

The large-scale hydropower potential of new proglacial lakes

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Ongoing climate change is causing significant glacier retreat at the global scale. In this context, much attention is devoted to potential negative impacts such as diminishing water resources, shifts in runoff seasonality, or increases in cryosphere-related hazards. In this contribution, we provocatively take a different view, and explore the hydropower potential of areas projected to become ice free during the course of the century. In a worldwide analysis, we focus on presently-glacierized areas from which new proglacial lakes are likely to emerge, particularly exploring the possibility of new artificial installations.

Our analyses are based on estimates of the subglacial topography, model-derived projections of glacier evolution and runoff, and on topographical analysis of the glacier surroundings. These elements allow us to estimate future glacier-lake geometries, future water yields from glacierized catchments, and hydraulic heads of potential hydropower infrastructure. Following the Hydropower Sustainability Assessment Protocol, we combine our analyses for the technical potential with environmental, social, and economic indicators to obtain a first-order ranking of the attractiveness of each investigated site.

Our results highlight that for individual regions of the world, the theoretical hydropower potential from such newly deglaciated areas is large. For the European Alps, for example, we estimate a total annual potential in the order of 30 TWh, with the top 10 sites providing about 3.5 TWh a year. Similar results are found for Scandinavia or New Zealand. Even larger potentials are present across High Mountain Asia, with totals close to 400 TWh annually. Our estimates require some delicate assumptions, which we will highlight and discuss in our contribution.