Extracting clear ice surface of mountainous glaciers of Karakoram Range using Machine Learning for different Band Ratio compositions of OLI

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Glaciers of Hindu-Kash Karakoram Himalaya (HKH) significantly contribute to the earth's climate. However, the region needs more detailed knowledge about its glaciers. Specifically, the stability of glaciers in the Karakoram range of the Hunza sub-basin is a well-known anomaly. Therefore, monitoring its glaciers is needed to understand the dynamics of climate change in HKH. Glacier inventory is baseline data for monitoring, and the clear-ice surface is a quantifying parameter of glacier changes. Recently, Operational Land Imager (OLI), exploited with machine learning (ML), is highly recommended for glacier monitoring due to improved accuracy. Therefore, it is necessary to update the current status of glaciers in sub-basin using OLI and ML. This study aims to evaluate the current extent of clear ice in the sub-basin to examine stability and to explore the application of ML for extracting clear ice from OLI and assess accuracy. Random Forest classifier of ML set with minimum Root means square error (0.1 to 0.4), was used through SNAP environment. Results indicate satisfactory spatial distribution of clear ice in higher elevations (> 5000 meters) with 10 % area difference percentage exhibited in overall extent. However, 28 glaciers (area > 5 km2) showed variation in the extent and confirmed the localized heterogeneity. Overall accuracy (82% to 83%) and kappa coefficient values (0.64 to 0.65) confirm the significance of individual bands of OLI. It is concluded that the glaciers in the sub-basin have an overall stable clear-ice extent, except for variations in terminal ends. Whereas machine learning has a significant role in the automatic extraction of clear ice when exploited with the OLI.