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Analyzing Land Use Impacts on Streamflow Response in a Tropical Watershed: A Hydrometric and Geochemical Approach

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Climate change and unsustainable land use practices such as quarrying have the potential to negatively impact the hydrology and water resource availability in catchments. Throughout the Caribbean, hillside quarrying has become a common practice. While these activities remove large sections of the critical zone, very little work has been done on how hillside quarrying impacts storm response and catchment water storage. The study is particularly important given the expected changes to rainfall patterns in the Caribbean under future climate change. We hypothesised that the removal of the critical zone during quarrying will increase the magnitude of streamflow response to storm events due to its close proximity to the river, while also reducing the overall storage of the watershed. This study utilized a hydrometric and geochemical approach with direct measurements of rainfall and streamflow, and bi-weekly water sample collections for geochemistry and ^{18}O and ^{2}H stable isotopes between the 3.6 km^2 Acono (forested) and the adjacent 3.6 km^2 Don Juan (quarried) watersheds, located in Trinidad and Tobago. A total of 1207 mm of rainfall occurred, with 87.3% falling from August to November (wet season) and 12.7% from December to March (dry season). The $\delta^{18}O$ in rainfall ranged from -7.7 to 0.3 ‰ across both seasons with an average $\delta^{18}O$ of -3.5±1.8‰ during the wet season and 0.1±0.5‰ in the dry season. During the dry season the mean $\delta^{18}O$ of stream water showed a difference between the forested (-2.8±0.3‰) and quarried (-3.1±0.3‰) catchments whereas there was little differences in $\delta^{18}O$ in the forested catchment (-3.3±0.3 ‰) and quarried catchment–(-3.2±0.27‰) in the wet season. Our stream $\delta^{18}O$ dry season results suggests that different sources of water or anthropogenic influences such as water from settling ponds in the quarry could have impacted the $\delta^{18}O$ of the quarried stream as we expected the forested catchment to be more stable. Sample collection at these sites is ongoing and additional parameters such as soil water isotopes and rainfall, soil and stream ion chemistry are expected to improve our understanding of the translation from rainfall to streamflow. This research will allow us to gain a better insight of the current hydrological processes within this catchment and aid in the long term adaptive planning for factors such as climate change and further land use change.