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# Implementation of a Dynamical Glacier Scheme in a regional climate model over the Western Himalaya – Karakoram region

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Glaciers play an important role for the annual cycle of river discharge in the Himalayan region, including the Indus river. So far, little is known about the effects of climate change on the glaciers of the Indus basin and the corresponding influence on river discharge. One possibility to assess future glacier changes in the Himalayas in a physically consistent manner is to apply regional climate models (RCMs) and to use their output for driving dedicated glacier (mass balance) models. However, this offline approach does not account for possible feedback mechanisms between surface glacier cover and the regional climate. To overcome this deficiency a simplified dynamical glacier scheme (DGS) working on a sub-grid level was developed and implemented into the RCM REMO. So far, the scheme has been applied over the European Alps only. These studies indicated that the observed regional glacier mass balance could be approximately reproduced by the model system.

In the present work, the DGS is transferred to the Western Himalaya – Karakoram region. The main focus is to assess the transferability of the DGS to regions other than the European Alps and its performance in a different climatic setting. Our results for the Upper Indus Basin indicate a satisfactory performance of the DGS over this region. However, a number of shortcomings appear which are presumably related to the simplified treatment of certain processes in the DGS. These shortcomings are analyzed in more detail in order to give suggestions for future model development. The experiments performed reveal that the usage of a DGS is necessary to adequately simulate the climate of heavily glaciated areas and to assess the impacts of climate change on regional glacier mass balance.