Watersheds are increasingly understood to function as connected networks, with the strength of connections between landscape compartments – for example, hillslopes and river channels – controlling various system dynamics (Figure 1) (Fryirs, 2013). In mountain landscapes, where catastrophic hillslope processes like landslides are important and potentially fairly frequent events, the response of a particular watershed to a spate of landslide activity is likely strongly influenced by this coupling. The strength of this coupling is controlled, at least in part, by the hydrology of the watershed in question. In relatively dry landscapes (like, for example, the semi-arid Colorado Front Range or the mesas of the Colorado Western Slope (Figure 2, right-hand side)), landslides that occur may be largely disconnected from valley bottom rivers, with sediment deposits that remain stored on hillslopes for many years, safe from the hydrologic highway offered by steep mountain rivers. Conversely, in relatively wet landscapes (like, for example, Taiwan (Figure 1, left-hand side)), landslides may be fairly well-connected to valley bottom rivers, with landslide-generated sediment transported relatively quickly downslope by subsequent rainfall events. The time it takes for these two landscapes to transport sediment produced by landslides is thus likely very different: in the former, it may take centuries to evacuate, whereas in the latter, a pronounced sediment response may occur in the years immediately following hillslope failure. The time scale of response is important for many reasons, including short-term management concerns – like anticipating how long river flooding may occur following large mass movement events – to long-term landscape development questions – like how landslides influence downstream river erosion and the form and shape of mountain landscapes.

Schematic depiction of sediment (dis-)connectivity (lateral e.g. hillslope-channel, longitudinal along channel network) and its most relevant factors.

<img src="connectivity\_img.jpg" alt="drawing" width="500" height=”500”/>

\*Figure 1. A graphical depiction of connectivity, with barriers to connectivity (i.e., low connectivity) represent by red symbols\*

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In this lab, we will simulate these sorts of different landscapes using Landlab and various components. We will do this by running two scenarios:

1. **High-connectivity scenario**: Here, we simulate landslide occurrence over a 20-year period that occurs simultaneously with fluvial processes (flow routing, erosion, etc.). This represents our wet landscape, where landslide sediment is frequently transported downslope to river channels by rainfall events. We then run this same model forward 20 more years to see how the river network evacuates sediment in these sorts of well-connected landscapes.
2. **Low-connectivity scenario:** Here, we simulate landslide occurrence over the same 20-year period, but we turn off fluvial and hydrological processes, essentially “stranding” the landslide sediment on the hillslopes. This represents our dry landscape, where landslide-derived sediment may remain perched high above river channels. We then “turn on” hydrological and fluvial processes and run the model forward 20 (and 200 and 2000) years, to see how the river network evacuates sediment in these more poorly connected landscapes.

Taking what we’ve discussed in class and what is introduced in the first paragraph, formulate some hypotheses of how the river network may respond in each scenario.