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Feedbacks in human-landscape systems

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As human interactions with Earth systems intensify in the "Anthropocene", understanding the complex relationships among human activity, landscape change, and societal responses to those changes is increasingly important. Interdisciplinary research centered on the theme of "feedbacks" in human-landscape systems serves as a promising focus for unraveling these interactions. Deciphering interacting human-landscape feedbacks extends our traditional approach of considering humans as unidirectional drivers of change. Enormous challenges exist, however, in quantifying impact-feedback loops in landscapes with significant human alterations. This paper illustrates an example of human-landscape interactions following a wildfire in Colorado (USA) that elicited feedback responses. After the 2012 Waldo Canyon Fire, concerns for heightened flood potential and debris flows associated with post-fire hydrologic changes prompted local landowners to construct tall fences at the base of a burned watershed. These actions changed the sediment transport regime and promoted further landscape change and human responses in a positive feedback cycle. The interactions ultimately increase flood and sediment hazards, rather than dampening the effects of fire. A simple agent-based model, capable of integrating social and hydro-geomorphological data, demonstrates how such interacting impacts and feedbacks could be simulated. Challenges for fully capturing human-landscape feedback interactions include the identification of diffuse and subtle feedbacks at a range of scales, the availability of data linking impact with response, the identification of multiple thresholds that trigger feedback mechanisms, and the varied metrics and data needed to represent both the physical and human systems. By collaborating with social scientists with expertise in the human causes of landscape change, as well as the human responses to those changes, geoscientists could more fully recognize and anticipate the coupled human-landscape interactions that will drive the evolution of Earth systems into the future.