

# Projected Climate Change Effects on Water Availability of the Metropolitan Region of São Paulo

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## Abstract

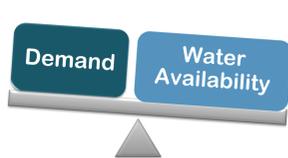
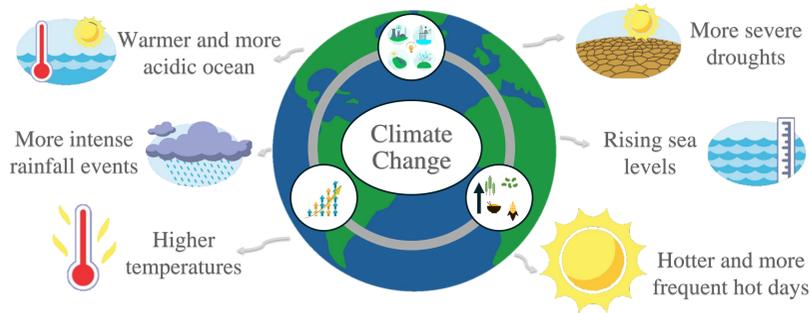
Climate change affects the global water cycle and has the potential to alter water availability for food-energy-water production and the ecosystems services on regional and local scales. In southeastern Brazil, the Cantareira Water Supply System reached unprecedented low levels in January 2015 compromising the water supply for the Metropolitan Region of São Paulo (MRSP). However, there is still few studies investigating the effects of climate change on water availability in this region. Here, we assess the influence of climate change on water availability in the Jaguari Basin, Southeastern Brazil using a modeling approach. This basin covers an area of about 1200 km<sup>2</sup> and it is the main source of the Cantareira Water Supply System, responsible for providing water for about 7 million people in the MRSP. To evaluate climate change scenarios, we use the lumped conceptual HYMOD model on daily time step. This model was calibrated and evaluated using daily observed data of precipitation, evapotranspiration, and discharge for the period of 1990 to 2009. To evaluate climate change scenarios, we used data of an ensemble of 17 General Circulation Models (GCMs), downscaled by MarkSim GCM working off a 30 arc-second climate surface spatial resolution forced by two Representative Concentration Pathways (RCP): RCP 4.5 and RCP 8.5. These data were integrated into the HYMOD to project scenarios (up to 2095) of water discharge. We find values of Nash-Sutcliffe Efficiency Coefficient (NSE) and Coefficient of Determination (R<sup>2</sup>) greater than 0.80 for the calibration and evaluation period. We also noticed an increase in the peak of runoff and a decrease in baseflow for both scenarios. Such changes reflect in a higher interannual variability, therefore, increasing the risk of drought and flood. In terms of Environmental Flow Requirement, the probability of exceedance Q<sub>90</sub>, reveal a clear pattern of decreasing, about 23% from 2010 to 2040, and reaching 28% by the end of the century. Our findings indicate that the water discharge could not be enough for the current and future water demand. Our results expose the fragility of the studied basin, presenting a technical and scientific information focusing on guiding the plans and strategies to deal with situations of water scarcity.

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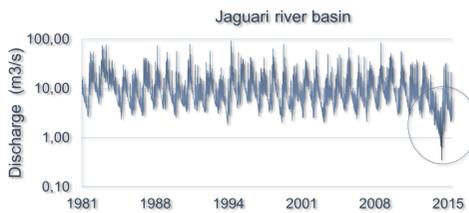
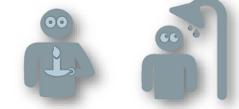
## INTRODUCTION



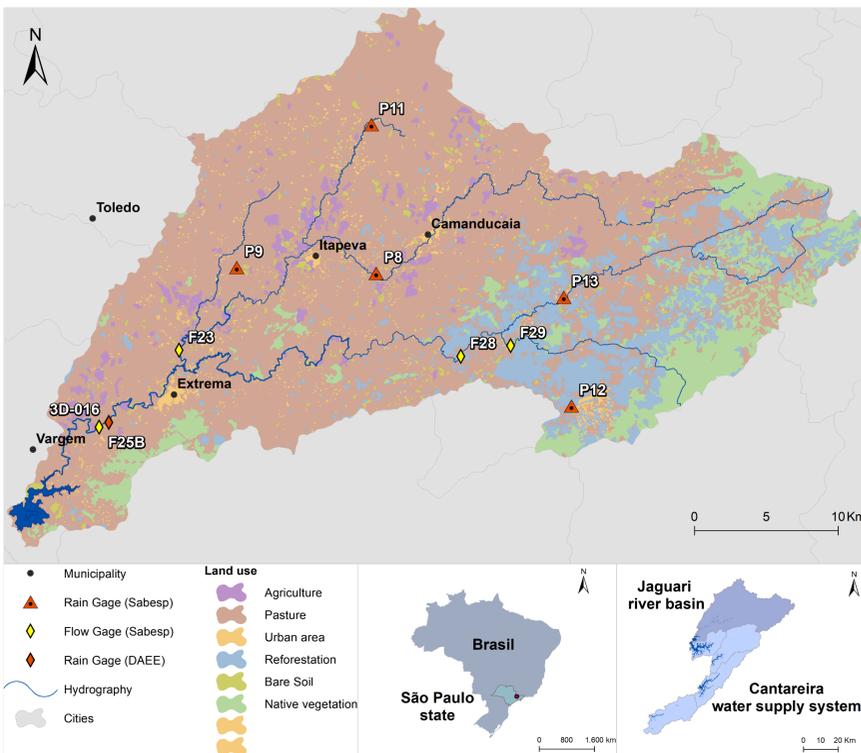
➤ Achieving a balance between water availability and demand is one of the most pressing environmental challenges in the twenty-first century.

2000 2014-2015

➤ The Southeast region of Brazil experienced two major droughts



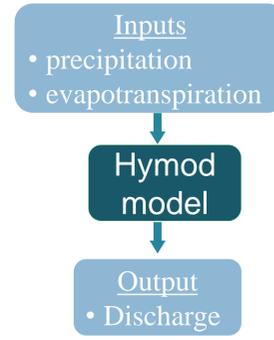
➤ It was the driest calendar year in its 123 years record.  
➤ Exposed Brazil's biggest metropolis to a crippling water crisis.



We assessed the influence of climate change on water availability in the Jaguari Basin using a modeling approach.

## MATERIALS & METHODS

1 Calibration and validation of HYMOD model  
Analysis of the model performance



1990 Warm-up 1991 Calibration 2000 Validation 2008

2 Run HYMOD with climate change data

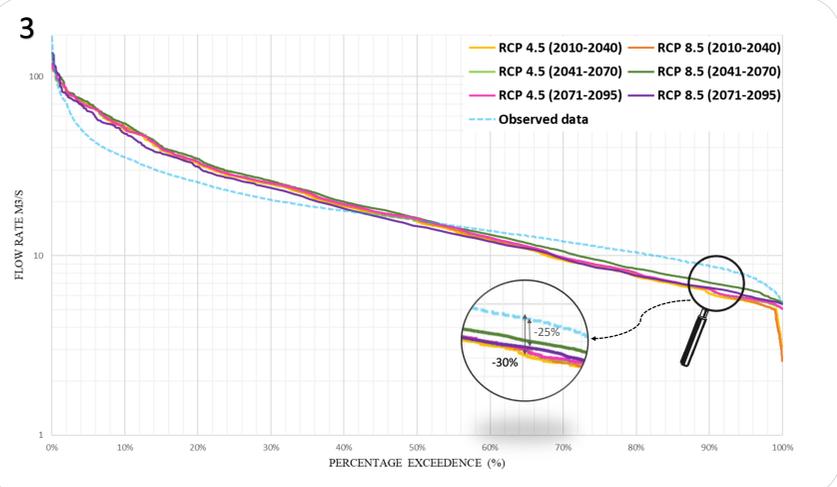
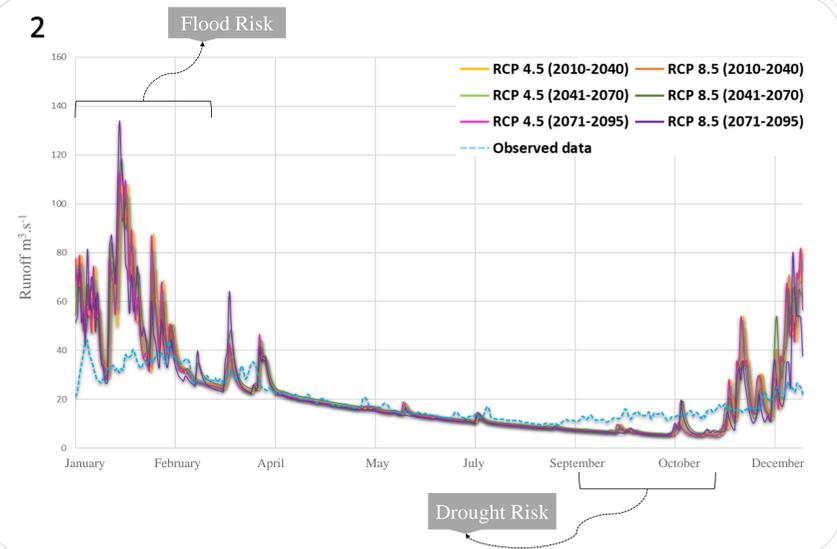
MarkSim GCM 0.30°x0.30° 2010 2095

17 GCMs RCP 4.5 RCP 8.5

3 Environmental Flow Requirement (EFR)

➤ EFRs quantify water needed to sustain the riverine ecosystem

Q<sub>90</sub> Q<sub>95</sub>



## CONCLUSIONS

- ✓ The projected climatic changes reflect a higher interannual variability, therefore, increasing the risk of drought and flood
- ✓ Our findings indicate that the water discharge could not be enough for future water demand
- ✓ Our results expose the fragility of the studied basin, presenting technical and scientific information focusing on guiding plans and strategies to deal with water scarcity situations.

## FUTURE WORK

A continued analysis of **Water Security Indicators** will be conducted in Sao Paulo Metropolitan Region. We will provide an important overview of climate change impacts on future water vulnerability and scarcity in the Jaguari basin, which can be used to guide the basin's water security plans and strategies.

## ACKNOWLEDGEMENTS

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## RESULTS

