Application of HydroGeoSphere to model climate change effects on three-dimensional hydrological processes in the Valles Caldera, New Mexico

Michael Wine (Dr. Daniel Cadol, advisor)

Earth and Environmental Science, New Mexico Tech

Purpose of Study

Hydrologic modeling is particularly crucial for mountainous watersheds in northern New Mexico, such as Valles Caldera, because recharge in these areas is relatively high due to orographic (topographic relief of mountains) precipitation effects combined with relatively low evaporative demand. The goal of this project is to model the hydrologic effects of climate change in Valles Caldera—including changes to hydrologic flux timing, spatial distribution, and magnitude.

Study Underway

To calibrate and validate a three-dimensional hydrologic model for the Valles Caldera watershed, the student will use HydroGeoSphere, which is capable of modeling the hydrology of a complex watershed. Following validation of the model, a second objective is to use the calibrated model with climate change data by downscaling the coarse climate grids provided by climate modelers to acceptable spatial and temporal resolution that account for the terrain complexity of Valles Caldera as well as precipitation intensity.

Benefits

This project will improve our understanding of the current hydrologic processes operating in Valles Caldera as well as the future processes, clarify what parameters contribute to model uncertainty, indicate the importance of flow across Valles Caldera's watershed boundaries, and demonstrate that the hydrology of an entire super volcano system can be modeled. The Valles Caldera hydrologic model developed as part of this project will assist New Mexico water resource planners by projecting future flows from the Jemez Mountain region.

Hydrologist Michael Wine is interested in applying geographic information systems and remote sensing to complex landscapes through three-dimensional hydrologic modeling. He will complete a PhD in hydrology at New Mexico Tech in 2015. Michael received a BS in applied ecology from Cornell University and an MS in natural resource ecology and management from Oklahoma State University. Here Michael is on a recent field campaign to measure stream channel characteristics to better model the hydrology of Valles Caldera watershed, located in the Jemez Mountains of northern New Mexico.