Martian landscape evolution

Alluvial fans and deltas

Valley networks

Earth arid zone

Linear dunes

Hyperarid Atacama

**Alluvial Fans on Mars**

The fate of Mars' surficial water has been one of the central questions in planetary science since the dawn of the Space Age. Today Mars is a global desert, too cold and dry to sustain liquid water on its surface. But the geology of Mars tells a different story, and the widespread fluvially modified landscapes act as a testament to the planet's warmer and wetter past. The effects of water on a landscape are the most unambiguous markers of past climate, and while difficult to decipher, understanding the processes responsible for their formation can provide clues into Mars' climatic history.

One such class of landform is the alluvial fans scattered across the southern martian highlands. These features are enigmatic; their large size necessitates significant volumes of surficial water but many may have formed as recently as the Hesperian-Amazonian boundary, a time period generally thought to have been dominated by a cold and dry climate. The alluvial fans may therefore be representative of the last episodes of widespread fluvial modification to the martian surface.

**Alluvial Fans on Earth**

In 2008, the Kosi river overtopped its embankment, inundating 3700 km2 of land and displacing nearly three million people. Although an extreme example, this event highlights the flood hazards of fan landforms. As relatively low-relief features in otherwise mountainous areas, fan surfaces are a desirable location for development, and portions of rapidly growing metropolises in the American southwest (including Las Vegas and Phoenix) are built directly on top of alluvial fans.

Arid alluvial fan flows are highly episodic and mostly unpredictable, so there is a poor understanding of the relation between a flow's hydrologic and sedimentologic properties and the subsequent deposits. In addition, channel avulsion occurs on a century to millennia timescale and cannot usually be readily observed in the field.

I use computational landform evolution modeling to examine whether avulsion on alluvial fans is driven primarily by differences in slope or the pre-existing inactive channel network, how changes in sediment size and supply in the catchment affect fan morphology and sediment sorting downfan, and the effect of basin subsidence on alluvial fan profile and channelization.