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"Future water-energy scenarios in a run-of-the-river plant: Anza basin, north-western Italy"

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Hydroelectric power production contributes to about 15% of the global electricity market. This technology, however, is adversely exposed to short, medium, and long term variations in climate and local-regional water budget. We investigate scenarios of hydroelectric power generation up to 2050 for an Alpine run-of-the-river plant within a heavily glacierized basin (Ceppo Morelli Dam, Anza River, Piedmont Region, Italy). To this end, we include a conversion from streamflow to energy in a hydrological model of the basin and we introduce a set of benchmark climate scenarios to evaluate expected future production. These are a "future-like-present" scenario assuming future precipitation and temperature inputs to be statistically equivalent to those observed during the recent past at the same location, a "warmer-future" scenario, which considers an additional increase in temperature, and a "liquid-only" scenario where only liquid precipitation is admitted. In addition, two IPCC-like climatic scenarios (RCP 4.5 and RCP 8.5) are considered. Uncertainty in glaciers' volume is accounted by initializing the hydrological model with two different inventories. Ensemble results for this plant reveal an average decrease between -40% and -19% of hydroelectric power generation, an average decrease between -20% and -38% of cumulative incoming streamflow volume at the plant, and a strong average decrease in the volume of glaciers (between -76% and -96% depending on the initial value considered, all results compared to present condition). Monte Carlo simulations show that results are also prone to high uncertainties. This study suggests that decision-makers will have to adapt type and features of hydroelectric production to both mitigate the effect of climate change and maintain the current electricity production and security of the plant.

Marco Bongio, Francesco Avanzi, Carlo De Michele, Hydroelectric power generation in an Alpine basin: future water-energy scenarios in a run-of-the-river plant, Advances in Water Resources, Volume 94, 2016, https://doi.org/10.1016/j.advwatres.2016.05.017.