

EGU2020-19973

<https://doi.org/10.5194/egusphere-egu2020-19973>

EGU General Assembly 2020

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## Multiple constraints and objectives should inform the negotiated filling of the Grand Ethiopian Renaissance Dam

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This study analyzes the implications of a variety of filling approaches of the Grand Ethiopian Renaissance Dam (GERD) for the outlet management and dam engineering. A daily water balance model of the GERD is developed and used to investigate the ability of the GERD outlets to enable six reservoir filling scenarios. Results show that the turbines' outlets, the bottom outlets, and the spillways would sufficiently provide downstream releases during the steady-state operation of the GERD. The river diversion outlets of the GERD are necessary to enable agreements on reservoir filling and the Ethiopian turbine phasing-in plan. The use of the river diversion outlets requires compliance with dam engineering constraints such as steel lining, head limit, and maximum flow speed. We propose a multi-objective optimization framework for reservoir filling whereby dam engineering constraints are considered in the negotiations on the initial filling of multi-year storage reservoirs.