A study of the transferability and robustness of an enhanced temperature-index glacier melt model

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Temperature-index models have been used in a wide range of applications, and a number of enhanced versions of this approach have been recently proposed in the literature. These proved to bring an important improvement over the simple standard version, and their performance can be compared to those of energy balance models when applied to one season of single catchment. However, a criticism that is normally moved to this type of approach is that such models depend on empirical parameters that are calibrated for the single glacier and are therefore not transferable. For this reason, their use for simulation of climate change impact on glaciers has been questioned.

In this study, we investigate the parameters' transferability and model generalisation of an enhanced temperature-index (ETI) model that was developed and tested on Haut Glacier d'Arolla, Switzerland, during the 2001 ablation season.
The original model parameters (temperature factor TF and shortwave radiation factor SRF) are re-optimised at five sites on Haut Glacier d'Arolla. The analysis is conducted computing surface melt by means of the ETI model and validating the results against the simulations of a physically-based energy-balance model.

The model performance is also tested separately in sunny and cloudy days, because the highest discrepancy with the reference melt is found on overcast days. By developing an algorithm for this separation based on the incoming shortwave radiation trends, a separate calibration of the model empirical parameters (including the threshold temperature) for these two types of meteorological conditions is conducted.

We also present some preliminary results of the model transferability in time (seasons 2005 and 2006 on Haut Glacier d'Arolla) and in space (application to Gornergletcher, a much bigger and not entirely temperate glacier in the Valais Alps, and to the Tsa de la Tsa glacier in the Italian Alps).
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