Assessing eco-hydrological impacts of temperature changes at the catchment scale

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Abstract
The sensitivity of fish populations to stream temperature changes is of major concern in many river basins. Silver Creek, Idaho is a spring-fed stream highly valued for its abundance of trout species. The aquifer system that recharges Silver Creek is located in a semi-desert mountain valley. This aquifer is under stress from increasing population and irrigation. Along with changes in morphology and possible climate changes these stresses have led to changes in the hydrologic and temperature regime of the Silver Creek Basin. In particular, higher temperatures and decreased flows in Silver Creek during the summer are threatening the aquatic habitat. A spatially distributed and integrated surface water, groundwater and temperature model of the Silver Creek Basin was developed in order to quantify the changes of these processes under different conditions. The model includes natural and anthropogenic hydrologic processes, surface heat balance components and movement of heat by advection-conduction. Measures of the ecological impact on trout can be evaluated by using a bioenergetics-based model that links temperature effects to trout growth. Growth rate is a good measure of fish health because it links temperature to other bio-energetic processes such as food consumption and metabolism. Optimal growth occurs at specific range of temperatures, which vary among different species of fish. The integrated tool will allow the evaluation of several management strategies at the catchment scale in order to find an optimal set of solutions for ecosystem status traded-off against other priorities of the basin. Initial results have shown that agricultural practices in the basin are critical in controlling flows to Silver Creek. Model runs representing stream restoration such as deeper channel profiles, showed reductions in the water temperature peaks and oscillations up to 10 degrees Celsius, approximating the range of optimal temperatures for trout.

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