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Geomorphic influence on catchment hydrology across the Andes-Amazon transition in Peru

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The steep topographic gradient along the eastern flank of the Andes mountains in Peru provides an exciting natural laboratory for investigating the geomorphic influence on catchment-scale hydrology. We have been using a combination of water stable isotope time series and solute concentrations to investigate this system across a range of time and spatial scales within the Madre de Dios river basin. This presentation will summarize the current state of this research effort, with a particular emphasis on new results from small catchments within the context of previous work on larger rivers. In work that is largely completed, focused at the scale of large rivers (up to tens of thousands of square kilometers in area), we found systematic differences in solute concentration-discharge relationships from high to low elevation, for major as well as trace elements. These differences are consistent with a dominant control by mixing of tributaries with varying composition, supported by water stable isotope data. Nonetheless, solute isotopic data indicate that there are also important differences in the weathering reactions across the geomorphic gradient. In an effort to isolate the role of hillslope processes (such as slope and permeability structure) on water flowpaths, we are currently working at the scale of smaller, first-order catchments (on the order of one square kilometer area), where the effects from mixing of heterogeneous tributaries are minimized. Preliminary data do not suggest major systematic differences water transit times (as inferred from O-18 time series) when comparing steep Andean catchments versus lowland catchments in the Amazon floodplain, as we initially hypothesized, but highly time-resolved samples collected during rainfall events point to significant differences in catchment flowpaths that can explain solute patterns and that suggest an important role of permeability in controlling the hydrology of these catchments.