Gully erosion of cultural sites in Grand Canyon
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I. Erosion control: Are checkdams working?
Results:
- a) small data set indicates checkdams do work to reduce erosion
- b) damaged structures are associated with steep gradients and high erosion
- c) woody debris checkdams appear to work better than rock linings

Recommendations:
- a) enlarge dataset
- b) continue erosion control, especially woody debris structures
- c) undertake necessary maintenance

II. Monitoring: Will photogrammetry remote sensing work?
Results:
- a) individual photogrammetric datasets had a vertical accuracy of 6-10 cm depending upon level of interpolation
- b) combined successive datasets had an accuracy of ~20 cm at best
- c) error can be minimized with numerical guides, but vegetation, shadows, weather, and photographic quality and cost are other problems

Recommendations:
- a) photogrammetry at this scale is not yet appropriate for monitoring moderate to small-scale gullies
- b) with more detailed photography and future technology, it probably will be

III. Geomorphology: Why is it happening?
Results:
- a) erosion is happening by the processes of infiltration-excess overland flow, minor piping, and knickpoint retreat
- b) eolian processes, biotic crust, and unexpected infiltration characteristics play a role in erosion
- b) erosion corresponds particularly well to high gradients
- c) an initial slope-area-based numerical model indicates gully erosion can likely be predicted based on up-catchment geomorphic properties

Recommendations:
- a) complete geomorphic studies, including empirically relating precipitation to erosion
- b) undertake the next step in predictive modeling of gully erosion
- c) study and understand eolian system
- d) baselevel hypothesis can be tested

Additional benefits:
- 1) training students
- 2) significant contributions to topical science