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Estimation of Sub Hourly Glacier Albedo Values Using Artificial Intelligence Techniques

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Glaciers are the most important fresh water reservoirs storing about 67% of total fresh water. Unfortunately, they are retreating and some small glaciers have already disappeared. Thus, snow glacier melt (SGM) estimation plays an important role in water resources management. Whether SGM is estimated by complete energy balance or a simplified method, albedo is an important data present in most of the methods. However, this is a variable value depending on the ground surface and local conditions.
The present research presents a new approach for estimating sub hourly albedo values using different artificial intelligence techniques such as artificial neural networks and decision trees along with measured and easy to obtain data. .
The models were developed using measured data from the Zongo-Ore station located in the Bolivian tropical glacier Zongo (68°10' W, 16°15' S). This station automatically records every 30 minutes several meteorological parameters such as incoming short wave radiation, outgoing short wave radiation, temperature or relative humidity. The ANN model used was the Multi Layer Perceptron, while the decision tree used was the M5 model. Both models were trained using the WEKA software and validated using the cross validation method. After analysing the model performances, it was concluded that the decision tree models have a better performance. The model with the best performance was then validated with measured data from the Equatorian tropical glacier Antizana (78°09'W, 0°28'S).
The model predicts the sub hourly albedo with an overall mean absolute error of 0.103. The highest errors occur for albedo measured values higher than 0.9. Considering that this is an extreme value coincident with low measured values of incoming short wave radiation, it is reasonable to assume that such values include errors due to censored data. Assuming a maximum albedo of 0.9 improved the accuracy of the model reducing the MAE to less than 0.1.
Considering that the model was successfully verified both in the inner tropics and the outer tropics, this model is a valuable contribution that may be used to project future scenarios in tropical glaciers.

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