Supplementary Materials for "Satellite-Based Analysis of Spatiotemporal Wildfire Pattern in the Mongolian Plateau"

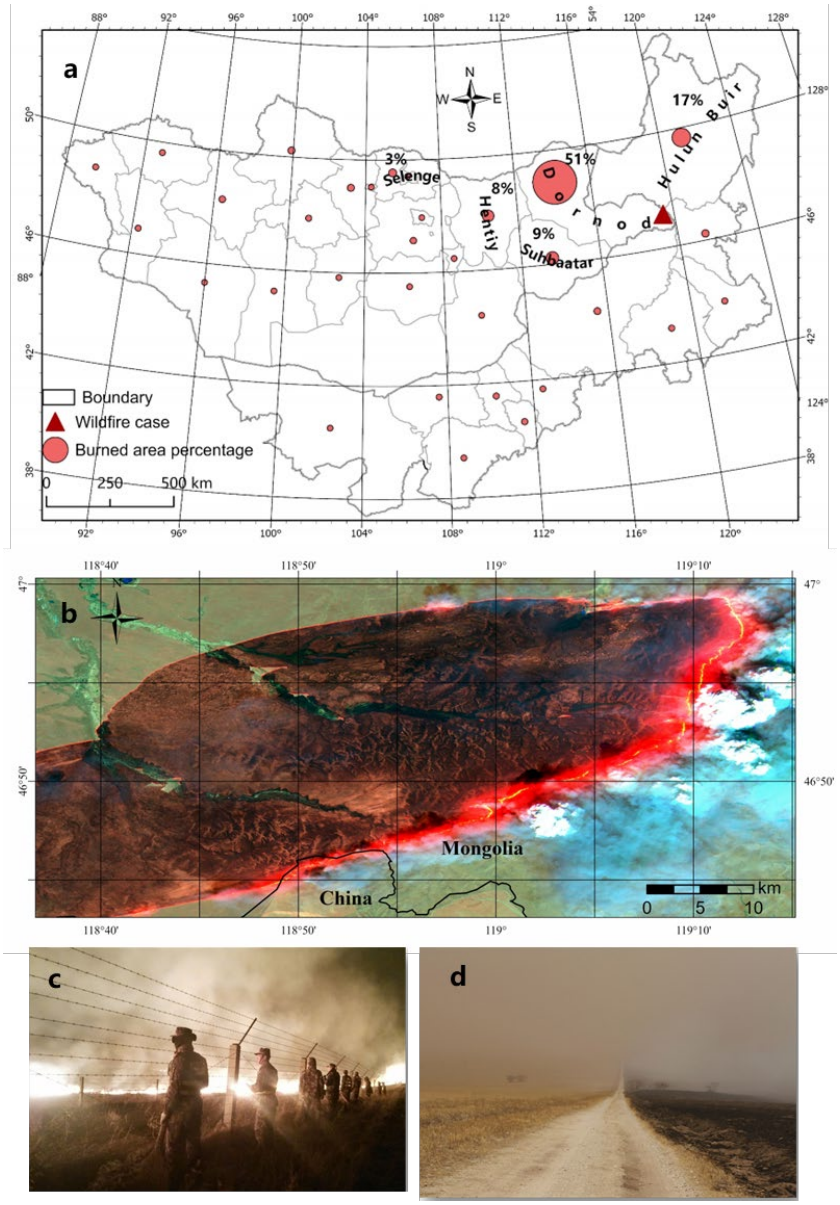
October, 2022

Overview

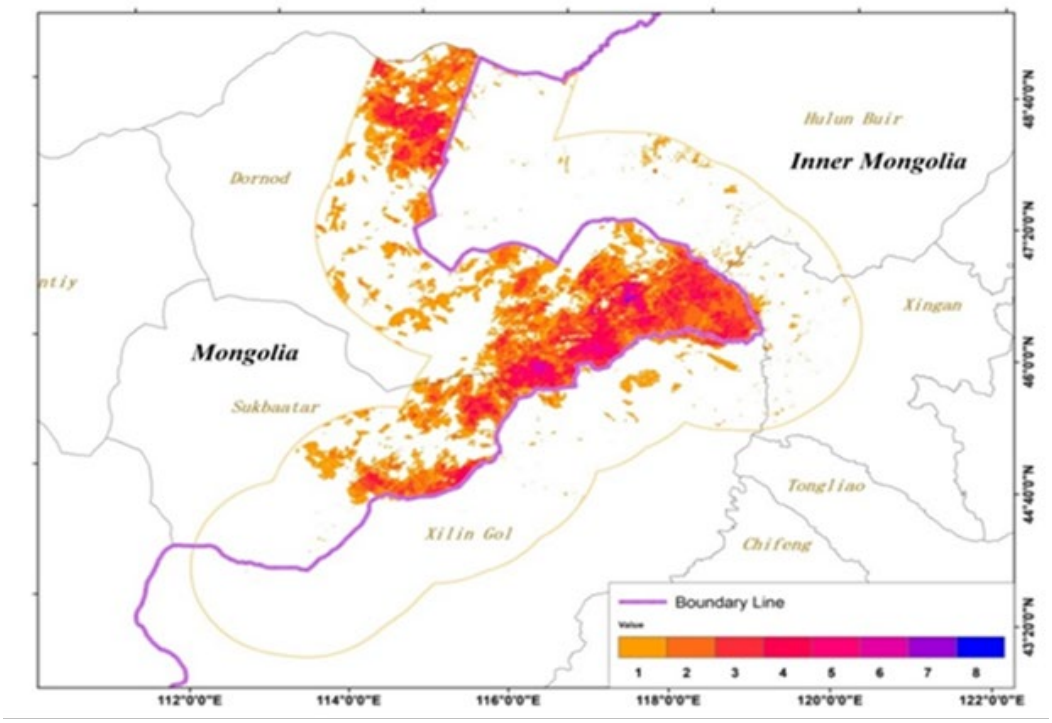
These Supplementary Materials accompany our paper, Satellite-based Analysis of Spatio-temporal Wildfire Pattern in the Mongolian Plateau. Below we list additional relevant appendices, figures, and tables that help to explain the data, methods applied, presented in the part of the analyses:

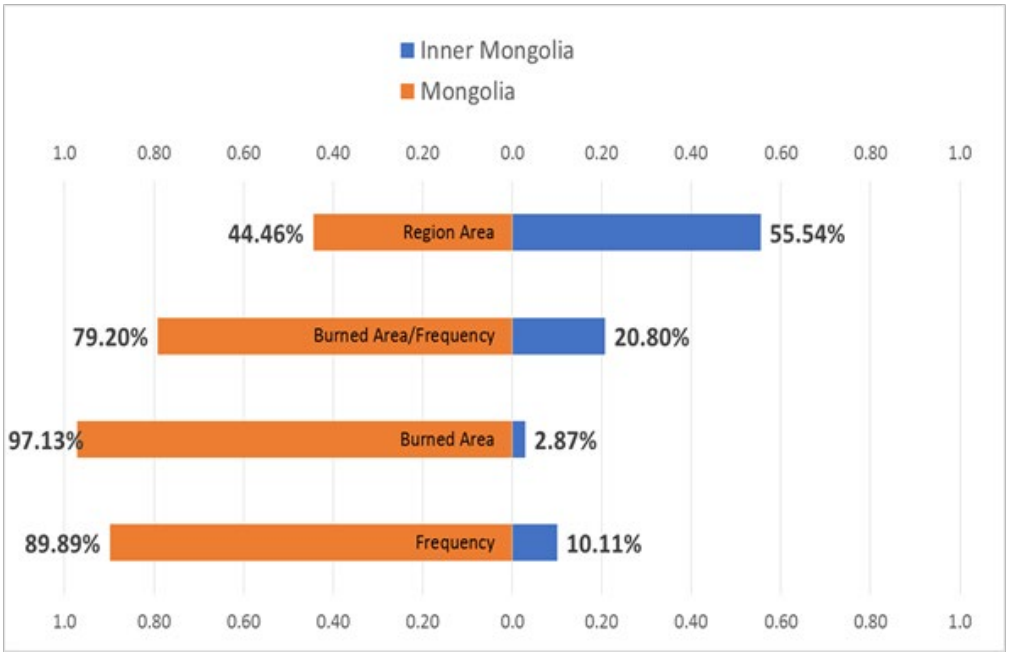
- **Figures:**
  - ✧ **Figure S1** Fire distribution in administrative units in the Mongolian Plateau (MP) and a cross-border fire case.
  - ✧ **Figure S2** Map of the most fire-prone region near the China-Mongolia border..
  - ✧ **Figure S3** Statistical summary of wildfire changing trend modes in the Mongolia plateau (MP)
- **Tables:**
  - ✧ **Table S1** Definitions of the classification of emerging hot and cold spot analysis in ArcGIS Pro 3.0.

FIGURES:

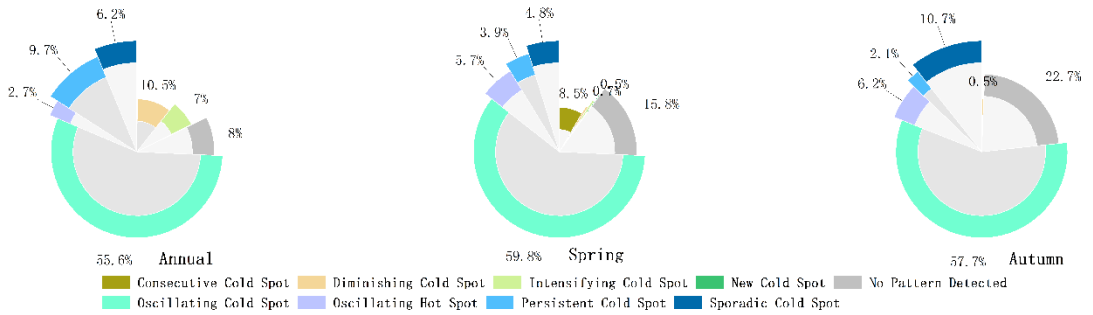


Supplementary Materials **Figure S1** Fire distribution in administrative units in the Mongolian Plateau (MP) and a cross-border fire case. (The Dornod Province of Mongolia is the most fire-prone region, accounting for 51% of the total burned area on the Mongolian Plateau, followed by Hulunbuir with 17%, Suhbaatar with 9%, Khentii with 8%, Selenge with 3%, and the other provinces together accounting for less than 12%). Subfigure (a) Fire distribution in administrative units in MP. Subfigure (b) An active smoky fire occurred in Dornod province near the China-Mongolia border on April 19th, 2022. Subfigure (c) Chinese firefighters guard along the China-Mongolia border to prevent a cross-border fire from Mongolia to the Chinese side. Subfigure (d) a photograph of burned grassland compared with unburned grassland on both sides of the road. Photos of Subfigure (c) and (d) are obtained from the internet source.





Supplementary Materials **Figure S2** Map of the most fire-prone region near the China-Mongolia border.



Supplementary Materials Figure S3. Statistical summary of wildfire changing trend modes in the Mongolia plateau (MP)

TABLES:

Supplementary Materials Table S2. Definitions of the classification of emerging Getis-Ord Gi* statistic analysis analysis in ArcGIS Pro 3.0.

Legend	Pattern type	Definition
	New Hot Spot	A location that is a statistically significant hot spot for the final time step and has never been a statistically significant hot spot before.
	New Cold Spot	A location that is a statistically significant cold spot for the final time step and has never been a statistically significant cold spot before.
	Oscillating Hot Spot	A statistically significant hot spot for the final time-step interval that has a history of also being a statistically significant cold spot during a prior time step. Less than 90 percent of the time-step intervals have been statistically significant hot spots.
	Consecutive Cold Spot	A location with a single uninterrupted run of at least two statistically significant cold spot bins in the final time-step intervals. The location has never been a statistically significant cold spot prior to the final cold spot run and less than 90 percent of all bins are statistically significant cold spots.
	Intensifying Cold Spot	A location that has been a statistically significant cold spot for 90 percent of the time-step intervals, including the final time step. In addition, the intensity of clustering of low counts in each time step is increasing overall and that increase is statistically significant.
	Persistent Cold Spot	A location that has been a statistically significant cold spot for 90 percent of the time-step intervals with no discernible trend in the intensity of clustering of counts over time.
	Diminishing Cold Spot	A location that has been a statistically significant cold spot for 90 percent of the time-step intervals, including the final time step. In addition, the intensity of clustering of low counts in each time step is decreasing overall and that decrease is statistically significant.
	Sporadic Cold Spot	A statistically significant cold spot for the final time-step interval with a history of also being an on-again and off-again cold spot. Less than 90 percent of the time-step intervals have been statistically significant cold spots and none of the time-step intervals have been statistically significant hot spots.
	Oscillating Cold Spot	A statistically significant cold spot for the final time-step interval that has a history of also being a statistically significant hot spot during a prior time step. Less than 90 percent of the time-step intervals have been statistically significant cold spots.
	No Pattern Detected	Does not fall into any of the hot or cold spot patterns defined below.

Getis-Ord Gi* statistic analysis

The Hot Spot Analysis tool calculates the Getis-Ord Gi* statistic for each year burned area dataset. The resultant z-scores and p-values tell you where features with either high or low burned area values cluster spatially. This tool works by looking at each feature within the context of neighboring features. A feature with a high value is interesting but may not be a statistically significant hot spot. To be a statistically significant hot spot, a feature will have a

high value and be surrounded by other features with high values as well. The local sum for a feature and its neighbors is compared proportionally to the sum of all features; when the local sum is very different from the expected local sum, and when that difference is too large to be the result of random chance, a statistically significant z-score results. When the FDR correction is applied, statistical significance is adjusted to account for multiple testing and spatial dependency. The Gi* statistic returned for each feature in the dataset is a z-score. For statistically significant positive z-scores, the larger the z-score is, the more intense the clustering of high values (hot spot). For statistically significant negative z-scores, the smaller the z-score is, the more intense the clustering of low values (cold spot).

The Getis-Ord local statistic is given as:

$$G_i^* = \frac{\sum_{j=1}^{n} w_{i,j}x_j - \bar{X}\sum_{j=1}^{n} w_{i,j}}{S\sqrt{\frac{\left[n\sum_{j=1}^{n} w_{i,j}^2 - \left(\sum_{j=1}^{n} w_{i,j}\right)^2\right]}{n-1}}} \quad (1)$$

where x_j is the attribute value for feature j, $w_{i,j}$ is the spatial weight between feature i and j, n is equal to the total number of features and:

$$\bar{X} = \frac{\sum_{j=1}^{n} x_j}{n} \quad (2)$$

$$S = \sqrt{\frac{\sum_{j=1}^{n} x_j^2}{n} - \left(\bar{X}\right)^2} \quad (3)$$

The G_i^* statistic is a z-score so no further calculations are required.