11.0± 6.6 °C respectively; the mean annual precipitation values for the WorldClim and weather station (Mann-Whitney U test, W = 184340, p-value = 0.936) were 825.5±488.0 mm and 829.5±506.7 mm respectively.



Comparison between the annual temperature and precipitation of WorldClim outputs (projected) and 613 meteorological stations observations (recorded) during 1960-1990 in China

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