Automatic Segmentation of Land and Glacier Classes Based on Deep Learning: A Case Study of Horseshoe Island

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Abstract:

The Earth's cryosphere depends on glaciers and ice shelves, which have a major influence on climate regulation. Their rapid withdrawal, especially the reduction of floating ice shelves, intensifies global climatic feedback mechanisms. This study targets the automatic segmentation of Antarctic ice cover in the Horseshoe Island region—an ecotone between continental ice sheets and the Southern Ocean. Utilizing freely accessible Sentinel-2 multispectral imagery from 2019 to 2021, a deep learning-based semantic segmentation approach was applied. The dataset was partitioned into training, validation, and test sets across four geophysical classes: sea, drift ice (sea-ice), land, and grounded ice (land-ice). Multiple convolutional neural network architectures were evaluated, with classification performance assessed via the IoU score. Among these, Segformer demonstrated superior efficacy, achieving an average IoU score above 70% across all categories. This work underscores the potential of deep learning for high-resolution ice mapping, enabling scalable and cost-effective monitoring of polar environments under climate change.

Keywords:

Remote Sensing, Drift ice segmentation, Deep learning.