**Title**

cGANs for multispectral snow extent analysis in the Alps

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**Abstract**

The Alps are experiencing a gradual reduction in snow cover due to rising temperatures, impacting the landscape and dependent ecosystems. While several models have been developed to study snow cover in the region, there is a lack of visual representations. This research employs a Conditional Generative Adversarial Network (cGAN) to generate a multispectral Landsat-8 image of the Alps using environmental data inputs. The study utilizes elevation, monthly precipitation, and monthly temperature data from November to March to produce an end-of-winter Landsat-8 image. The resulting multispectral image is then used to calculate the Normalised Difference Snow Index (NDSI) and determine the snow extent by counting pixels with NDSI values above 0.4. Two climate scenarios are considered, and the generated images are compared to actual Landsat-8 imagery. Findings indicate that while the generated imagery closely resembles the real imagery, the snow extent is generally underestimated in the current model configuration, and the snow reflectance is consistently overestimated across all training steps of the cGAN. Additionally, it is observed that increasing the spatial distance between the training and testing locations leads to increased error in the results. The thesis demonstrates the feasibility of using a cGAN to generate snow extent, but suggests that enhancements to the training dataset and cGAN architecture are necessary for improved accuracy. By leveraging the cGAN, future climate scenarios can be visually represented through multispectral imagery, enabling a more detailed understanding of potential future landscapes under different climate conditions.