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The benefit of atmospheric science methods for cryospheric research: Two examples

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Glacier-climate studies in the cryospheric sciences are still focusing strongly on the local scale in the case of mountain glaciers. However, individual mountain glaciers do show the potential to reveal climate change details beyond the local scale, as we have found from intensive studies of Kilimanjaro (East Africa). Exploitation of this potential requires, in our opinion, a look beyond the border of traditional glaciological methods as well. Here we present two such examples. The first refers to statistical downscaling of reanalysis data to daily precipitation on a glacier (which is an important quantity for mass balance studies), by using statistical weather forecasting methods and idealized numerical atmospheric modelling; Second, quantifying the local effect of vegetation changes on glacier mass balance (which is important to assess the role of local vs. large-scale drivers), by employing a numerical atmospheric model along with a physically-based glacier mass balance model; On-site measurements have been conducted on Kilimanjaro since 2000 (four automated weather stations in the meantime) and are available for validation of models used in the two examples. Preliminary results demonstrate that the inclusion of these techniques is capable of revealing more information about the climatic controls of glacier recession than traditional glaciological methods alone.