# Machine learning-based estimate of carbon sequestration loss after earthquake in subalpine forests of the Jiuzhaigou National Nature Reserve, Eastern Tibet Plateau


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## Introduction

A mega earthquake could cause remarkable impacts on terrestrial ecosystems, e.g., vegetation cover loss. Previous studies evaluating the impact of earthquake on ecosystem mainly used normalized difference vegetation index or enhanced vegetation index. However, very limited studies assessed the impact of earthquake on carbon sequestration loss.

## Method

We quantitively assessed the carbon sequestration loss (indicated by aboveground net primary production (ANPP)) after the 7.0-magnitude earthquake in Jiuzhaigou National Nature Reserve (JNNR) combining Landsat 8 and Sentinel 2 and 50 fixed inventory plots from 2019 to 2021. There approaches - linear regression (LR), random forest (RF) and extreme gradient boosting (XGBoost) were used to predict the spatial patterns of ANPP. Finally, the ANPP loss rate was used to evaluate the carbon sequestration loss after the earthquake.

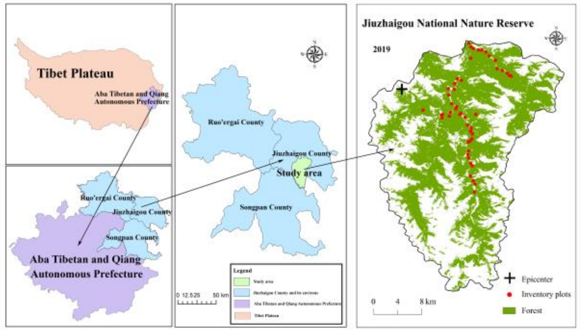


**Figure 1** The location of the study area and the filed plots.

## Results:

**(1) A** total of 5.75% forest area lost after the earthquake

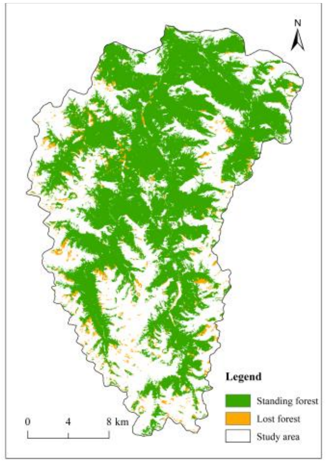


**Figure 2** The distribution of the standing and lost forest after the earthquake in the Jiuzhaigou National Nature Reserve.

**(2)** XGBoost model shows the best performance ($R^2$ = 0.71)

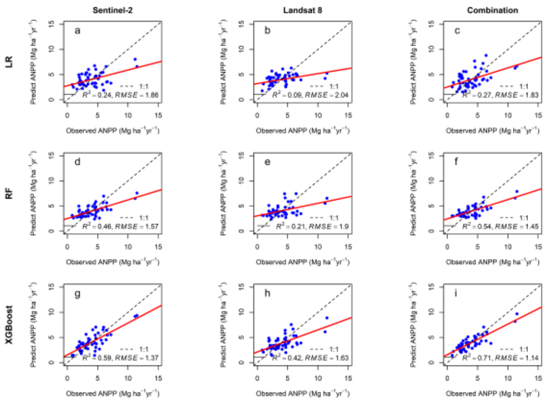


**Figure 3** The correlation between the predicted and observed aboveground net primary production (ANPP, Mg ha$^{-1}$ yr$^{-1}$) using different approaches and images.

**(3)** The most important variables were used for modelling and ANPP predicting.

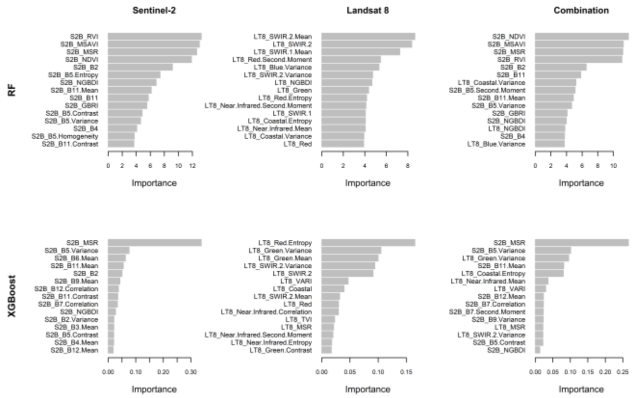


**Figure 4** The most important predictor variables for the RF (random forest) and XGBoost (extreme gradient boosting) model for three datasets.

**(4)** About 23.53% of the ANPP was lost after the earthquake.

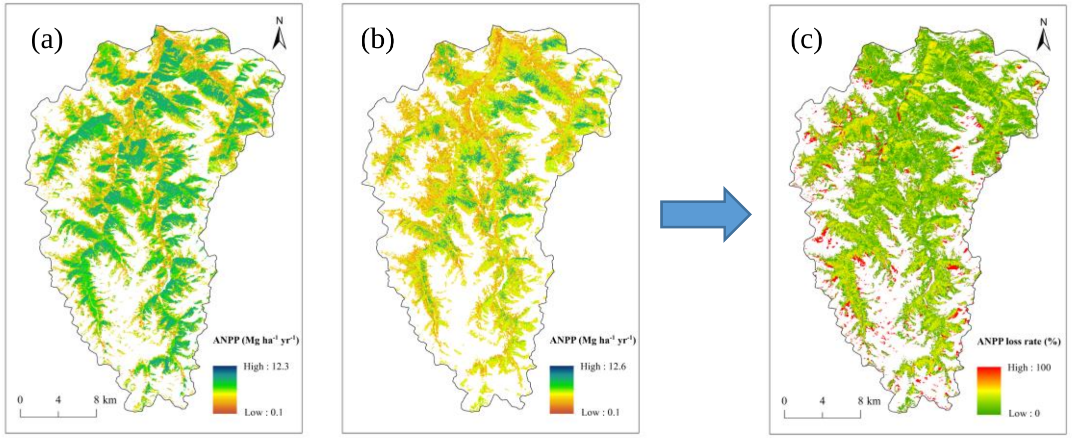


**Figure 5** (a) pre-earthquake, (b) post-earthquake predicted aboveground net primary production (ANPP, Mg ha$^{-1}$ yr$^{-1}$) and (c) ANPP loss ratein the Jiuzhaigou National Nature Reserve .

## Conclusion

(1) Regardless of modeling approaches, the combination of the Landsat 8 and Sentienl-2 could improve the model accuracy.

(2) Machine learning algorithm has great potentials in ANPP estimation and can accurately estimate ANPP. This result highlighted a potential approach for ANPP estimation using machine learning approaches with the combination of optical images

(3) The damage of the earthquake to subalpine forest cannot be ignored, which accompanied a large amount of forest carbon sequestration loss.


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