Program and Abstracts

69th Annual Meeting, Rocky Mountain Hydrologic Research Center

Wild Basin Lodge, Allenspark, Colorado, October 14, 2014, 9:00 – 5:00

Program

Opening comments—Glenn Patterson

Doesken, Nolan. Colorado Climate Center. *A meteorological retrospective on 2014, 2013 and the flood.*

Rense, William. Retired professor of Geography and earth Science, Shippensburg University of Pennsylvania. *Surviving the Colorado Floods of 2013.*

Williams, Mark. Floodplain Administrator, Town of Jamestown (CO). *A rude lesson in fluvial geomorphology: The Jamestown, Colorado, experience of September 12, 2013.*

Moody, John. United States Geological Survey, and David Gochis, National Center for Atmospheric Research. *Comparison of peak discharge estimates for the 2013 Front Range floods with historical and extraordinary floods.*

Anderson, Suzanne. University of Colorado. *Exhumation by debris flows in the 2013 Front Range storm: A role in landscape response to base-level lowering.*

Ryan, Sandra. U.S. Forest Service, Rocky Mountain Research Station, Ft. Collins, CO, and Sara Rathburn, Department of Geosciences, Colorado State University, Ft. Collins, CO, and Mark Dixon, Mountain Studies Institute, Durango, CO. *September 2013 flood and High Park Burn in the South Fork, Cache la Poudre River near Ft. Collins, CO.*

Brogan, Daniel J. and Peter A. Nelson. Department of Civil and Environmental Engineering, Colorado State University, Ft. Collins, CO. *A hydrologic and and geomorphic comparison of two extreme post-wildfire floods in the Colorado Front Range.*

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extraordinary Colorado floods, the 2013 floods are about an order of magnitude lower for the same drainage area. This probably reflects that the character of the rainfall was a prolonged low-intensity rainfall rather than a short, high-intensity rainfall associated with some of the extraordinary floods on record.

Scott Anderson, Suzanne Anderson, and Robert Anderson: *Exhumation by debris flows in the 2013 Front Range storm: A role in landscape response to base-level lowering.* Landscapes evolve over time scales vastly longer than the period for which historical records exist. It is therefore important to understand the degree to which modern observations capture the full range of geologically formative processes and process rates when intermixing the two time scales. Knickpoint migration lowers baselevel of hillslopes lining the channel, which then provokes a poorly understood transient adjustment of the hillslopes to the new condition. In September of 2013, a massive precipitation event in the Front Range of Colorado triggered over 1,300 debris flows and landslides in a historically sedate landscape (Coe et al., 2014). Within the Front Range, these landslides occurred almost exclusively along steep walls lining canyons cut into crystalline rock by headward propagating knickpoints. Here we employ topographic differencing, derived from repeat aerial LiDAR, to locate failures and estimate the volumes of material mobilized in 120 failures in a 102 km2 area west of Boulder. Combining these volumes with previously published 10Be-derived long-term erosion rates reveals that the volumes of material correspond to at least several hundred years of hillslope sediment production in the impacted basins. These results provide observational evidence that extreme events are a reasonable explanation for short and long-term sediment yield discrepancies. We infer that landsliding and debris flows are the primary mode of debris delivery from the canyon walls. These rare debris flow events both remove accumulated hillslope sediment, and scour steep, low order channels into the canyon walls.

Sandra Ryan, Sara Rathburn, and Mark Dixon: *September 2013 flood and High Park Burn in the South Fork, Cache la Poudre River near Ft. Collins, CO.* The High Park fire burned over 35,000 ha within the Cache la Poudre basin in early summer 2012, including an eastern portion of the South Fork Cache la Poudre (SFCLP) watershed. Given the proximity of the burn and the implications for water quality supplied to Fort Collins and Greeley, CO, there was an expressed interest on the part of the cities for improved understanding of sediment loads from these watersheds over the next few years. Prior to burning, data on sediment transport (suspended sediment and bedload) were collected by researchers from the US Forest Service, providing baseline information on sediment loads in the SFCLP. In 2013, bedload was measured during snowmelt runoff using standard pressure-difference samplers identical to those used previously in 1989 and 1997. A turbidity sensor was deployed as a surrogate measure of suspended sediment concentration. The turbidity signal was calibrated using both grab samples and samples obtained from an automated water sampler triggered to collect during substantial increases in turbidity values. Additional sampling stations were later established downstream of the main SFCLP site in conjunction with assessments of channel extension and sedimentation from severely burned hillslopes and gulches, one of which was mulched for erosion control in spring 2013.

Steven Fassnacht and Juan Ignacio Lopez-Morena: *Patterns in snowpack trends across the mountains of the western United States.* With increased warming, seasonal snowpacks are tending to decrease. Climate change patterns in these snow dominated environments are typically computed using monthly data - often temporally static indices, such as April 1st snow water equivalent (SWE). The installation of the snow telemetry (SNOTEL) network across the Western United States provides real-time daily SWE data. We use these data to investigate changes in the snowpack patterns, specifically accumulation and melt. Twenty measures of snowpack accumulation and melt are derived and used to determine trends in snowpack patterns. Many of these SNOTEL stations have been in place for more than 30 years so these patterns represent similar periods to climate normals. While the trends are not spatially homogeneous, various distinct temporal patterns are present. We further investigate larger-scale ecological changes and their possible impact on these observed trends.

Zach Schwalbe, Wendy Ryan, Nolan Doesken and Andrew Muniz: *Long term rain gauge comparisons for hydrologic and climatological applications.* Multiple rain gauges have been operated simultaneously for several decades at the historic Fort Collins, Colorado weather station on the campus of Colorado State University. Using 24-hour observations from a National Weather Service standard rain gauge as reference, this study examined the performance of the 4"-diameter gauge used by the Community Collaborative Rain, Hail and Snow network (CoCoRaHS) from a 20-year side-by-side comparison. Data since 2008 from a tipping bucket gauge and a low-cost manual "wedge" gauge will also be compared. Similarities and differences in observed precipitation as a function of time of year and precipitation type (rain vs snow) will be examined and discussed.

Joel Sholtes: *Characterizing the probability of river change from floods with network-derived geomorphic and hydraulic information.* River change during floods results from a number of processes including excess stream power (or shear stress) acting on the river boundaries as well as longitudinal changes in stream power resulting in surpluses or deficits of transport capacity relative to the incoming sediment load. This results in channel bank and bed degradation in some cases and sedimentation and avulsion in others. Whereas this is a natural process in rivers, in terms of flood hazards to human infrastructure, river change is often ignored in floodplain management policy underestimating flood impact risk. With improvements in geospatial data, new tools have been developed to estimate hydraulic (stream power) and geomorphic (channel geometry and valley width) at the network scale. Relating these variables to observations of channel change can inform guidance as well as statistical models linking type and severity of channel change. I will review existing methods, discuss how they apply to Front Range rivers, and lay out a framework for creating a probabilistic model to predict river change here. The goal of this work is to advance the science behind predicting river change and to create better information on flood hazards for floodplain management.