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Sensitivity study and uncertainties assessment of the permafrost model for the Swiss Alps

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Modeling the evolution and the sensitivity of permafrost in the European Alps in the context of climate change is one of the most relevant and challenging task of the permafrost research in progress. The one dimensional soil-snow-atmosphere model CoupModel (Jansson & Karlberg 2001) has already been applied successfully for permafrost modeling in the Swiss Alps (Engelhardt et al. 2010, Scherler et al. 2010). Two sites in the Swiss Alps have been studied with a particular focus: the active rock glacier Murtèl (Upper Engadine), and the Schilthorn massif (Bernese Alps). In order to evaluate the sensitivity of the model to changes in air temperature and precipitations, a sensitivity study of the model has been carried out using a delta change approach. Annual and seasonal deltas were applied to air temperature and precipitation input series until the end of the century using a large parameter range in equidistant steps. The resulting ground thermal regimes and active layer thicknesses of rock glacier Murtèl and the Schilthorn massif are analysed and presented in this contribution.

In addition, the General Likelihood Uncertainty Estimation (GLUE) method is used to assess the uncertainty of the simulations within the CoupModel (Jansson 2012). This method is based on an unbiased sampling of parameter values during simulation considering all combination of prescribed parameter values, such as thermal conductivities or snow parameters. Statistical performance indicators as Root Mean Square Error or Coefficient of Determination are used to define the acceptance of values and to assess the uncertainty. By this, not only the most appropriate parameter values for consistent subsurface modeling for the two permafrost sites can be determined, but model-based uncertainty ranges of the resulting ground temperatures and active layer thicknesses can be estimated.

References:

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