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A framework for evaluating regional hydrologic sensitivity to climate change using archetypal watershed modeling

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ABSTRACT

The current study focuses on the development of a regional framework to evaluate hydrologic and sediment sensitivity, at various stages of urban development, due to predicted future climate variability. This work is framed around archetypal watersheds, which are regional representations of observed physiographic features (i.e., geomorphology, land cover patterns, etc.) with a synthetic basin size and reach network. Each of the three regional archetypes (urban, vegetated and mixed urban/vegetated land covers) simulates satisfactory regional hydrologic and sediment behavior compared to historical observations prior to a climate sensitivity analysis. Climate scenarios considered a range of increasing temperatures, as estimated by the IPCC, and precipitation variability based on historical observations and expectations. Archetypal watersheds are modeled using the Environmental Protection Agency's Hydrologic Simulation Program- Fortran model (EPA HSPF) and relative changes to streamflow and sediment flux are evaluated. Results indicate that the variability and extent of vegetation play a key role in watershed sensitivity to predicted climate change. Temperature increase alone causes a decrease in annual flow and an increase in sediment flux within the vegetated archetypal watershed only, and these effects are partially mitigated by the presence of impervious surfaces within the urban and mixed archetypal watersheds. Depending on the extent of precipitation variability, urban and moderately urban systems can expect the largest alteration in flow regimes where high flow events increase in frequency and magnitude. As a result, enhanced wash-off of suspended-sediments from available pervious surfaces is expected.

Full Text

http://ftp.sccwrp.org/pub/download/DOCUMENTS/AnnualReports/2013AnnualReport/ar13_389_408.pdf