Geophysical Research Abstracts
Vol. 13, EGU2011-3935, 2011
EGU General Assembly 2011

Hydrologic similarity among headwater basin responses to climate change based on six decades of studies at long-term ecological research (LTER) sites in the United States

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Experience and results emerging from over six decades of streamflow and vegetation studies at long-term ecological research (LTER) sites can provide insights into hydrologic similarity. Long-term streamflow records from LTER sites provide information on responses, adaptation and resilience to climate variability and the effects of many processes on water yield. Using long-term climate and stream flow records (archived in the LTER clim/hydro DB website), we assessed the sensitivity of water yield from ecosystems to past land use change and climate variability since 1950, and contrasted these patterns in at least six major regions of the U.S.: Pacific Northwest, Southwest, Rocky Mountains, Midwest, Southeast, and Northeast, as well as Canada. Water yield from headwater ecosystems has responded to climate change, but responses also display some ecological resilience to climate change. Hydrologic responses to climate change are smaller than responses to experimental vegetation treatments. Nevertheless, climate change effects on hydrology may propagate downstream throughout the drainage network in larger basins. These findings demonstrate several aspects of hydrologic similarity. First, similarities in hydrologic responses to climate warming were observed among basins with similar climatic regimes, especially the presence of a seasonal snowpack, even when these basins differed in other respects. Second, many basins displayed little or no response to climate warming because of a variety of mechanisms that adjust ecosystem water use in response to changing temperature and moisture. Thus, the characteristics of ecosystems, including species composition and especially disturbance history, appear to be very important in understanding and explaining differences in basin water yield over time. This implies that studies of hydrologic similarity will benefit from considering ecological factors and the history of vegetation disturbance.