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Assessing the Risk of Hydrological Drought through the Severity-Duration-Frequency Approach

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Recent studies have focused on characterizing different aspects of drought (i.e. meteorological, soil moisture, hydrological, or even, socio-economic drought). However, the complexity of the phenomenon and the uncertainty associated to the data analyzed makes it difficult to predict its associated risk and resulting impacts. In this work, we used the severity-duration-frequency approach for hydrological drought to analyze the risk of the Cantareira System in Brazil, the main water source for the Metropolitan Region of Sao Paulo, which has been recently affected by drought. Our approach combined water demand and supply conditions. For water demand, we set up one stationary and one non-stationary threshold. For water supply, we used: (a) hydrologic modeling simulations using as climatic input historical series (1962-2015) from the regional climate models Eta-INPE, HadGEM-ES, and MIROC5; (b) monthly historical reconstructed streamflow data (1930-2016). We used the Generalized Extreme Value distribution to fit the hydrological deficit data for return periods of 2, 10, 20, and 100 years. Results showed greater water deficits for the cases that used the reconstructed hydrologic time series (compared to the cases using hydrologic modeling) but, for the simulations using the hydrologic modeling, results showed greater water deficit for the MIROC5 model. Greater water deficits existed for the non-stationary threshold water demand case. Furthermore, the diagnostic plots found that the longest droughts showed better fit for the Gumbel distribution. This approach may be useful for regional water resources management, helping on the quantification of the impacts of hydrological drought and its uncertainty.

Key words: Hydrological droughts, climate change, urban water, SDF approach.