



Landforms of Urban Watersheds

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From the *Sanitary City* to the *Sustainable City*



Sanitary



Sustainable

Watershed boundaries maintained through urbanization...



But major earth-movement is reshaping soils within those boundaries

Herrmann et al. 2017. *Plant and Soil*
Herrmann, Schifman, and Shuster 2018. *PNAS*
Schifman, Herrmann, and Shuster, in review

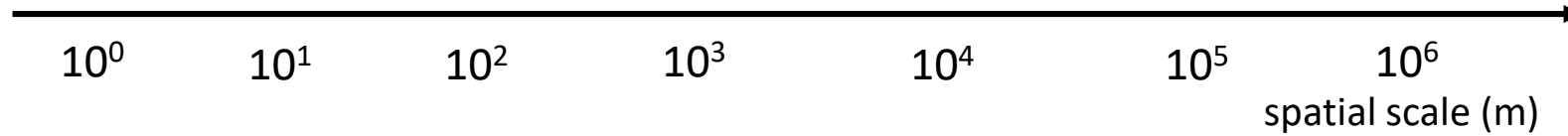
Geomorphic features

Morphometric landform type

Drainage network and
basin characteristics

Hillslope-scale landforms

Slope angle,
local parameters



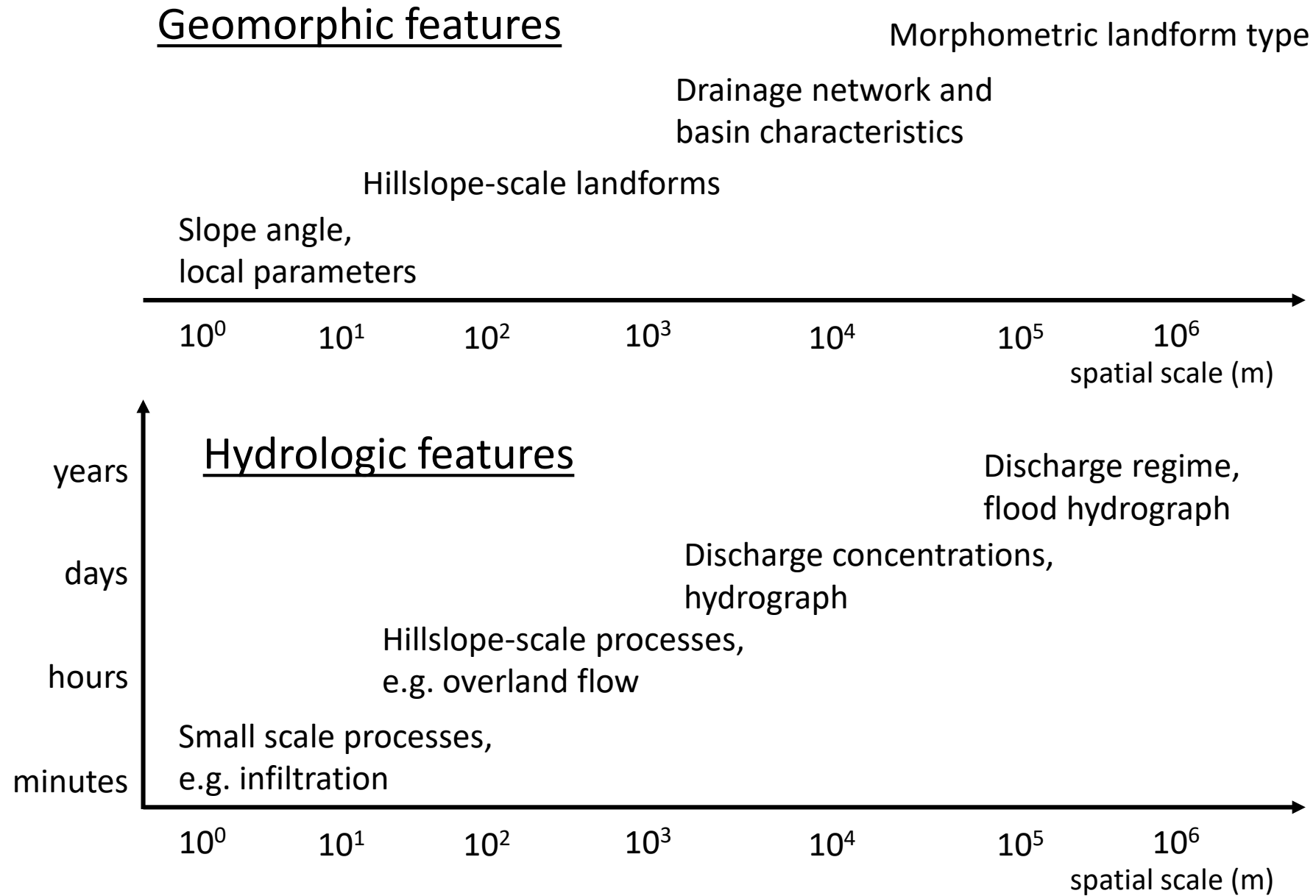


Figure redrawn from Anderson and Burt 1990 *Process Studies in Hillslope Hydrology*

Quantifying Constituent Landforms of Watersheds

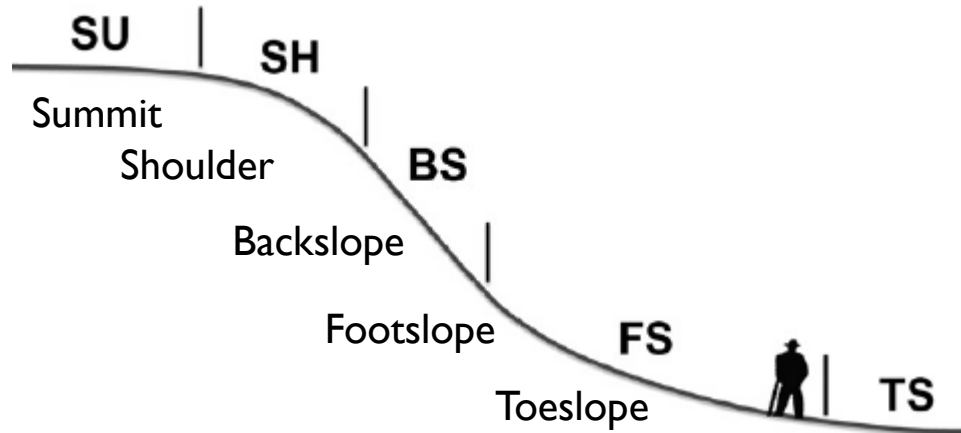
System

Units

Features

Source

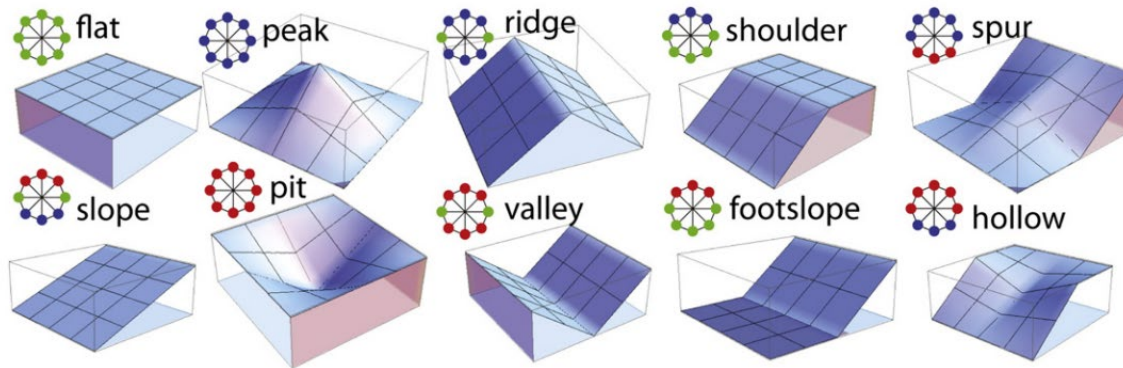
Hillslope
positions



Relation spatial
dependence as
determined by hydrology;
Fixed analytical scale;
Corresponds to USDA-
NRCS soils data

Miller and
Schaetzel.
2015. SSSA/

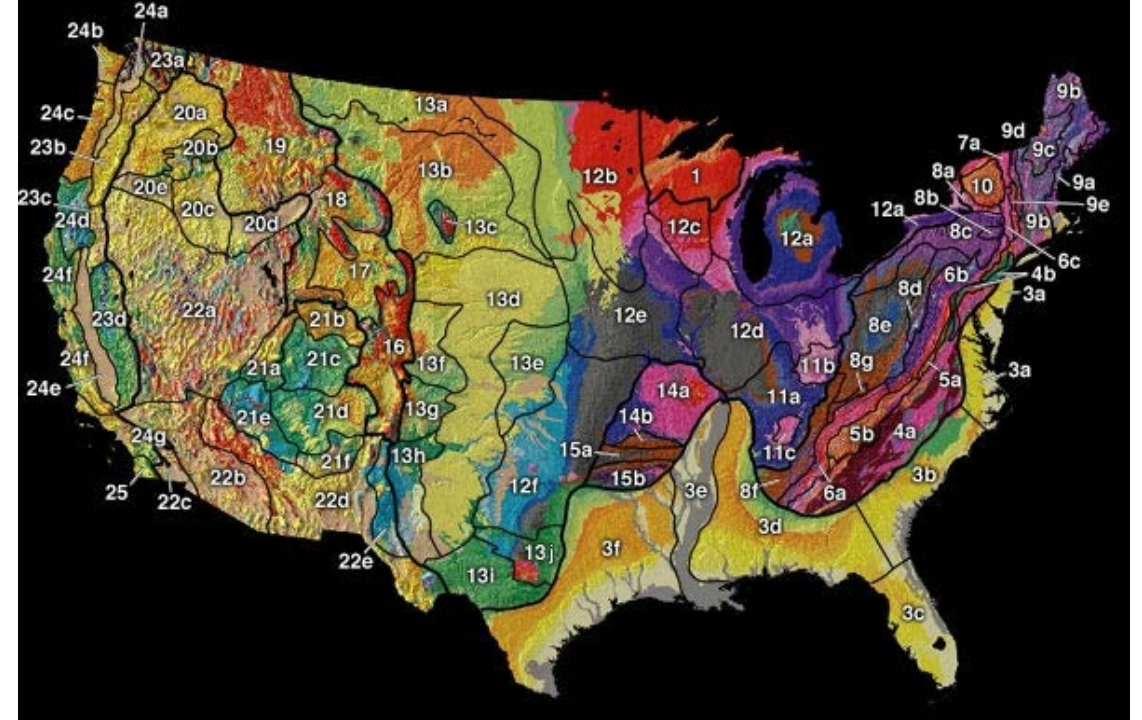
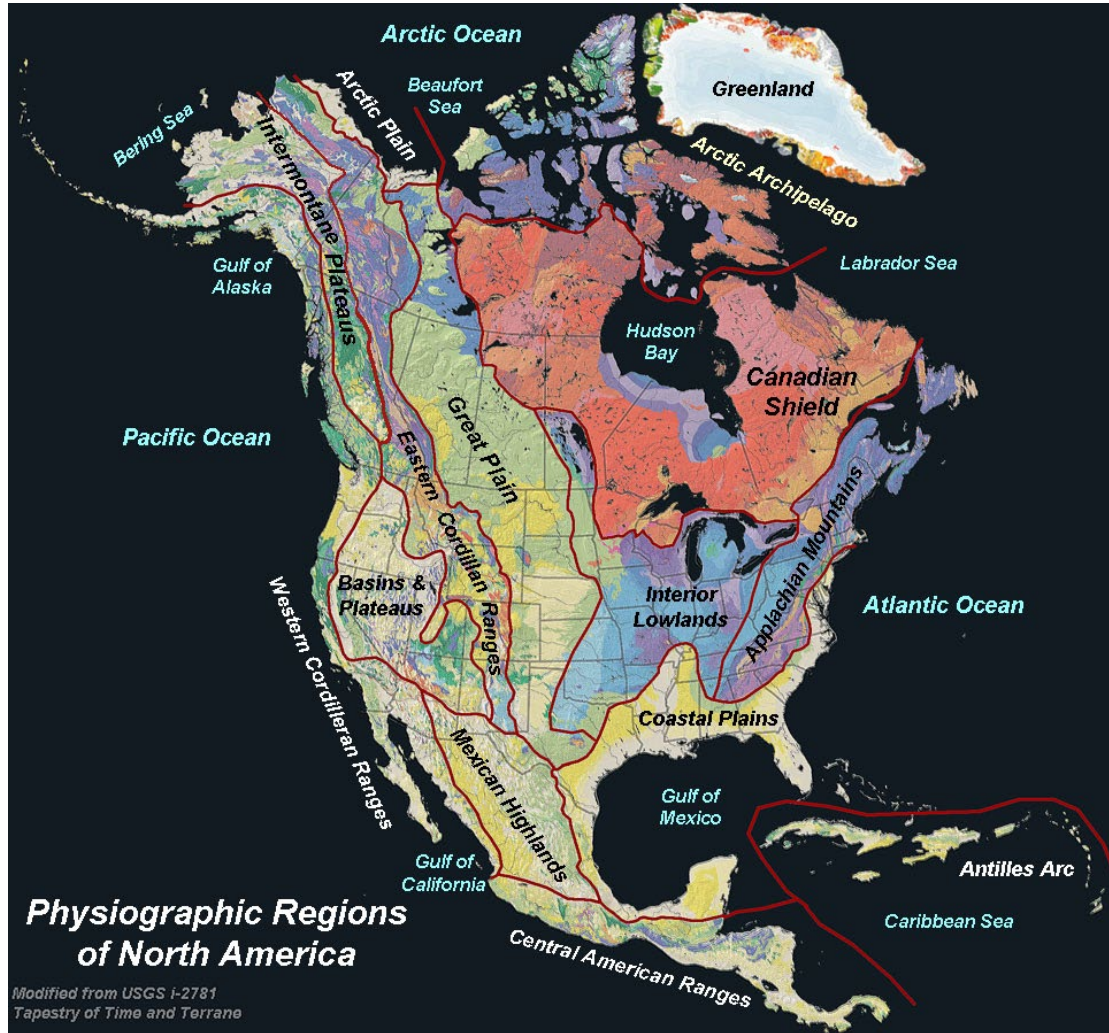
Geo-
morphons



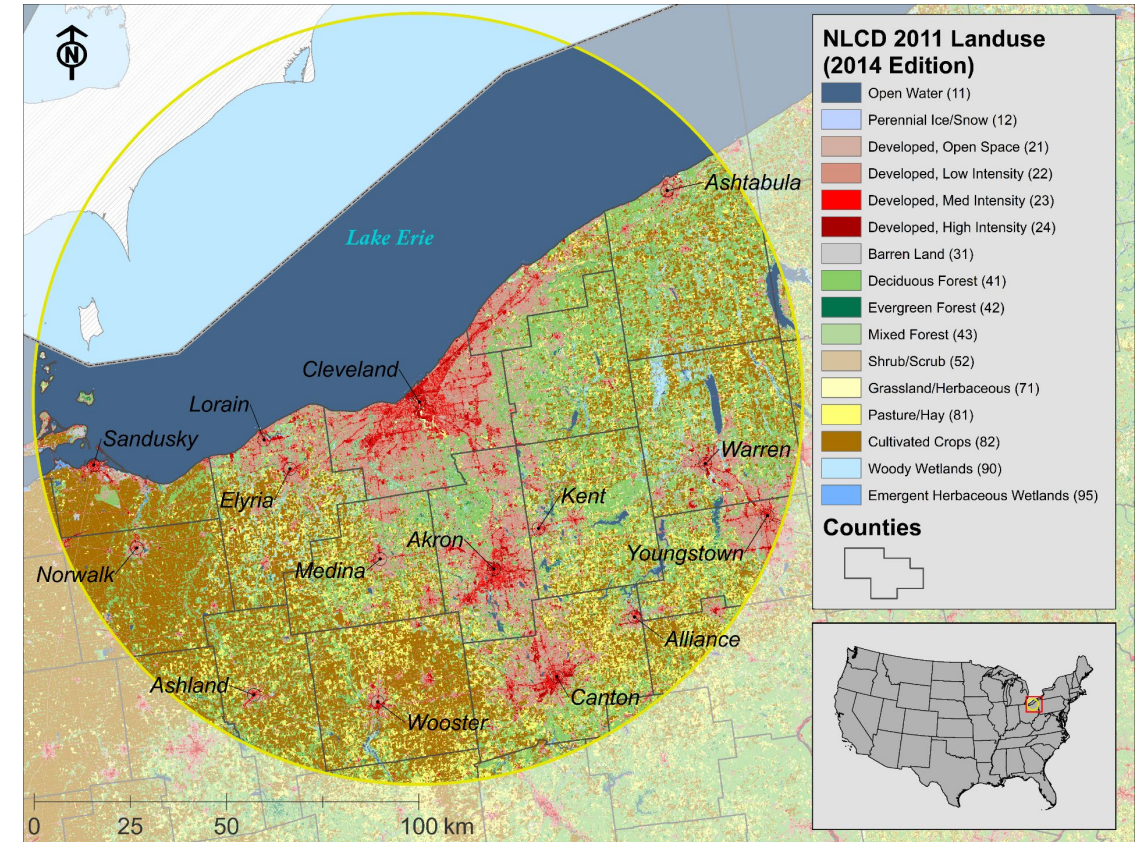
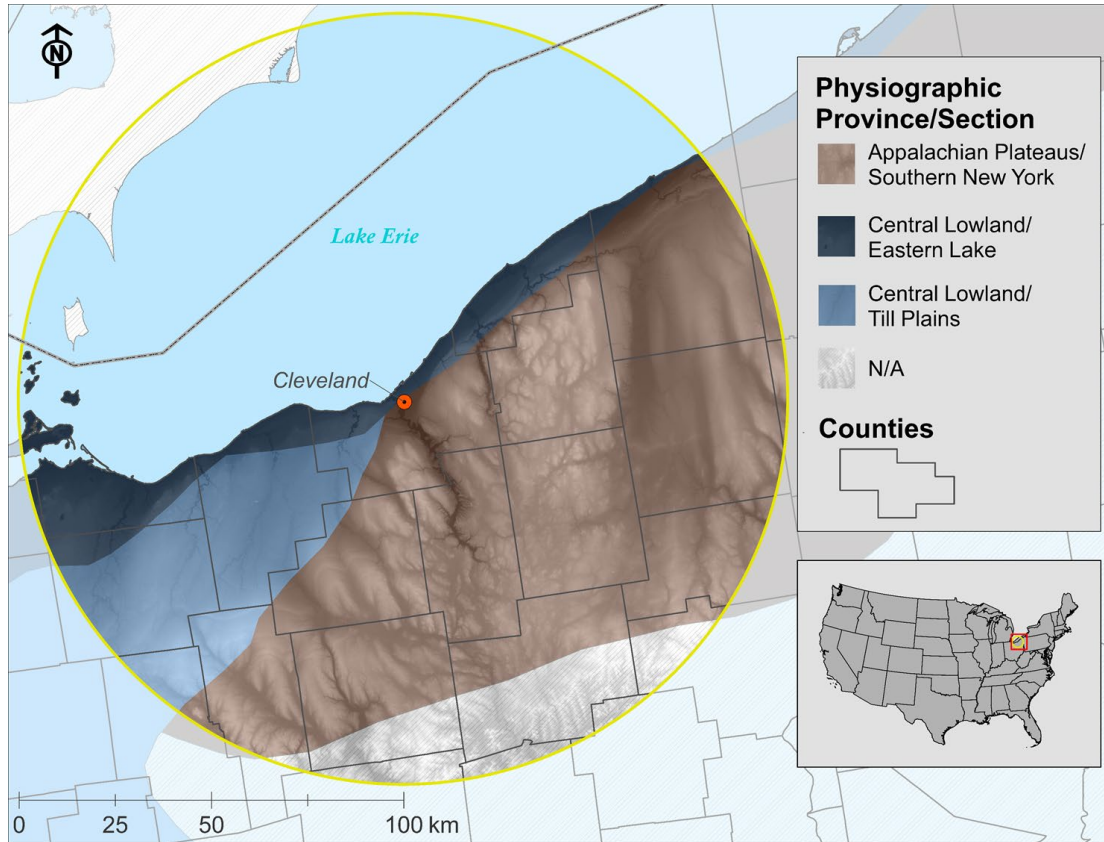
Spatial independence;
Analytical scale responds
to local landscape;
Greater landform detail
than hillslope position

Jasiewicz and
Stepinski. 2013.
Geomorphology

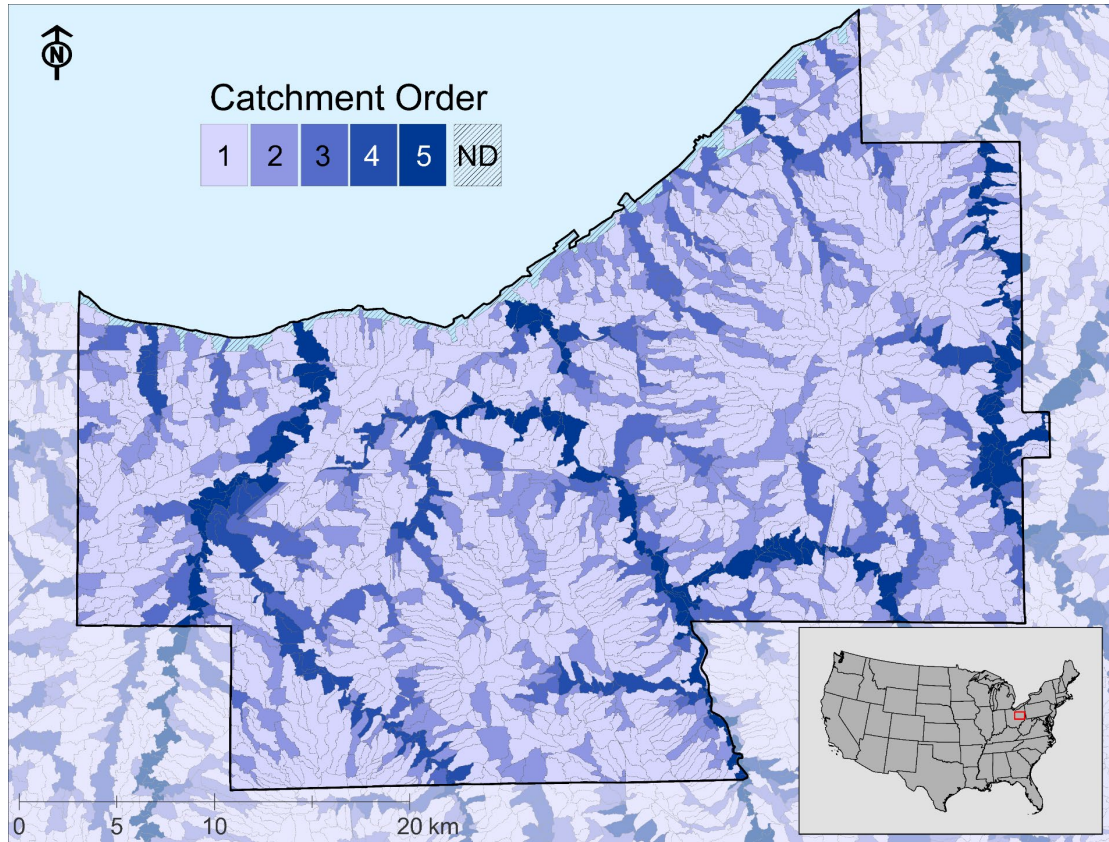
Physical Geographic Divisions to Organize Urbanization's Effects on Landform



Examining Cleveland/Northeast Ohio



Examining Cleveland/Northeast Ohio



- Generate ArchHydro catchments with 3 m DEM
- Select 1st-3rd stream order catchments with mean slope <6%
- Assign catchments to categories by dominant Land Use/Land Cover
 1. Urban (**N=112**)
 2. Suburban (**512**)
 3. Exurban (**556**)
 4. Farmland (**1848**)
 5. Wildland (**2189**)

6%

3.4°

16.7

1.0

Model for Digital Classification of Hillslope Position

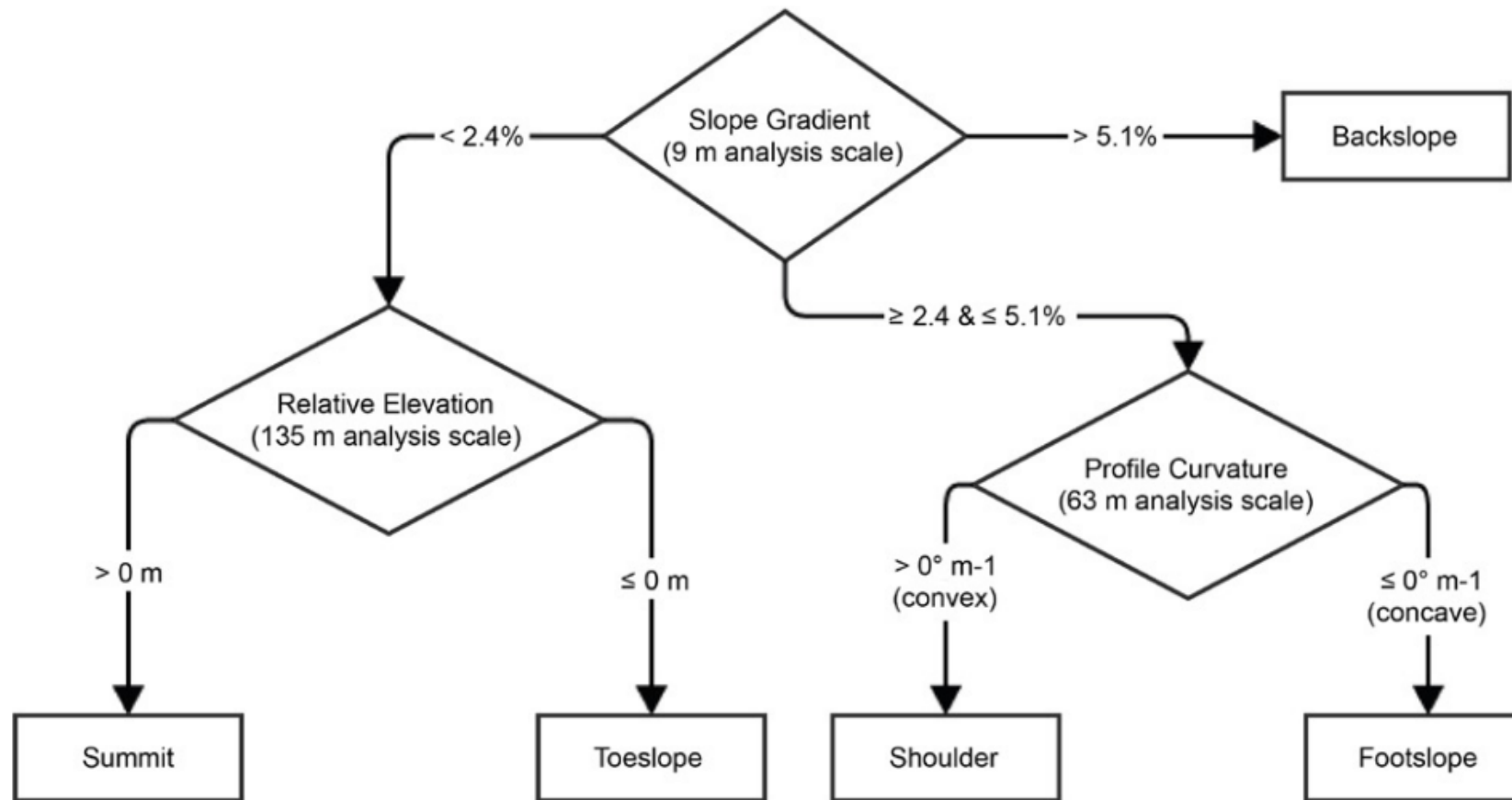
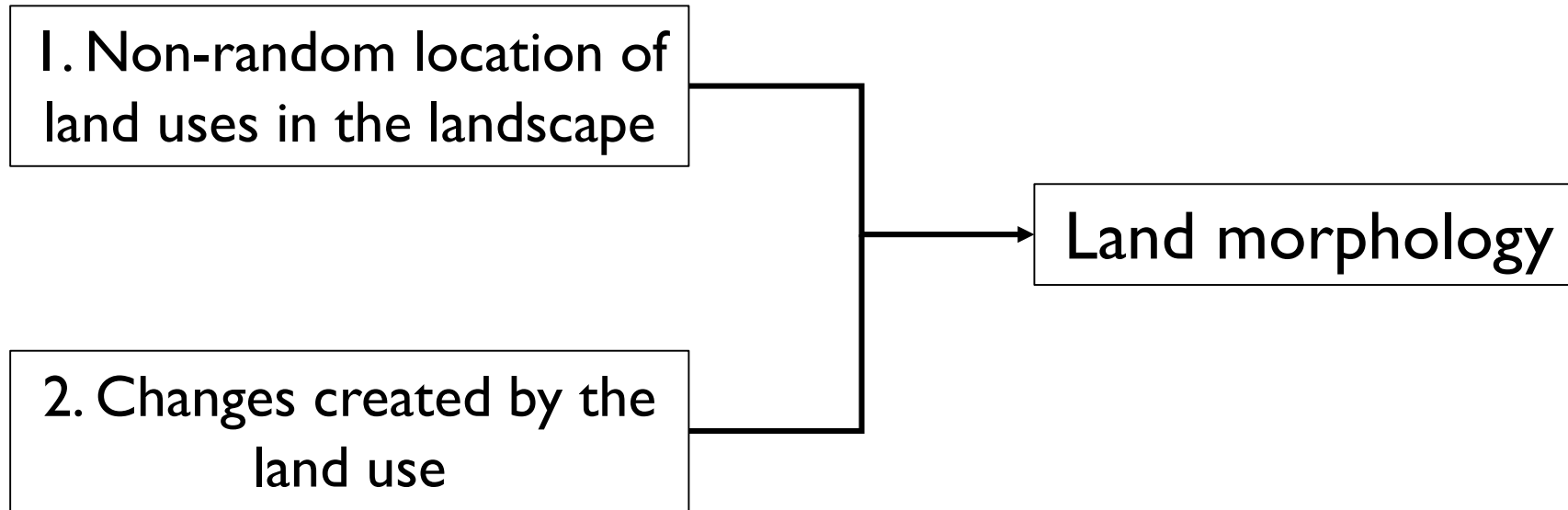


Fig. 10. Flow diagram for the calibrated, digital hillslope position model. Note that profile curvature was calculated as described by Wood (1996) and relative elevation was calculated as described by Miller (2014).

Two Factors Determining Emergent Patterns

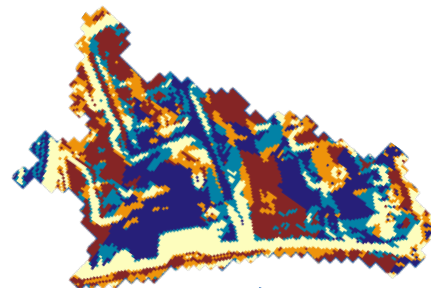
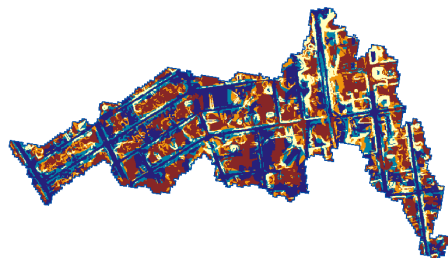
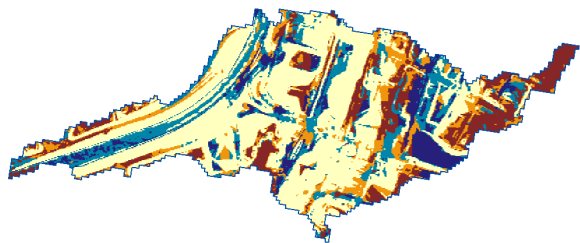
That I won't be separating



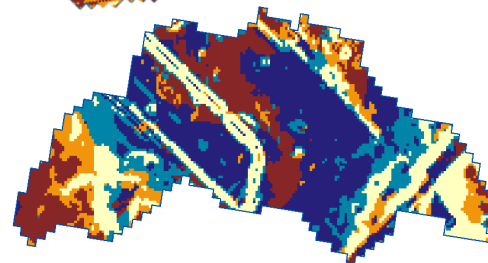
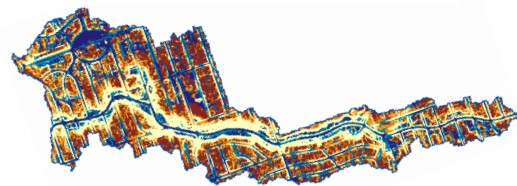
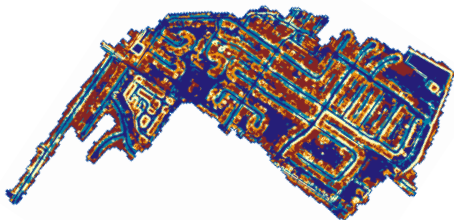
What We are Going to See

1. Relative occurrence of hillslope positions across LULC classes
2. Differences in patchiness based on hillslope position polygon size across LULC classes

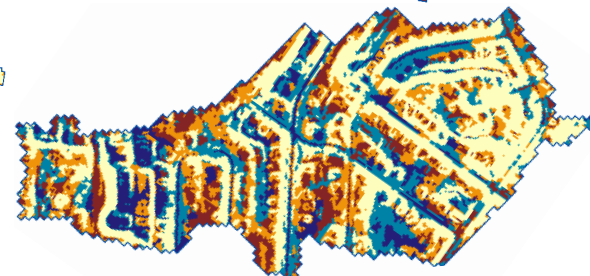
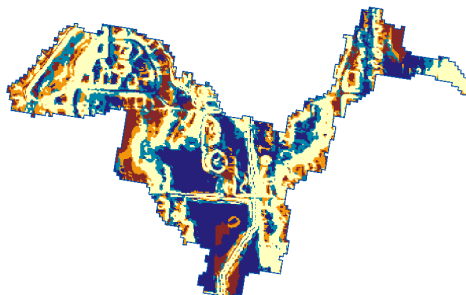
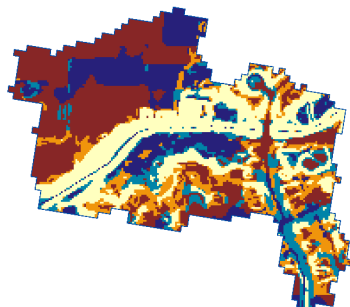
Urban



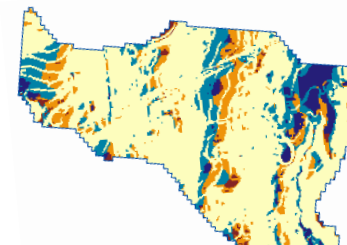
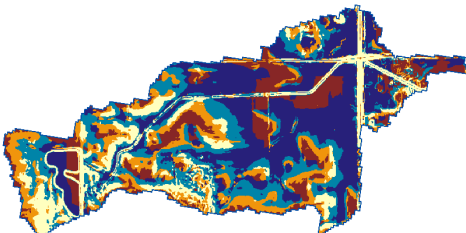
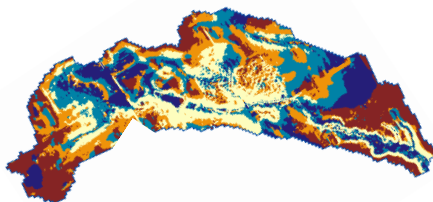
Suburban



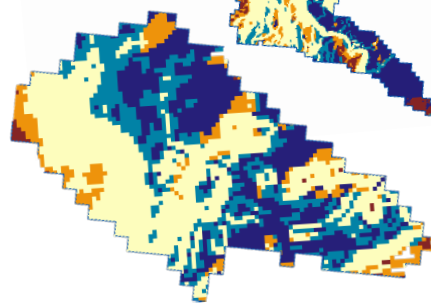
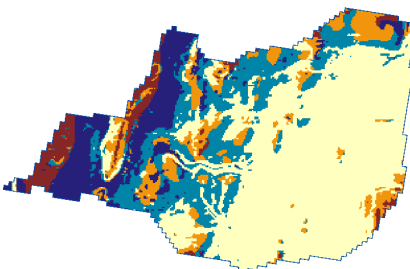
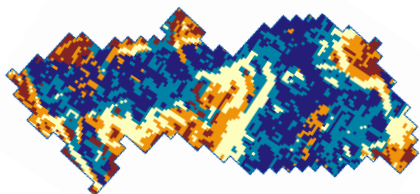
Exurban



Farmland

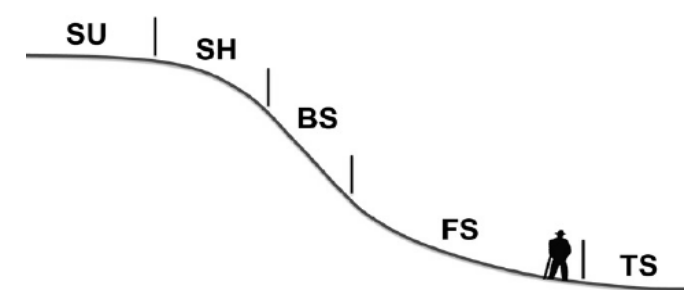
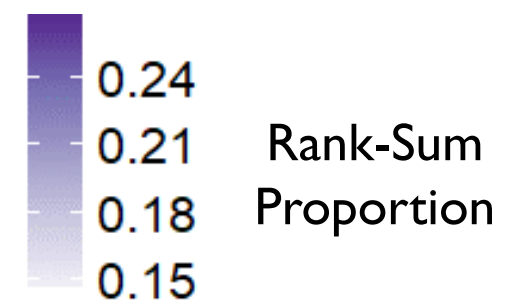
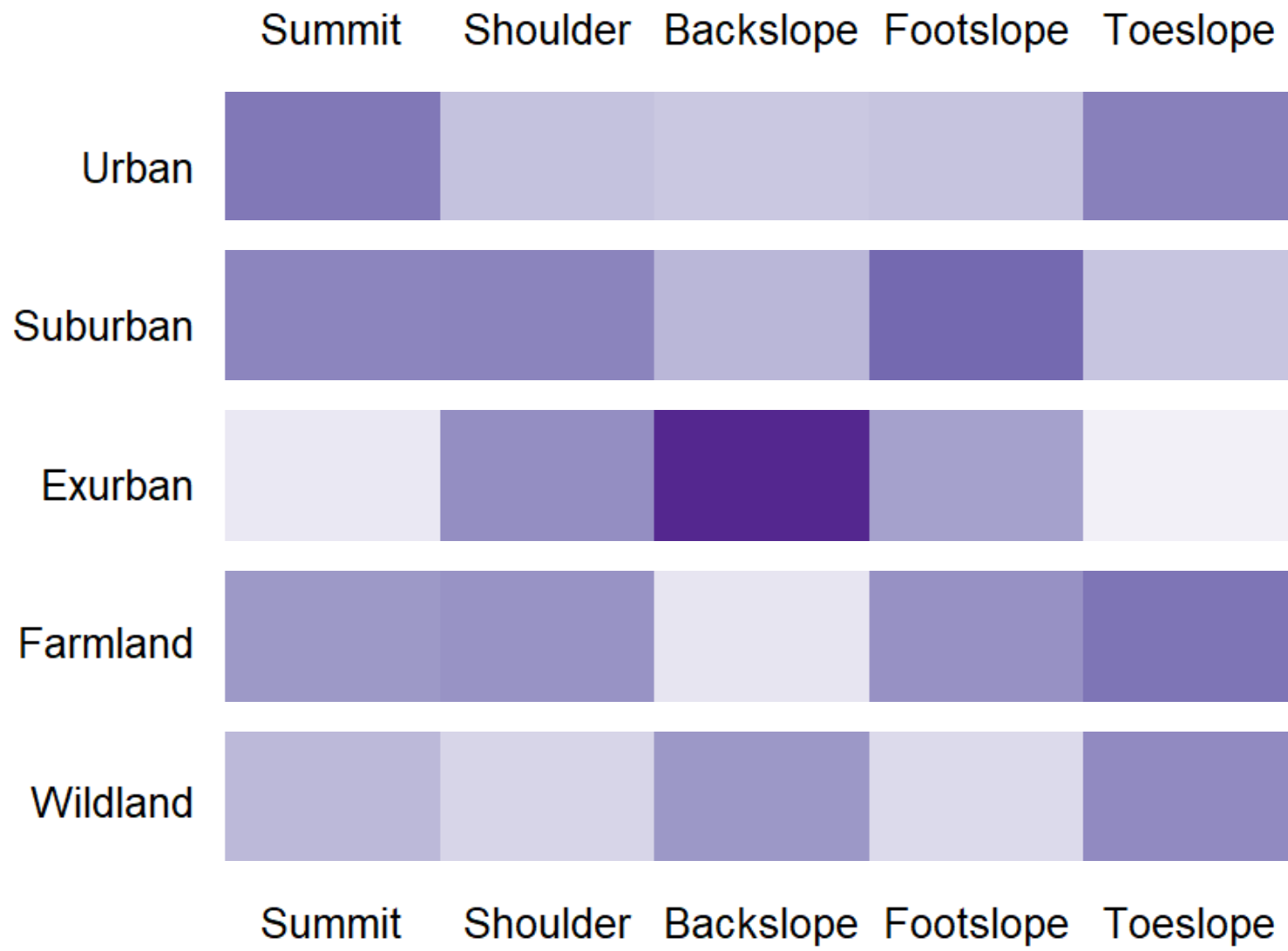


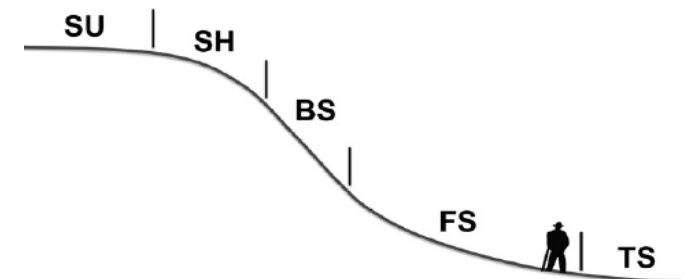
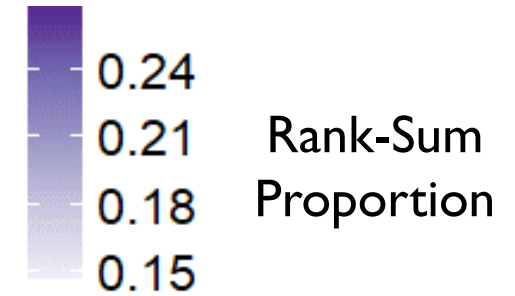
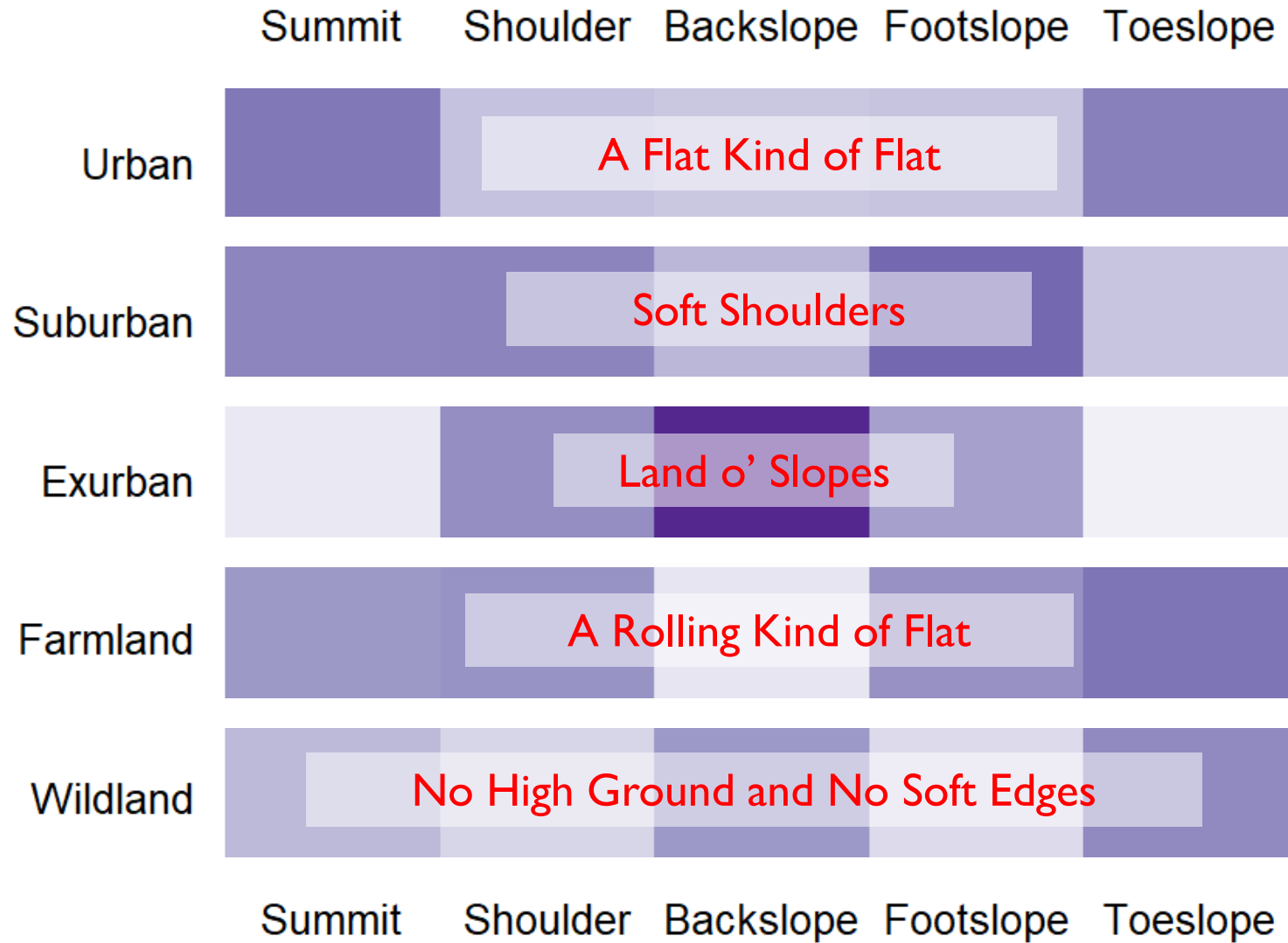
Wildland



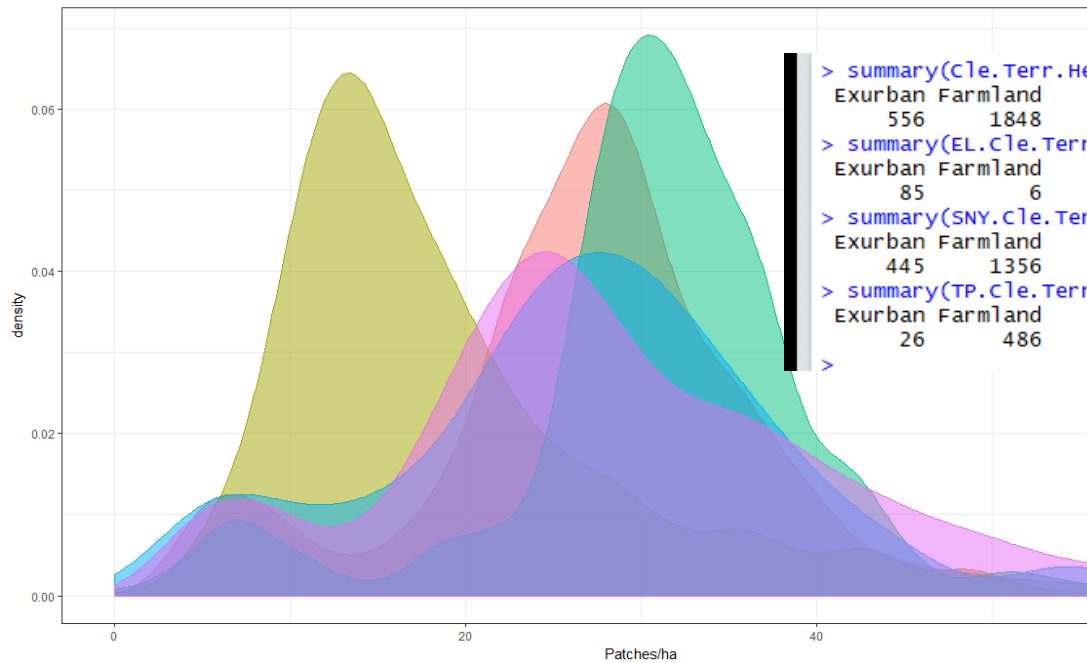
Random Catchment Samples



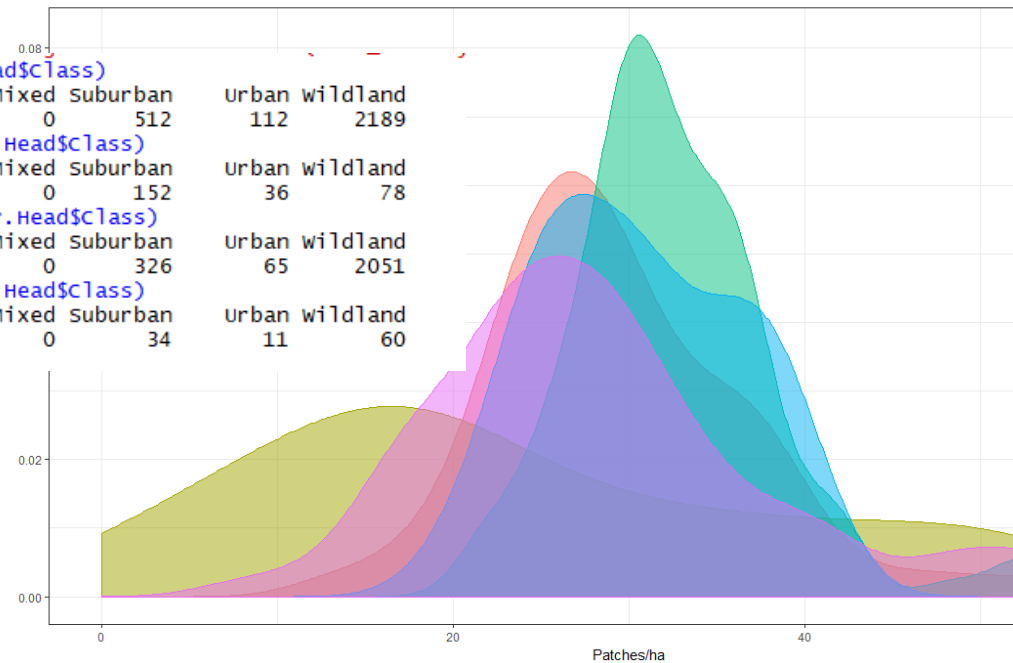




All Sections



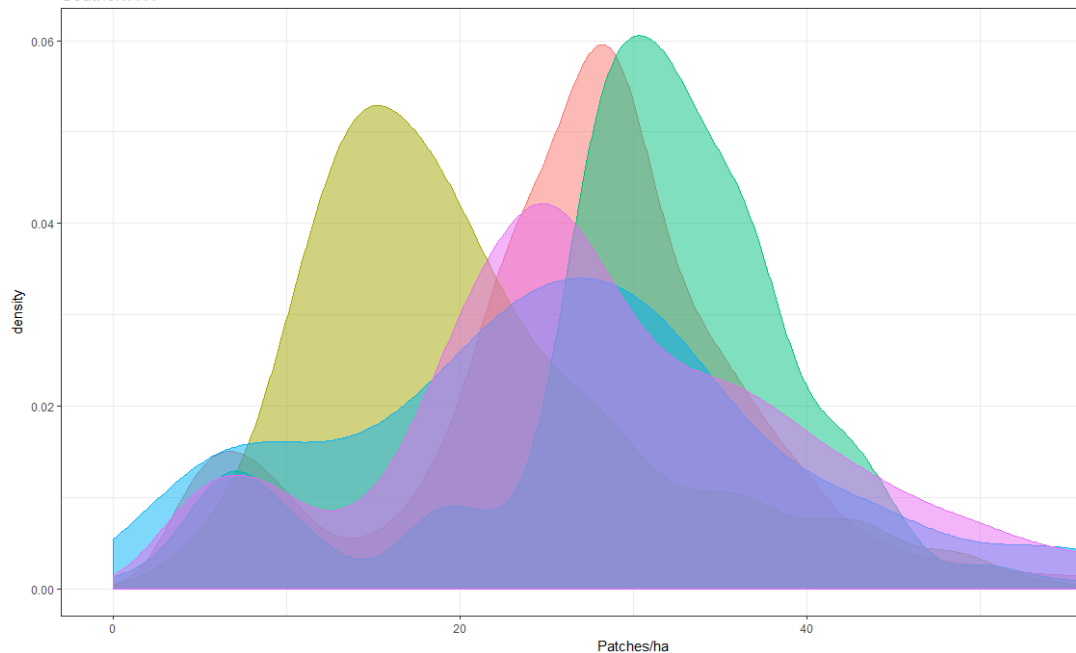
Eastern Lake



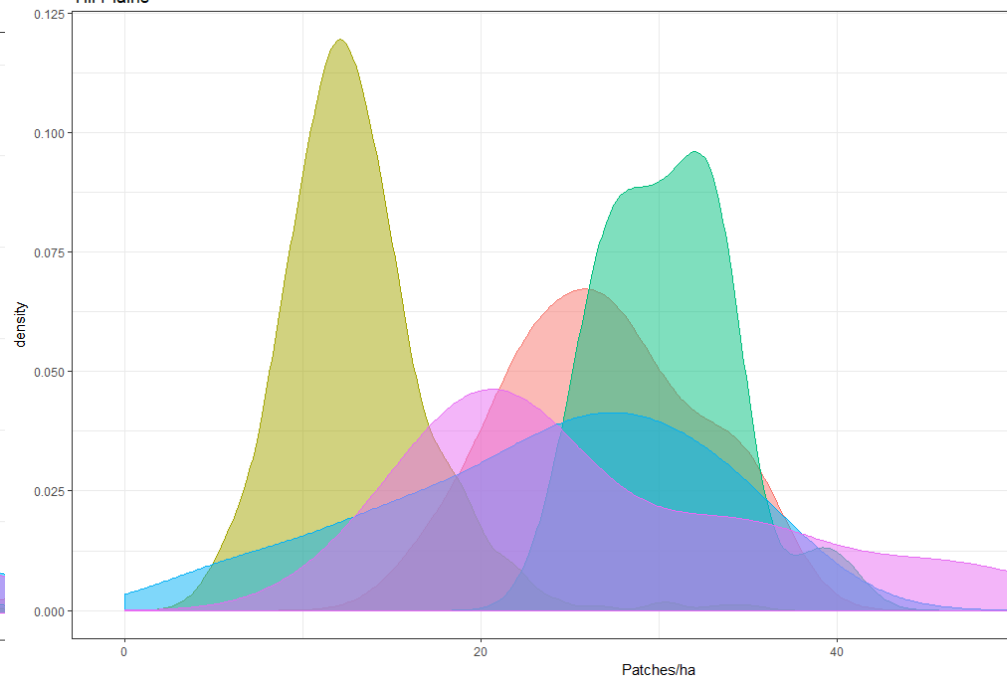
Class



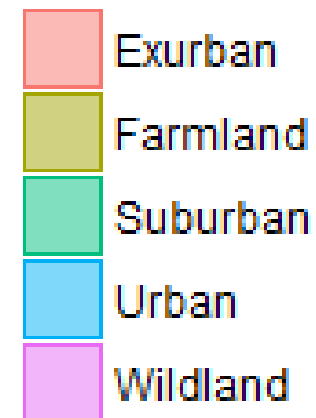
Southern NY



Till Plains



Class





O R I S E

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Thank you



Artwork by Lauren Bon; Phrase by Manuel Castells