GULLY EROSION OF CULTURAL SITES

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I. Erosion Control

How do we mitigate it?

II. Photogrammetry

How do we monitor it?

needs = very l

III. Geomorphology

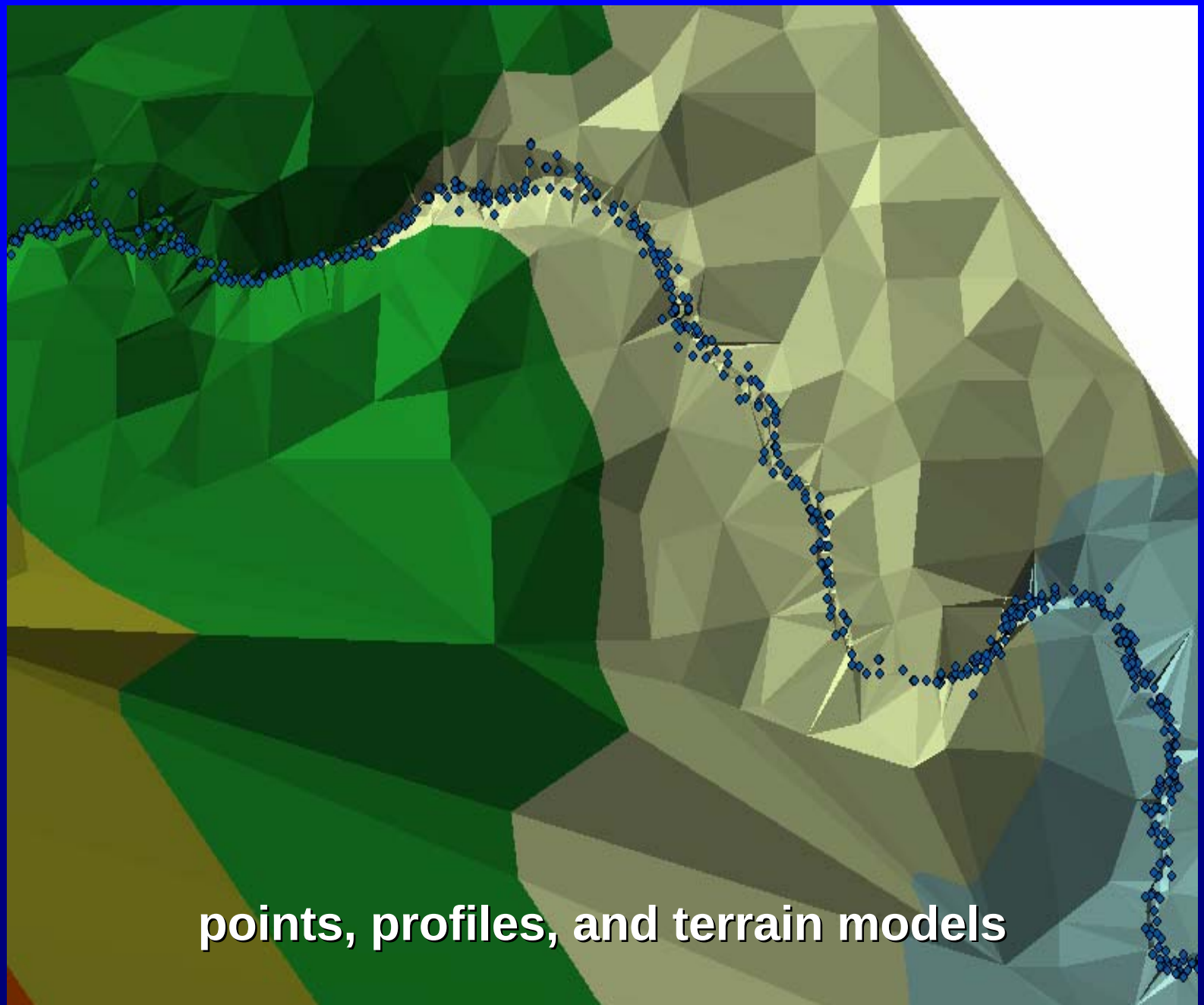
Why is it happening?

Research Design

- **9 study sites, 22 gullies**
- **4 photogrammetry sites, 10 gullies**
- **comparison before and after the 2002 monsoon to ground survey “truth”**

N.B. The original presentation included a map which was removed to protect sensitive cultural information.

Methods



points, profiles, and terrain models

Results—Photogrammetric Vertical Accuracy

Interpolation (- to +)

Summary of February photogrammetry accuracy assessment for combined sites (m)

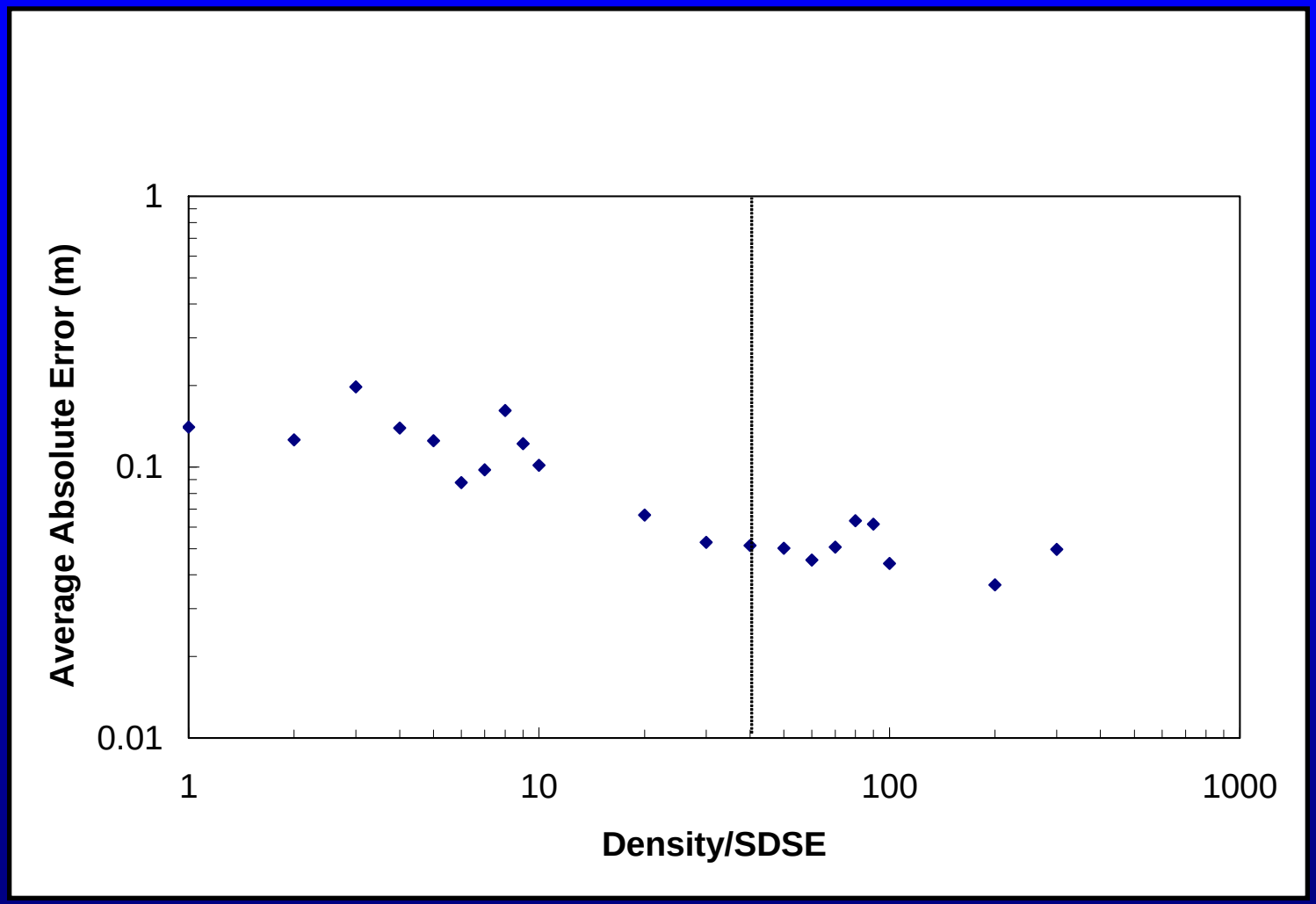
Site	n	mean	stdev	min (q_0)	q_1	median (q_2)	q_3	max (q_4)
Points	84	**0.07**	**0.07**	0.00	0.03	0.04	0.08	0.48
Profiles	983	**0.06**	**0.06**	0.00	0.02	0.04	0.09	0.45
Cross sections	207	**0.09**	**0.09**	0.00	0.04	0.07	0.13	0.44
Semi-auto TINs	4936	**0.08**	**0.11**	0.00	0.02	0.05	0.10	1.22
Manual TINs	5444	**0.09**	**0.10**	0.00	0.03	0.06	0.11	0.97
DEMs	20230	**0.10**	**0.10**	0.00	0.03	0.07	0.13	2.49

Summary of October photogrammetry accuracy assessment for combined sites (m)

Site	n	mean	stdev	min (q_0)	q_1	median (q_2)	q_3	max (q_4)
Points	77	**0.08**	**0.08**	0.00	0.02	0.05	0.11	0.45
Profiles	983	**0.09**	**0.07**	0.00	0.04	0.07	0.12	0.59
Cross sections	207	**0.09**	**0.07**	0.00	0.03	0.06	0.14	0.35
Semi-auto TINs	3636	**0.10**	**0.10**	0.00	0.03	0.08	0.13	1.33
Manual TINs	207	**0.10**	**0.10**	0.00	0.03	0.07	0.12	0.77
DEMs	19424	**0.10**	**0.11**	0.00	0.03	0.07	0.13	2.16

Interpolation (- to +)

Results—GIS Error Analysis



THE POINT : optimal error = 5-7 cm

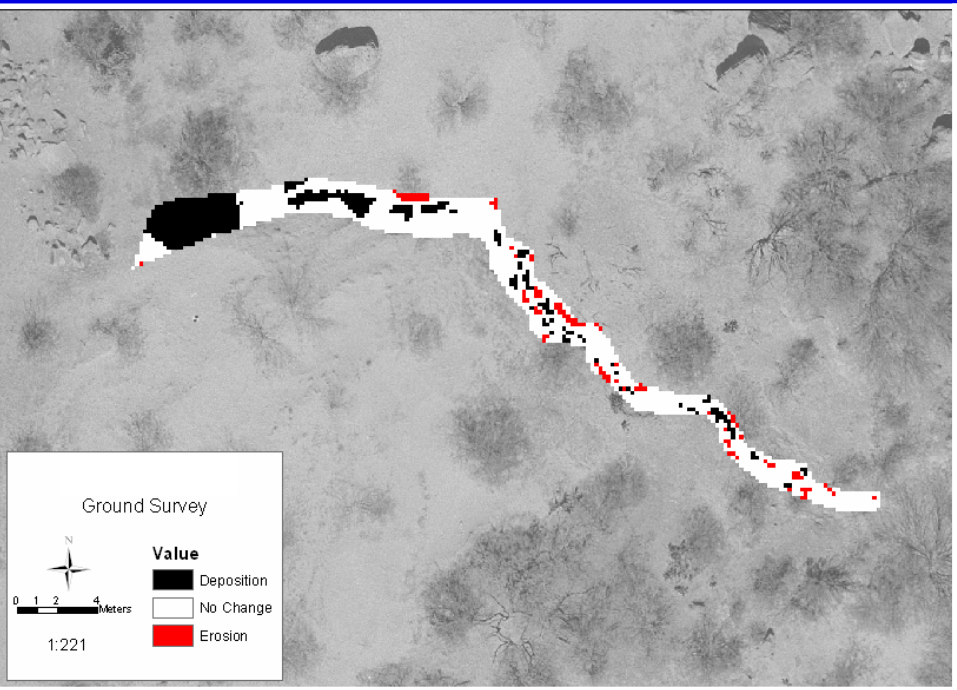
Results—Change Detection

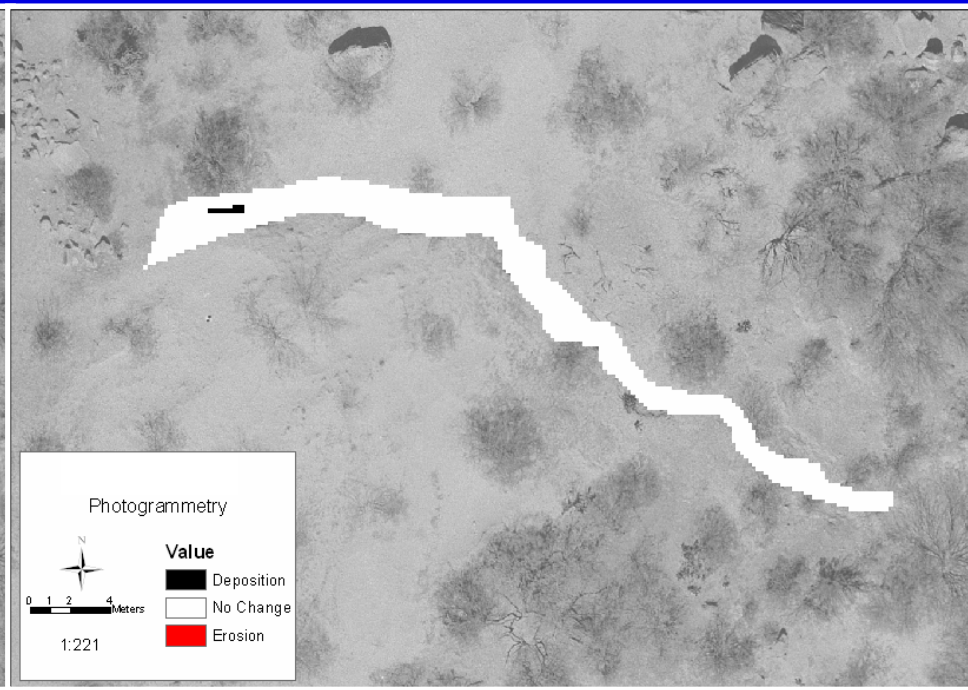
~10 cm of observed change over study period

Results—Change Detection

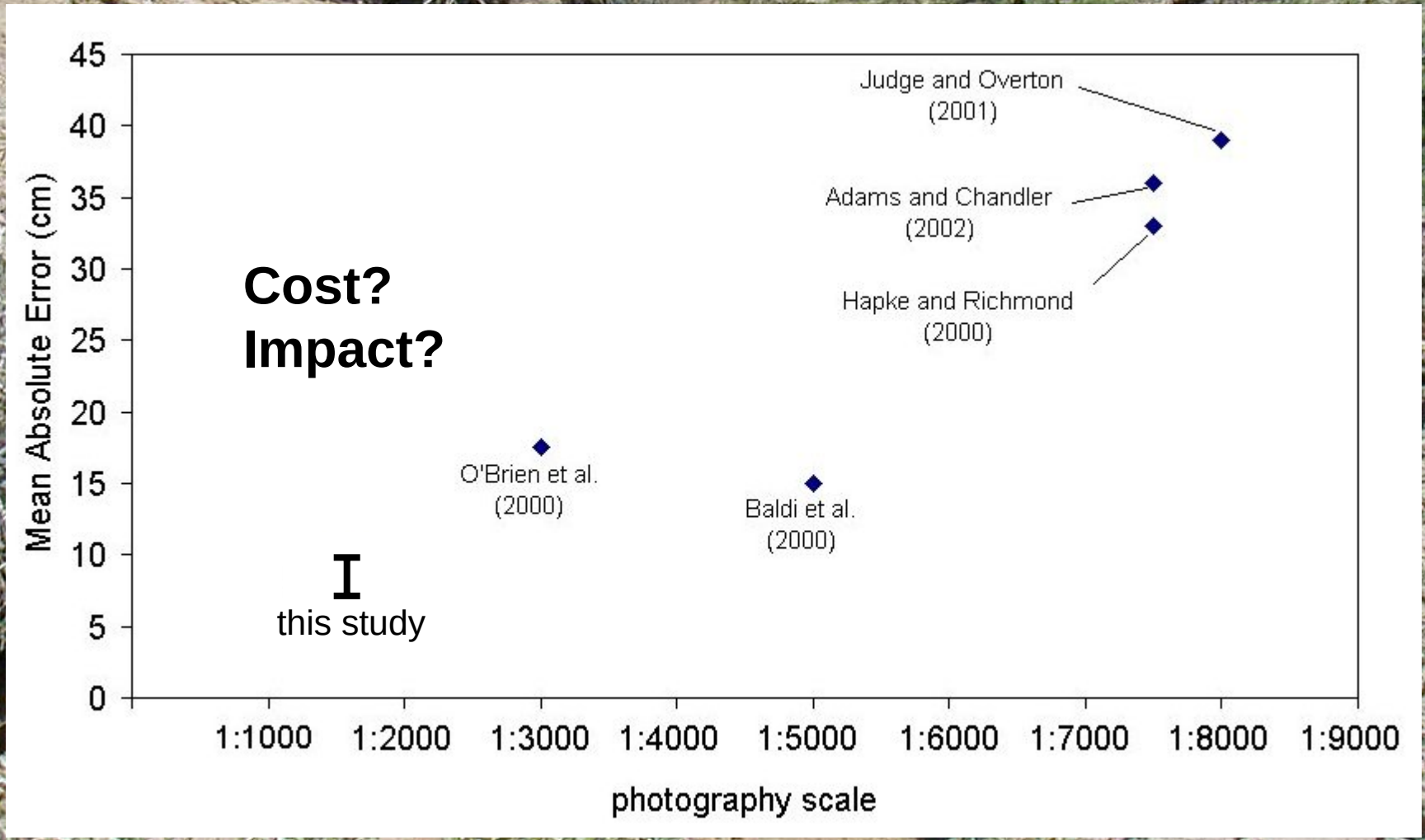
propigated error between two datasets = ~20 cm

best likely at this photographic scale = ~15 cm

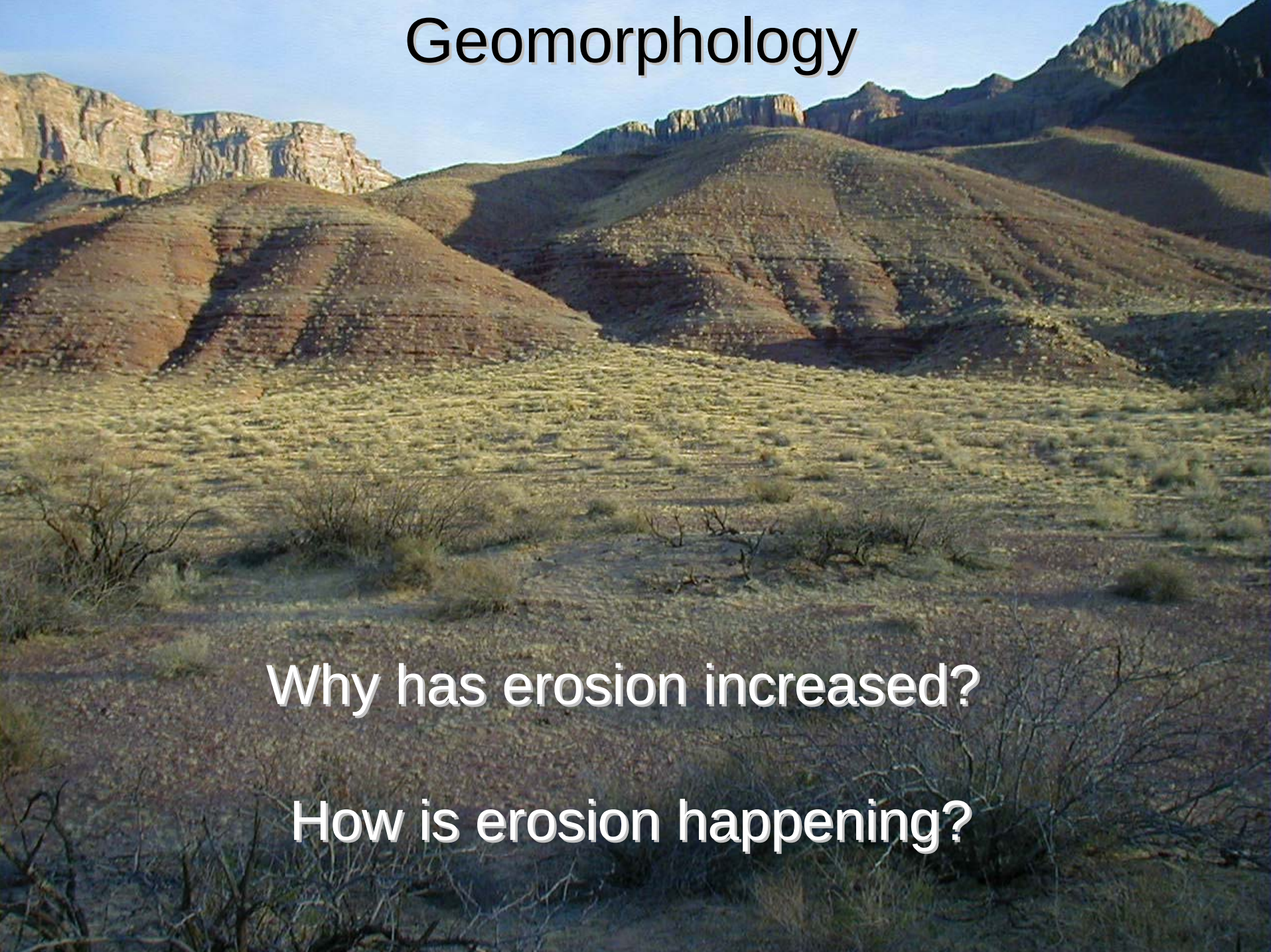




Photogrammetry
not yet useful for monitoring erosion < ~20 cm

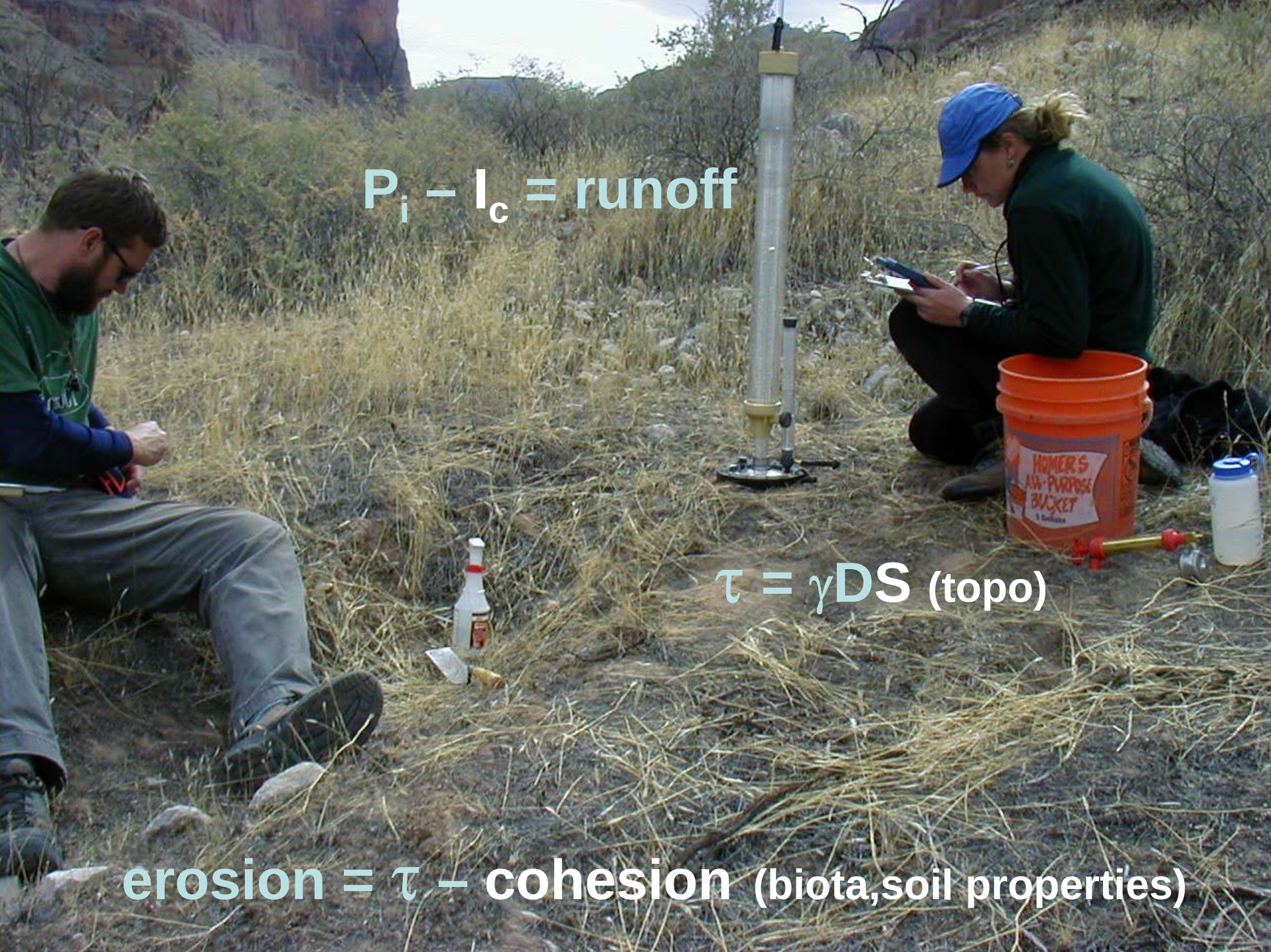


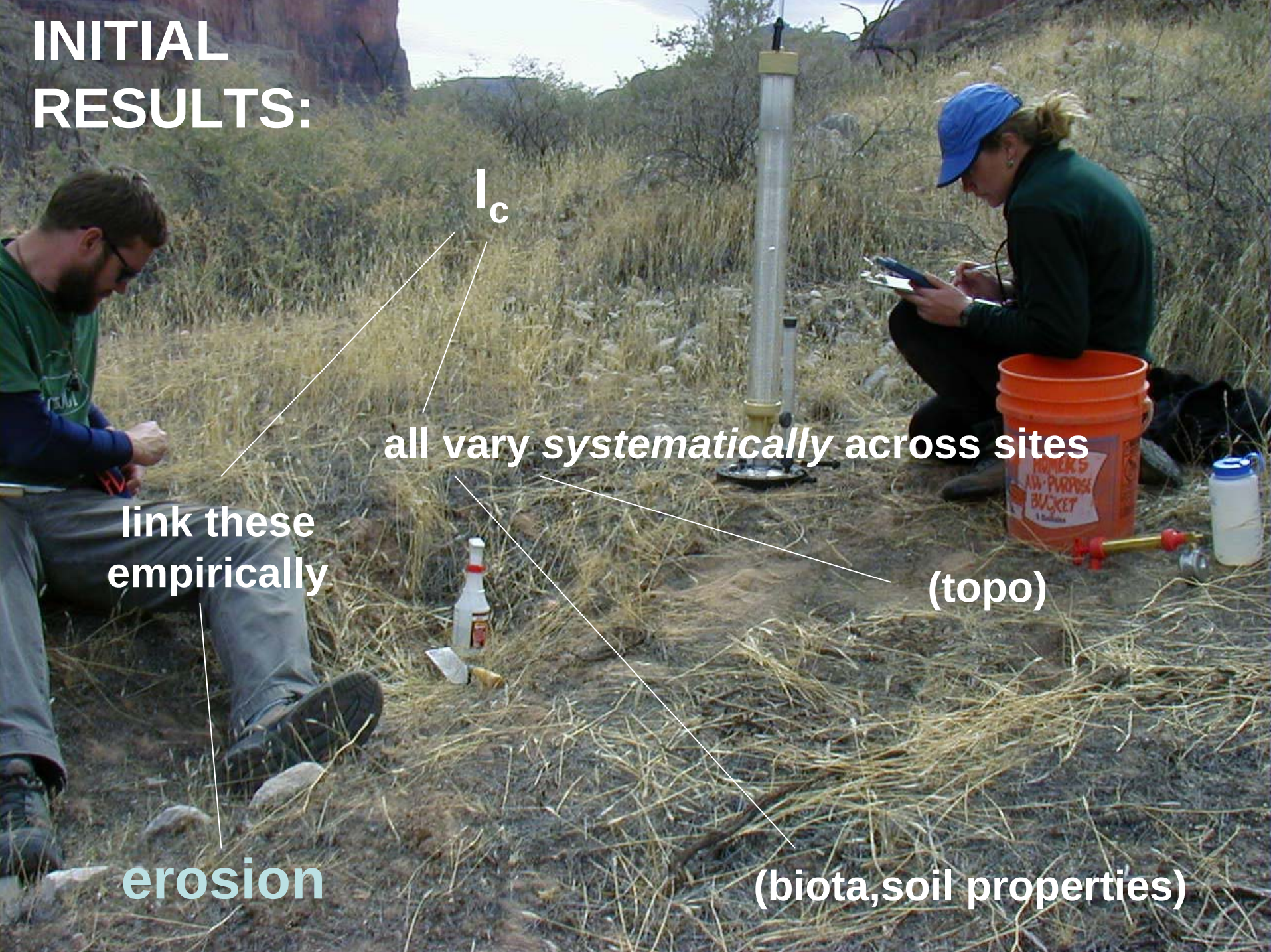
Geomorphology



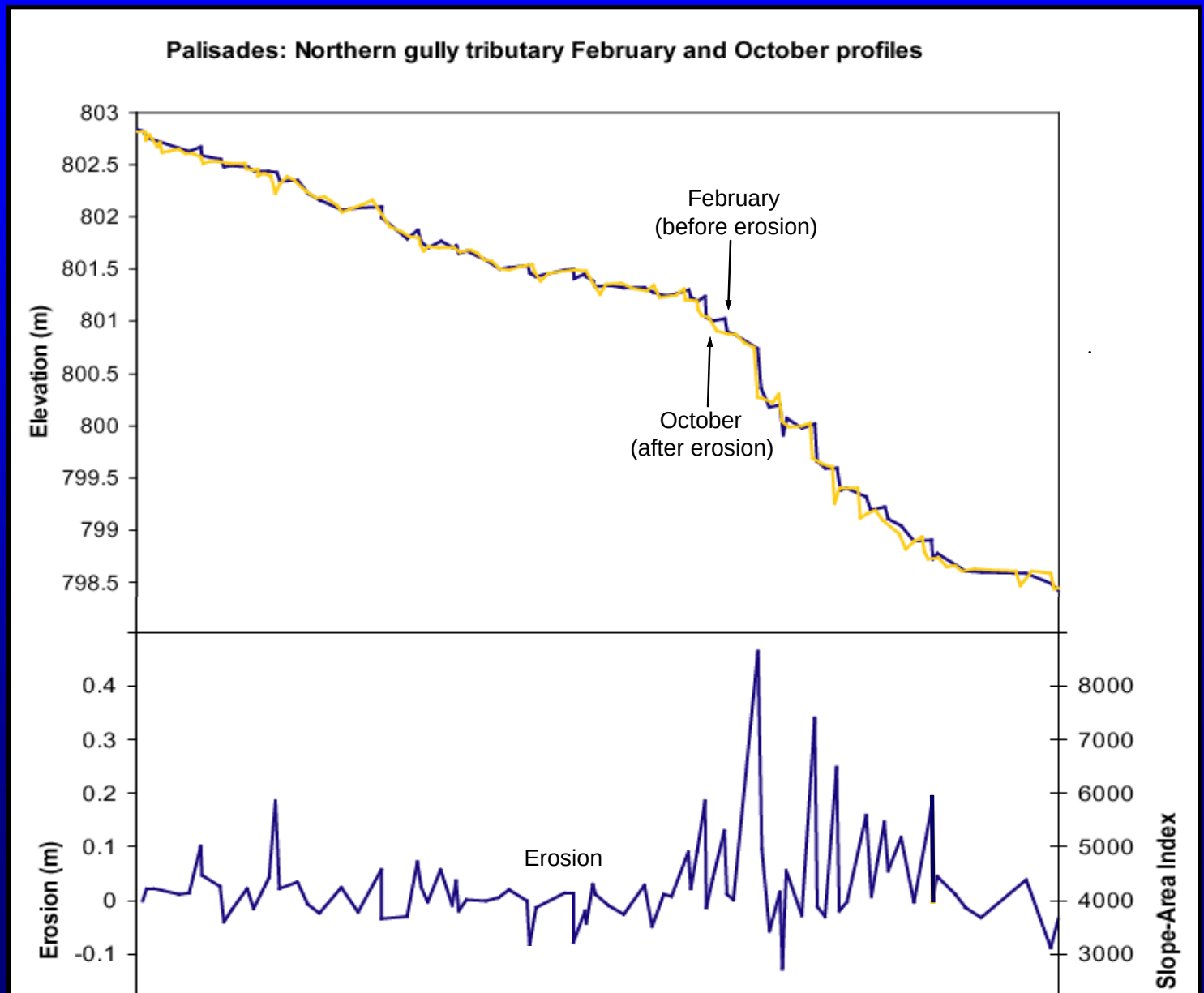
Why has erosion increased?

How is erosion happening?

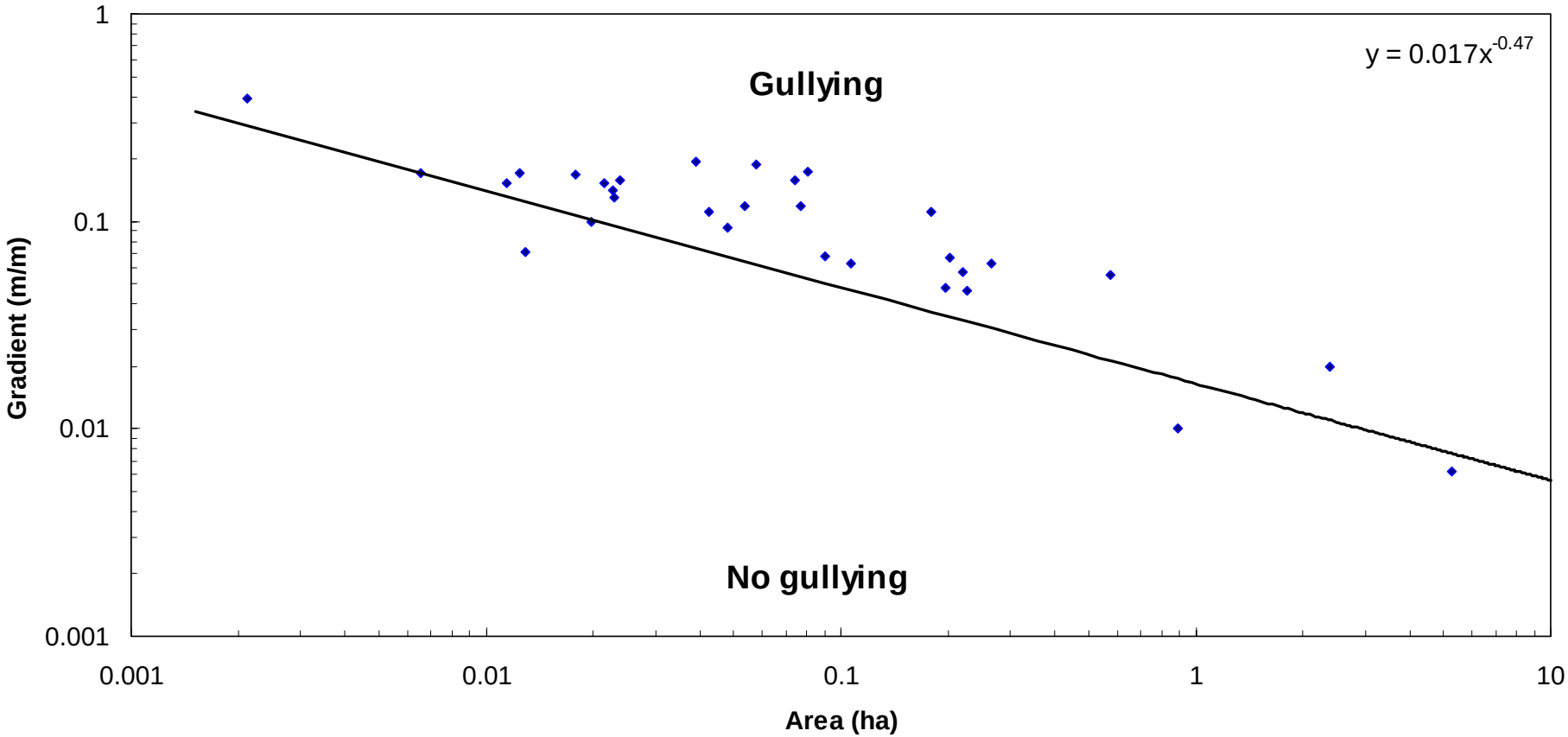

$P_i - I_c$ = runoff
$\tau = \gamma DS$ (topo)
erosion = τ – cohesion (biota,soil properties)


INITIAL RESULTS:
I_c
all vary *systematically* across sites
link these empirically
(topo)
erosion
(biota,soil properties)

erosion, knickpoint formation, and checkdam failure correlate with high gradient

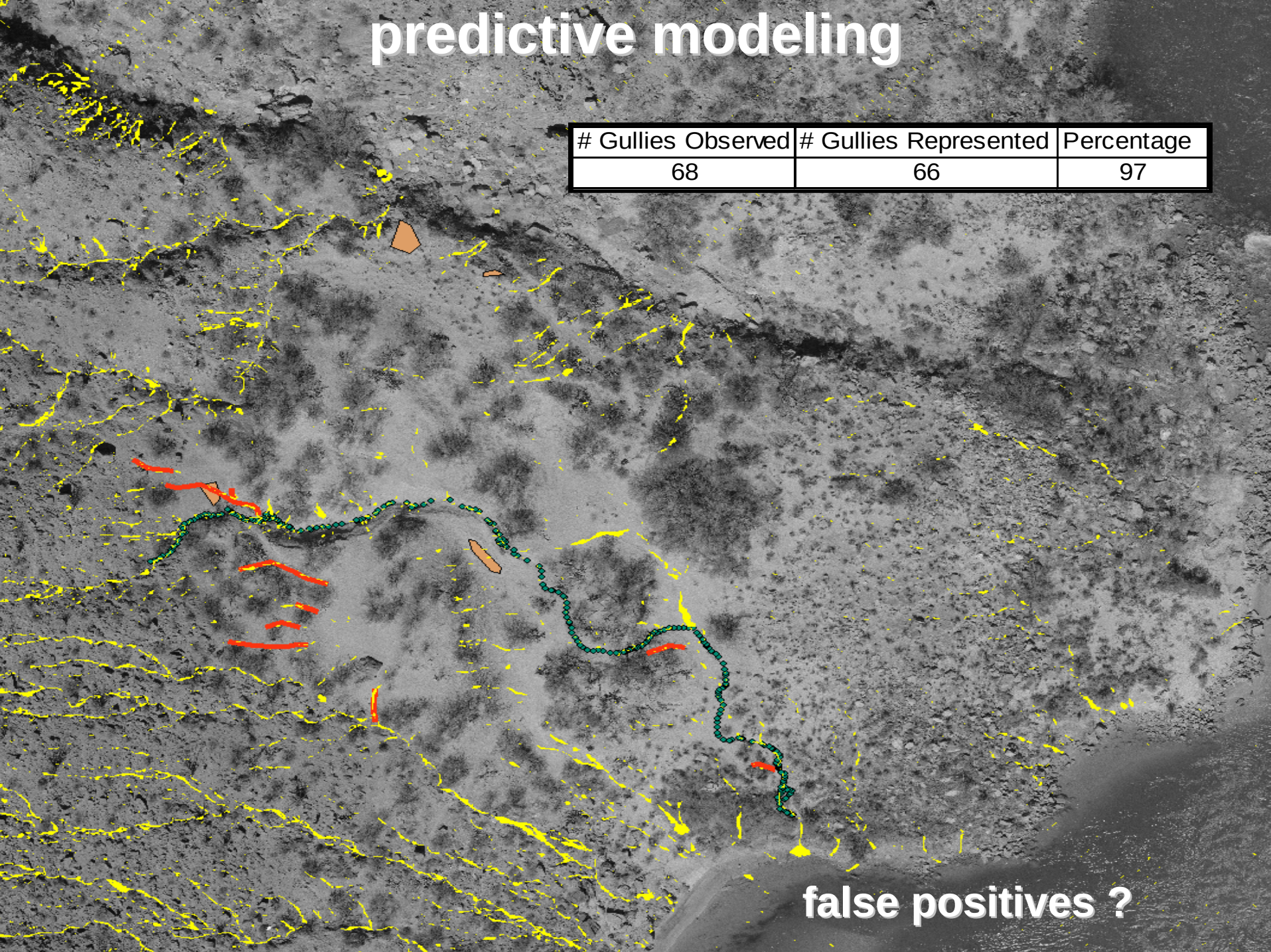


slope-area erosion threshold



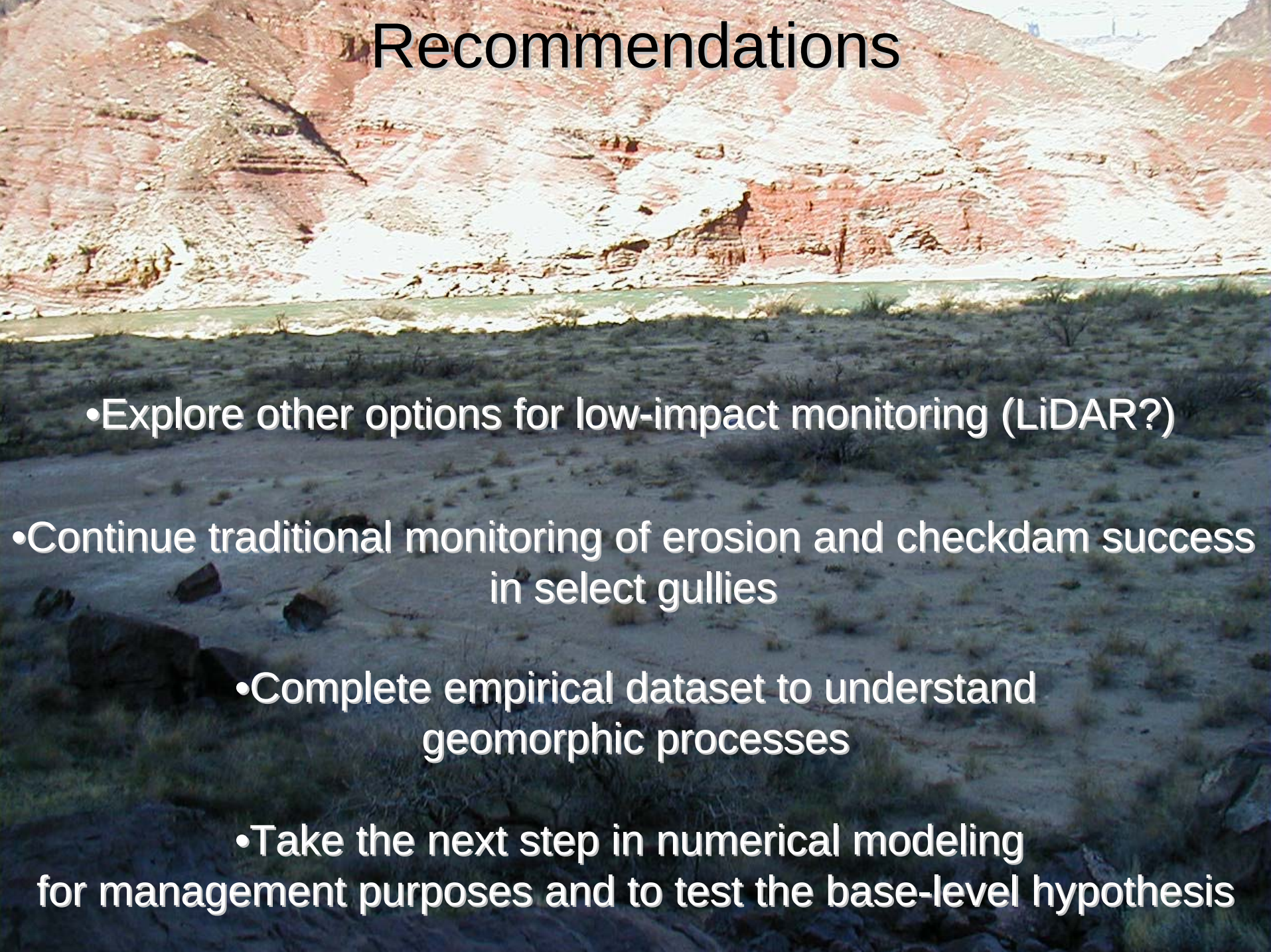
predictive modeling

# Gullies Observed	# Gullies Represented	Percentage
68	66	97



false positives ?

Recommendations



- Explore other options for low-impact monitoring (LiDAR?)

- Continue traditional monitoring of erosion and checkdam success in select gullies

- Complete empirical dataset to understand geomorphic processes

- Take the next step in numerical modeling for management purposes and to test the base-level hypothesis