Research | Disturbance Hydrology

Landscape disturbances, characterized by relatively abrupt disruptions to hydrologic function, can dramatically affect ecologic function, resilience of water resources, and hazards to human lives and infrastructure. Disturbances span a broad spectrum of anthropogenic and natural stressors and can be both endogenous (internal) and exogenous (external). While much is known about the effects of individual disturbances, the commonalities between disturbance impacts and integration with ecological theory are only now being explored. Furthermore, interactions between overlapping disturbances in space and time are a critical focus for future research in the hydrologic sciences.

Focal areas

Hydrologic response following wildfire

Wildfires are a growing problem with a global reach, leading to increased natural hazards, threats to water resources, and ecological consequences. Understanding how wildfire affects individual hydrologic processes and interactions within the hydrologic cycle is essential for natural hazard prediction, water resource protection, and synthesizing commonalities with hydrologic impacts from other landscape disturbances. Our work examines the short-term (days to 2 years after the fire) natural hazards implications as well as long-term (years to decades after the fire) water resources issues related to vegetation and soil recovery. Our investigations combine field measurements of surface and subsurface response to rainfall, laboratory characterization of soil-hydraulic properties, and numerical modeling of water, solute,

and sediment movement to improve our understanding of hydrologic impacts of wildfire. Ongoing and recent wildfire-related projects include locations in Colorado, New Mexico, Alaska, and Washington.

Forest harvest impacts on subsurface hydrology

The hydrologic consequences of forest harvest substantially affect water resources and natural hazards in the Western U.S. and in the developing world. While general timescales of the impacts of forest harvest are known, effects of forest harvest on flow through unsaturated soil and interactions with underlying weathered bedrock need further exploration. This frontier of hydrologic research has major implications for bedrock groundwater recharge, the resulting baseflow, and slope failure. Ongoing and recent forest land use projects include locations in Oregon and Panama.

USGS Collaborators

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Selected Publications (most recent listed first)

Ebel, B.A., and B.B. Mirus (2014), Disturbance hydrology: challenges and opportunities, Hydrological Processes, 28, 5140-5148, doi: 10.1002/hyp.10256

Ebel, B.A. (2013), Simulated unsaturated flow processes after wildfire and interactions with slope aspect, Water Resources Research, 49, 8090–8107, doi: 10.1002/2013WR014129

Ebel, B.A., J.A. Moody, and D.A. Martin (2012), Hydrologic conditions controlling runoff generation immediately after wildfire, Water Resources Research, 48, W03529, doi: 10.1029/2011WR011470

Ebel, B.A., K. League, and R.I. Borja (2010), The impacts of hysteresis on variably-saturated hydrologic response and slope failure, Environmental Earth Sciences, 61, 1215-1225, doi: 10.1007/s12665-009-0445-2

Ebel, B.A., K. League, D.R. Montgomery, and W.E. Dietrich (2008), Physics-based continuous simulation of long-term near-surface hydrologic response for the Coos Bay experimental catchment, Water Resources Research, 44, W07417, doi: 10.1029/2007WR006442