Poster Session 2

Commons East, Easel 68

1:00 PM to 2:30 PM

Modeling Monsoon Flood Erosion in the Eastern Himalaya: Using GeoClaw to Simulate Velocity and Depth for High Discharge Annual Flows

Max Philip (Max) Vanarnam, Junior, Earth & Space Sciences (Physics)
Mentor: Susannah Morey, Earth and Space Sciences
Mentor: Katharine Huntington, Earth And Space Sciences

When seeking to better understand specific bedrock river erosional processes due to flooding, numerical modeling can help answer many questions, specifically the extent to which floods contribute to setting the landscape. The eastern Himalaya experiences multiple flooding events of different magnitude: annual monsoon floods ($10^3 m^3/s$) and centennial outburst floods ($10^5 m^3/s$). This region also experienced at least two ancient megafloods during the Holocene ($10^6 m^3/s$). Previous studies of flooding in the region have assessed the potential geomorphic role of the outburst floods and megafloods; however, the relative geomorphic impact of annual monsoon flooding remains unknown. To fully understand the relative erosive power of these eastern Himalayan floods, it is necessary to compare the hydraulics of outburst dam-break floods to the hydraulics of seasonal monsoon flow. To do this, we use the program GeoClaw to numerically simulate monsoon flood flow in this region. GeoClaw, which uses the 2D shallow water equations, has accurately been used to model outburst flooding events, including the centennial outburst floods and the ancient megafloods. By modifying the program to simulate constant monsoon discharge, we can analyze patterns of flow velocity and depth (GeoClaw outputs) to understand the spatial pattern of shear stress during monsoon floods. We expect to find that monsoon flow will yield lower magnitudes of shear stress and more homogeneous patterns of potential erosion compared to those observed for the outburst floods and megafloods. Understanding these erosional spatial patterns will help us better recognize the relative contributions of various magnitude floods and the extent to which each can set the landscape.

Poster Session 2

Commons East, Easel 71

1:00 PM to 2:30 PM

Determining the Month of Soil Carbonate Formation for Paleoclimate Reconstruction

Nicole Sarieddine, Senior, Earth and Space Sciences: Geology
Mentor: Katharine Huntington, Earth And Space Sciences
Mentor: Julia Kelson, Earth and Space Sciences

Carbon dioxide concentrations have been on the rise since preindustrial times due to anthropogenic emissions. Understanding how past climates have responded to changes in the atmosphere is important to understand how our current climate will react to changes in our present-day atmosphere. Soil carbonates record the temperature at the time of their formation in their stable isotopic composition (called clumped isotope geochemistry). Ancient soil carbonates can record the temperature and allow us to better understand paleoclimates. Understanding what time of year soil carbonates form allows us to better interpret the temperature being recorded. The timing of changes in soil moisture is likely one of the most important environmental factors to consider. We test whether soil carbonates form during soil drying events using soil moisture and temperature data measured remotely by a satellite called Soil Moisture Active Passive (SMAP). This satellite has been gathering near-surface soil moisture data globally since 2015 at 35-65 km resolution. We compare the air temperature of the month with the greatest net negative soil moisture content month (determined from the satellite data) to the measured growth temperature of soil carbonates (estimated through geochemistry). We first compare the month of drying of three locales in North America, then extend the analysis globally to all locations for which soil carbonate clumped isotope data exist. Preliminary results suggest that the temperature of the month with the most drying agrees with formation temperature we estimated from clumped isotope geochemistry within one degree for a site in Nebraska and within seven degrees for a site in Wyoming. These results suggest that soil drying promotes soil carbonate formation in some environments. By using soil carbonates to explain past climates, we will improve temperature change estimates, which will help improve climate models for the future.

POSTER SESSION 2

Commons East, Easel 70

1:00 PM to 2:30 PM

Paleo Basemap to Investigate Flooding Patterns and Geomorphic Change from the Bridge of the Gods Flood 550 Years Ago

Maxim Thomas (Max) Podhaisky, Senior, Earth and Space Sciences: Geology, Art
Mentor: Katharine Huntington, Earth And Space Sciences
Mentor: Susannah Morey, Earth and Space Sciences

The Bonneville Landslide dam, also known as the Bridge of the Gods, blocked the Columbia River about 550 years ago at the site of the modern Bonneville Dam, on the Washington-Oregon border. According to Klickitat lore, the Bridge of the Gods was created by the chief of all gods to join the lands north and south of the river. The dam's failure, thought to be a result of the violent dispute between the chief's sons, led to an outburst flood that drowned a forest and carved the Cascade Rapids. Sedimentary deposits from this dam break flood have been observed downstream, but the flood behavior and inundation pattern remains unknown. In this study, we created a paleo-digital elevation model (DEM) of the Columbia Valley Gorge landscape before the flood, which will serve as the basemap for numerical models of the flood. The paleo-DEM combines three data sets: 1) topographic data derived from the 1868 and 1901 U.S. Coast and Geodetic Survey historic topographic survey maps and bathymetric depth values from hydrographic sheets; 2) bathymetry of the Lower Columbia River with removed modern structures in Portland, validated by tide records from 1853 to 1876; and 3) bathymetry upstream from the Bonneville Dam, merged with adjacent topography and derived from NOAA data. In ArcGIS, we filled in data holes and modern channels and subtracted modern structures in an attempt to accurately represent the paleo-environment. Because the Columbia estuary is heavily influenced by tides, we used historic tide observations to create a low and high tide paleo-DEM to make preliminary analyses of how the tide might have influenced this flood. Once we know the paleo-topography of the Columbia Gorge, Portland basin, and Columbia Estuary, we can begin to numerically model this flood and explore its geomorphic impact.