CLIMATE CHANGE IMPACTS IN A COLOMBIAN ANDEAN TROPICAL BASIN

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Summary

The Colombian Andean tropical Basins are particularly vulnerable to climate change and therefore, local studies are required to estimate their impacts. The Andean region is one of the most affected by ENSO phenomenon; a close correlation between ONI and flow index was found in Chinchina River Basin, located in Colombia. The raised frequency of extreme rainfall over the percentile 95 and 99 was detected in gauge stations during the period 1981-2010 relative to 1971-2000. Using the IPCC projections for the period 2010-2039 and statistical downscaling of HADCHM3, CSIRO and CCMA models predict different climate change impacts in this Basin for scenarios A2 and B2. Increasing in temperature up to 1.2°C and positive and negative trends in precipitation were estimated. Reductions in water supply up to 13% were calculated with the physically based conceptual model called Tetis. Therefore, these impacts could increase the vulnerability of this tropical Basin.

Introduction

In Colombia[1], it is expected as consequences of climate change, reductions in water availability and increases in extreme events and thus adaptive measures by the different economic sectors are required in order not to limit its development because water is a significant enabler of economic prosperity and wellbeing; therefore, small local villages and urban centers need to be prepared to overcome risks, but effective adaptation responses and risk management require knowledge of climate change and climate variability impacts[2].

Methods

Colombian water resources are greatly affected by changes in rainfall patterns influenced by El Niño and La Niña[1], which were evaluated using ONI Index registered by NOOA. Climate change hydrological impacts were carried out as follows:

Model Calibration: hydrological model parameters estimation using climatic inputs and observed flows. → **Model Validation** for the current period 1981-2010 and for historical periods (1971-2010 or 1961-1990); → **Climatic data estimation** according to climate change scenarios A2-B2 with HADCHM3, CSIRO and CCMA models → **Hydrological simulation** for the period 2010-2039.

Figure 1: Methodological Framework

Case Study

Chinchiná River Basin is an Andean tropical Basin located at the south central region of Caldas, Colombia. It rises in the National Natural Park Los Nevados at 5400 m.a.s.l and flows into the Cauca River at 800 m.a.s.l. All thermal floors are found in this Basin which has an extension of only 1050 km^2 and a length of 68 km.

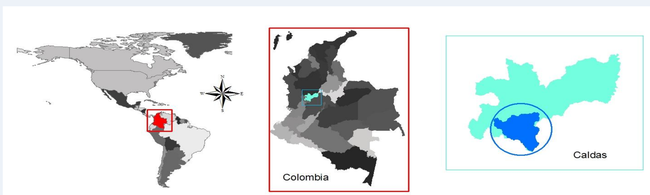
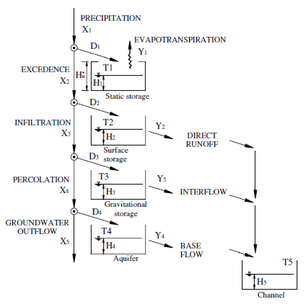
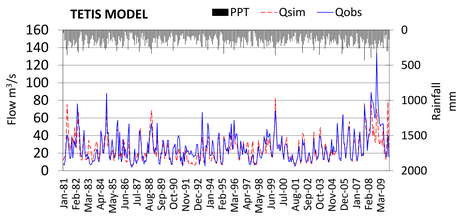


Figure 2: Chinchina River Basin location

Results

The conceptual balance lumped model called TETIS[3] was applied for hydrological modeling. TETIS Model simulated the stream flow trends very well using average daily and monthly data, as shown by the statistical indicators[4], which are in agreement with the graphical results (Figure 3).





	PBIAS	NASH	MAE	RSME	RSR
TETIS simulation	5,7%	0,66	6,77	2,60	0,59
Performance Rating	Very good	Very good	Good	Good	Good

Figure 3: Tetis Model and hydrological Modeling

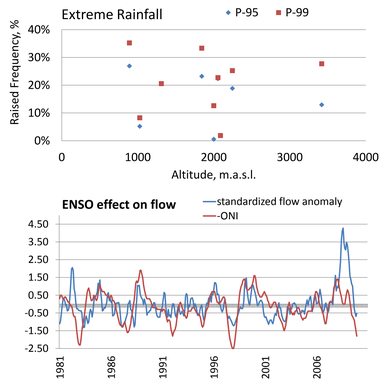


Figure 4: Extreme events and ENSO influence

The raised frequency of extreme rainfall over the percentile 95 and 99 was detected in stations located in the Basin during the period 1981-2010 relative to 1971-2000 as shown in Figure 4. The ENSO influence was confirmed by the direct relationship between the standardized flow anomalies and the negative value of the ONI index (Figure 4).

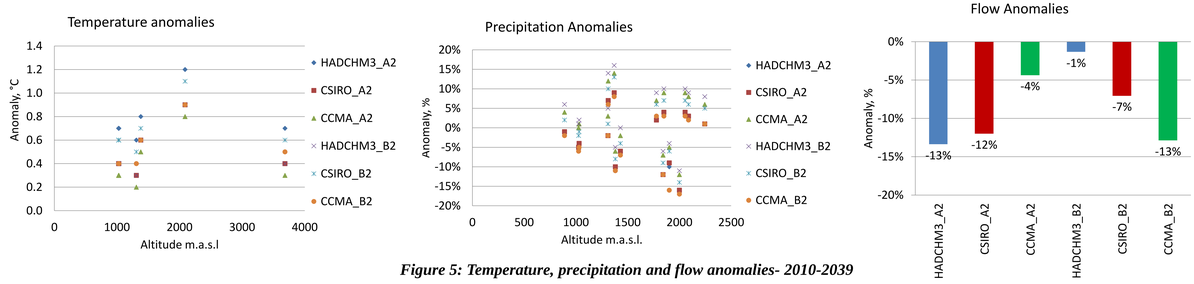


Figure 5: Temperature, precipitation and flow anomalies- 2010-2039

Using the IPCC projections for the period 2010-2039 and statistical downscaling by the delta method with resolution of 1 km x 1 km, the models HADCHM3, CSIRO and CCMA predict different climate change trends for scenarios A2 and B2 (Figure 5): The mean temperature could increase up to 1.2°C; whereas mean precipitation exhibit both positive and negative trends. Reductions in surface runoff up to 13% have been estimated with hydrological modeling under climate change conditions.

Conclusions

The main impacts due to climate change in a Colombian Andean Tropical Basin, Chinchina River, for the current period are the raised frequency of extreme rainfall over the percentile 95 and 99. For future conditions, 2019-2039, possible impacts vary depending on models and scenarios; increasing in temperature up to 1.2°C and reductions in surface runoff up to 13% were estimated with HADCHME model under A2 scenario. If the models are correct, growing conflict over water resources distribution is very likely in this tropical Basin, particularly during the dry season. Therefore, effective adaptation measures are required to reduce effects and impacts of climate change and climate variability in the Chinchina River Basin.

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