How agriculture and urbanization modify regional flow regimes across the United States

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Abstract. Using daily discharge data from the USGS, we analyzed how hydrologic regimes vary with land use in four large hydrologic regions that span a gradient of natural land cover and precipitation across the continental US. In each region we identified small streams (contributing area < 282 km^2) that have continuous daily streamflow data. We characterized the composition of land cover of the watersheds in terms of aggregate measures of agriculture, urbanization, and least disturbed ("natural"). We calculated hydrologic alteration using 10 ecologically-relevant hydrologic metrics that describe magnitude, frequency, and duration of flow for 158 watersheds within the Southeast (SE), Central (CE), Pacific Northwest (NW), and Southwest (SW) hydrologic regions of the United States. In an analysis of flow alteration along gradients of increasing proportion of the three land cover types, we found many regional differences in hydrologic responses. Relative to natural land cover in each region, urbanization either increased (SE and NW) or decreased (SW) peak flows, decreased minimum flows (SE, NW, and SW), decreased near-bankfull flows (SE, NW, and SW), and increased flow variability (SE, NW, and SW). Agriculture had similar effects except in the SE, where near-bankfull flow durations increased. Overall, urbanization appeared to induce greater hydrologic responses than similar proportions of agricultural land cover. Ecological and geomorphic responses to human alteration of land cover must calibrated to the regional hydroclimatological, geologic, and historical context in which the streams occur to determine the degree to which stream responses are region-specific versus geographically independent and broadly transferable.

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