

Applying U-net to establish the distribution map of Alpine Treeline Ecotone in Xue Mountain

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Taiwan is renowned for having the highest density of high mountains globally, with over 200 peaks surpassing an elevation of 3,000 meters. Among these peaks, the Alpine Treeline Ecotone (ATE) serves as a transitional zone between different vegetation types, and the species distribution, spatial coverage variation, and migration patterns within the ATE are crucial indicators for evaluating the impact of climate change and warming environments on Alpine ecosystems. To study the ATE changes, this research focuses on a typical ATE in the Xue Mountain glacial area, approximately 4 square kilometers. Specifically, this study utilizes features from various vegetation indices and texture features (GLCM) based on the Worldview-2 satellite imagery from 2012 and 2021, and a U-net model is employed to establish classification maps for the ATE in Xue Mountain.

The study classifies four important land cover types: trees, krummholz, bare land, and shadows. Additionally, four different combinations of features: the original 8 bands from satellite imagery, vegetation indices, and texture features (GLCM) are utilized to establish the U-net model. The preliminary results show that incorporating original bands with vegetation indices and texture features (GLCM) achieves the highest overall accuracy of 79.1%. Compared to the classification result using only original bands, the F1-score is improved by 36.4%, 12.6%, 1.5%, and 2.6% for trees, krummholz, bare land, and shadows, respectively. In short, this study integrates remote sensing imagery and deep learning classification methods to create a detailed ATE map, providing valuable references for governmental agencies in formulating policies for managing Alpine ecosystems in the Xue Mountain Glacial area.

Keywords: Alpine Treeline Ecotone (ATE), U-net, vegetation indices, texture features (GLCM)