# Generation of Daily Mid-high Spatial resolution Surface Reflectance Dataset and its Application in Grassland Utilization Intensity Monitoring

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## Introduction

- Grassland is an important component of terrestrial ecosystems, but due to human activities and natural changes, the productivity and ecological service capacity of grassland ecosystems have declined. Ecological environmental problems such as land desertification and grassland degradation have become hotspots of global concern.
- Therefore, timely and accurate understanding of the changes in grassland type distribution, vegetation utilization methods, and intensity is of irreplaceable significance for protecting the ecological environment. Optical images with medium to high resolution are the most commonly used data source for grassland remote sensing monitoring. However, due to data acquisition limitations, it is difficult to obtain time-continuous data using a single data source, which affects the accurate monitoring of grassland distribution, utilization methods, and intensity.
- With the increase in the availability of different medium to high resolution remote sensing data, the integration of multiple data sources to generate high temporal and spatial resolution data for grassland monitoring has been widely used. However, there are relatively few studies on grassland monitoring that consider the fusion of China's high-resolution data with other medium to high resolution data without introducing low spatial resolution data.
- To address this issue, this study aims to combine China's satellite products and other medium to high resolution optical remote sensing data to generate daily medium to high resolution surface reflectance data for grassland monitoring.

## Challenge

The study of grassland utilization intensity is a complex process. Monitoring the intensity of grassland utilization involves difficulties in collecting and verifying samples, and it is challenging to measure it precisely at the pixel level. Only a certain area range of grassland carrying capacity can be obtained.

## References

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2. Griffiths P, Nendel C, Pickert J, et al. Towards national-scale characterization of grassland use intensity from integrated Sentinel-2 and Landsat time series[J]. Remote Sensing of Environment, 2020, 238: 111-124.

3. Gómez Giménez M, Jong D, Della Peruta, R.,et al. Determination of grassland use intensity based on multi-temporal remote sensing data and ecological indicators[J]. Remote Sens. Environ. 2017, 198: 126-139.

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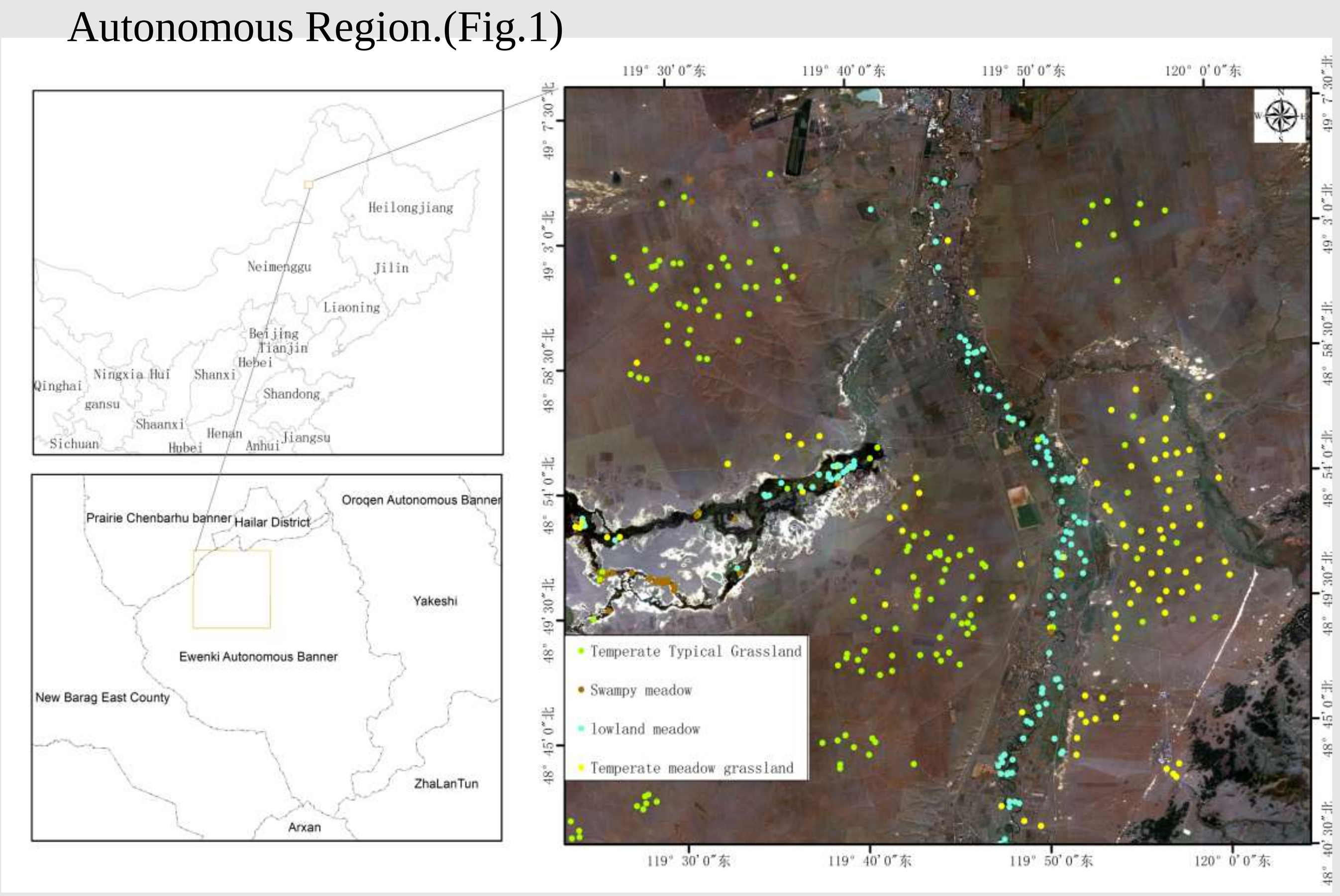
## Conclusions

Based on a daily scale NDVI time series dataset, a grassland utilization intensity estimation method was proposed for both pasture and mowed areas. A Grassland Utilization Intensity Index was developed, enabling the estimation of grassland utilization intensity in the study area. The results effectively capture variations in grazing intensity, which is of significant importance for monitoring grassland utilization conditions.

## Materials and methods

### 1 Study area:

A 50 km × 50 km block was selected as the study area from Ewenke Autonomous Banner, Hulunbeier City, northeastern Inner Mongolia Autonomous Region.(Fig.1)




### 3 Construction of a spectral reflectance conversion equation for GF-6 WFV:

$$y_i = \beta_1 + \beta_2 x_i$$
$$x_i = \{x_1, x_2, x_3, \ldots\}$$
$$y_i = \{y_1, y_2, y_3, \ldots\}$$

In the equation, $x_i$ represents the GF-6 WFV dataset, and $y_i$ represents the HLS dataset, with each dataset being arranged in chronological order for each corresponding pixel

$$\beta_1 + \beta_2 x_1 + r_1 = y_1$$
$$\beta_1 + \beta_2 x_2 + r_2 = y_2$$
$$\beta_1 + \beta_2 x_3 + r_3 = y_3$$

$$S(\beta_1, \beta_2) = \sum_{i=1}^{n} (r_i)^2$$
$$\frac{\partial S}{\partial \beta_1} = 0$$
$$\frac{\partial S}{\partial \beta_2} = 0$$

$x_n$ the equation, $r_i$ represents the residual of the model fit.
The partial derivatives with respect to $\beta_1$ and $\beta_2$ were calculated, and the optimal $\beta_1$ and $\beta_2$ for each pixel were determined when the residual value was minimized.

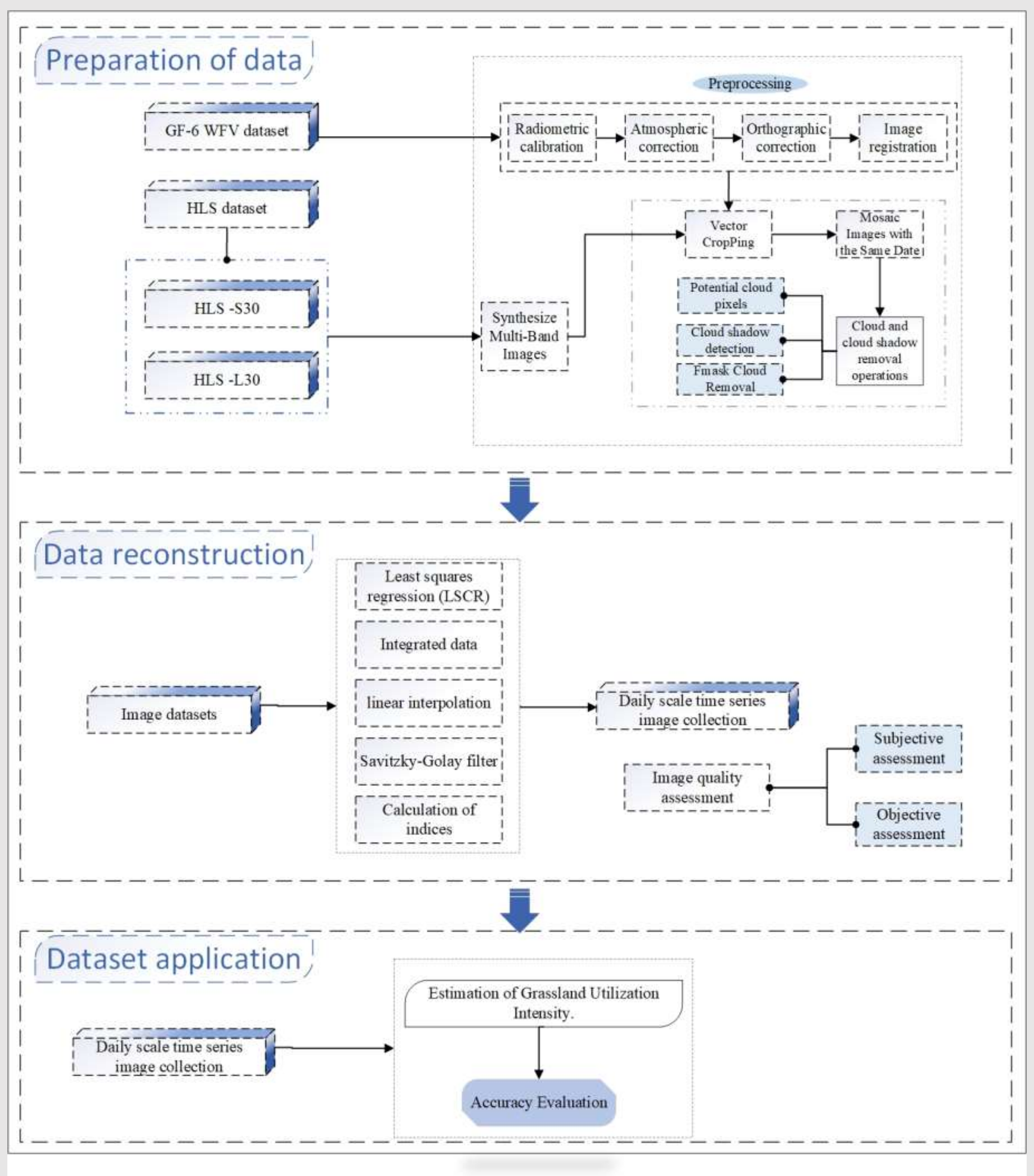
### 4 Time Series Selection and Filtering Processing:

The image data used in this study exhibit discontinuities, and the time intervals between images are uneven. Therefore, in image reconstruction, we employed a method of **local piecewise linear interpolation** for image interpolation. This method divides the interpolation interval into several small intervals and fits a linear function within each of these small intervals.
Subsequently, we applied a **Savitzky-Golay** filter to achieve time series data smoothing, as shown in the following formula:

$$Y'_j = \frac{\sum_{i=-n}^{n} C_i Y_{j+i}}{N}$$

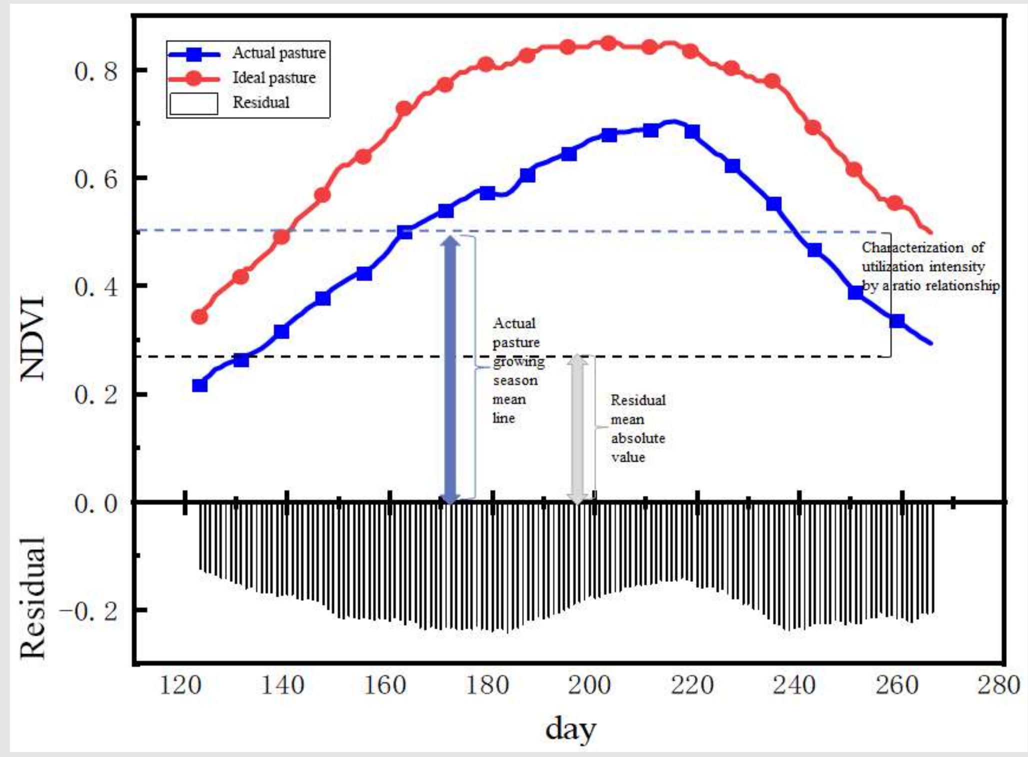
### 2 The framework:

In this study, a framework was established for fusing HLS L30, HLS S30, and GF-6 WFV data to generate a high-resolution surface reflectance dataset in the daily scale, and an application was carried out to monitor the grassland utilization way and utilization intensity. The flowchart of the calculation was shown in Fig. 2.

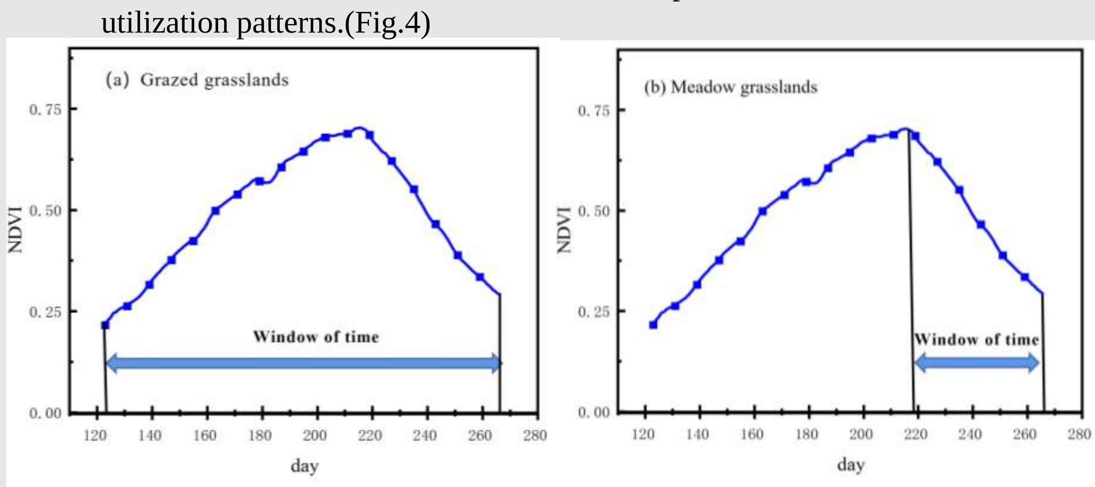



### 5 Utilization Intensity Monitoring:

A grassland utilization intensity index has been proposed, and Figure 3 illustrates the core idea behind the calculation of this index.

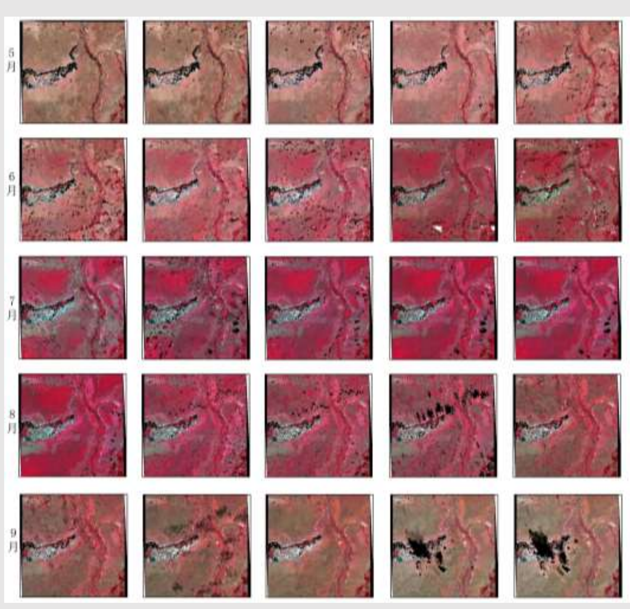



There are differences in the time window for pastures under different utilization patterns.(Fig.4)

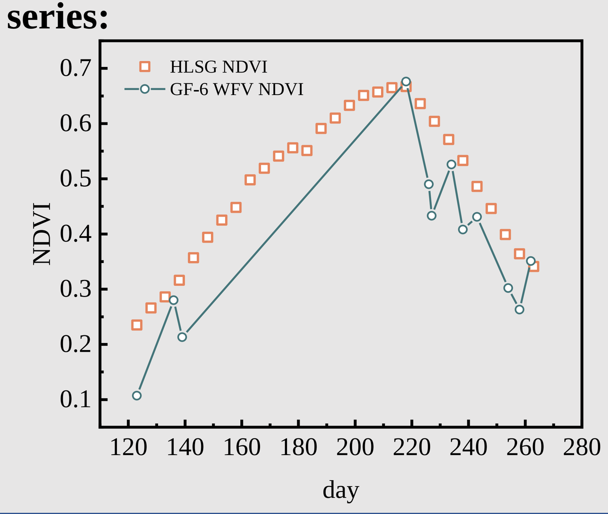



## Result

### 1 Demonstration of partial image effects of the daily scale dataset:

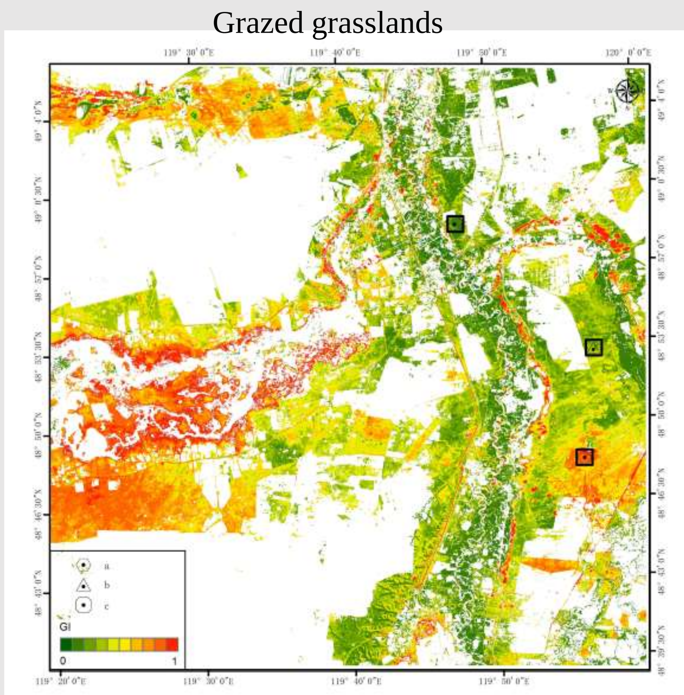


### 2 Comparison of GF-6 raw images and HLSG time series:




### 3 Results of grassland use intensity estimation:

Grazed grasslands



Meadow grasslands