Climate change projections and water level decrease in a Brazilian multipurpose reservoir

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Abstract Data from climate projections were used to analyze the possible climate change effects on the water level of a Brazilian multipurpose reservoir for the 2050s. Two scenarios based on optimistic (RCP 4.5) and pessimistic (RCP 8.5) climate change projections concerning greenhouse gas emissions were simulated using a one-dimensional hydrodynamic model. In comparison with the baseline simulation (2009-2018), it was identified water level decrease trends, especially regarding the rainfall reduction. Such behavior may affect water availability and impair the reservoir uses, which may also demand adaptive management strategies for the reservoir operation.

Keywords: Hydrodynamic modeling, climate change assessment, Itupararanga Reservoir, water resources management.

Methods

Study site

- Itupararanga reservoir: São Paulo, Brazil (Figure 1)
- Multiple uses: drinking water supply, power generation, recreational uses.

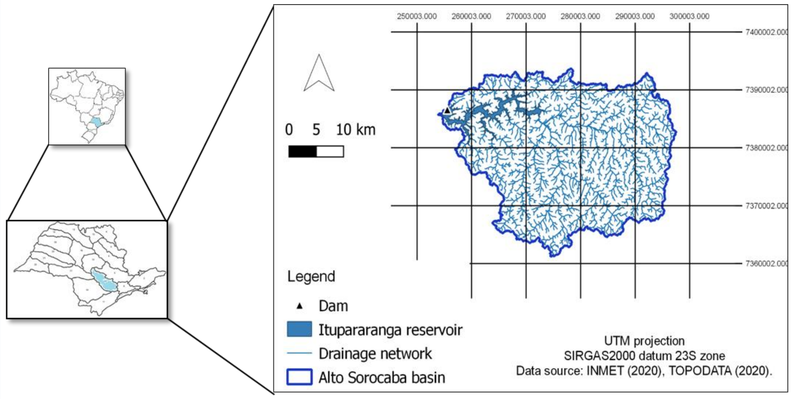

Figure 1: Itupararanga Reservoir location, its basin area and drainage network.

Modeling procedure

Chou et al., 2014
Hipsey et al., 2019

Results

- The model was able to accurately represent the water level (RMSE<0.7m, *r*=0.8)
- Climate change projections revealed an increase in air temperature and short-wave radiation and a rain decrease for the 2050s (Table 1)
- The simulated water level would drop and reach the dead storage for the Mid2050's (Figure2)

Table 1: Climate variables daily average and standard deviation for the baseline and future projections.

Meteorological Data	Baseline	RCP 4.5	RCP 8.5
SW (W m^{-2})	213.9 (61.2)	217.2 (59)	223.6 (51)
AT (°C)	20.6 (2.7)	22.3 (4.2)	23.6 (3.1)
RH (%)	75.2 (7.2)	85.3 (11.5)	73.3 (13.8)
WS (m s^{-1})	2.2 (0.8)	2.3 (0.8)	2.4 (0.6)
Rain (mm d^{-1})	3.2 (5.0)	2.5 (6.0)	1.9 (3.1)

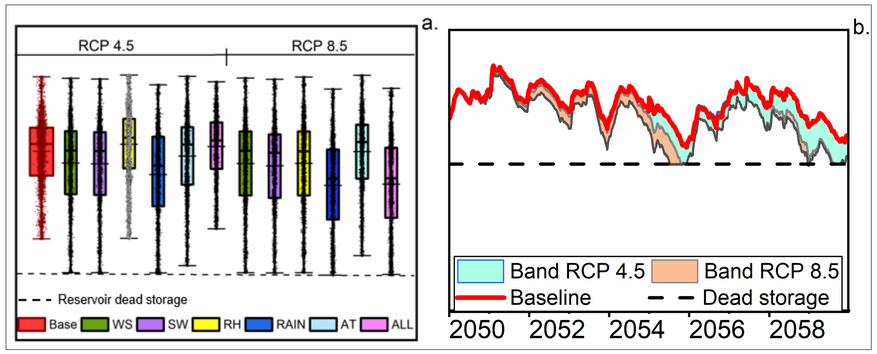

Figure 2: Simulated water level (m): a. Average value and outliers for each scenario; b. Minimum water level for climate change scenarios.

Conclusions

The projections indicate water level drop, which might require adaptive management strategies for reservoir operation to avoid possibility of water rationing in the near future.

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