Land cover and socioeconomic indicators in Tijuana

Land cover following rapid urbanization on the US–Mexico border: Implications for conceptual models of urban watershed processes

Trent Wade Biggs[a,*], Emily Atkinson[a], Rebecca Powell[b], Lina Ojeda-Revah[c]

[a] *Department of Geography, San Diego State University, 5500 Campanile Drive, San Diego, CA 92182-4493, USA*
[b] *Department of Geography, University of Denver, 2050 East Iliff Ave., Room 118, Denver, CO 80208, USA*
[c] *Departamento de Estudios Urbanos y de Medio Ambiente, El Colegio de la Frontera Norte, km 18.5 carretera escénica Tijuana - Ensenada, San Antonio del Mar, Tijuana, BC 22560, Mexico*

Concrete and Poverty, Vegetation and Wealth? A Counterexample from Remote Sensing of Socioeconomic Indicators on the U.S.–Mexico Border*

Trent W. Biggs
San Diego State University

William G. Anderson
San Diego State University and Anderson Geographics and Consulting

Alberto Pombo
El Colegio de la Frontera Norte, Tijuana, Mexico

Motivation:

Tijuana River Watershed drains across borders

Land cover (VIS) impacts runoff and sediment loading to TJ estuary

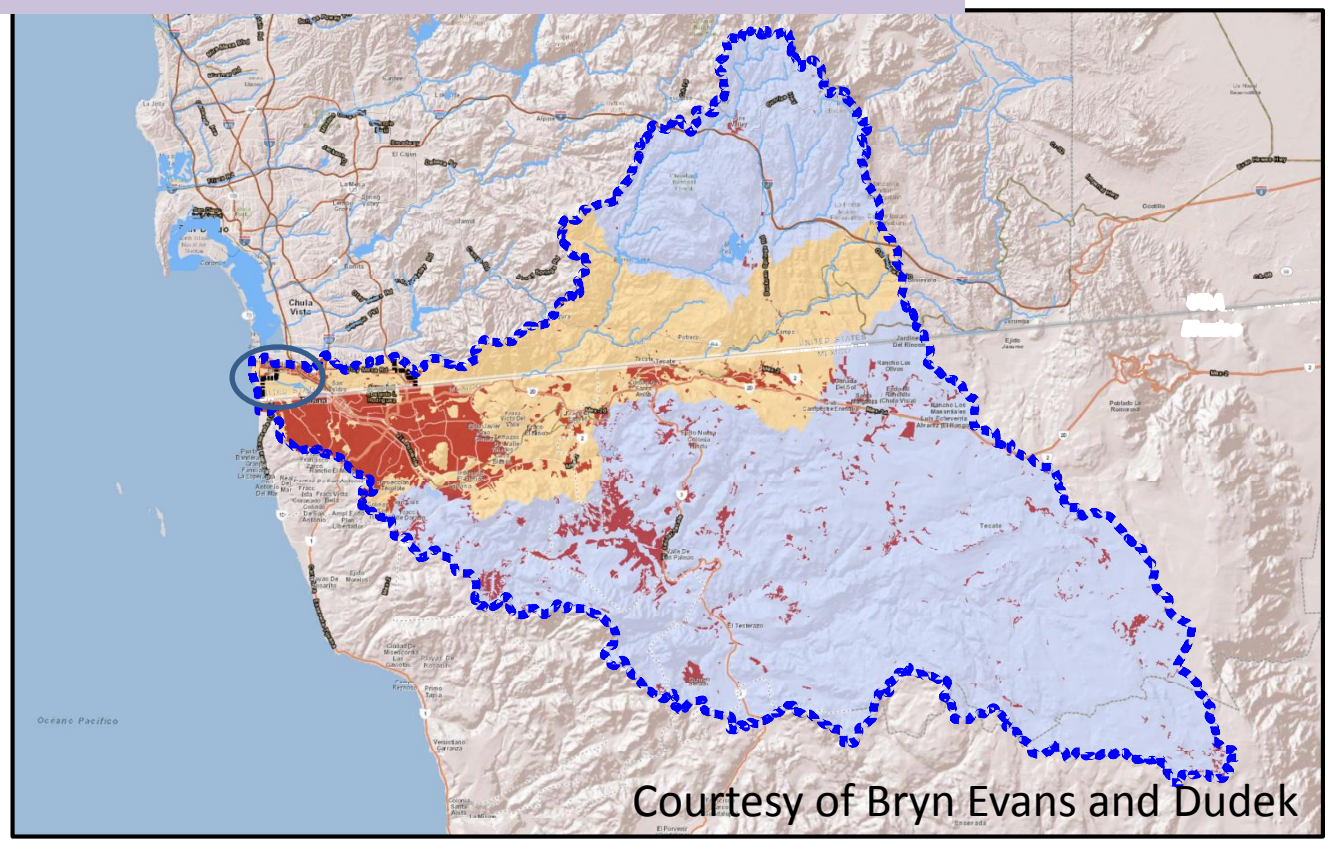
Research questions

What is the proportion of vegetation, soil and impervious surface?

How do VIS fractions change with time since urbanization?

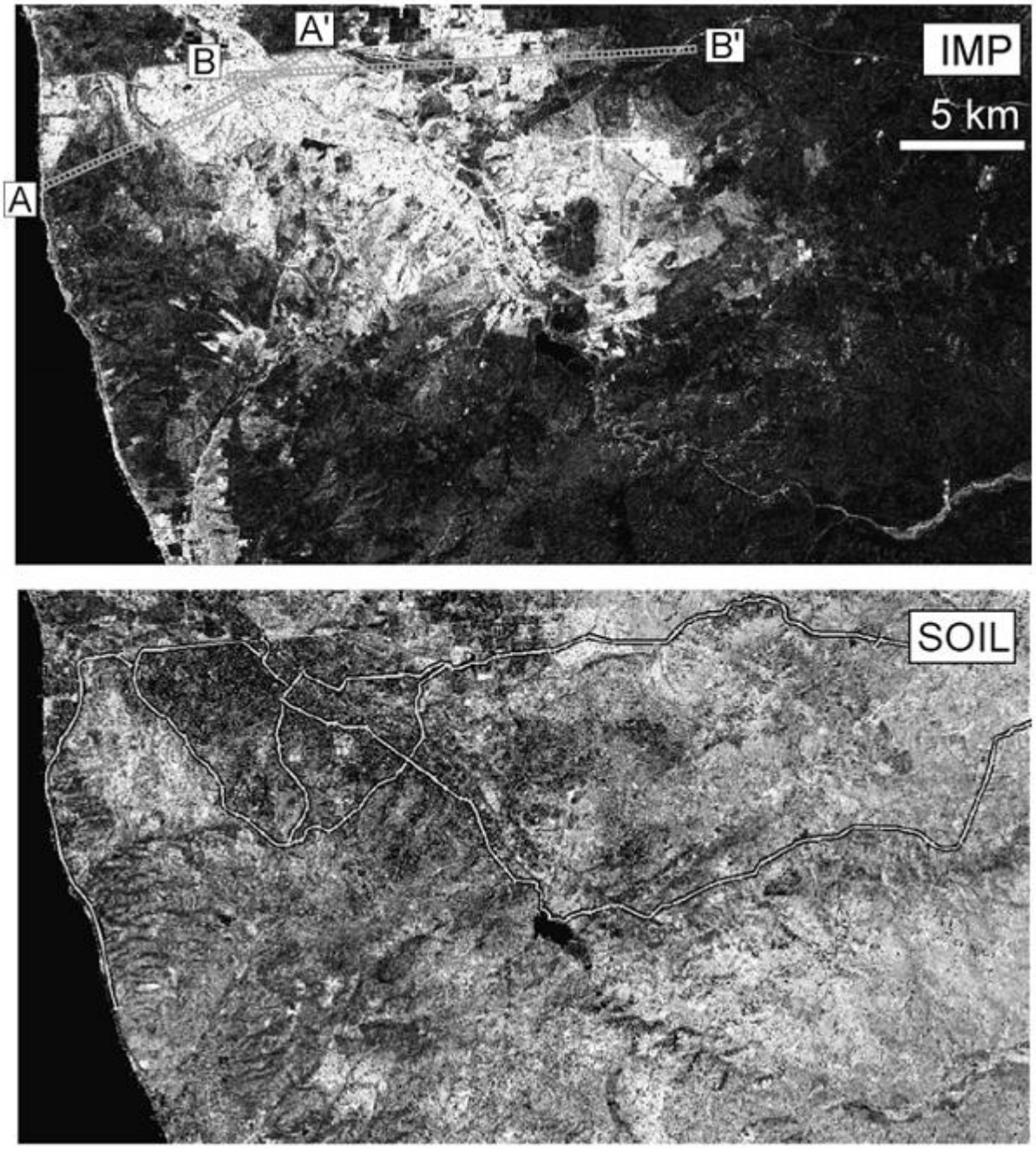
What is the socioeconomic structure of VIS?

Can VIS and other variables predict socioeconomic attributes?



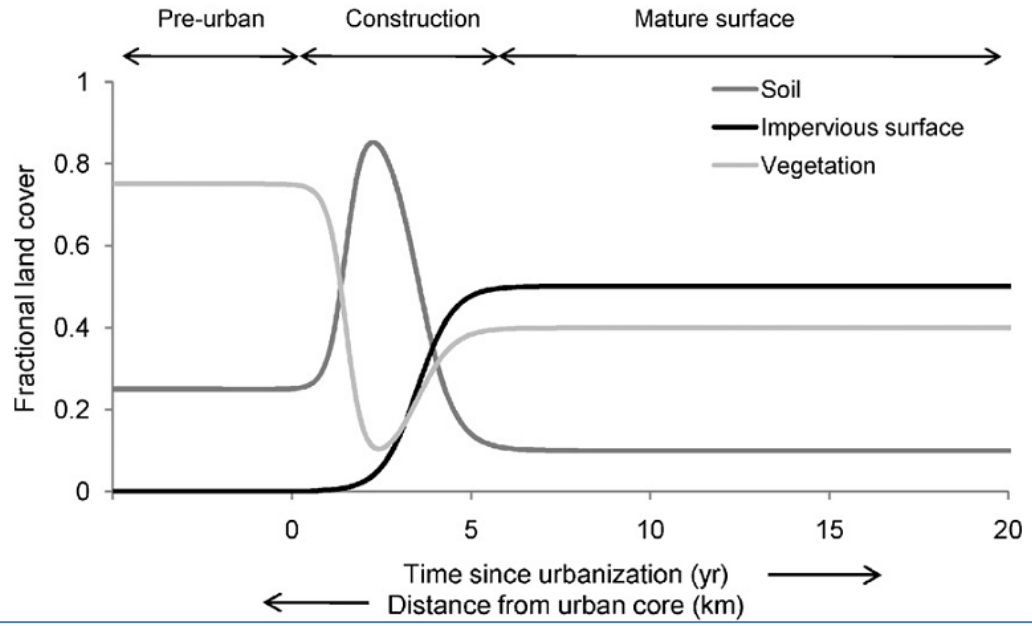
What are the VIS fractions?

Landsat image classification into impervious surface, soil and vegetation



How do VIS fractions change with time since urbanization?

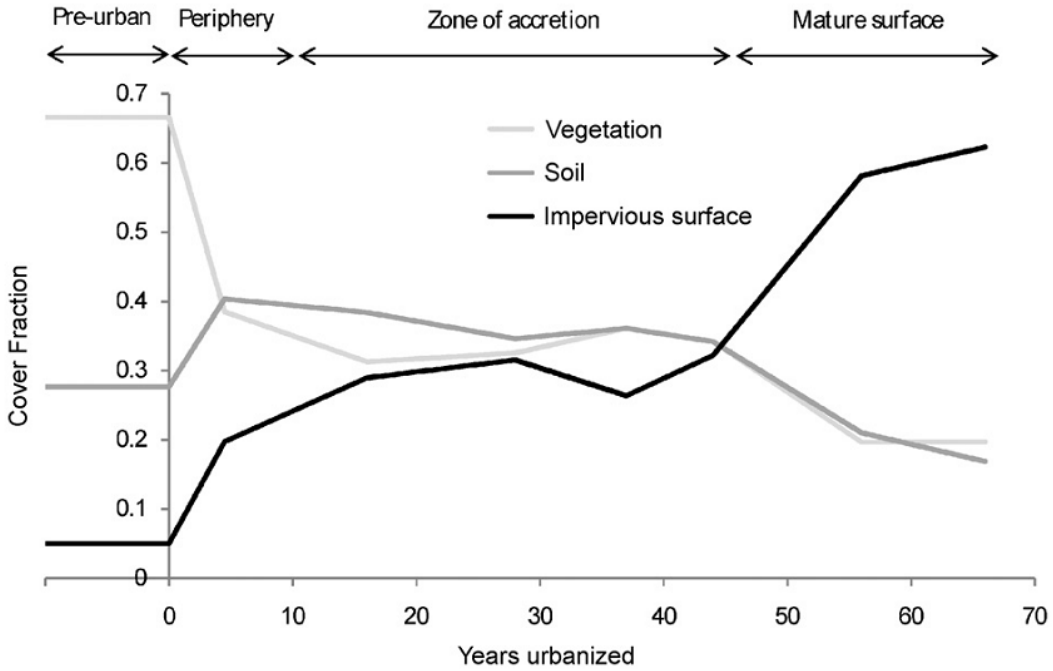
Theory from US:
Brief period of soil exposure during construction
Transition to Veg + Impervious



Observed in Tijuana:

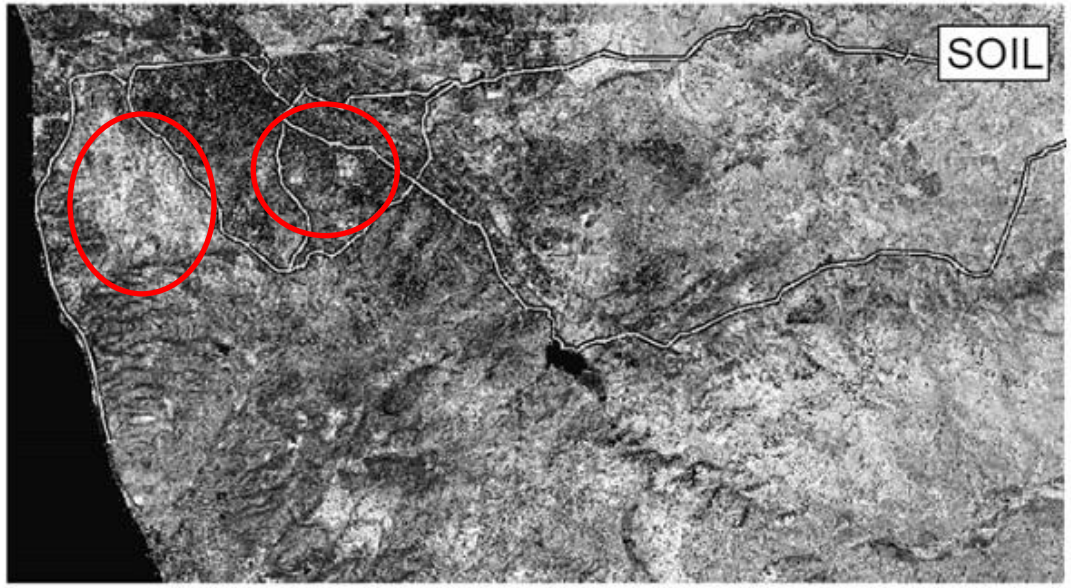
Why isn't there a big, sudden expansion of bare soil?

Why does soil remain high for so long?

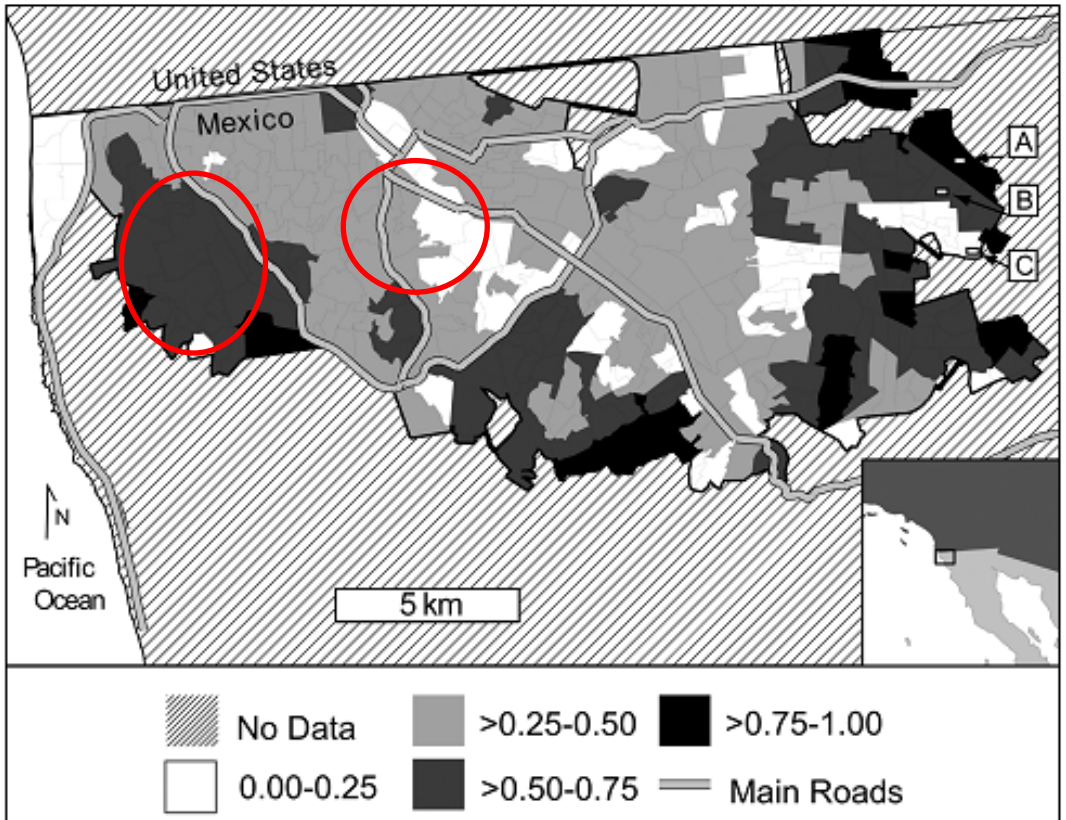


What is the socioeconomic structure of land cover?

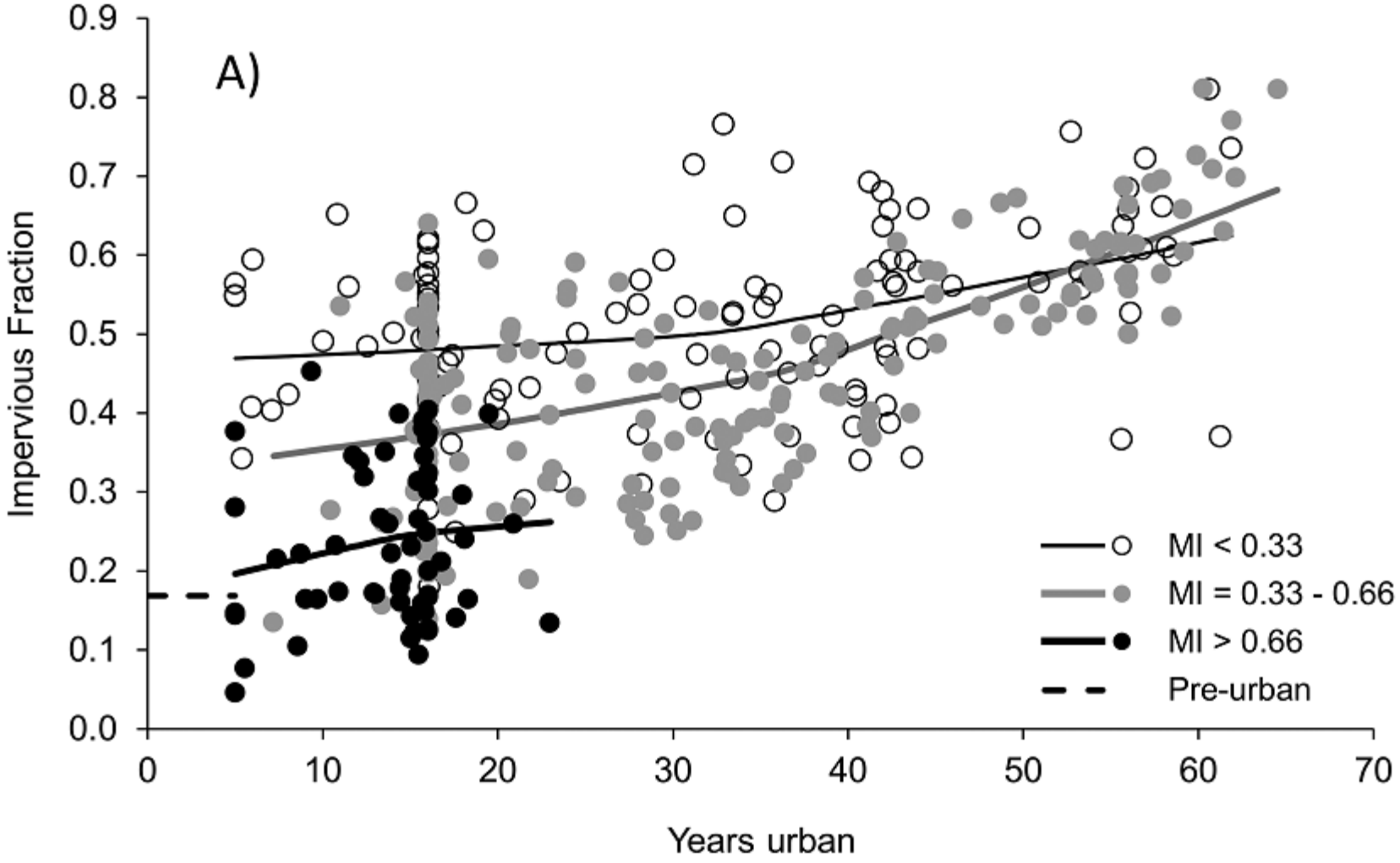
Is vegetation associated with wealth, and concrete with poverty, as in the US?



Marginality Index

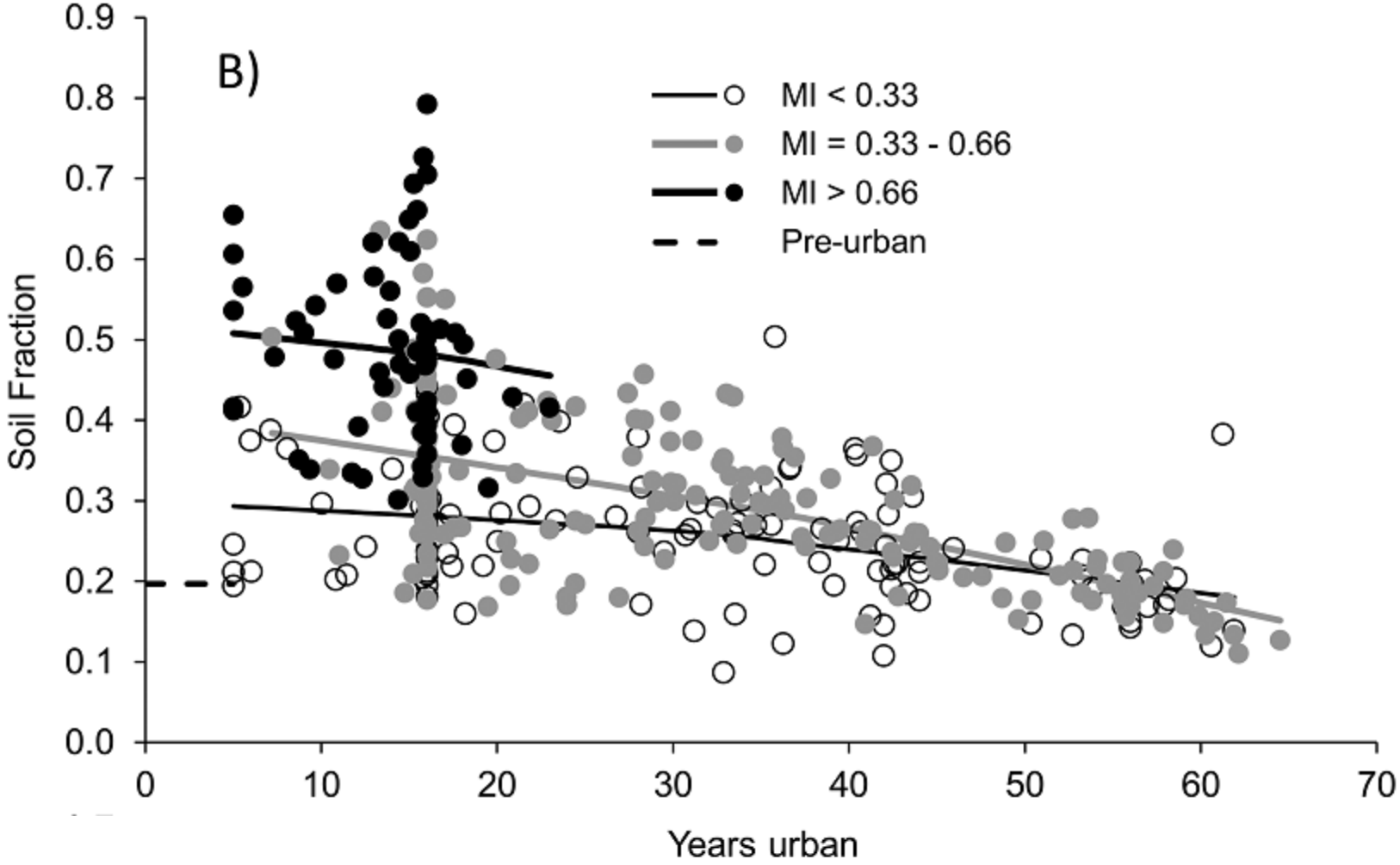


Wealthy areas have more impervious surfaces (concrete) than poor areas
Small difference in vegetation by marginality, mostly due to topography, undeveloped area
* Opposite of pattern in USA



Poor areas are recently urbanized and have high soil fractions.

Rich areas are both recently and long-urbanized, but have low soil fractions (and veg) and high impervious fractions.



Periphery

Urbanized < 5 years

Poor

Rich

A.
MI: 0.93
Age: 5 y
Slope: 4.6
PopD: 1.8

B.
MI: 0.52
Age: 15 y
Slope: 2.4
PopD: 3.4

C.
MI: 0.13
Age: 5 y
Slope: 2.5
PopD: 21.9

300 m

Griffin-Ford Model (1980).

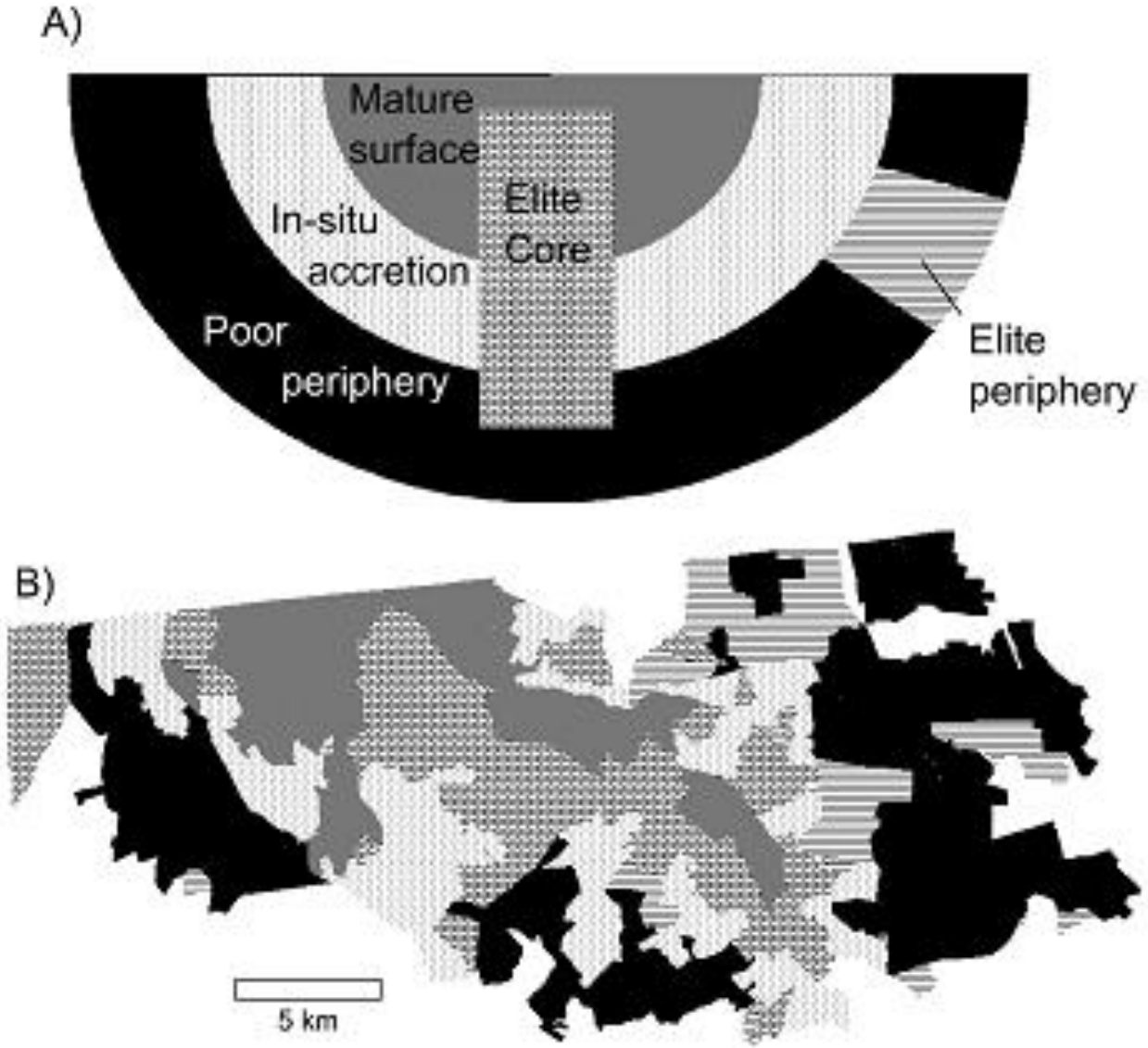
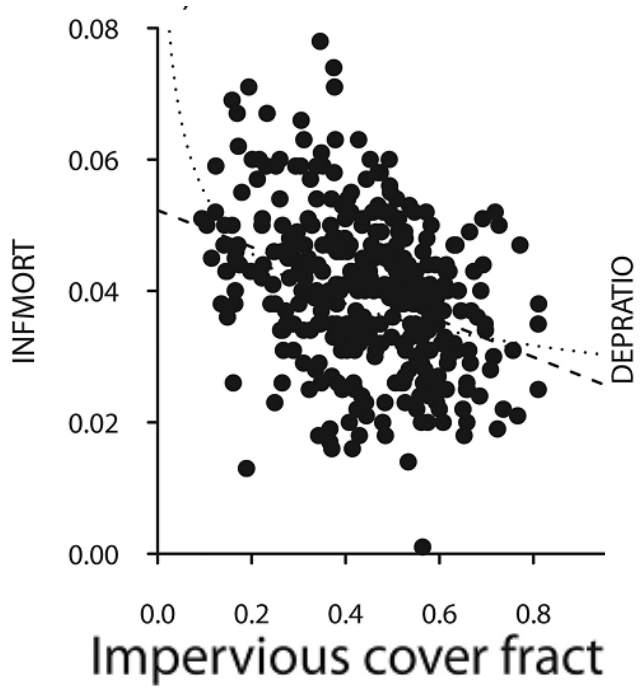


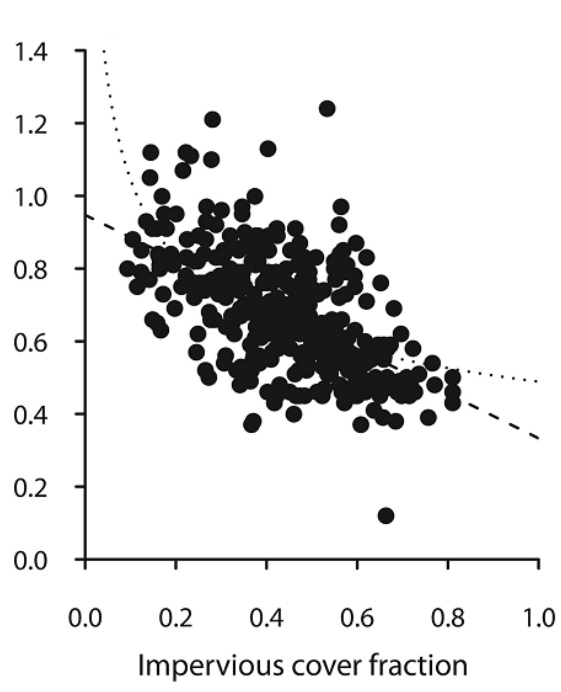
Figure 9. Conceptual model of Latin American city structure, adapted from Griffin and Ford (1980), including A) a schematic and B) classification of the census tracts in Tijuana.

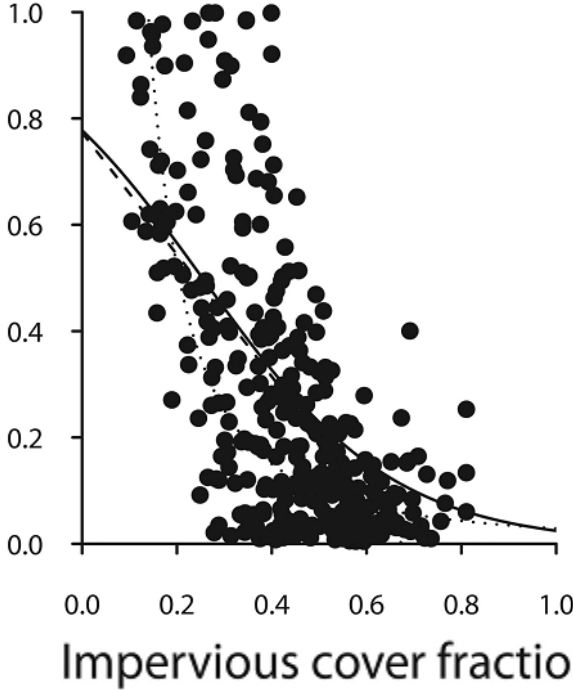
Infrastructure indicators can be (sort of) predicted by land cover
Health indicators not

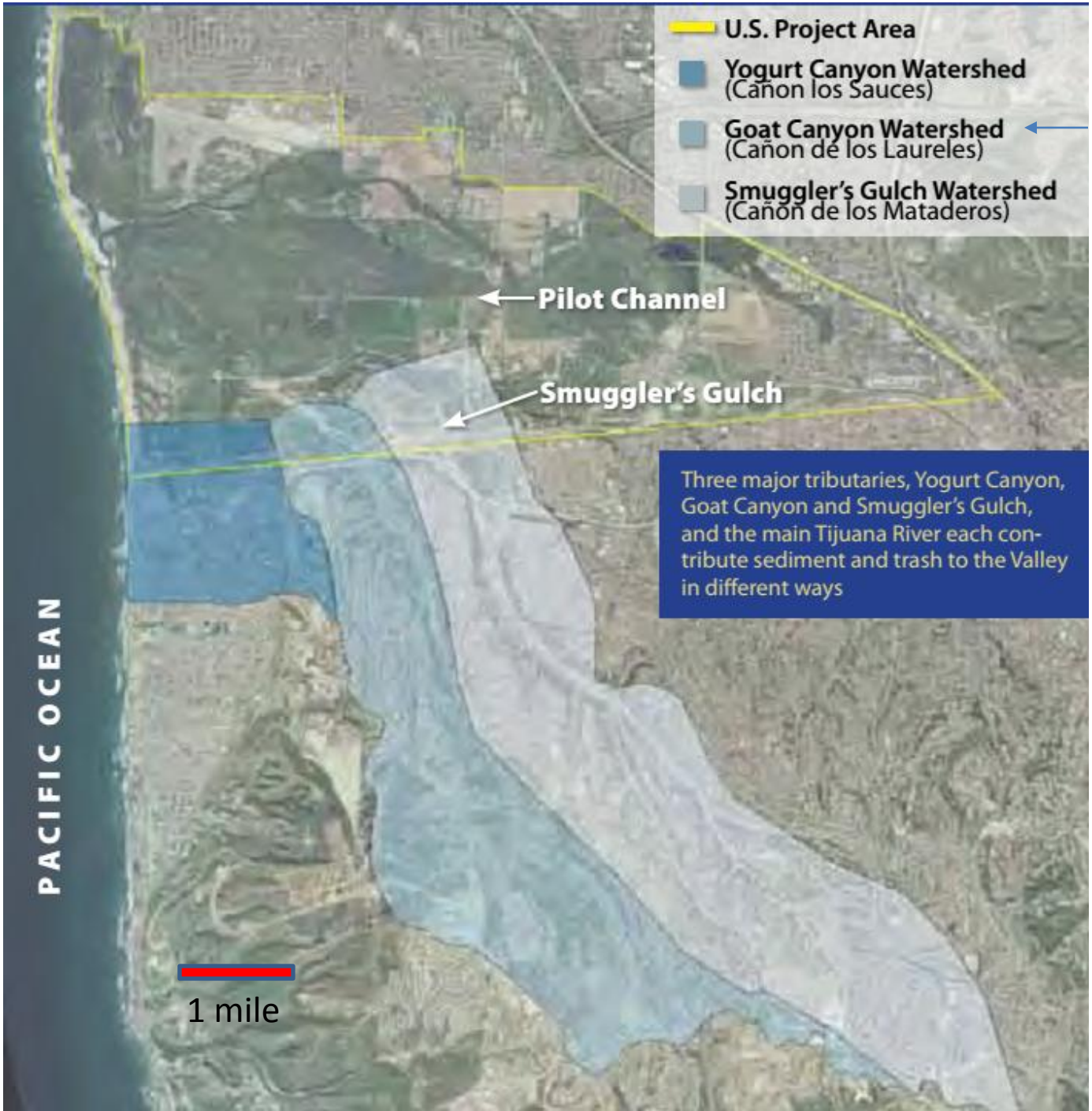
Table 5 *Regression results for socioeconomic indicators as functions of soil cover (SOIL), slope (SL), and years urbanized (YR)*

	β			Lmg				
	SOIL	**SL**	**YR**	**SOIL**	**SL**	**YR**	**R^2**	**RMSE**
MI	0.94	0.010	*ns*	0.27	0.05	0.05	0.37	0.16
Health, education, demography								
INFMORT	0.027	0.0007	*ns*	0.08	0.05	0.02	0.15	0.011
FERT	0.54	0.02	*ns*	0.05	0.09	0.01	0.14	0.288
Housing and infrastructure								
NODRAIN	1.06	0.007	−0.002	0.35	0.04	0.13	0.52	0.15
NOWATER	1.24	0.008	−0.003	0.33	0.03	0.13	0.49	0.20





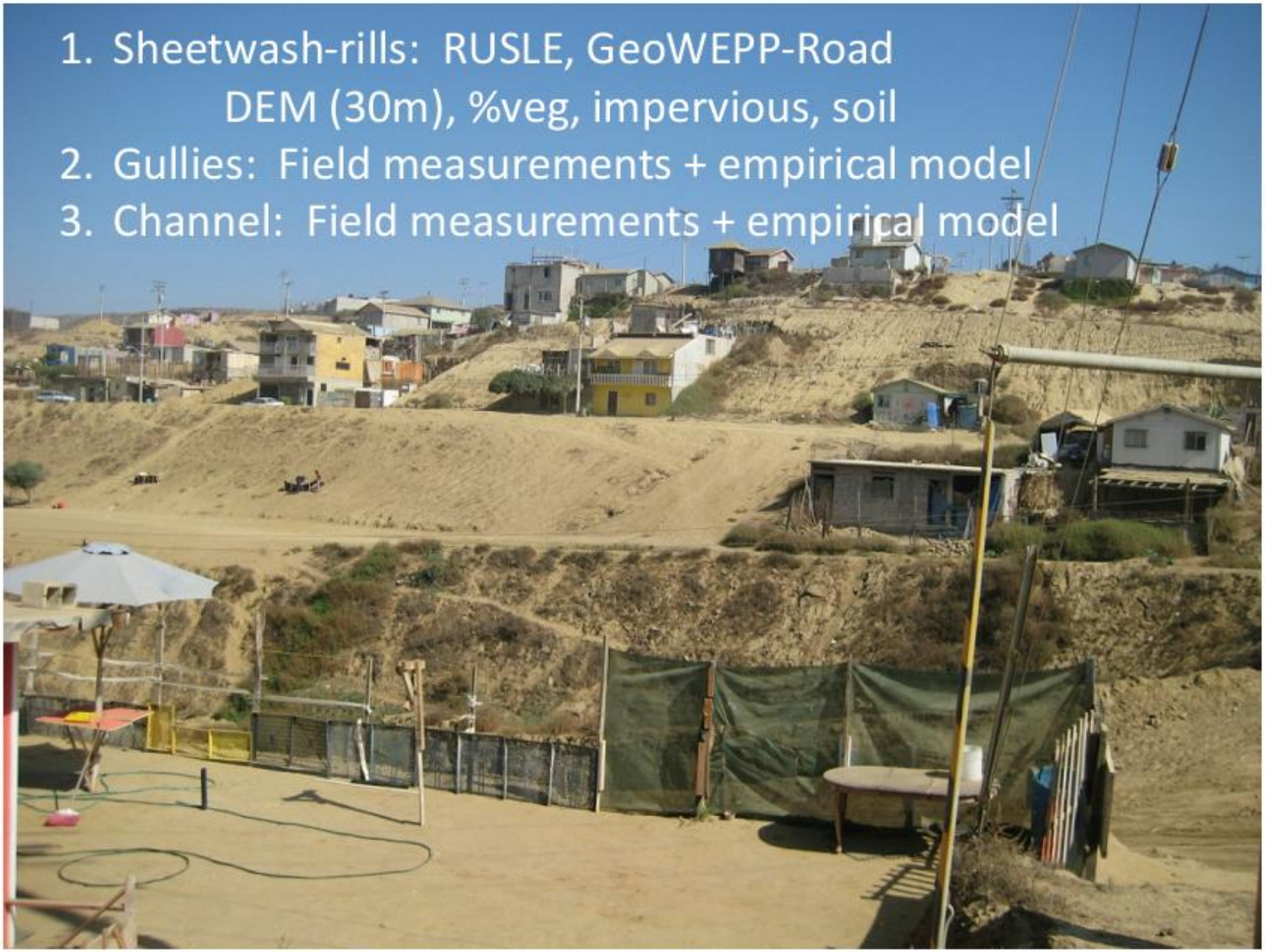


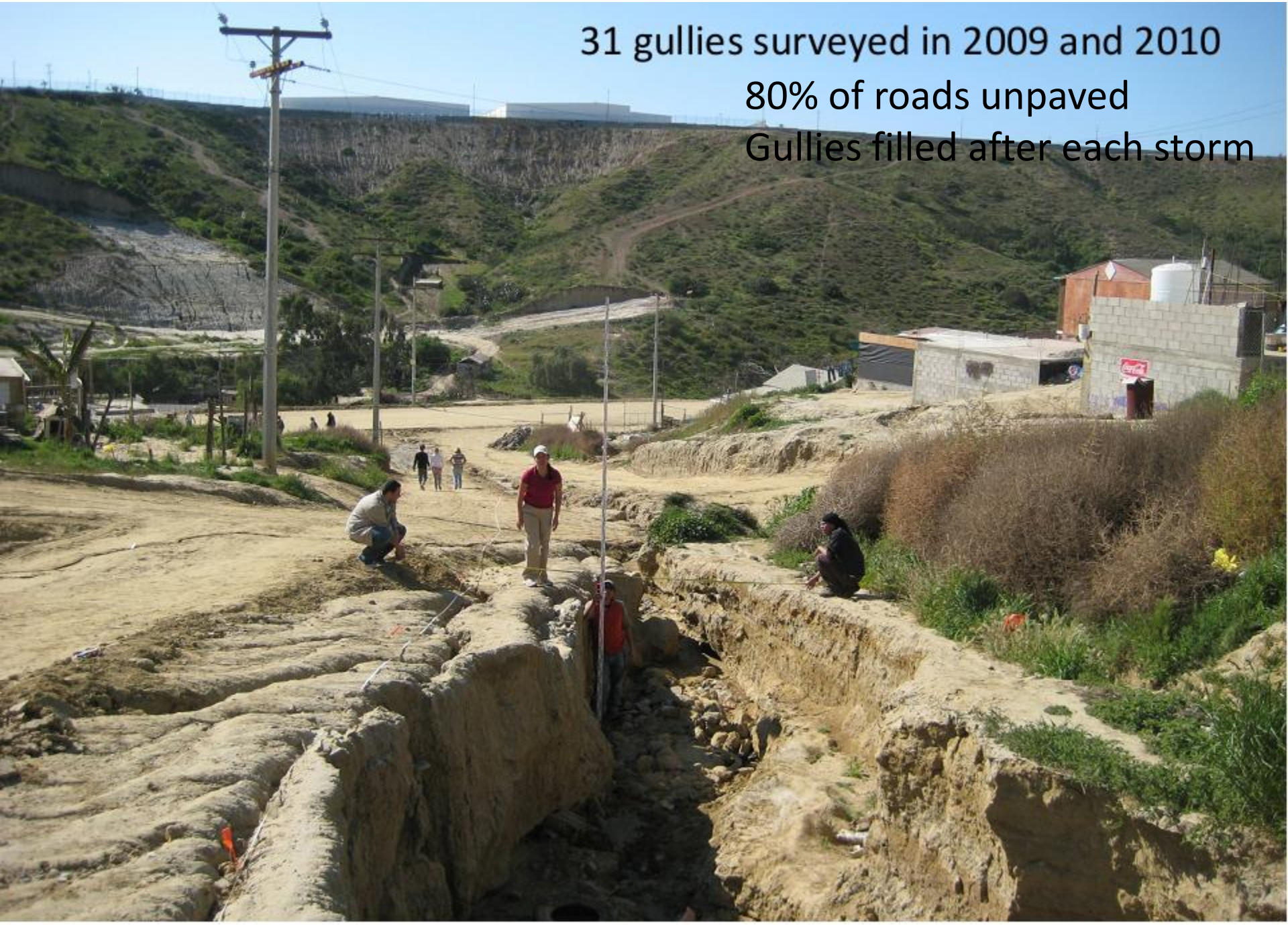


4.5 sq miles

Courtesy of Bryn Evans and Dudek

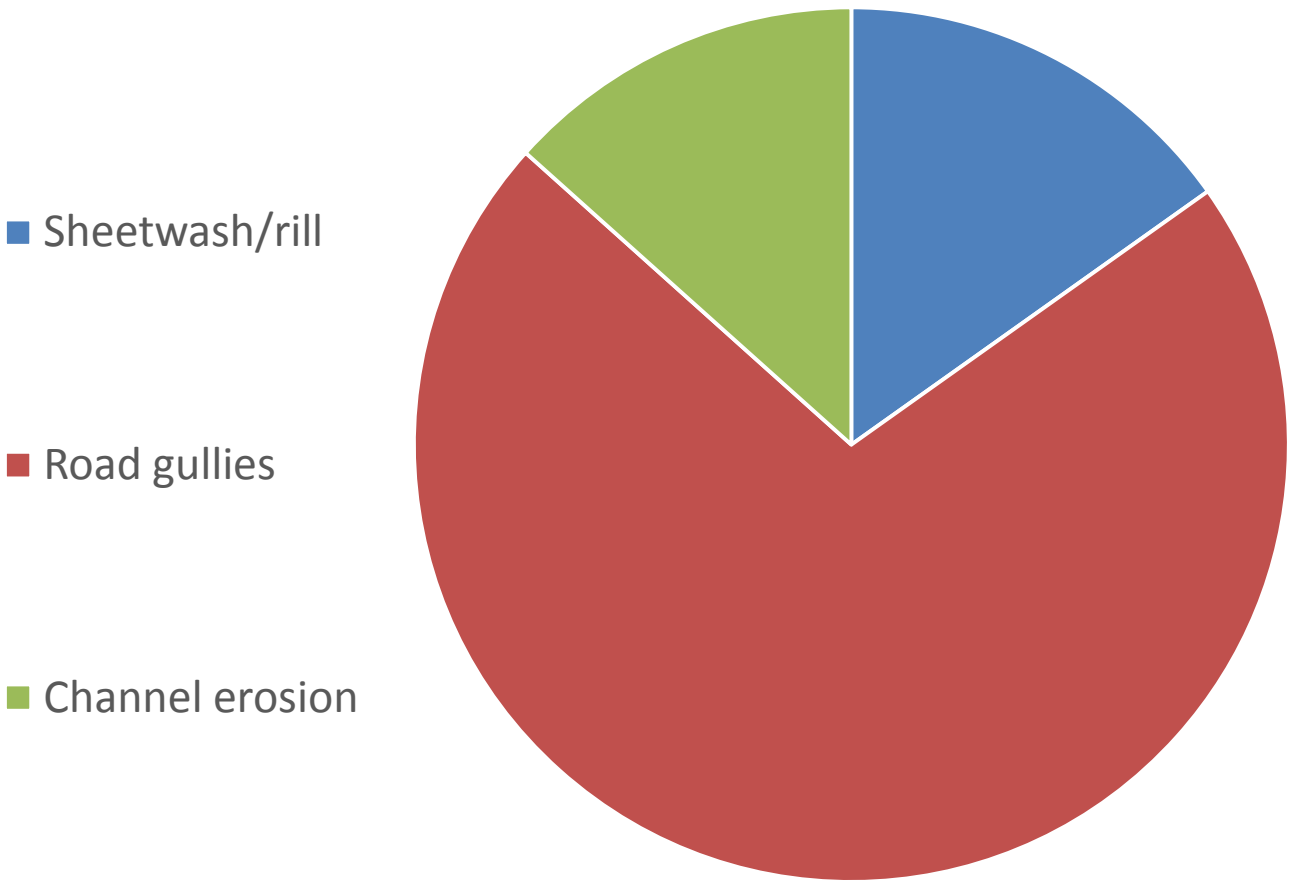
Erosional processes in Los Laureles (Goat) Canyon



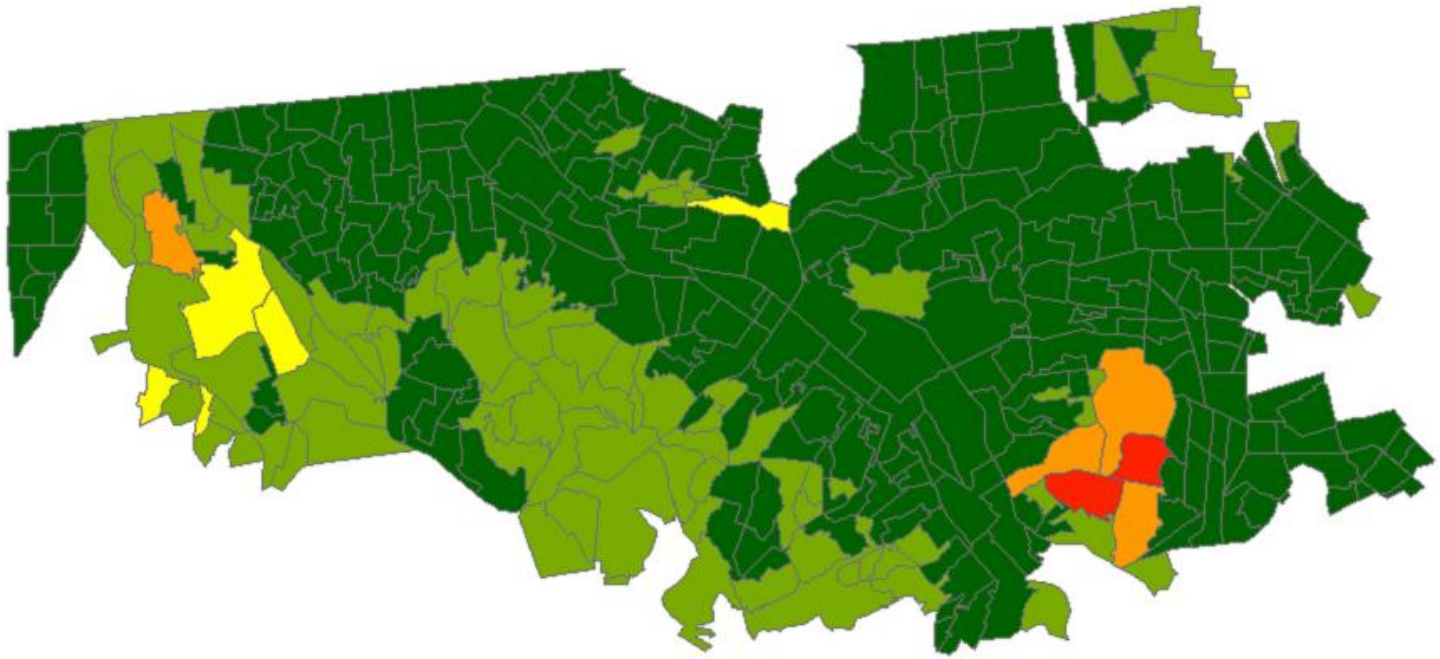

31 gullies surveyed in 2009 and 2010
80% of roads unpaved
Gullies filled after each storm


Channel erosion

Road erosion is a dominant source of sediment in Goat Canyon



Map of potential sediment production in Tijuana by census tract



USLE_average_tons per ha

- 0 - 6
- 6-12
- 12-18
- 18-24
- 24-34

This is for sheetwash erosion…what about other types?