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The contribution of glaciers to streamflow and surface water supply: a global-scale analysis

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Glaciers are important contributors to streamflow (Q), acting as water storage units during the accumulation season of a glaciological year and releasing water during its melting season. Glaciers often play an essential role in semiarid regions where the anthropogenic pressure on surface water resources is very high (e.g., Indus basin). The climate-driven glacier retreat observed worldwide is having major consequences on surface water supply. Here, we present a model-based approach to estimate the contribution of glaciers to streamflow and surface water supply over the global continental area (except Greenland and Antarctica). We refer to this contribution, i.e. the fraction of Q that can be explained by the presence of glaciers as opposed to their absence, as glacier-dependent streamflow (GDS). GDS is derived from the global hydrology model WaterGAP 2.2d at 0.5° resolution; it is equal to the difference between Q computed with the standard version of the model, which does not include glaciers, and Q computed with a non-standard version that includes glaciers (Cáceres et al., 2020). Global maps of mean yearly and mean monthly GDS are given in absolute values (m^3/s), and in percentage of Q and of consumptive water use from surface water over two 30-year periods, 1951-1980 and 1981-2010. The model performance is evaluated by comparing Q simulated with WaterGAP 2.2d including glaciers to observations from the Global Streamflow Indices and Metadata archive (GSIM) downstream from glaciers. With this study, we aim (1) to identify the regions that rely the most on GDS for surface water supply and are therefore most vulnerable to water scarcity problems related to glacier retreat, (2) to identify spatial and temporal changes (e.g., shifts in seasonality, long-term trend) in GDS between 1951-1980 and 1981-2010, and (3) to evaluate the performance of WaterGAP 2.2d including glaciers in terms of Q.

Cáceres, D., Marzeion, B., Malles, J. H., Gutknecht, B. D., Müller Schmied, H., and Döll, P.: Assessing global water mass transfers from continents to oceans over the period 1948–2016, 24, 4831–4851, https://doi.org/10.5194/hess-24-4831-2020, 2020.