5-4 - EXPLORING VARIABILITY IN PEAK DISCHARGE AND EROSION CAUSED BY THE JUNE 2022 ATMOSPHERIC RIVER FLOOD IN NORTHERN YELLOWSTONE NATIONAL PARK

Wednesday, 15 May 2024

9:05 AM - 9:25 AM

Cedar Ballroom (Davenport Grand Hotel)

Abstract

In June of 2022 an extreme atmospheric river flood caused extensive bank erosion and infrastructure damage in northern Yellowstone National Park (YNP). On the lower Lamar River, peak discharge was 170% of the next highest peak of 1996 (gaged since 1923) and resulted in widespread overbank gravel deposition and channel change. In June 1918, however, flooding on the Lamar system produced similar peak flows, as shown by indirect discharge estimates and tree-ring dating. In 2022, peak discharges and flood effects varied considerably in northern YNP. The upper Lamar River had a peak discharge significantly less than 1918, likely the result of less precipitation and snowmelt in the relatively low elevations of the upper Lamar drainage in the Absaroka Range. The high flows experienced by the lower Lamar River, however, were the result of extreme discharges in tributaries that drain the Beartooth Range where Soda Butte Creek and Pebble Creek had discharges similar or greater than 1918 and discharge on Slough Creek produced extensive mid channel bar deposition greater than 2 m. In western YNP, the Gallatin River experienced little bank erosion or bed material transport, although some reaches showed minor channel scour and gravel bar deposition on glacial outwash substrates. In central YNP, the Gardiner River experienced minimal bank erosion on upper reaches, however, there was extensive bank erosion, landslides, and sediment deposition in the Gardner River Canyon where the steep, confined channel focused stream power along the valley margins. Flood magnitudes differed markedly between the Gallatin and Beartooth drainages despite similar amounts of rainfall and snowmelt. The Gallatin River drainage, dominated by highly fractured and macroporous limestone and extensive thick colluvium with gentler range flanks allows for greater infiltration and reduced peak flows. In contrast, basins in the Beartooth Range drain steeper slopes of low-permeability laharic volcaniclastic rocks, with more exposed bedrock and relief up to 900 m, which promotes rapid runoff and extreme flooding. The frequency and magnitude of rain-on-snow floods is likely increasing in YNP because of anthropogenic warming, as the high-elevation snowpack becomes more susceptible to rapid melting and late spring precipitation shifts from snow to rain.

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