Comparing Existing Ecological Systems Maps of For the Eastern USA

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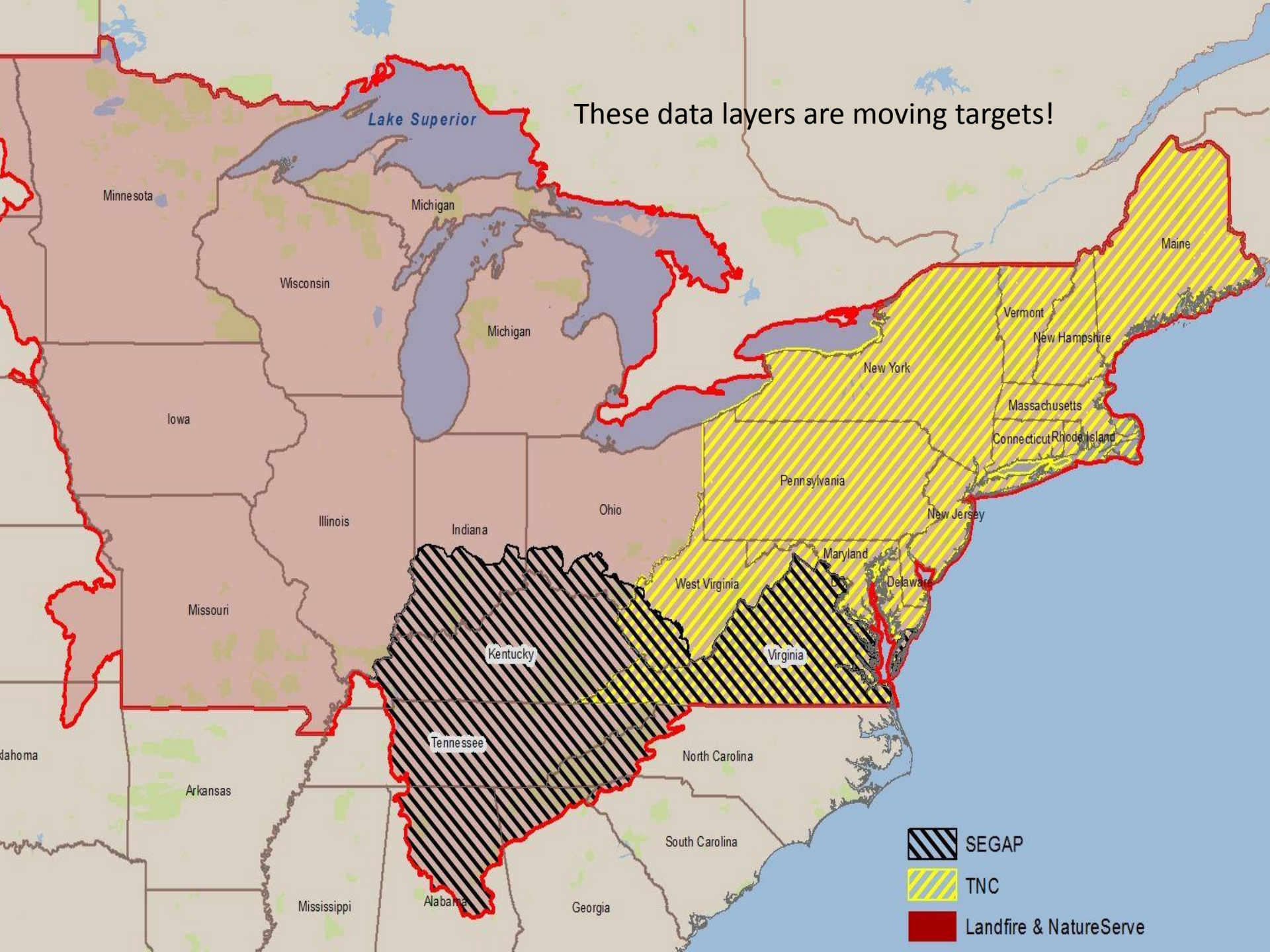
These data layers are moving targets!



Workshop Outline

- Compare Maps & Provide Overall Impressions
  - Input Data & Methods
  - Map Legends (classification)
  - Quantitative and Qualitative Comparisons
- Presentations / Perspectives by Map Producers
  - SE GAP, LANDFIRE, NatureServe, TNC
- Characteristics of a Better Product
- Mechanisms to Achieve a Better Product
- Future Options

Perspectives Vary; Communication is Difficult

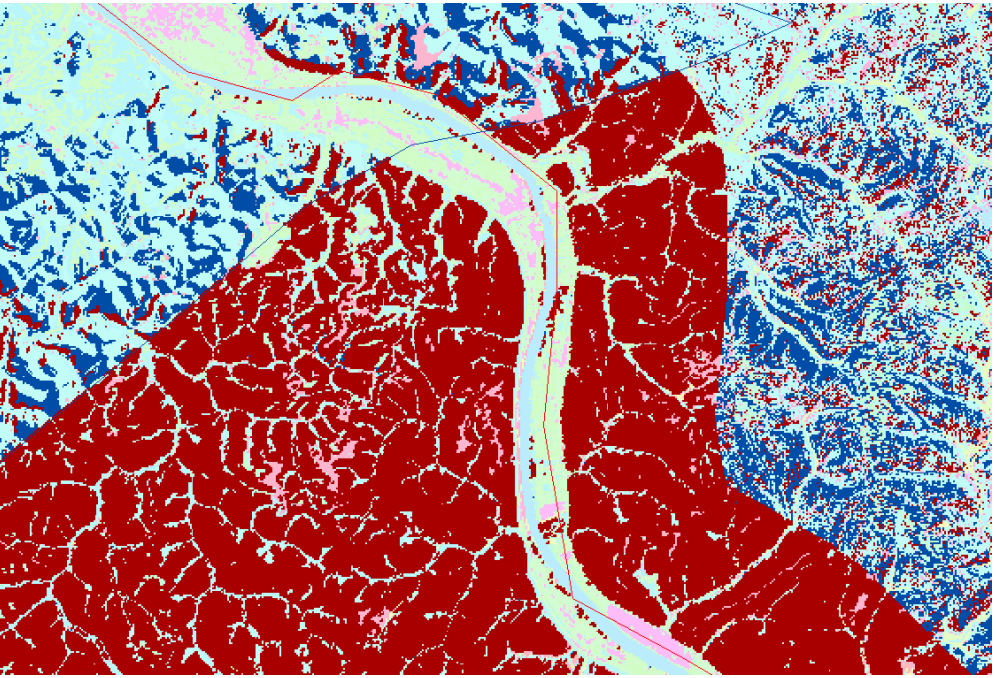
- National, state, & local map users
- Vegetation classification versus mapping (remote sensing)
- Ecologists: Western, Midwestern, Eastern
- Take home: what works for one user, or in one region, may not work universally
- To what extent can methods vary for a national product? Do regional/local projects need to be done separately?

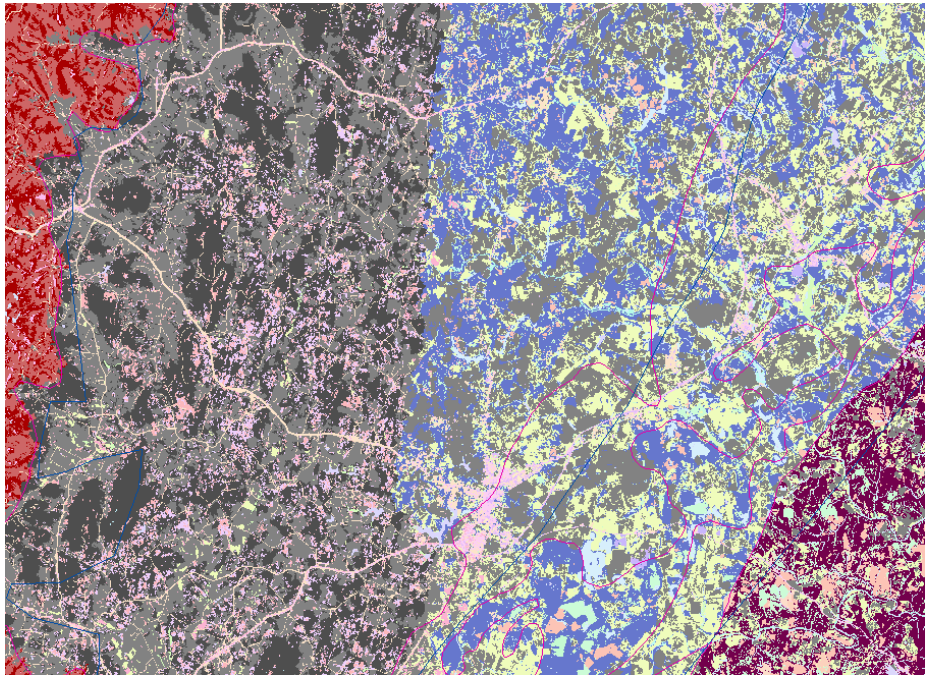
"Everywhere is walking distance if you have the time."
— Steven Wright

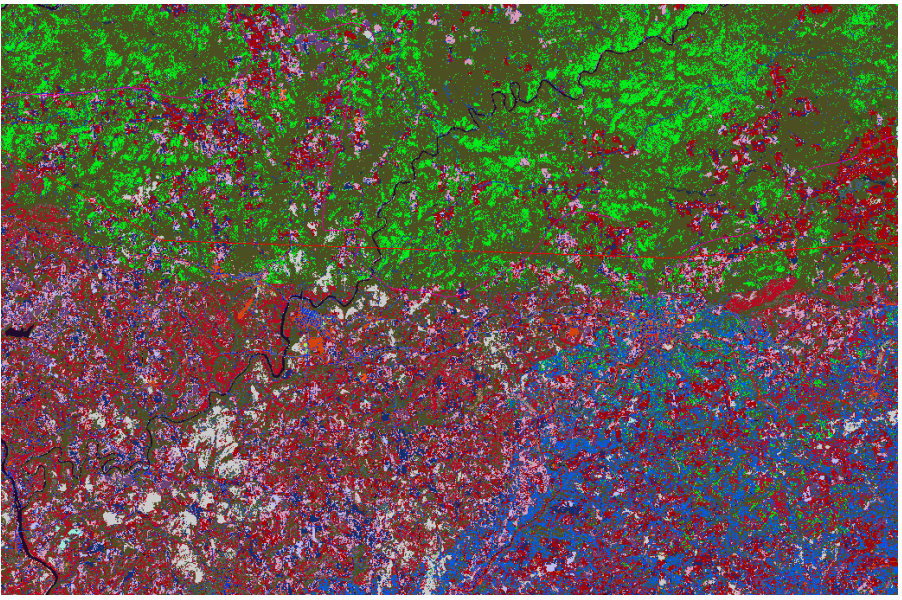
Issues In Common

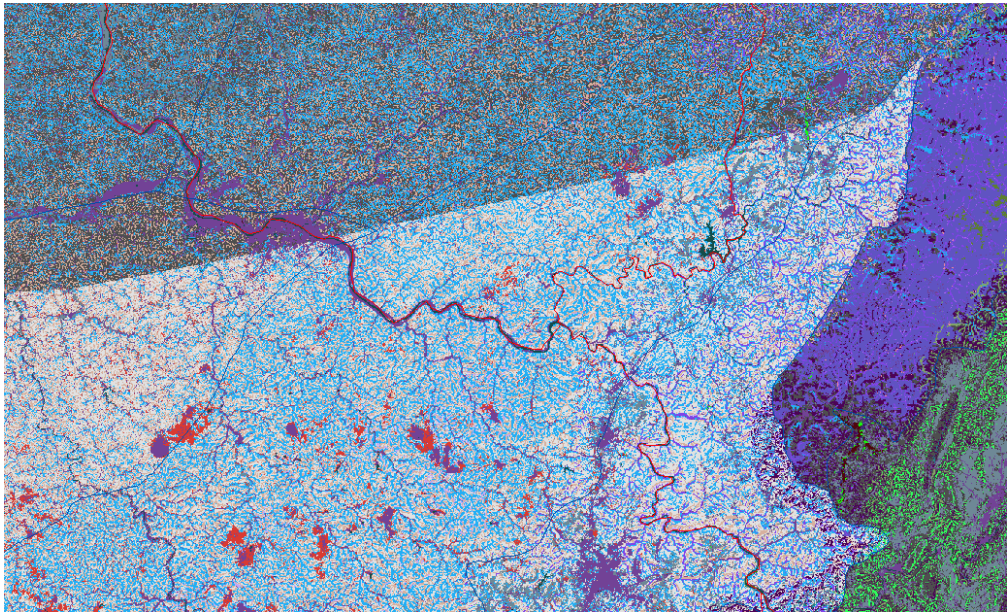
- Products not appropriate for use below about 1:50,000
- Seams in the data are apparent & hard to explain
- Use of Ecological Systems Classification
  - Ruderal or disturbance types not well done
  - Targets are of variable ‘map-ability’
  - ‘Map-able’ and useful variation in vegetation may missed
  - Alternate classifications/map legends may be preferred
  - No good post-facto plot summaries (descriptions of what was actually mapped)
- Accuracy Assessment is difficult (practically impossible)
  - Access, funding
  - Observer bias/variation
  - Treatment of ‘near misses’ vs ‘bad misses’ (fuzzy assessment)
  - For practical reasons, measured accuracy is most often from cross-validation, and may be limited to common types
  - For land use/land cover, 60% is typical measured accuracy

Visible Seams



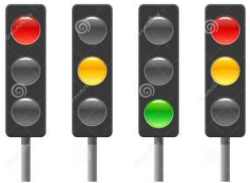






Products are Remarkably Different

- All started with Ecological Systems as targets
- All products have apparent “seams”
- Difficult to say which is more accurate
- Difficult to combine to make a better product in a systematic way
- Difficult for the user to modify (TNC product is easier)
- TNC product is best documented and most cartographically appealing



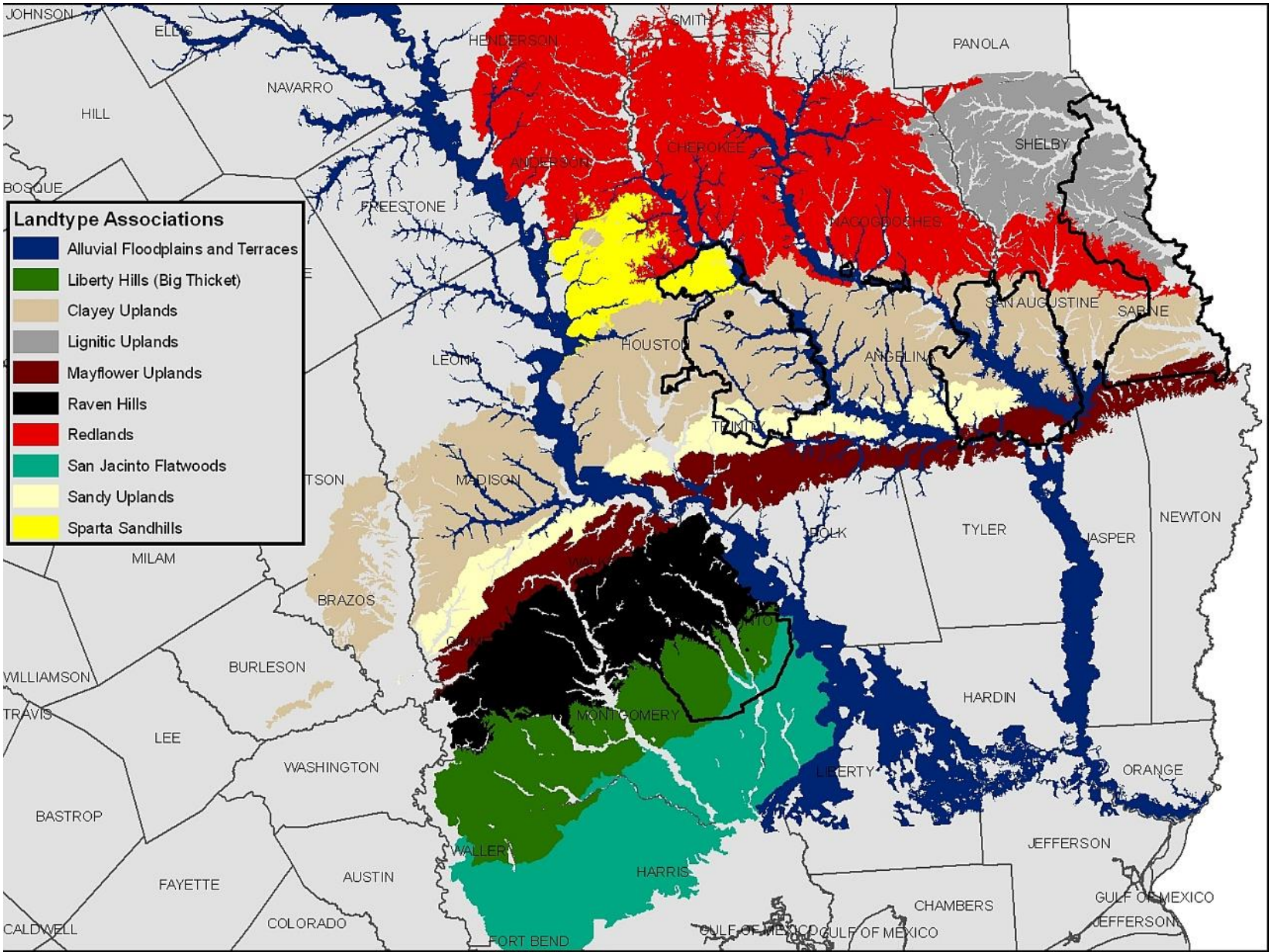
Common Information Used (1 of 2)

- Legend (classification) target list
  - Anderson land use/land cover (NLCD)
  - Ecological Systems and modifications
  - Non-natural/semi-natural types (variable list)
  - NVC-based list may be adopted in future
- Satellite remote sensing-derived data
  - Values from reflectance bands
  - Indices from the original data
  - Change data
  - Sub-pixel derived information (canopy cover, impervious cover, etc.)

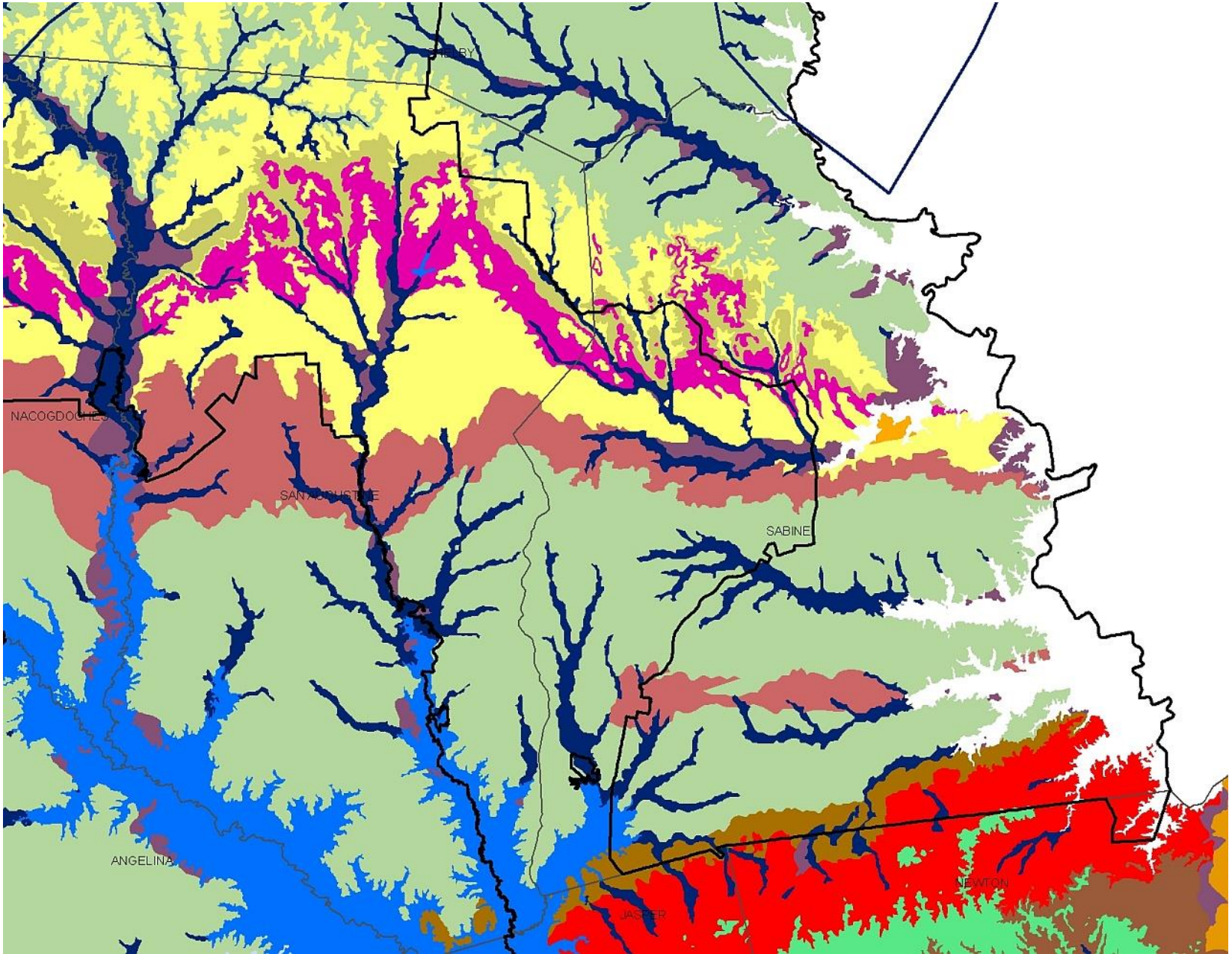
Common Information Used (2 of 2)

- Geophysical data (a subset of ancillary data)
  - Climate variables
  - DEM-derived information (elevation, slope, aspect, land position solar insolation, moisture indices, curvature, roughness)
  - Landform models (here, 7 classes, but sometimes up to 20)
  - Surface Geology
  - Digital soil surveys
- Ancillary data
  - Ecoregion boundaries
  - Species or type ranges
  - Hydrology-based information (e.g. stream buffers, distance)
  - Existing maps (e.g. NWI, NASS, coastal classifications, mines)
  - Other information
- Air Photos (videography)

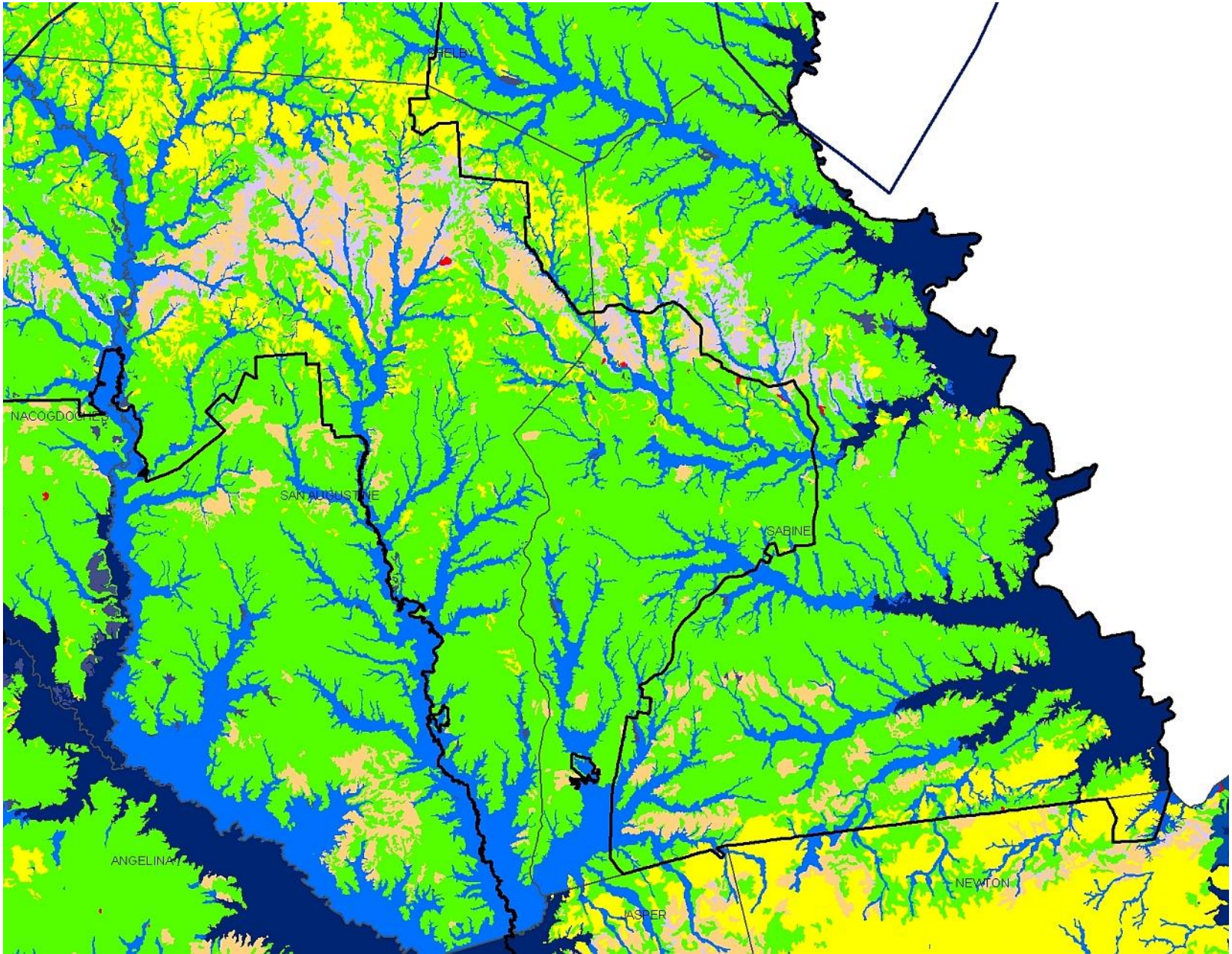
Southeast Texas Example: Landtype Associations



Southeast Texas Example: Surface Geology – 250,000 Scale Layer



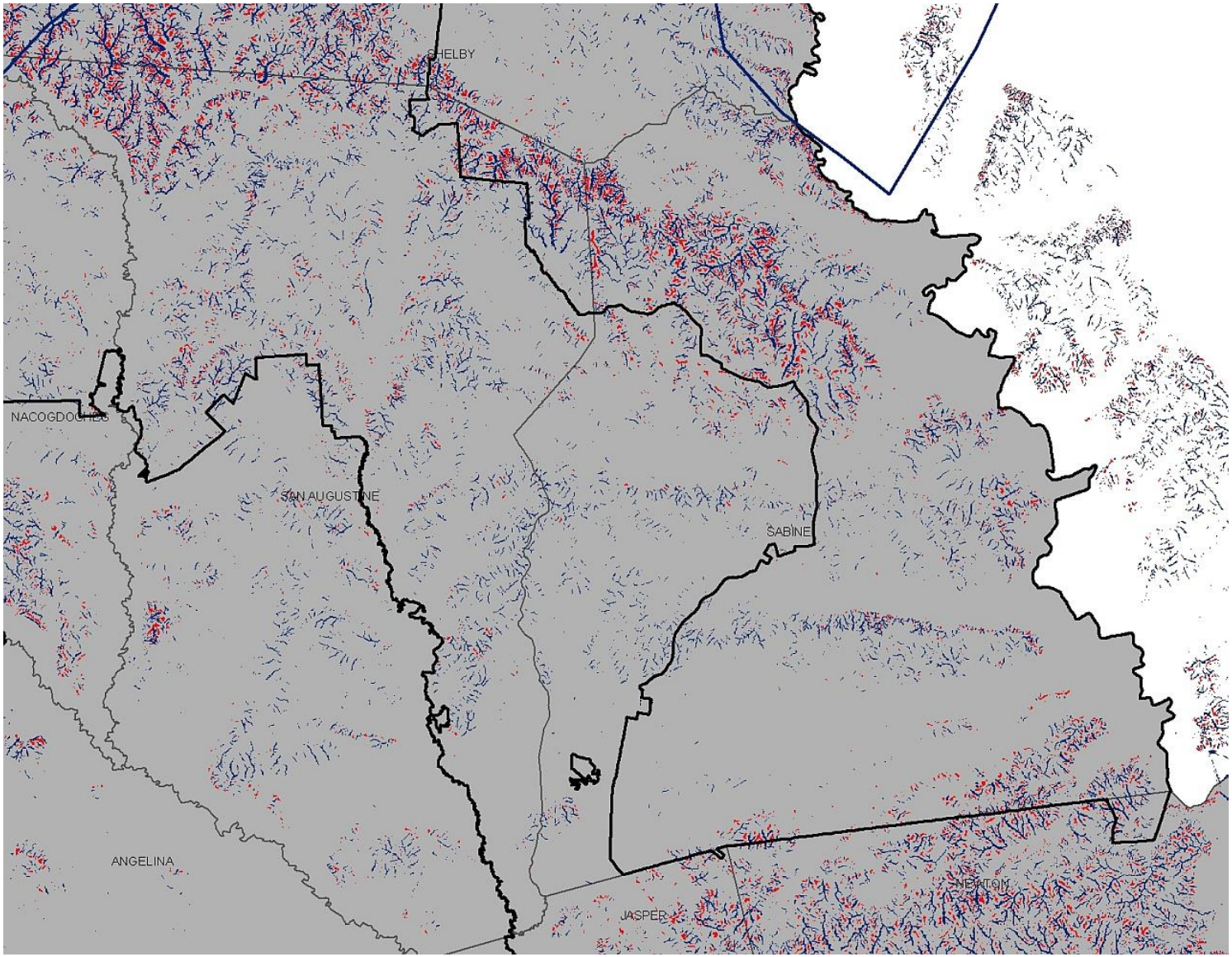
Soils – Grouped SSURGO Soil Map Units



Landscape Position – From Digital Elevation Model

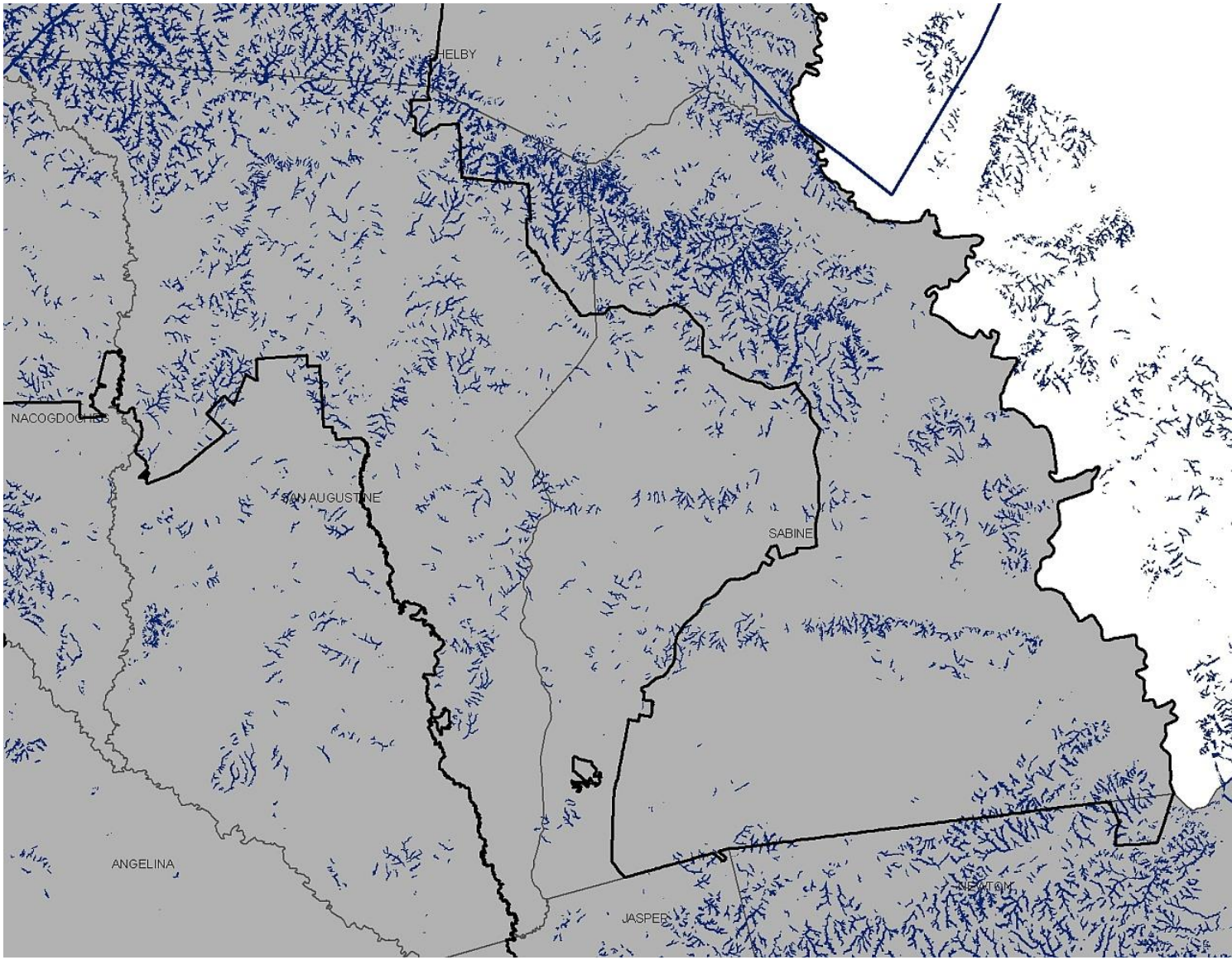
Determine relative topographic position of each pixel based on 100m radius using weighted average.

High (red) and low (dark blue) landscape positions identify mesic lower slopes and hilltop sites.

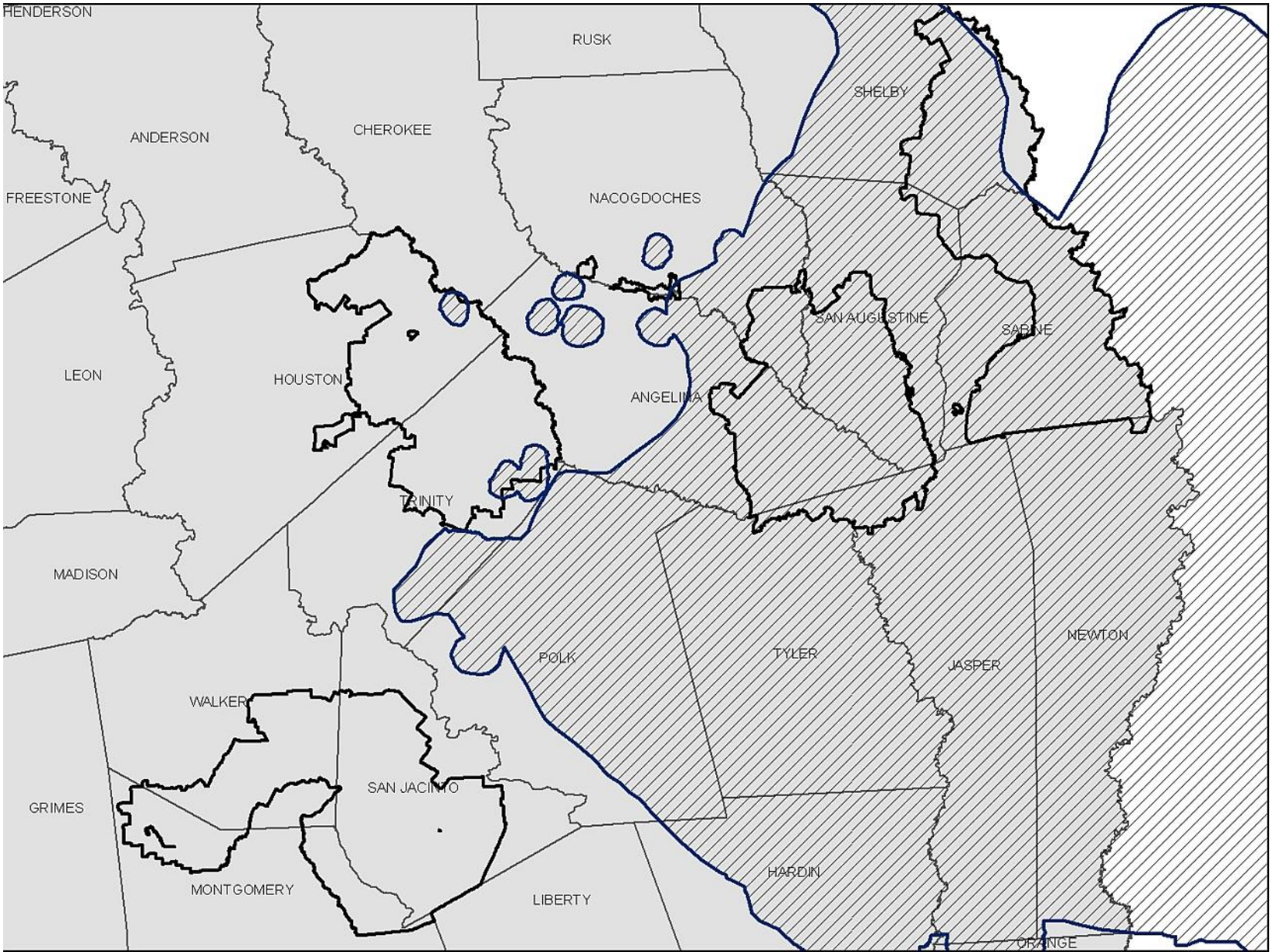


Modeled Ravines

Combined Low Landscape Position with Slopes > 20% within 20 m of those Low Sites where they are juxtaposed



Range of Longleaf Pine



General Methods Used to Generate Maps

- Classification of units based on explanatory data
  - classified sample plot + units (pixels or polygons) + explanatory data = mapped type
- Map overlays using ancillary data (surface geology, soils, landforms, floodplain data layers, etc.)
  - original type assignment + ancillary data = new type

Outline of Methods Used

- LandFire:
  - Sample plot + pixel + explanatory data = mapped type
  - Classifications performed on segmented data sets, usually
    - image-based: forest, shrub, grass, etc.
    - Abiotic-based: floodplain, wetland, elevation
- Southeast Regional GAP Analysis:
  - Similar to LandFire, with addition of mapping types using ancillary data via map overlays:
    - Original type + overlay layer (ecoregion line, geologic layer, etc.) = final mapped type
  - Methods varied by region and type in unknown ways
- TNC:
  - Sample plot + 100 acre hexagon + explanatory data = matrix type
  - Assigned 30m resolution, 7-class landform model units to type based on the hexagon in which the unit was contained
  - Non-matrix types modeled using ancillary data via map overlays
  - In flat areas (simple landscapes), assign landforms to type (skip hexagons)
- NatureServe: modified LandFire or SEGAP in various ways, mainly using range corrections and ancillary data

LANDFIRE

Generate List of Types

↓

Collect (or Generate) Plot Data

↓

Develop Training Data: Assign Plots to Types Using Sequence Tables

↓

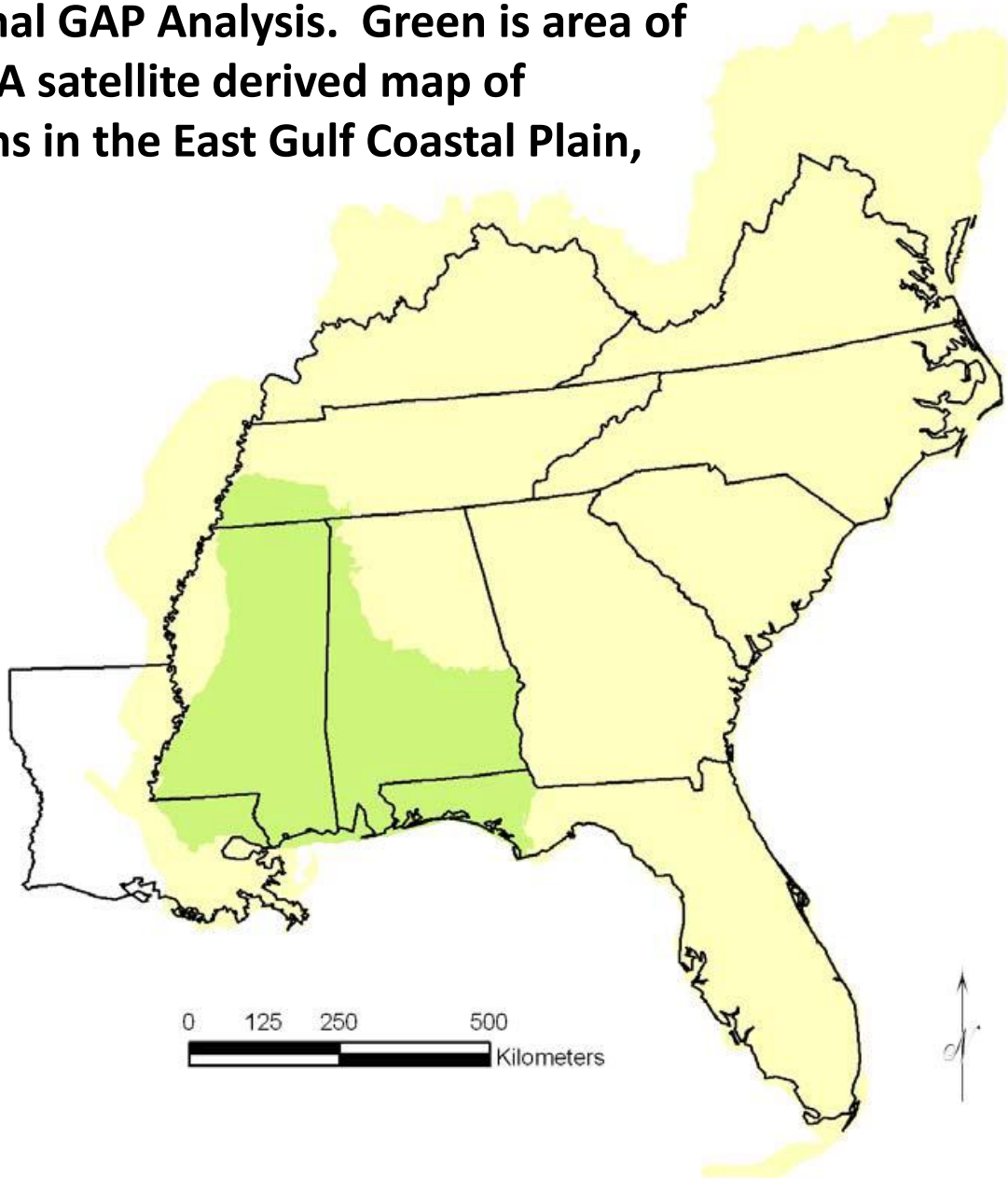
Explanatory Data: From remote sensing, DEMs, sometimes digital soils, other information →

Supervised Classification of Pixels Based on Plots & Explanatory Data

← Segment data using imagery and abiotic information into about 7 modeling groups before classification

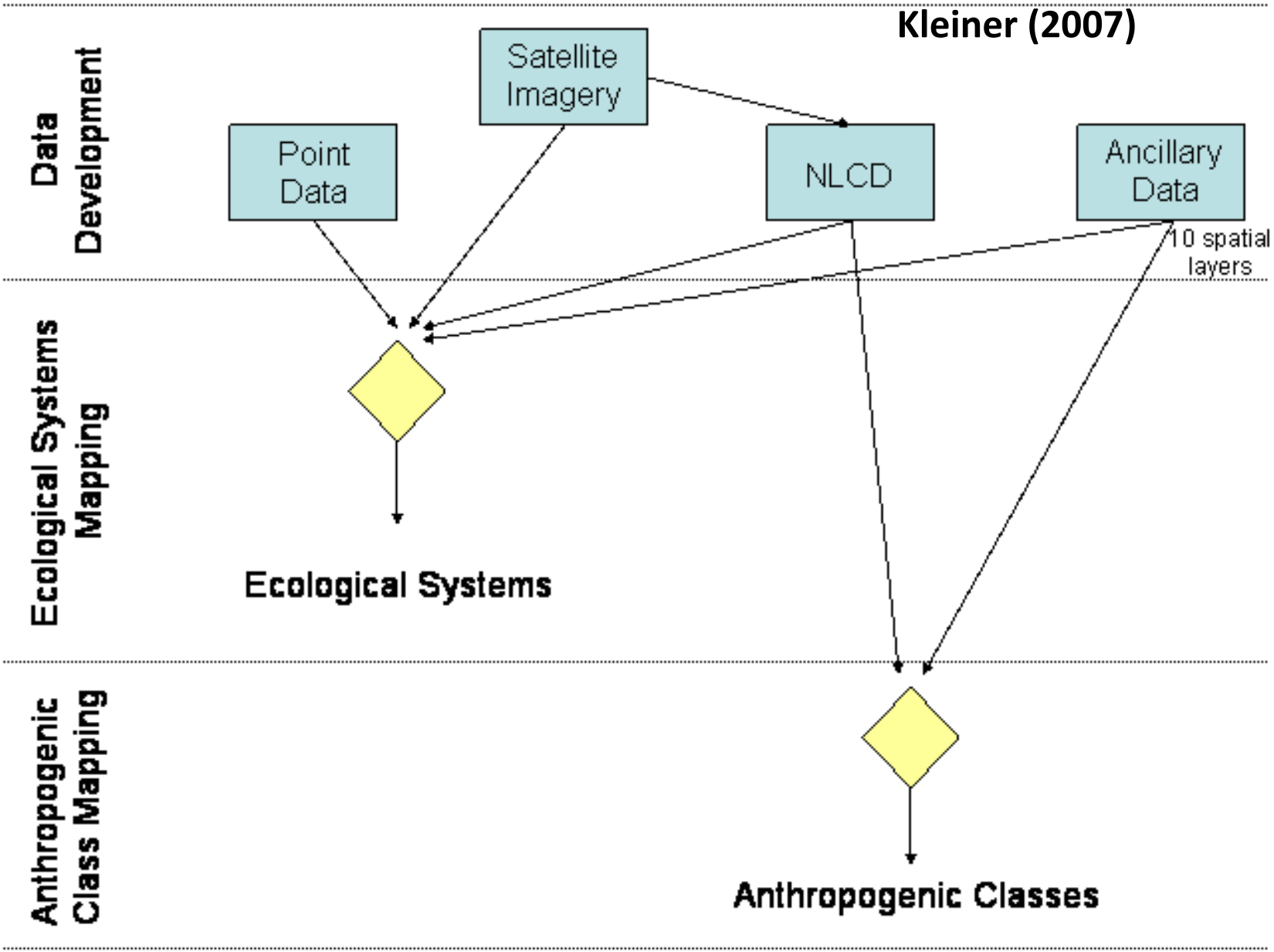
Base method assumes explanatory data are sufficient to accurately classify pixels if adequate plot data exist

Southeast Regional GAP Analysis. Green is area of Kleiner's (2007): A satellite derived map of Ecological Systems in the East Gulf Coastal Plain, USA

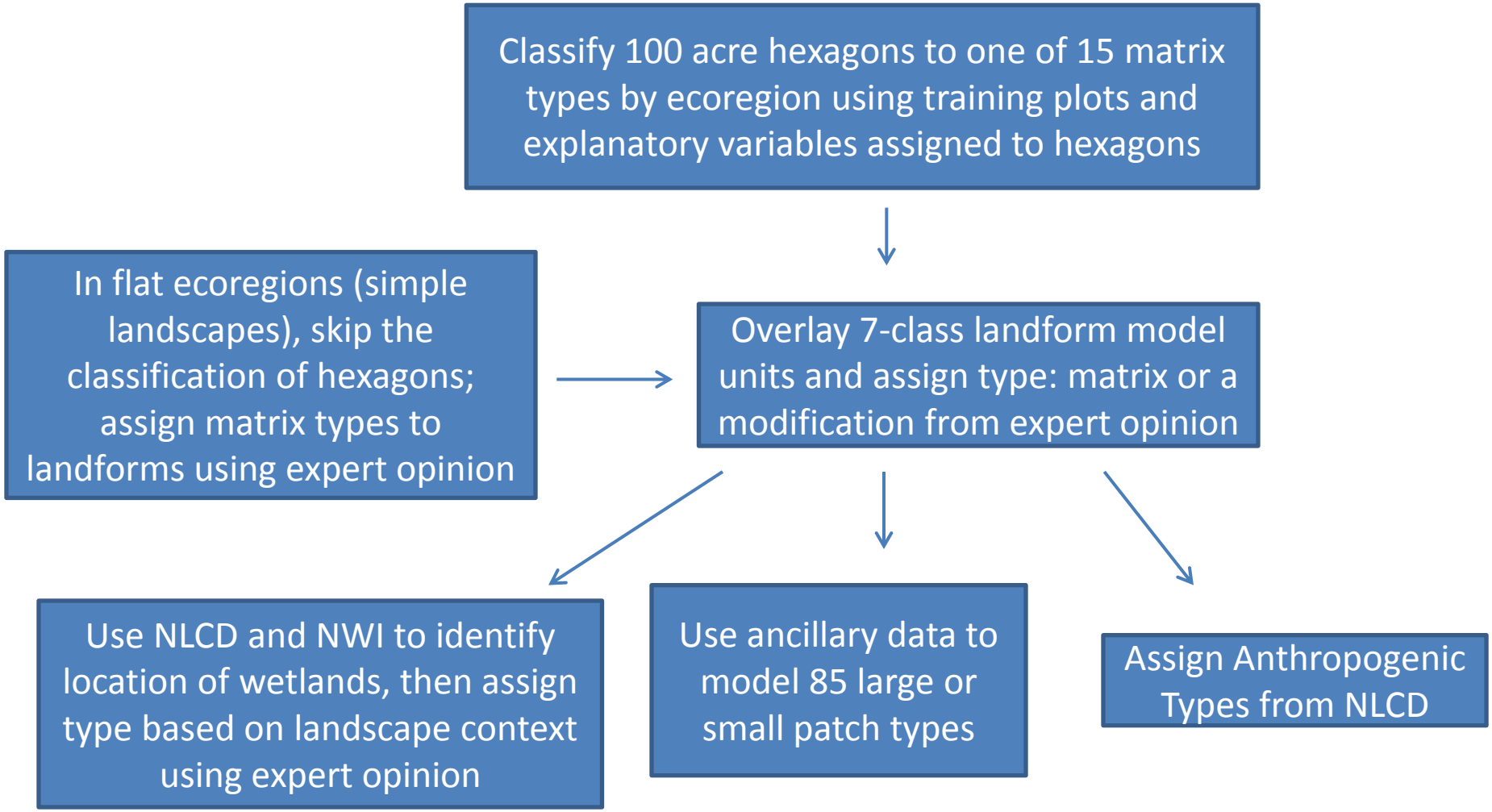


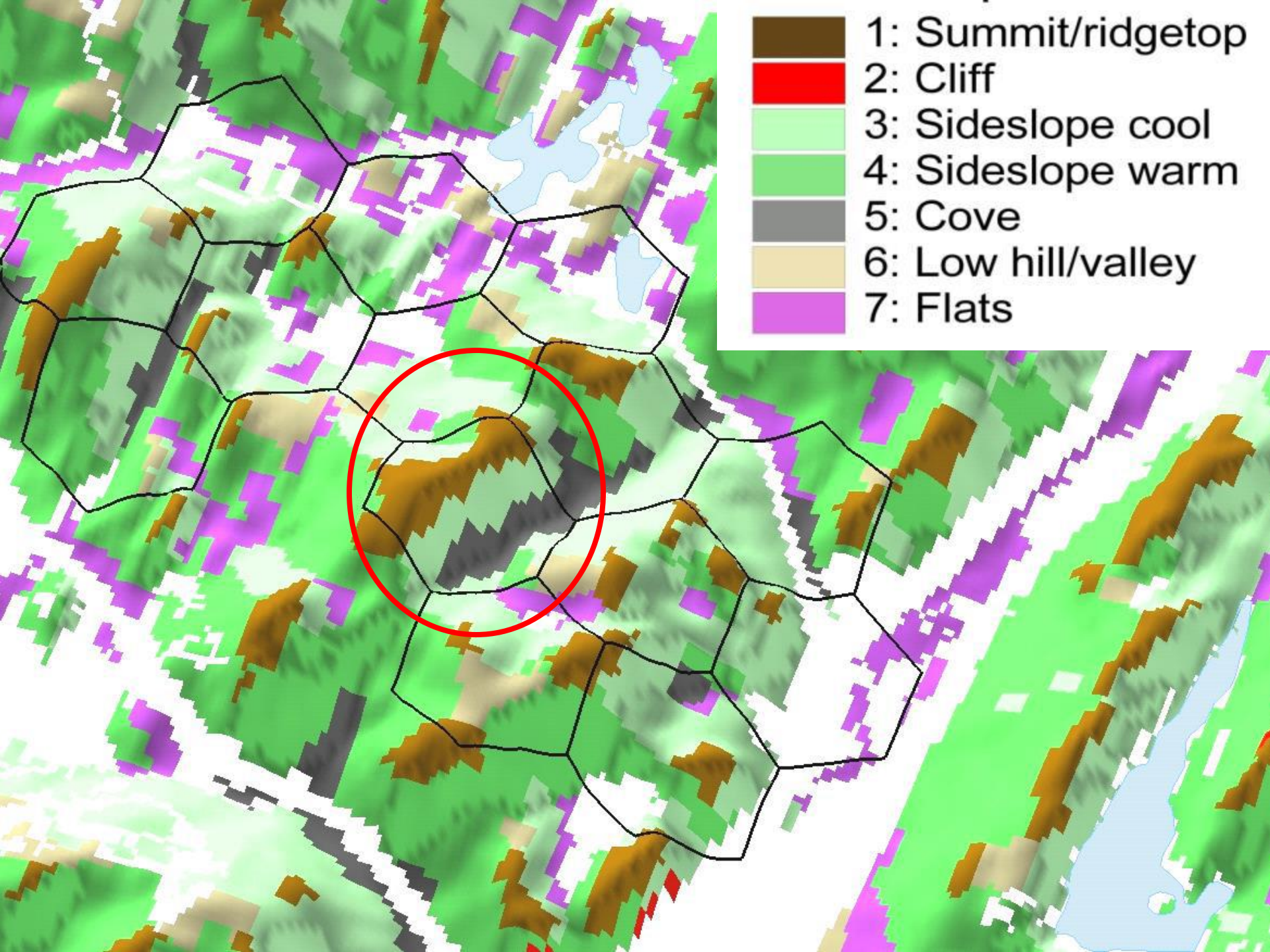
Southeastern Regional GAP Analysis

- Overall, similar to LandFire
- Used ‘land cover modifiers’ based on NLCD (produced at same time as SEGAP in some places)
- Methods varied across the region
- Kleiner (2007) mapped 50 types:
  - 7 were directly similar to NLCD
  - 10 were from NLCD types with ‘range-enforced’ rules (basically, ecoregions defined the range of types)
  - 22 were ‘spatial query with ancillary data’
  - 6 were ‘manual image interpretation’ and 5 ‘individual systems mapping’


Kleiner (2007)
Data Development
Satellite Imagery
Point Data
NLCD
Ancillary Data
10 spatial layers
Ecological Systems Mapping
Ecological Systems
Anthropogenic Class Mapping
Anthropogenic Classes

TNC: assign landform polygons to (mainly matrix) types, and model patch types from ancillary data

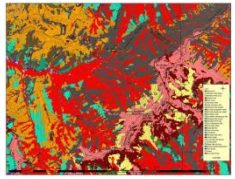



1: Summit/ridgetop
2: Cliff
3: Sideslope cool
4: Sideslope warm
5: Cove
6: Low hill/valley
7: Flats

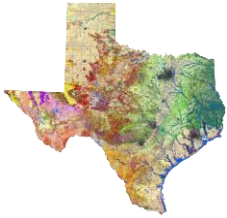
Unique Aspects

- Landfire
  - large number of disturbance types mapped
  - ‘Stepwise’ process with separated tasks
  - Mapped more targets directly via pixel classification
- SEGAP
  - Explicit development of NLCD; use with ancillary data for mapping
  - Land cover modifiers
  - Probably will not be re-done
- TNC
  - Best documented
  - Cartographically appealing & ecologically logical
  - Geophysical modifiers
  - Limited mapping of disturbance types (number, not necessarily area)
- NatureServe
  - Modifications designed to improve other maps
  - Georeferencing does not match others in places

Other Efforts



- Simon and co-workers (2005, 2011, 2013)
  - Generated Ecological Zones from fine-resolution landform modeling
  - Similar to prevailing potential or historic vegetation
  - Field sampling to support effort
  - Used MAXENT models to define types, then overlay of models to map landscape
- Elliott, Diamond, & Others: Texas & Oklahoma
  - Generated land cover & ancillary data, and used Ecological Systems as initial targets (interpreted more ruderal types)
  - Generated image objects from NAIP photos at 10m resolution
  - Landcover, ancillary data, and then types were attributed to image objects; more types mapped versus other efforts
  - Extensive work on soil map units as ancillary data
  - >15,000 new, georeferenced field points collected in support allows post-facto summaries & descriptions of what was actually mapped



Characteristics of an Improved Product

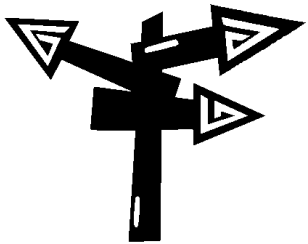
- Mapping Targets (communities, geophysical setting)
- Accuracy
- Thematic Resolution
- Spatial Resolution
- Post-facto plot summaries & descriptions of what was actually mapped

Mechanisms for Production

- Funding
- Involvement of partners
- Development of mapping targets
- Best methods

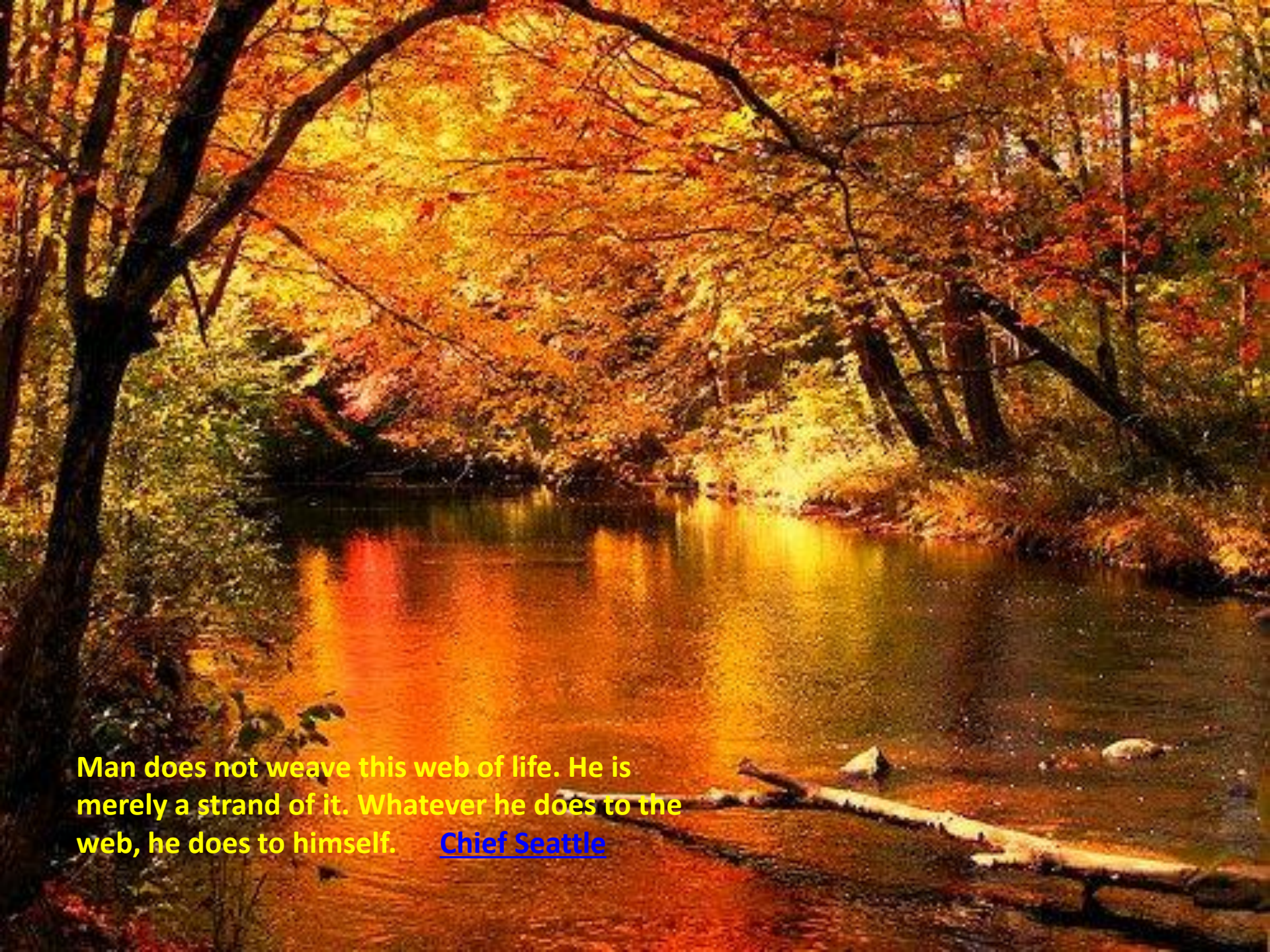
Future Options

- Use a National Product
  - Institutional production tends to ensure up-dates (especially NLCD; probably LandFire)
  - Ensures a minimal level of compatibility for roll-up at any resolution
  - Tends to consider fewer needs for local users
  - “Free” to the user
- Create and Use a Regional or State Product
  - Can be “better” at least in some ways (TNC; MoRAP for TX and OK; Simon 2005, 2011, 2013 ‘ecological zones’ - not reviewed) but this is not ensured
  - Production is at cost to the users
  - Up-dates are uncertain (not institutional; on-going costs)
  - Tend to better address needs of local users



Brainstorm: Ideas for Discussion

- Uniform, fine-resolution, accurate map of geophysical settings would be useful
- Workers looking on national roll-ups get pretty comfortable with coarse, inaccurate data … workers at a local level expect too much from these types of efforts …
- More mapped types is not always better
- Need for post-facto plot summaries, so we know what was mapped
- Classification targets themselves: if plant communities are ephemeral, what should we be mapping?
- Composition of much of the vegetation on the modern landscape is not well known in some regions; the existing NVC seems inadequate
- Western regions lend themselves to different methods than in the Midwest or East
- Would states or regions be better off to use NLCD and ancillary data to ‘roll their own’?


Man does not weave this web of life. He is merely a strand of it. Whatever he does to the web, he does to himself. Chief Seattle