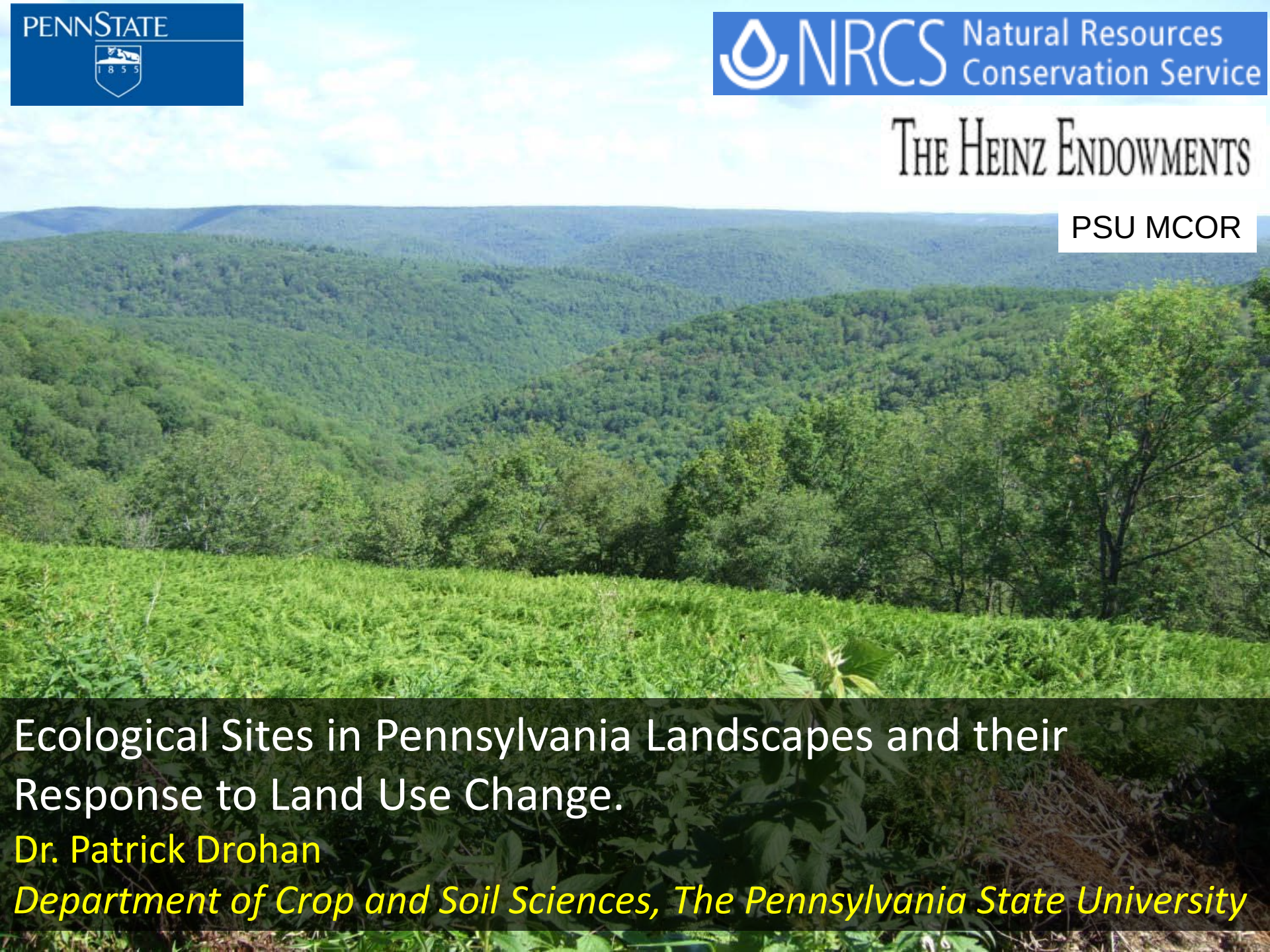
PENNSTATE

NRCS Natural Resources Conservation Service

THE HEINZ ENDOWMENTS

PSU MCOR



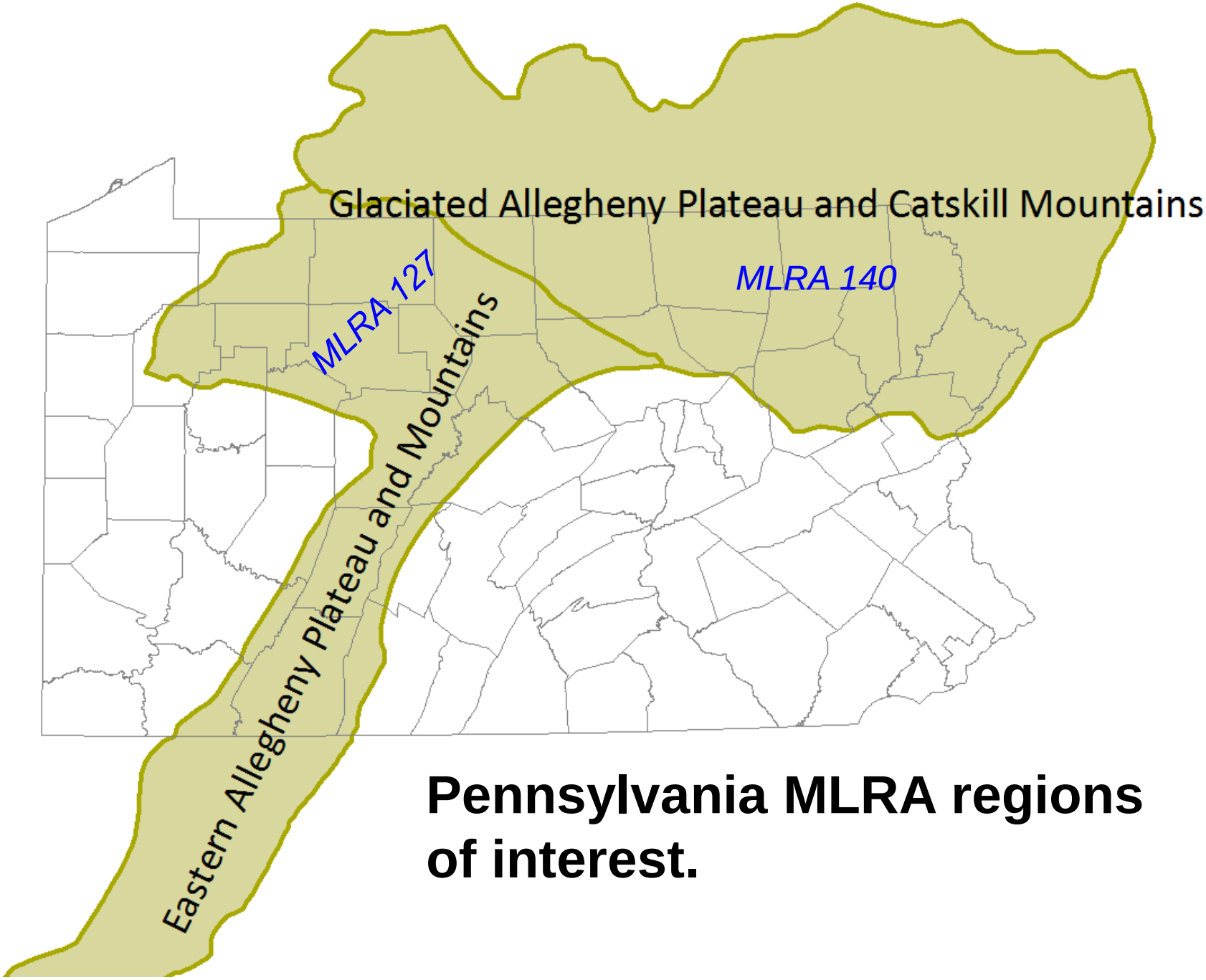
Ecological Sites in Pennsylvania Landscapes and their Response to Land Use Change.

Dr. Patrick Drohan

Department of Crop and Soil Sciences, The Pennsylvania State University

Project Goals

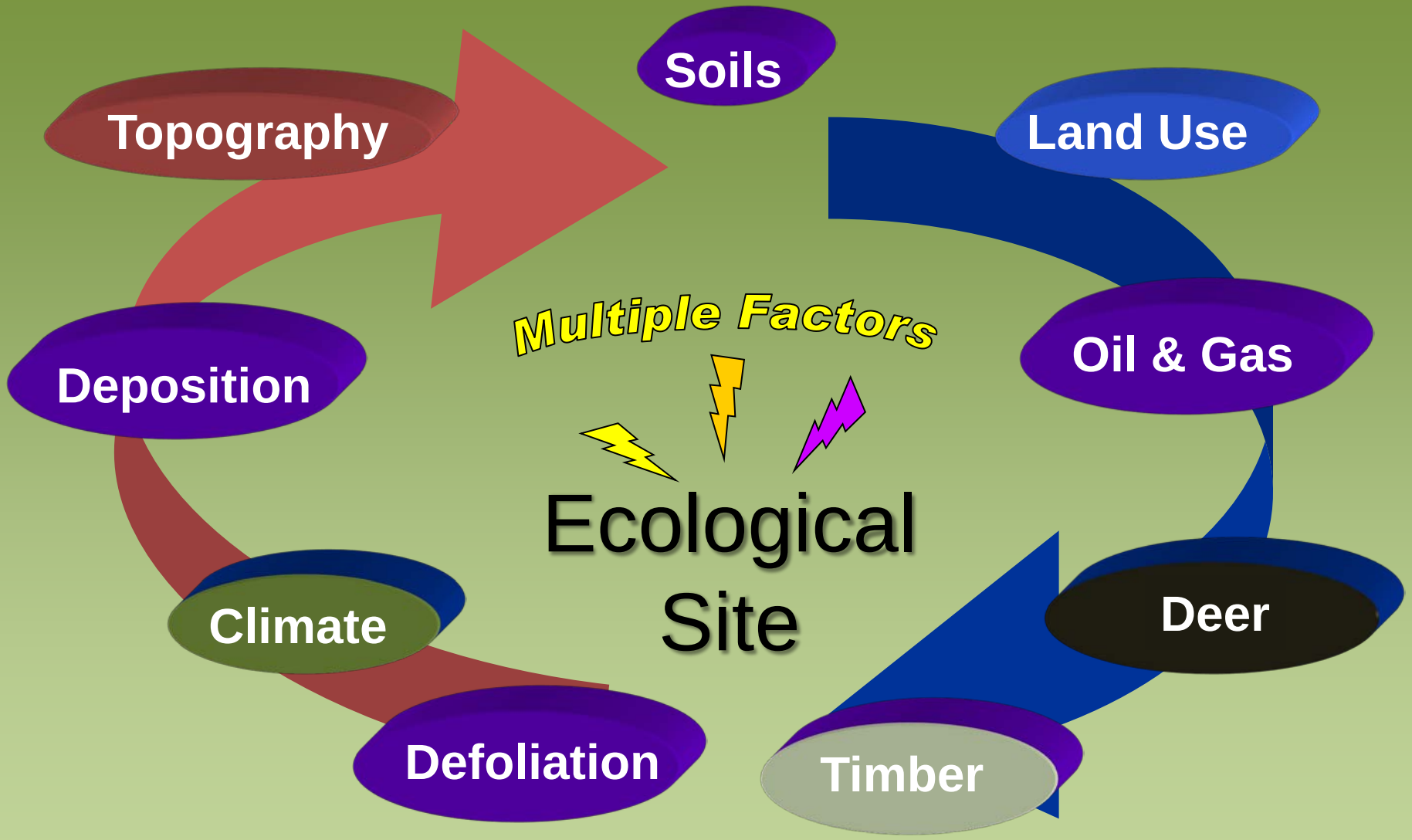
1. Identifying Ecological Sites in MLRAs 127 and 140, and developing Ecological Site Descriptions;
2. Quantifying soil change on select Ecological Sites; and
3. Developing preliminary S&T Models for select Ecological Sites.



Pennsylvania MLRA regions of interest.

Complex Land Use History

Does a Native Site Still Exist?

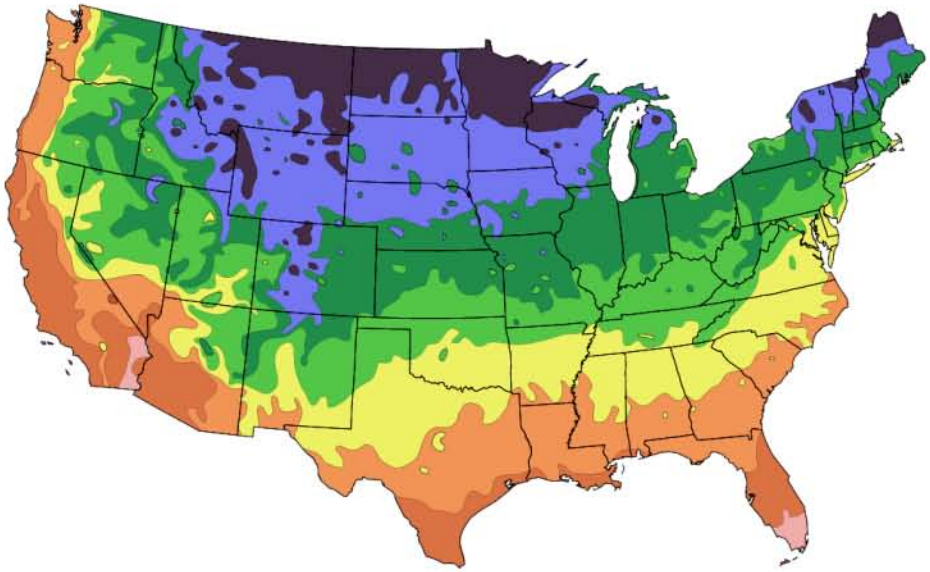


Example Conditions Affecting a Sugar Maple Eco-Site

Percent changes in forest composition with historic logging (Whitney, 1990).

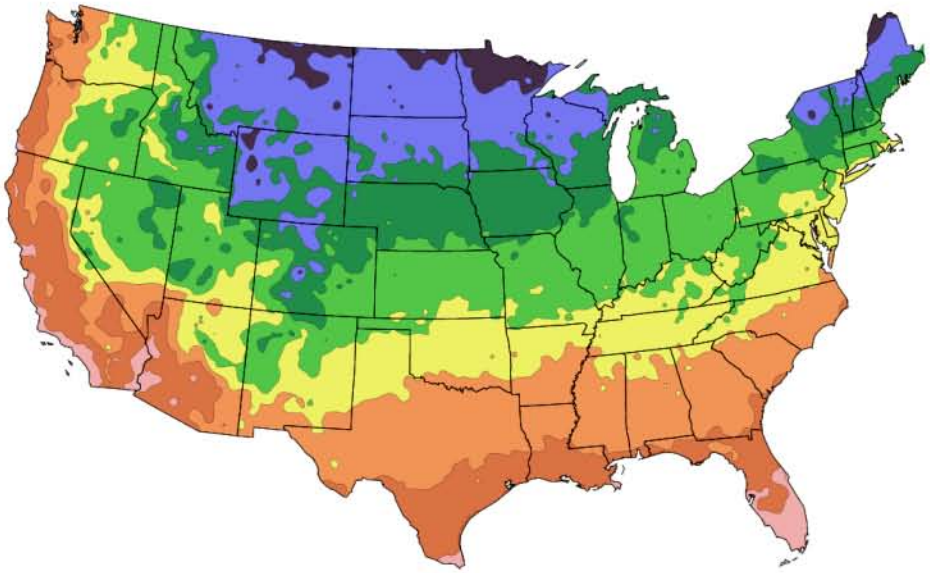
Species	*Pre-Settlement*	*Post Settlement*
Beech	44	6
Hemlock	20	6
Sugar Maple	5	13
Red Maple	5	27
White Pine	5	<1
Black Cherry	<1	23

1990 Map



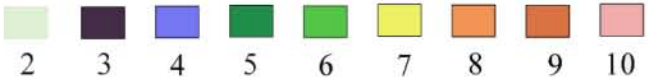
After USDA Plant Hardiness Zone Map, USDA Miscellaneous Publication No. 1475, Issued January 1990

2006 Map



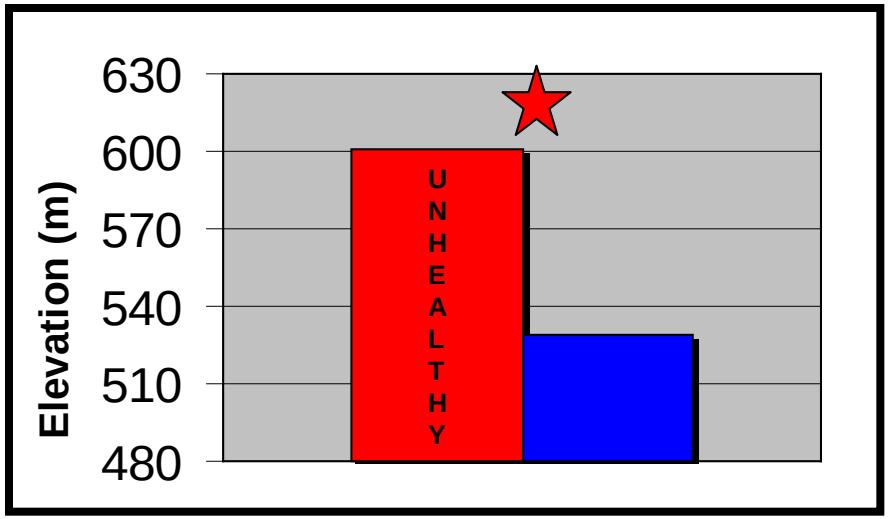
National Arbor Day Foundation Plant Hardiness Zone Map published in 2006.

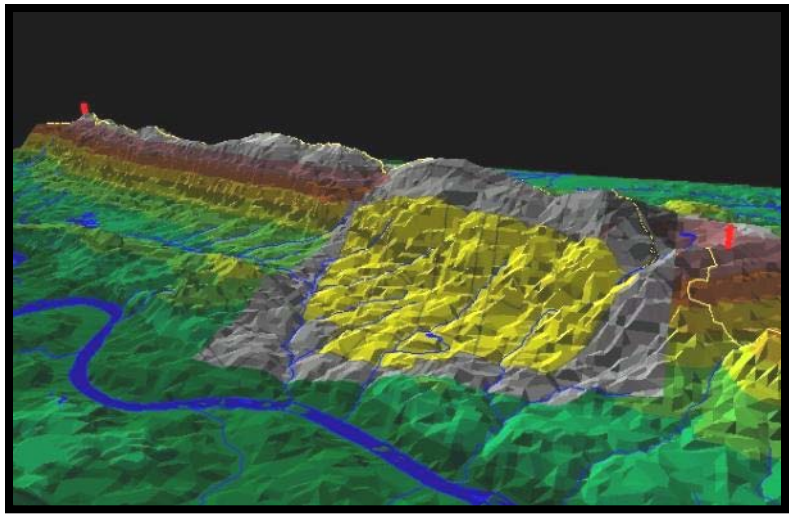
Zone



© 2006 by The National Arbor Day Foundation®

Elevation and Position





Change is subtle:
10 year period

Topo. Position	Decline	Non-declining	%Dead
Foot/toe slope	1	4	8%
Back slope	5	12	16%
Ridge/nose	3	3	21%
p-value		0.53	0.63

Drohan et al. (2002)

Sulfate Wet Deposition

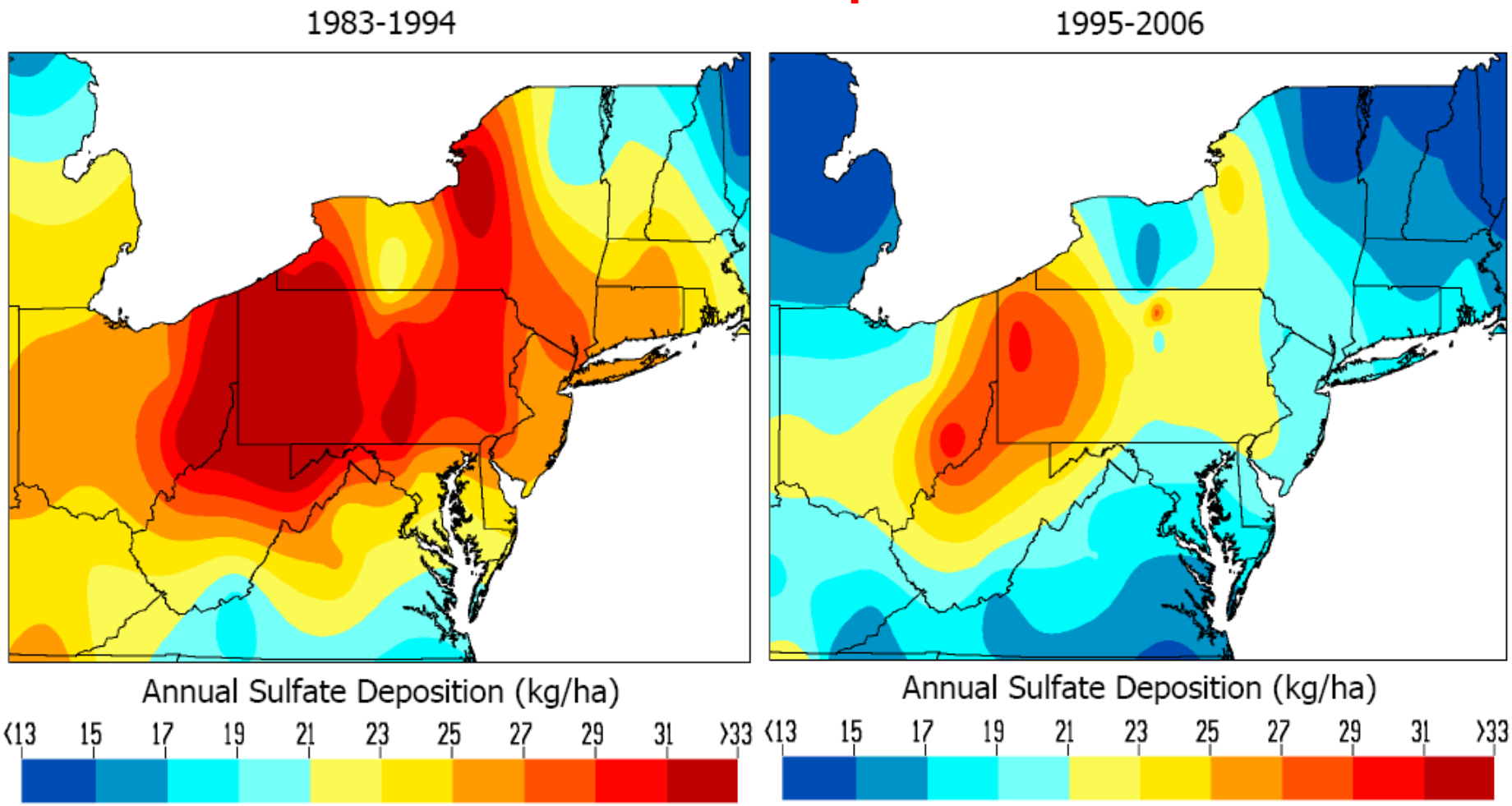
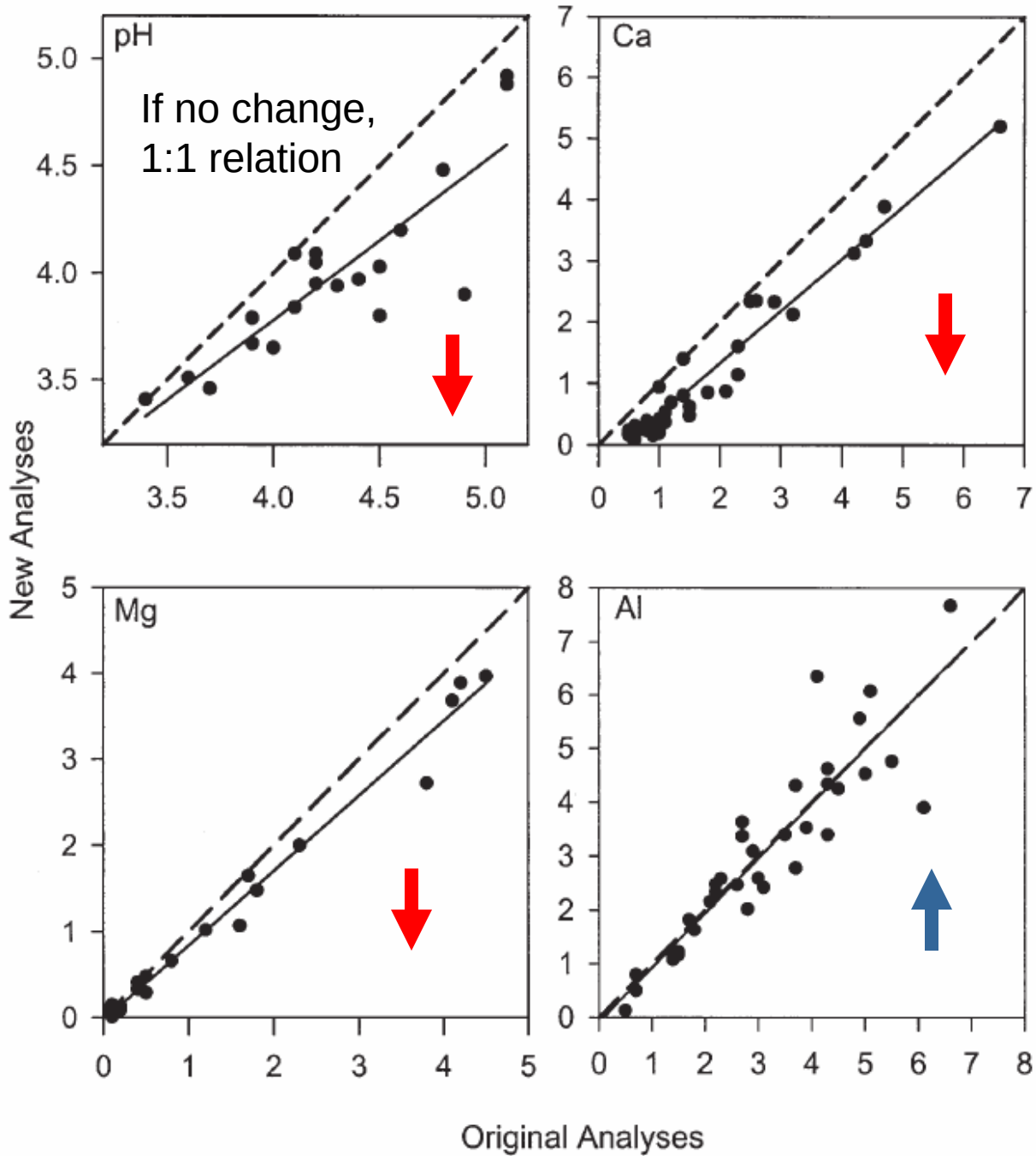


Figure 7. Mean annual sulfate wet deposition across Pennsylvania and neighboring states before (1983-1994) and after (1995-2006) implementation of Title IV of the Clean Air Act Amendments of 1990.

Frpm, Reductions in Acidic Wet Deposition Following Implementation of the Clean Air Act Amendments of 1990: 1995-2006
Authors: James A. Lynch, Hunter C. Carrick, Kevin S. Horner, Jeffrey W. Grimm

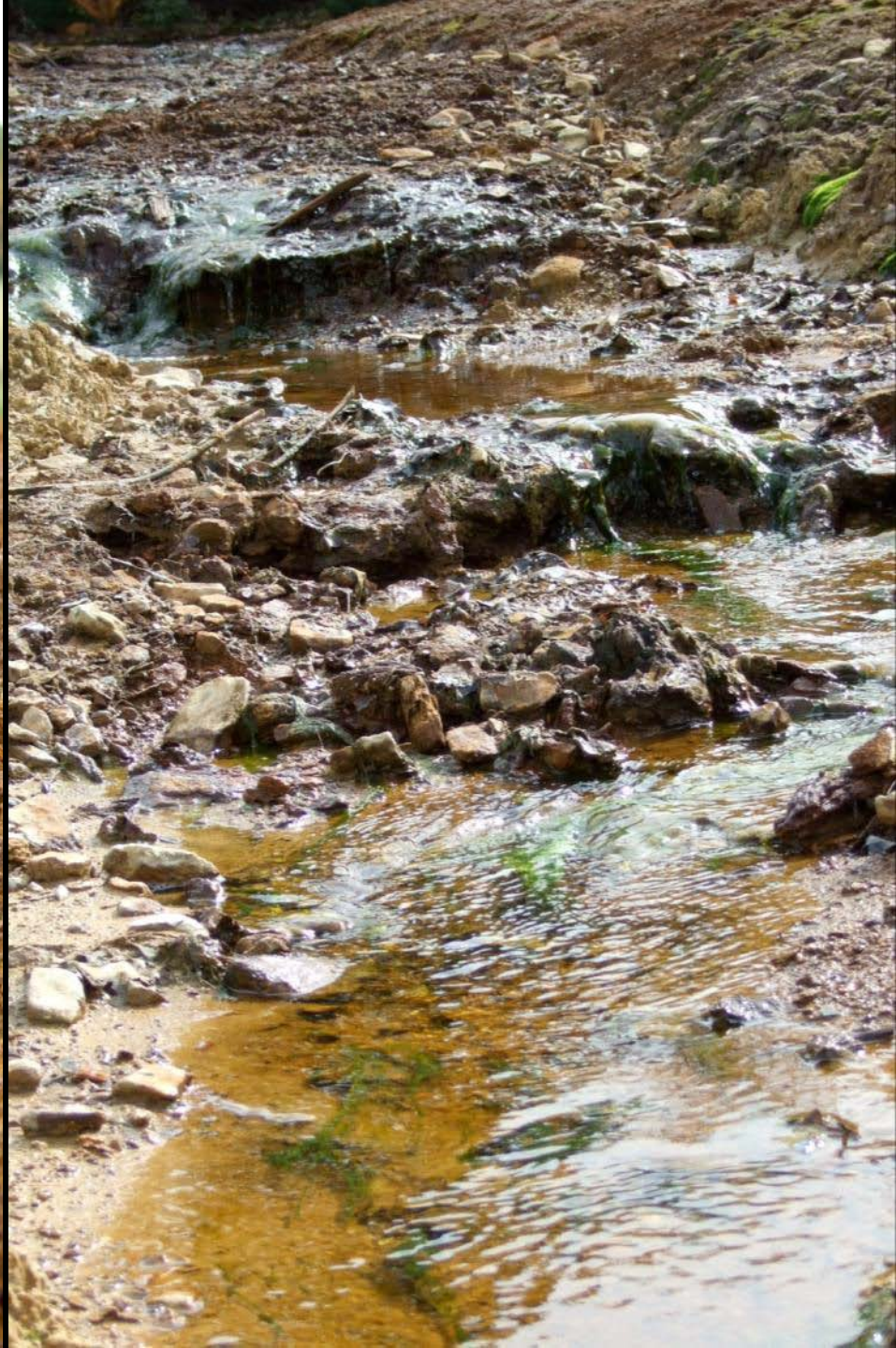
Soil chemistry change over 30 years

Original samples taken in 1967



Bailey et al. (2005)

AMD Surface Crusts



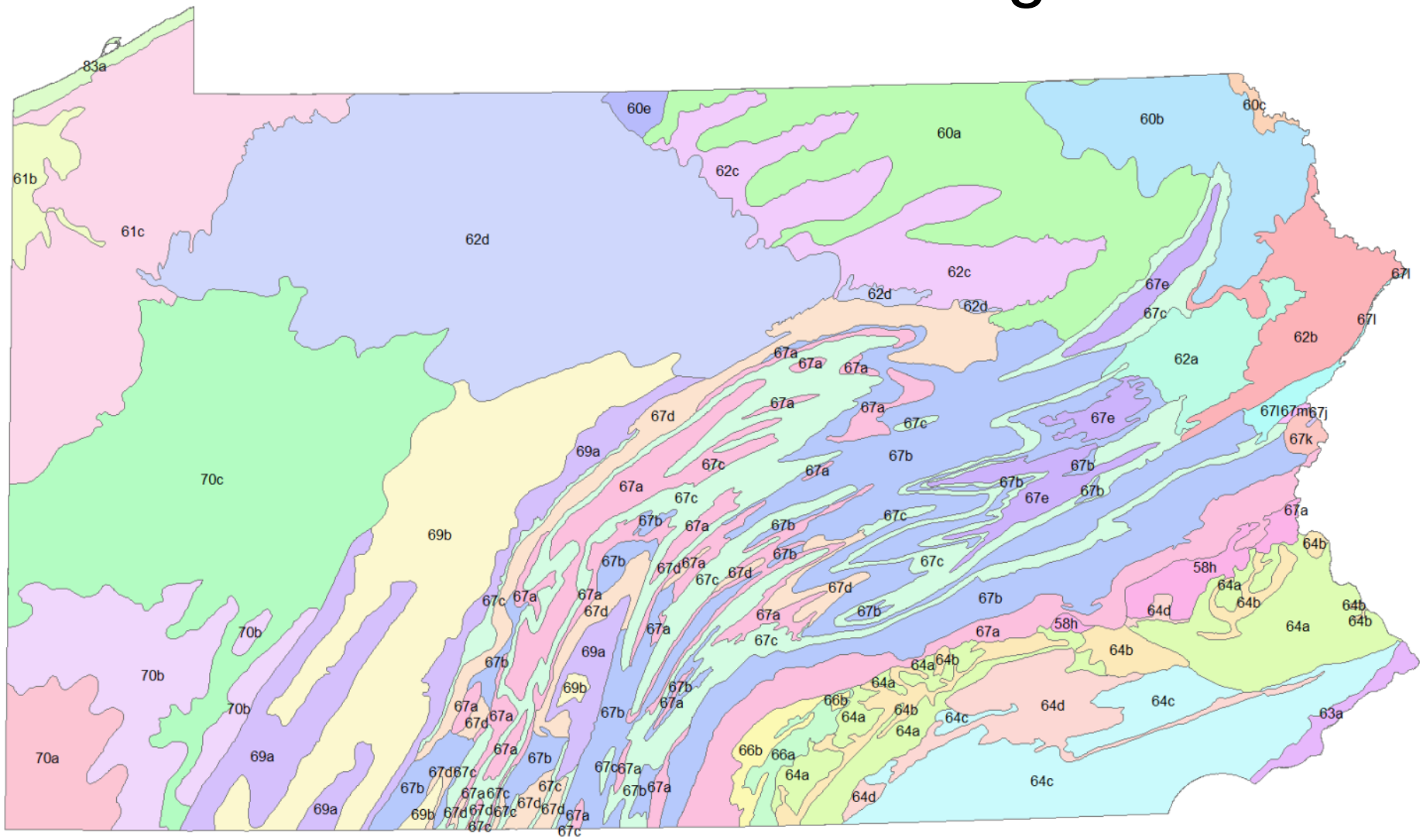
A
D
G
B
E
H
C
F
I

Finding Pennsylvania's Ecological Sites

Key Landscape/Soil Variables

- Topography
  - Slope, aspect, elevation
  - Concavity or convexity
  - Potential wetness or droughtiness
- Profile depth to a restricting layer
  - Drainage class
- Inherent versus dynamic properties
  - Mineralogy, texture, structure or lack of

1. EPA Level 4 Ecoregions



Woods et al. (1999)

EPA Lvl 4 Ecoregions

62e. Low Catskills

The Low Catskills (62e) is a forested and highly dissected ecoregion less than 5 miles (8 km) wide in northeastern Pennsylvania. Here, the Delaware River **has deeply entrenched** into the glaciated Appalachian Plateau, creating cliffs and steep-walled valleys. Many high-gradient tributaries occur and stream organisms associated with riffles are common. **Topography** is rugged for this part of the commonwealth and local relief ranges from about 450 to 800 feet (137-244 m). Crestal elevations are from approximately 1,300 to 1,800 feet (396-549 m) and are high enough to insure a short growing season of about 130 days, varying according to local topography and slope aspect.

1.

2.

The soils of Ecoregion 62e are mostly Inceptisols. Most formed on Olean Till and some developed on Quaternary alluvium. They overlie nearly horizontal, Devonian age sandstone, siltstone, and shale of the Catskill Formation. The **soils** are characterized by stoniness, shallowness, low fertility, and acidity, which, together with the rugged terrain and brief growing season, make the area best suited to woodland (Higbee, 1967). **The natural vegetation** was mostly Northern Hardwoods (dominants: sugar maple, yellow birch, beech, and hemlock) (Cuff and others, 1989, p. 52). Some wetland vegetation occurs on poorly drained sites, and northern rock plants grow on the Delaware River cliffs in northeastern Wayne County (Erdman and Wiegman, 1974, p. 50).

3.

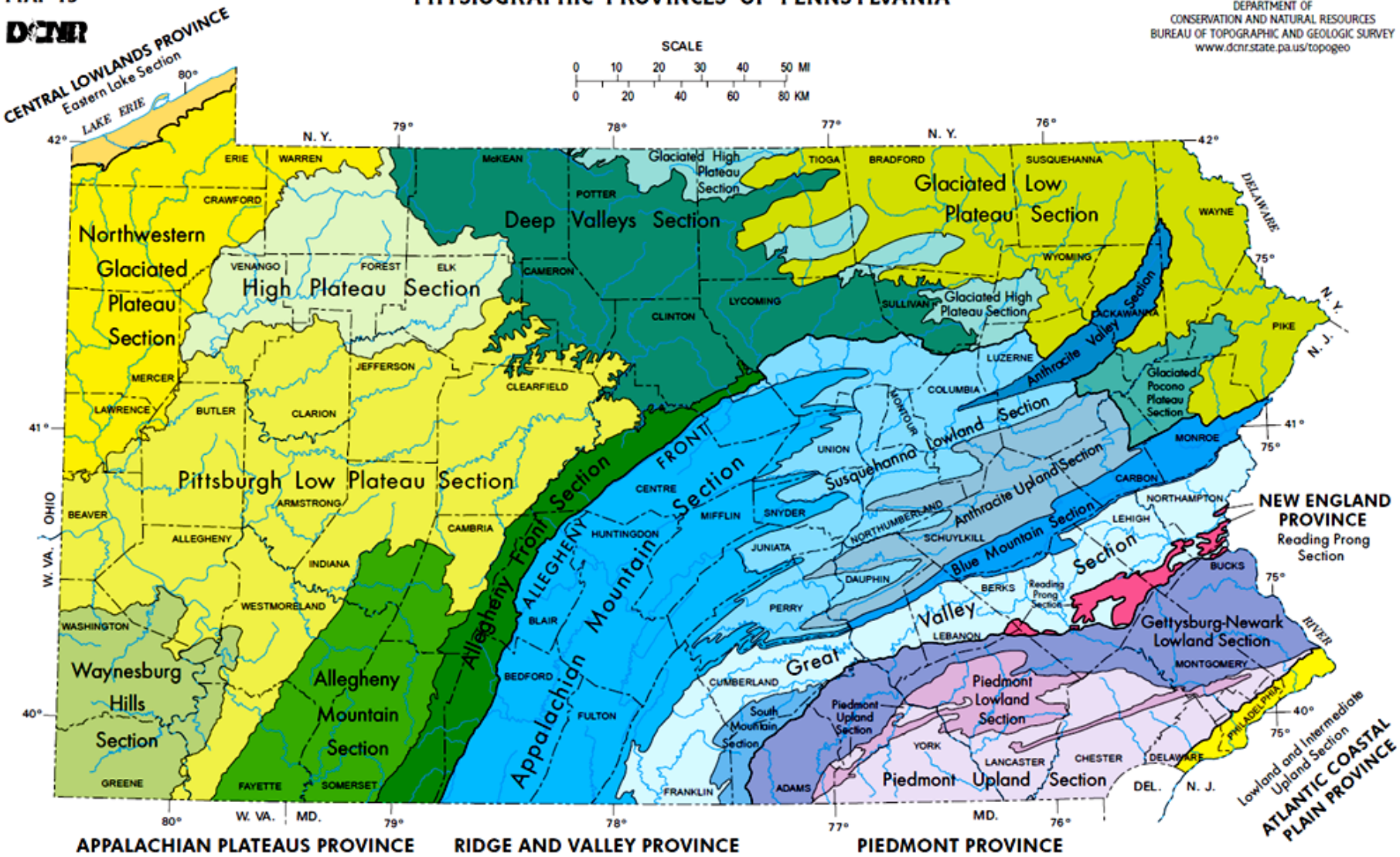
4.

The boundary between Ecoregion 62e and the less dissected Northeastern Uplands (60b) occurs at the forest density and topography break shown on the Scranton 1:250,000-scale topographic map; Ecoregion 62e is much more rugged and wooded than Ecoregion 60b. Ecoregion 62e extends across the Delaware River into New York, where it becomes much more extensive.

MAP 13

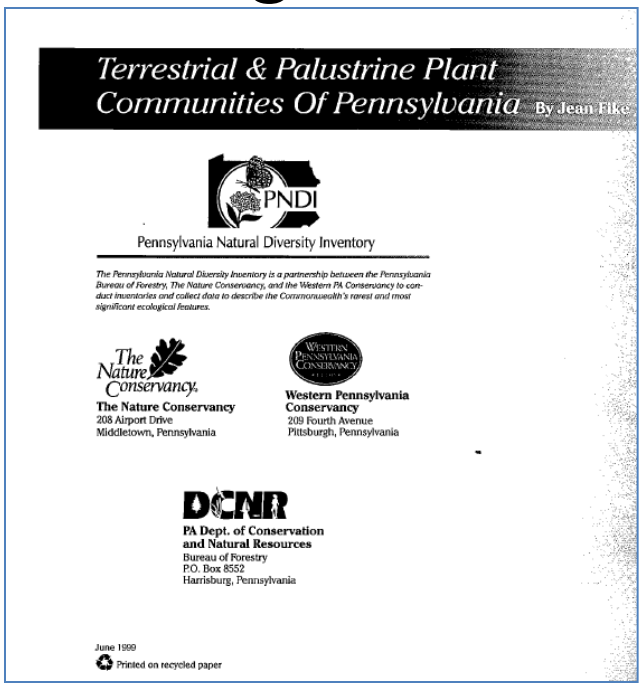
PHYSIOGRAPHIC PROVINCES OF PENNSYLVANIA

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF
CONSERVATION AND NATURAL RESOURCES
BUREAU OF TOPOGRAPHIC AND GEOLOGIC SURVEY
www.dcnr.state.pa.us/topogeo



Compiled by W. D. Sevon. Fourth Edition, 2000.

2. Vegetation, state specific data



Terrestrial & Palustrine Plant Communities Of Pennsylvania By Jean Fike

PNDI

Pennsylvania Natural Diversity Inventory

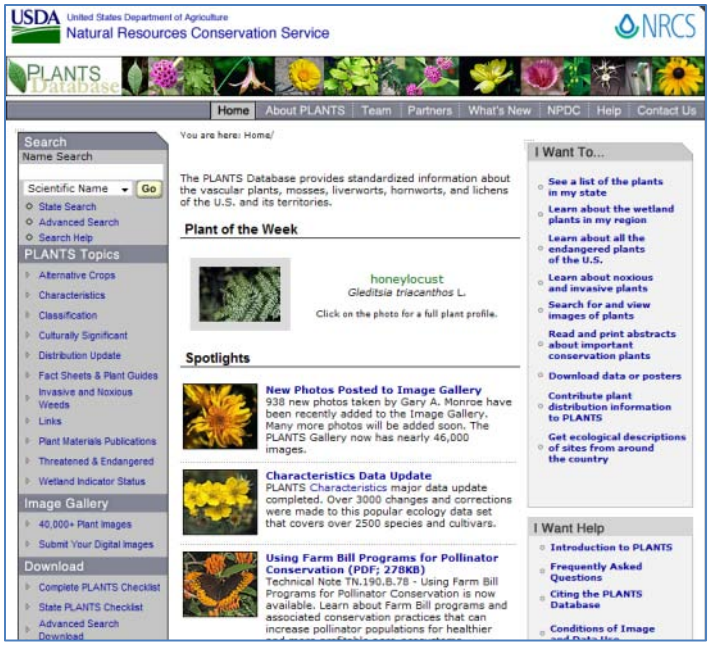
The Pennsylvania Natural Diversity Inventory is a partnership between the Pennsylvania Bureau of Forestry, The Nature Conservancy, and the Western PA Conservancy to conduct inventories and collect data to describe the Commonwealth's rarest and most significant ecological features.

The Nature Conservancy
208 Airport Drive
Middletown, Pennsylvania

Western Pennsylvania Conservancy
209 Fourth Avenue
Pittsburgh, Pennsylvania

DCNR
PA Dept. of Conservation and Natural Resources
Bureau of Forestry
P.O. Box 8552
Harrisburg, Pennsylvania

June 1999
Printed on recycled paper



USDA United States Department of Agriculture
Natural Resources Conservation Service
NRCS

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The PLANTS Database provides standardized information about the vascular plants, mosses, liverworts, hornworts, and lichens of the U.S. and its territories.

Plant of the Week

honeylocust
Gleditsia triacanthos L.
Click on the photo for a full plant profile.

Spotlights

New Photos Posted to Image Gallery
938 new photos taken by Gary A. Monroe have been recently added to the Image Gallery. Many more photos will be added soon. The PLANTS Gallery now has nearly 46,000 images.

Characteristics Data Update
PLANTS Characteristics major data update completed. Over 3000 changes and corrections were made to this popular ecology data set that covers over 2500 species and cultivars.

Using Farm Bill Programs for Pollinator Conservation (PDF; 278KB)
Technical Note TN.190.B.78 - Using Farm Bill Programs for Pollinator Conservation is now available. Learn about Farm Bill programs and associated conservation practices that can increase pollinator populations for healthier

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See a list of the plants in my state
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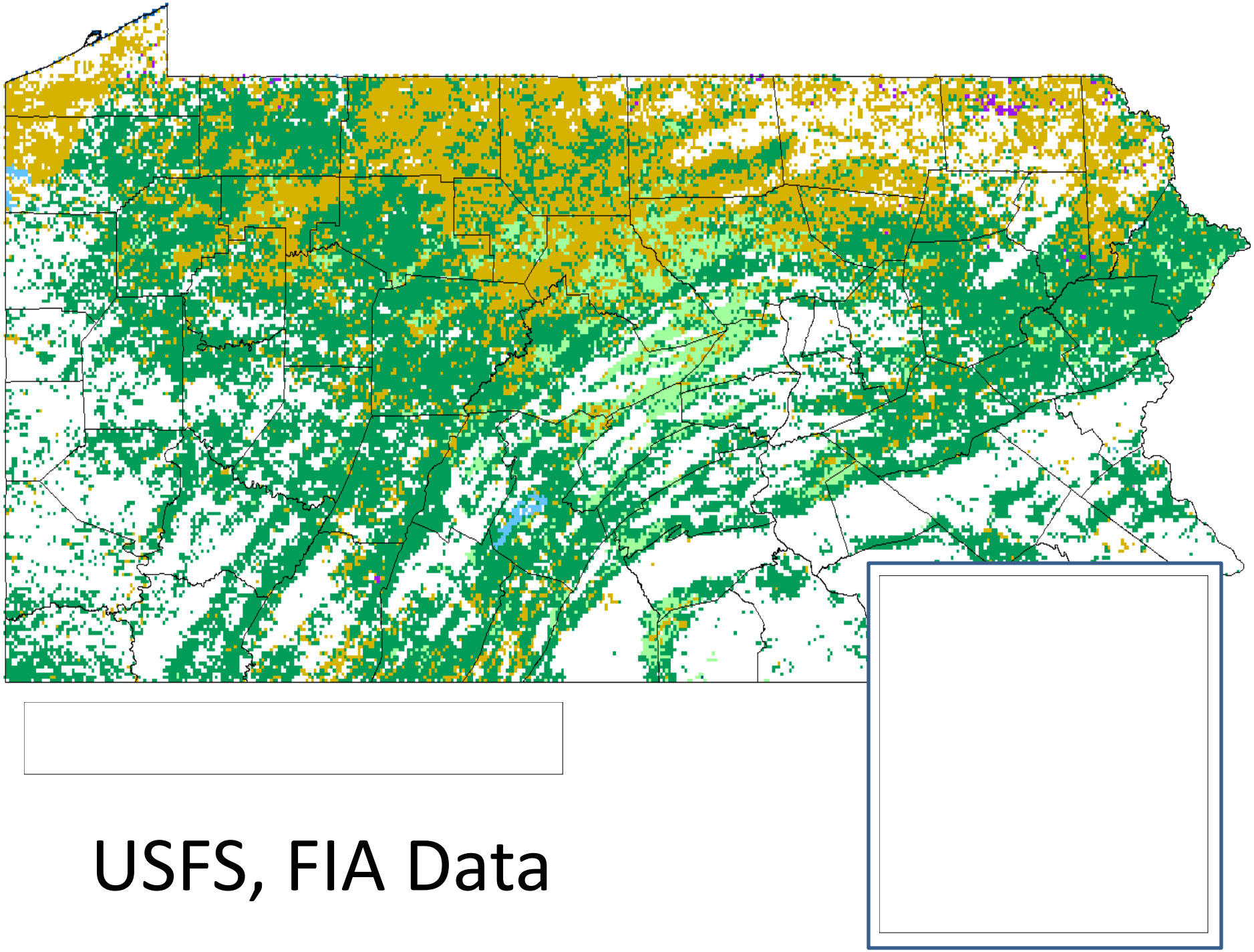
PA GAP

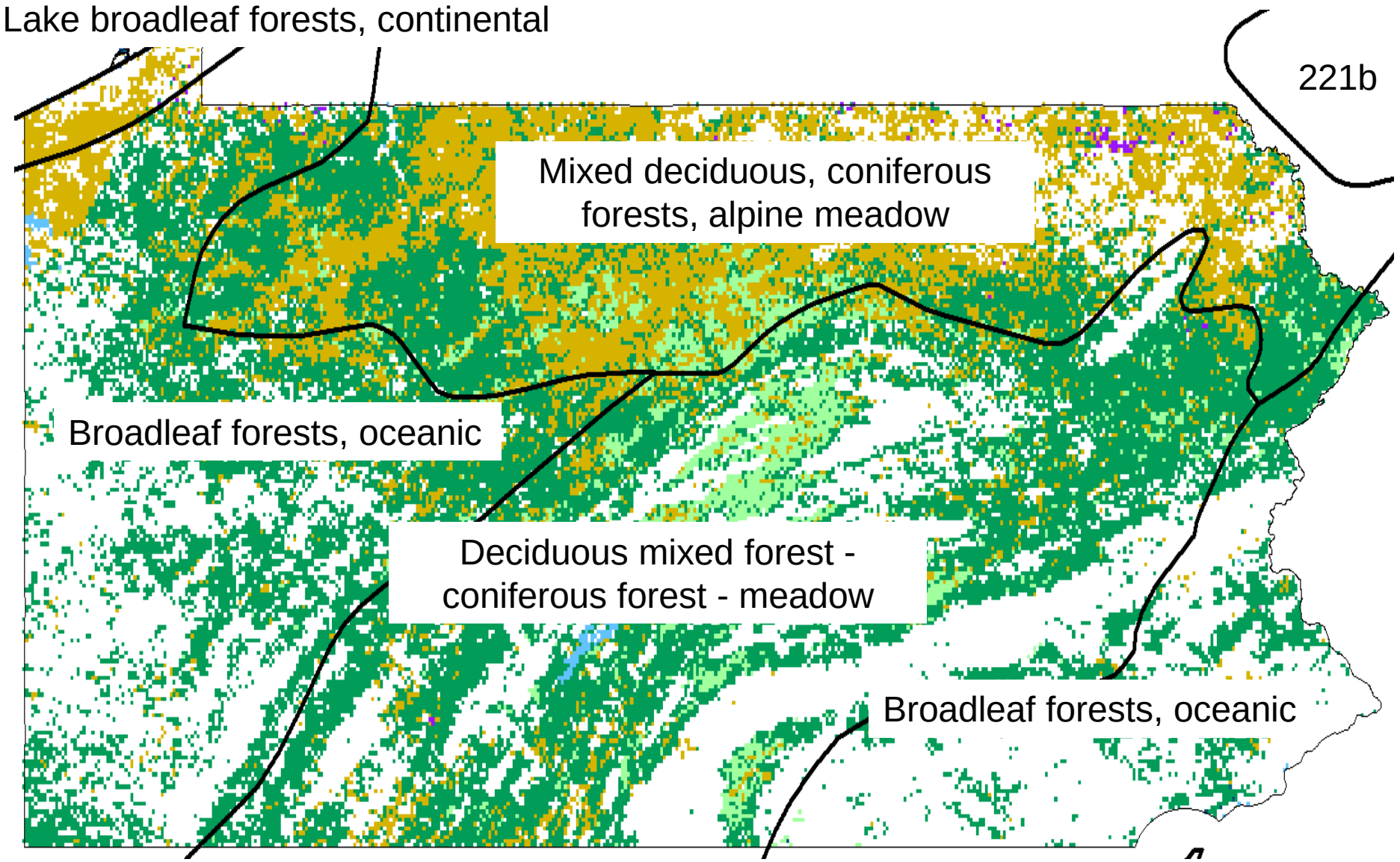
PENNSYLVANIA GAP ANALYSIS PROJECT

A geographic approach to planning for biological diversity



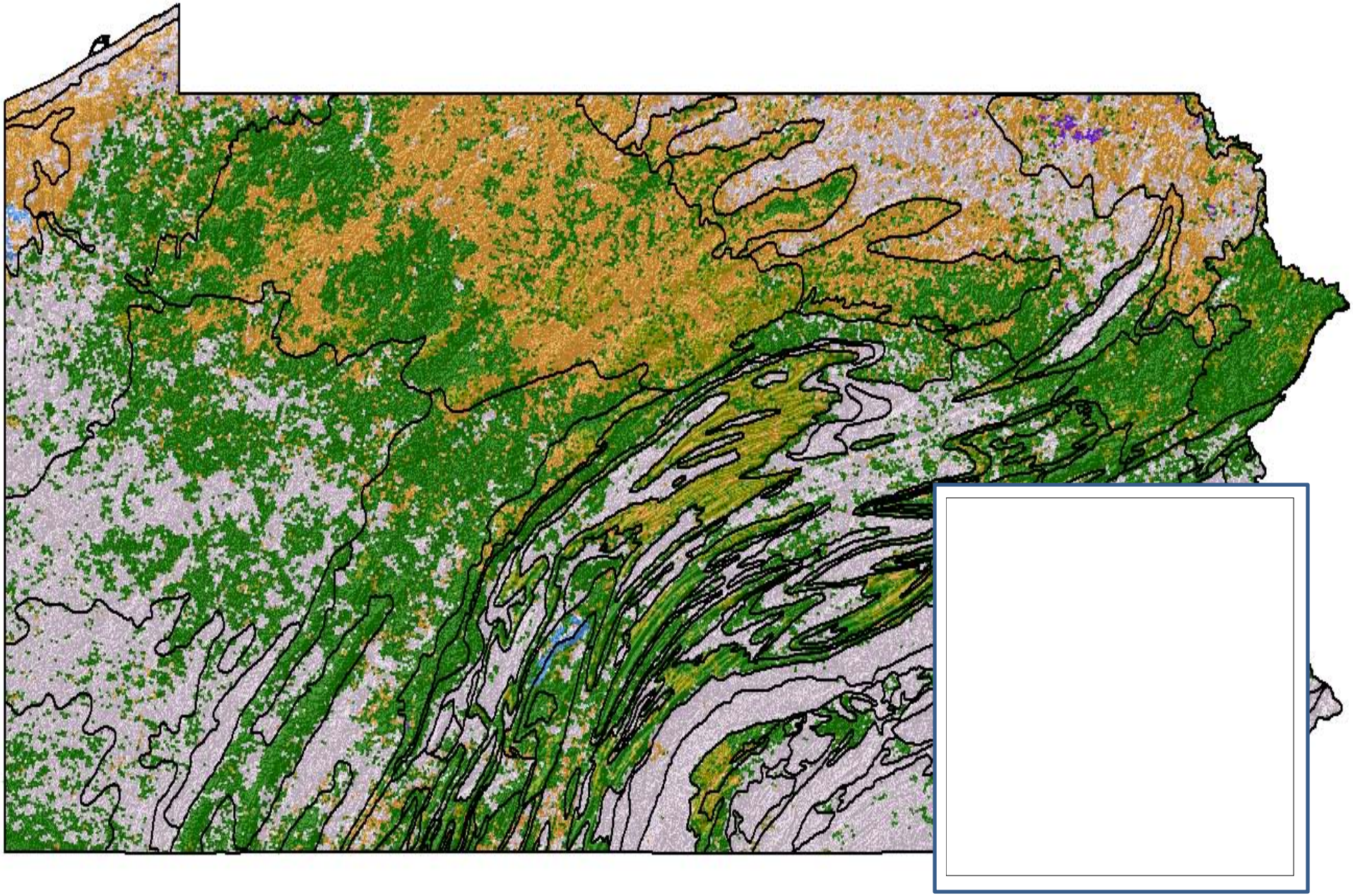
USFS, FIA Data

USEPA Ecoregions and FIA data

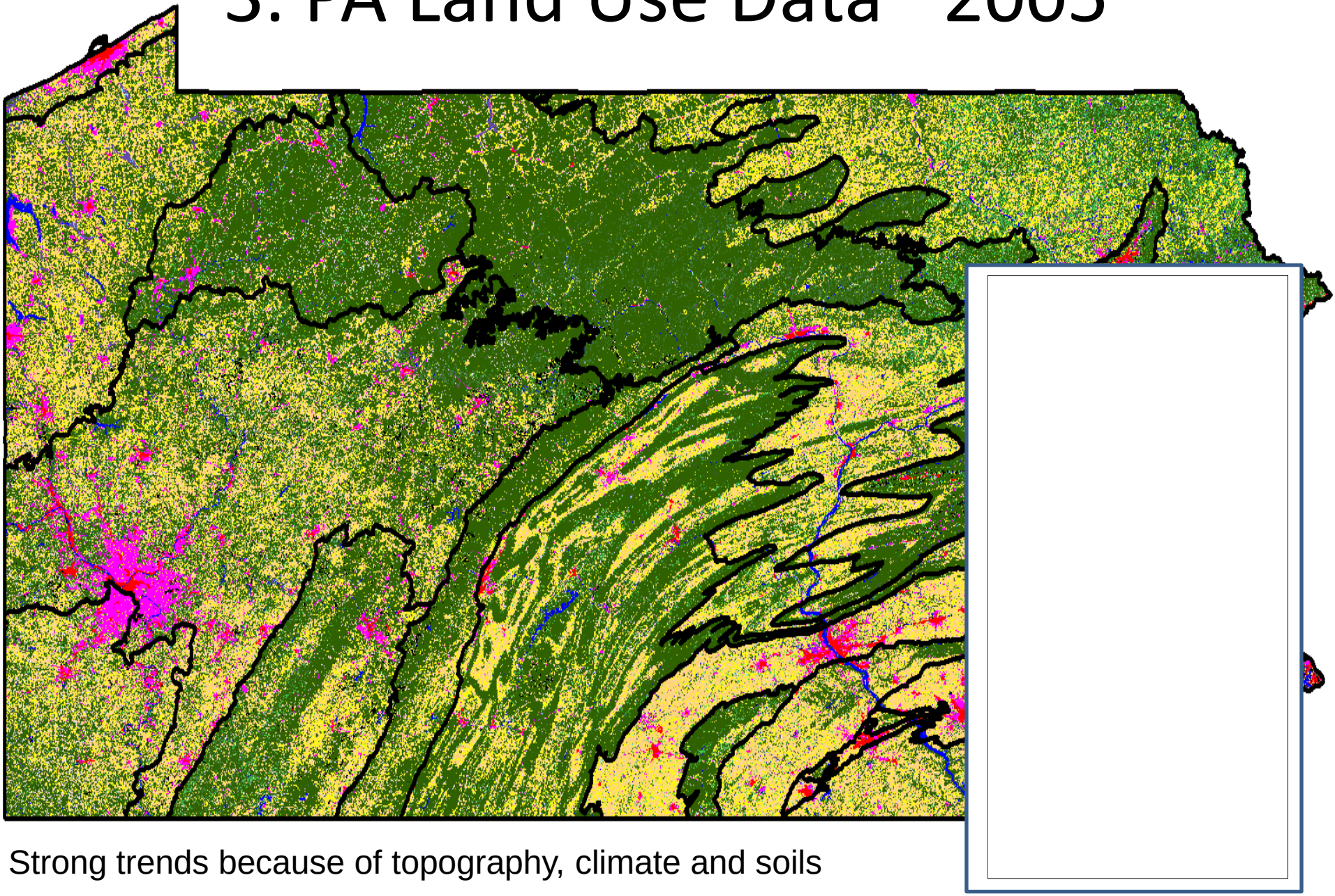


McNab et al. (2005)

USEPA Level 4 Ecoregions and FIA Data



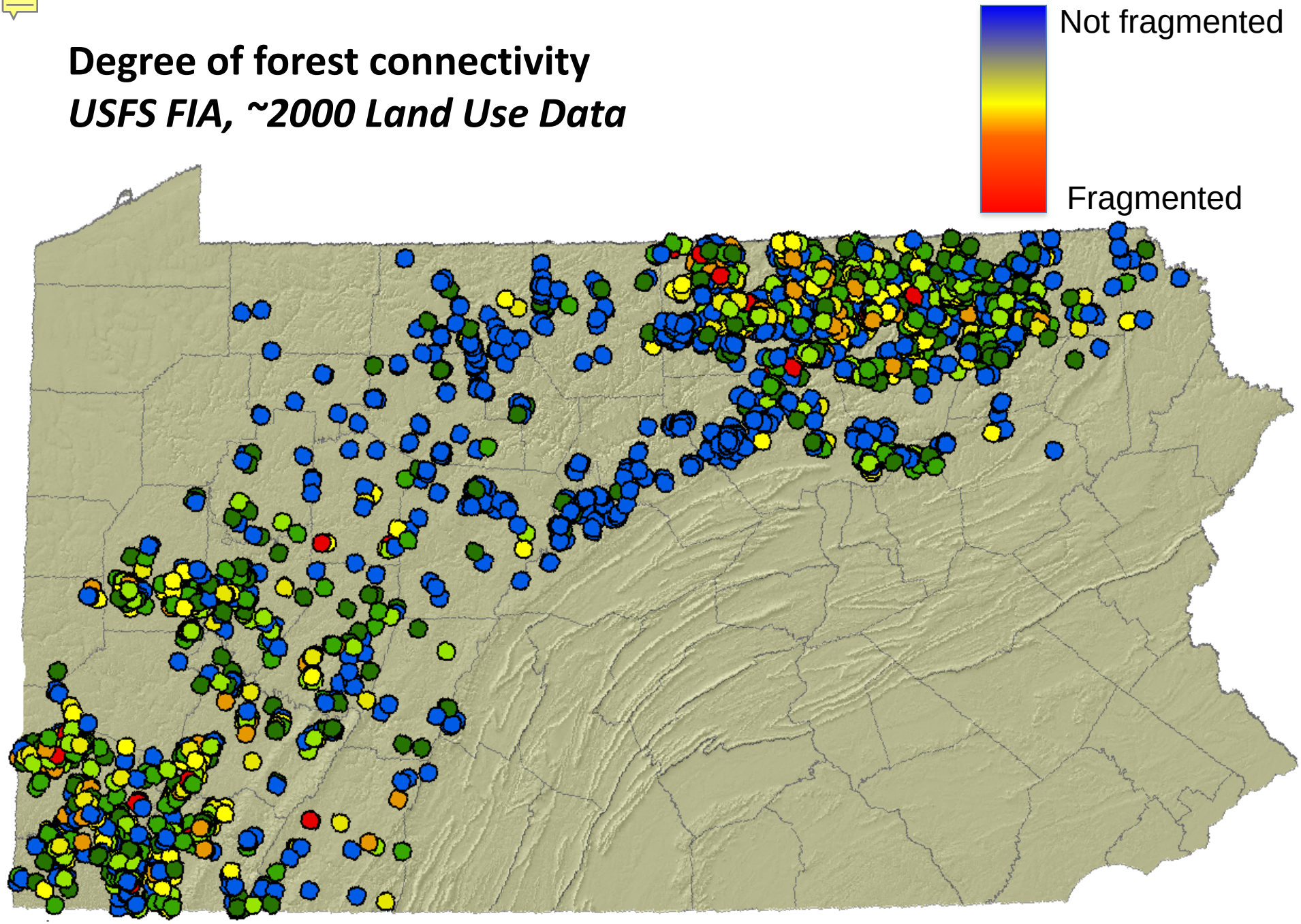
3. PA Land Use Data ~2005



Strong trends because of topography, climate and soils

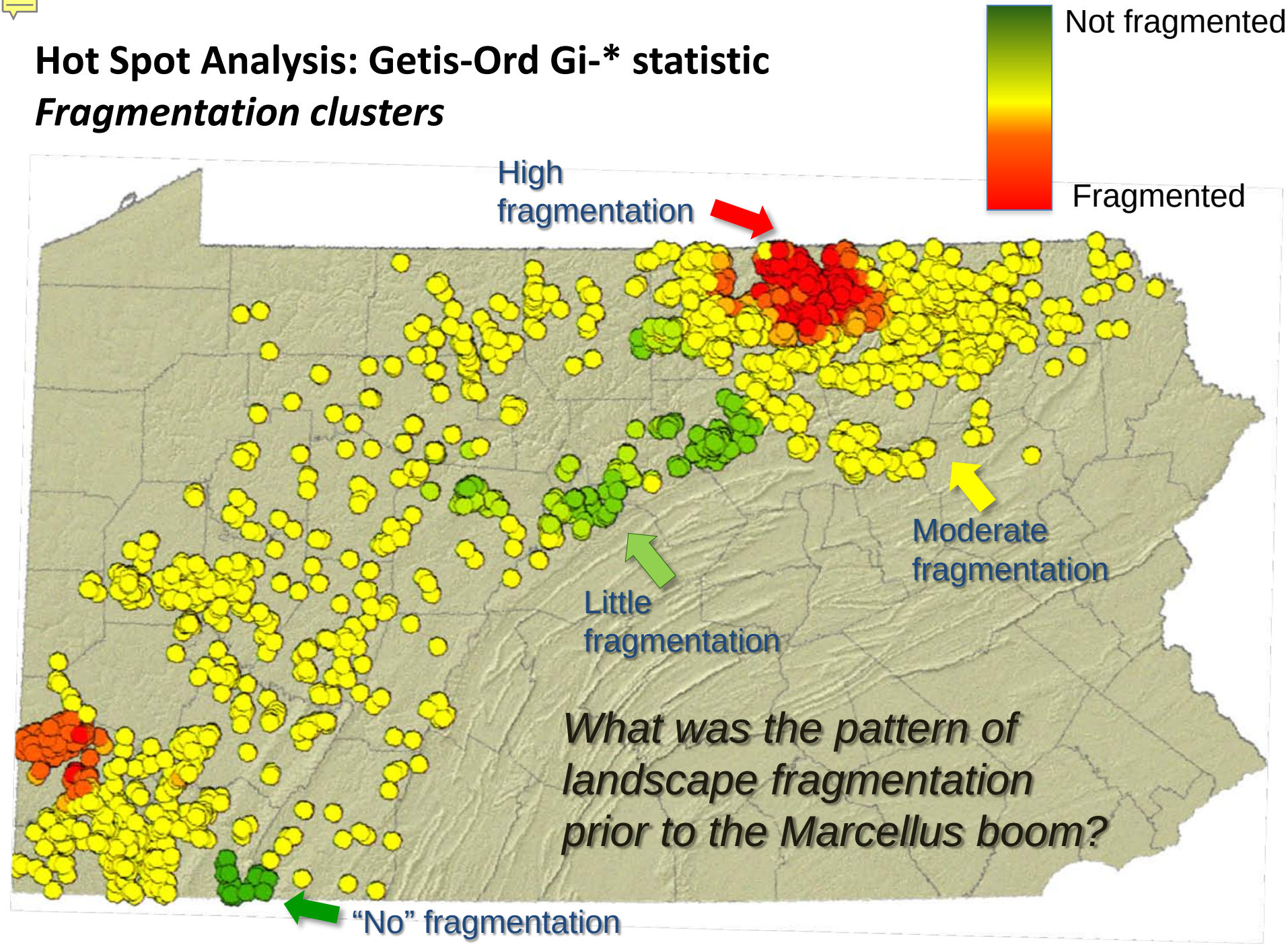
Degree of forest connectivity

USFS FIA, ~2000 Land Use Data

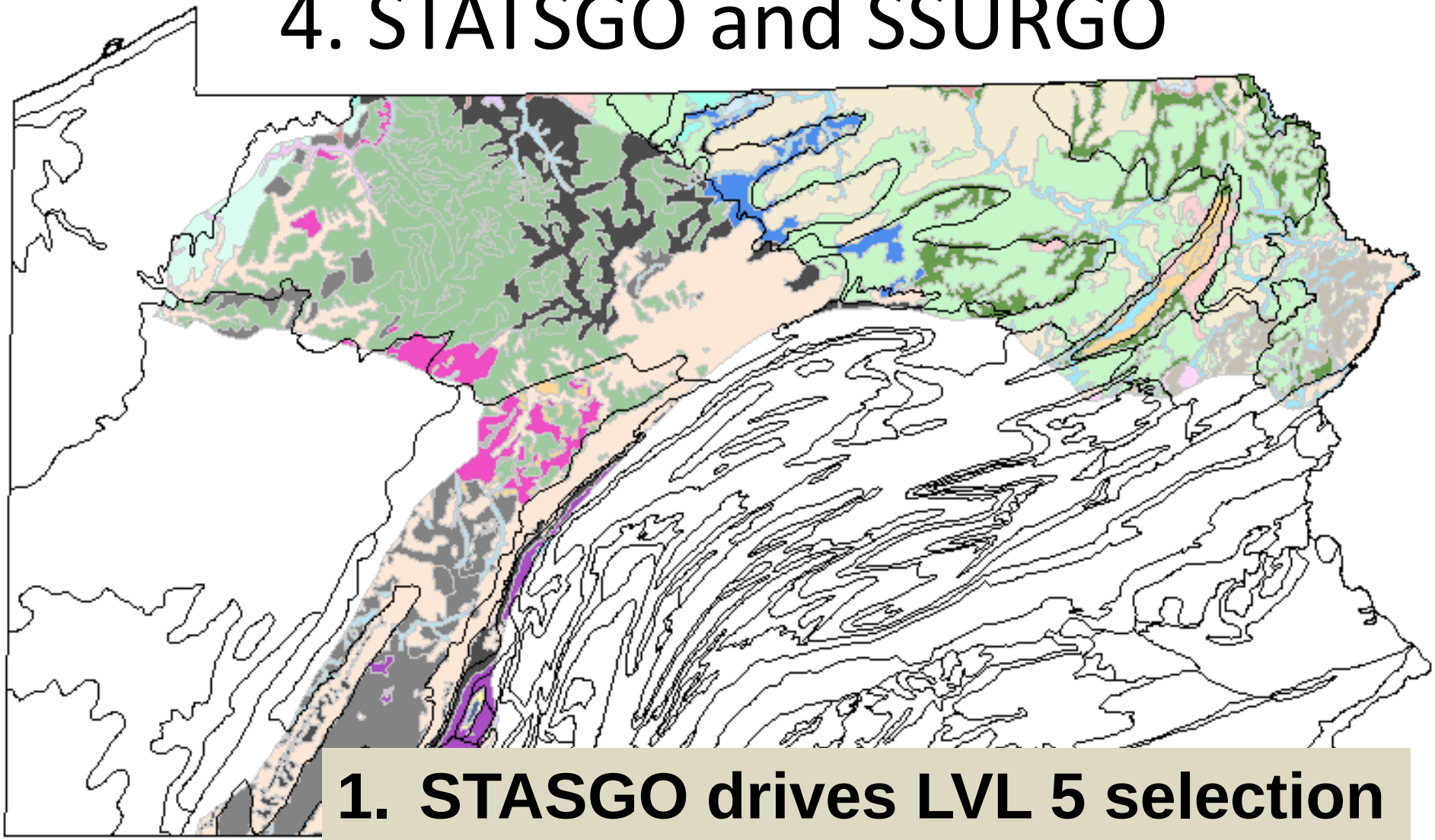


Hot Spot Analysis: Getis-Ord Gi-* statistic

Fragmentation clusters

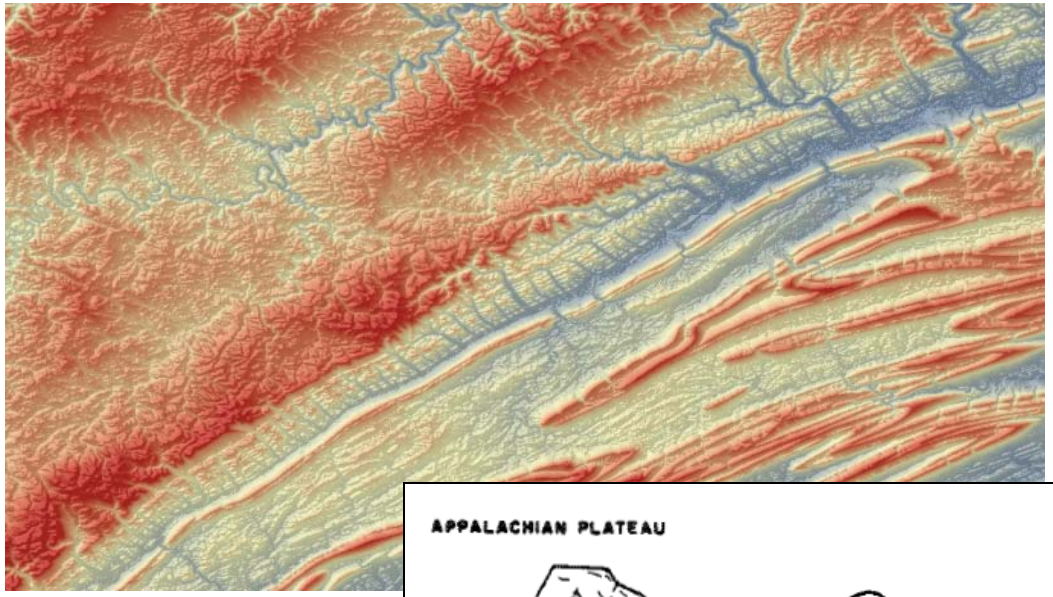


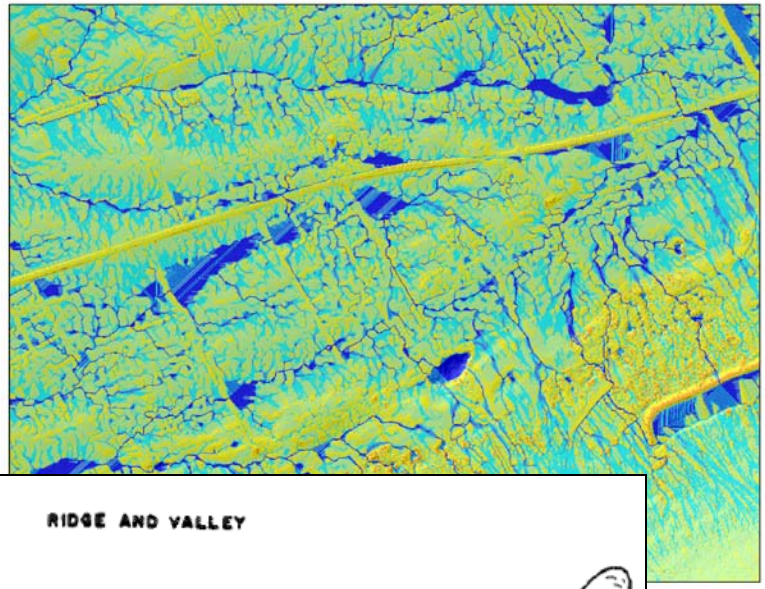
4. STATSGO and SSURGO

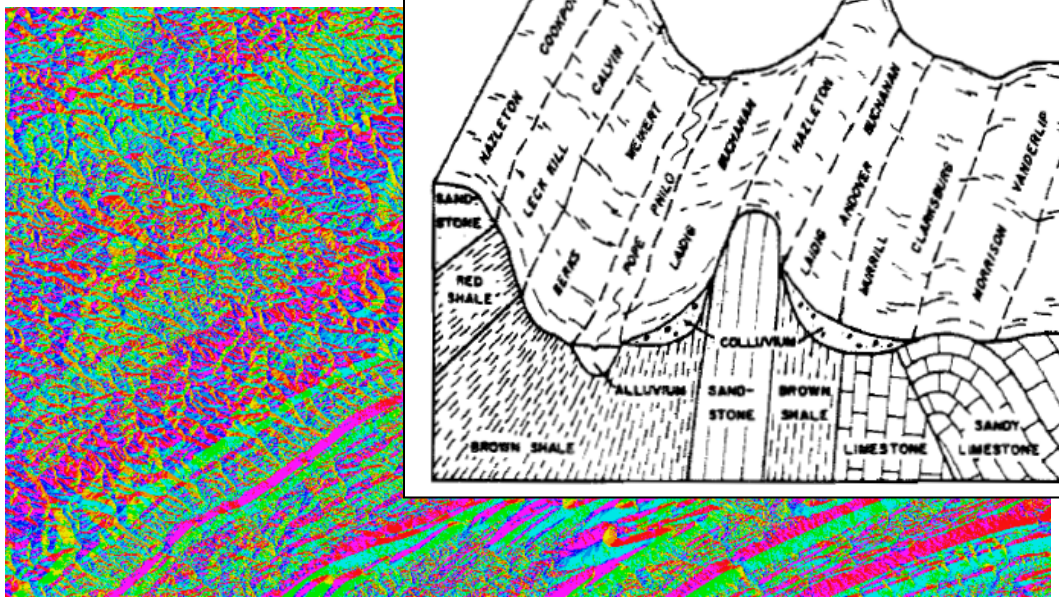


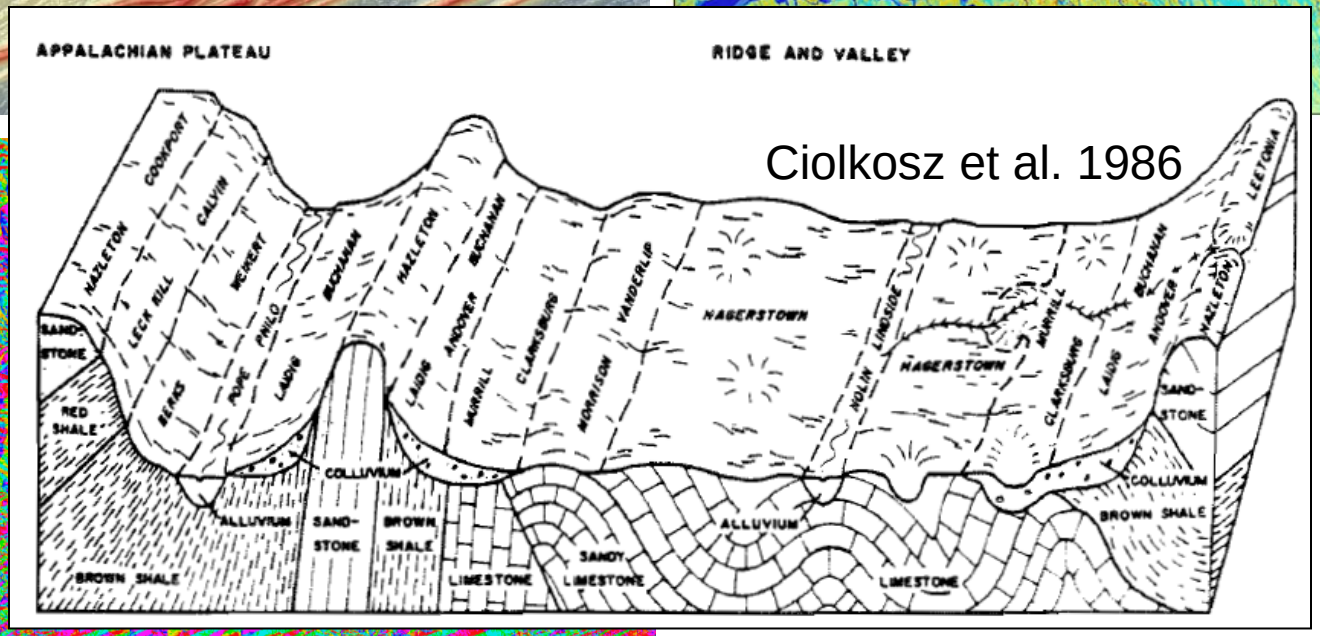
1. **STASGO drives LVL 5 selection**
2. **SSURGO refines ESs (LVL 6)**

4. Topography

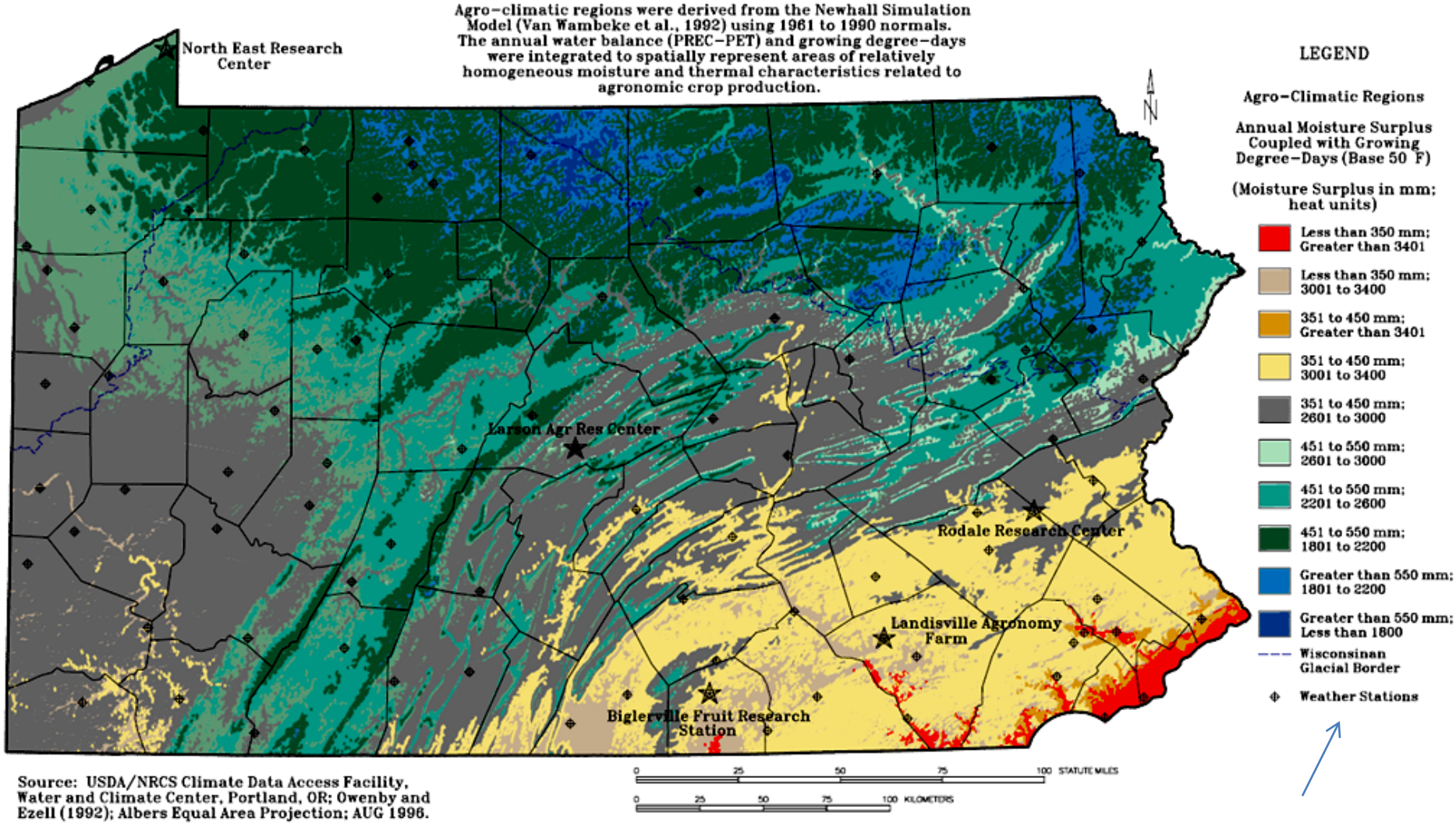








6. Agro-Climatic Regimes



Source: USDA/NRCS Climate Data Access Facility, Water and Climate Center, Portland, OR; Owenby and Ezell (1992); Albers Equal Area Projection; AUG 1996.

Figure 15. Agro-climatic regions of Pennsylvania.

Moisture-surplus in mm; heat units

Soil Climate Regimes of PA
Waltman et al. (1997)

Pennsylvania Ecological Sites

- Wildland(MLRA 127 and 140): ~26 so far
- Wetland (state-wide): 15 -17 based on Brooks et al. (2011)
- Subaqueous (state-wide): 8-11 based on Erich (2010), and non-published work.
- Agricultural and Urban areas are “states” of Ecological Sites.

Key Observations of States

- Change from native in %cover, basal area or stand index
- O horizon presence *relative to native*
- A horizon thickness (or A over Ap)
- Truncated profiles; no silt loam A….right to a silty clay.
- Buried surfaces (Euro-alluvium)
- Whole profile %OC
- Phosphorus
- pH and conductivity (too flashy?)

Ecological States

- Urban/Suburban
  - New (>30% veg)
  - Old (>25 years per Scharenbroch et al. (2005); >30% veg)
  - Park/Native
  - Transition/Abandoned lot
  - Built/Industrial; ~100% surface sealed

Ecological States

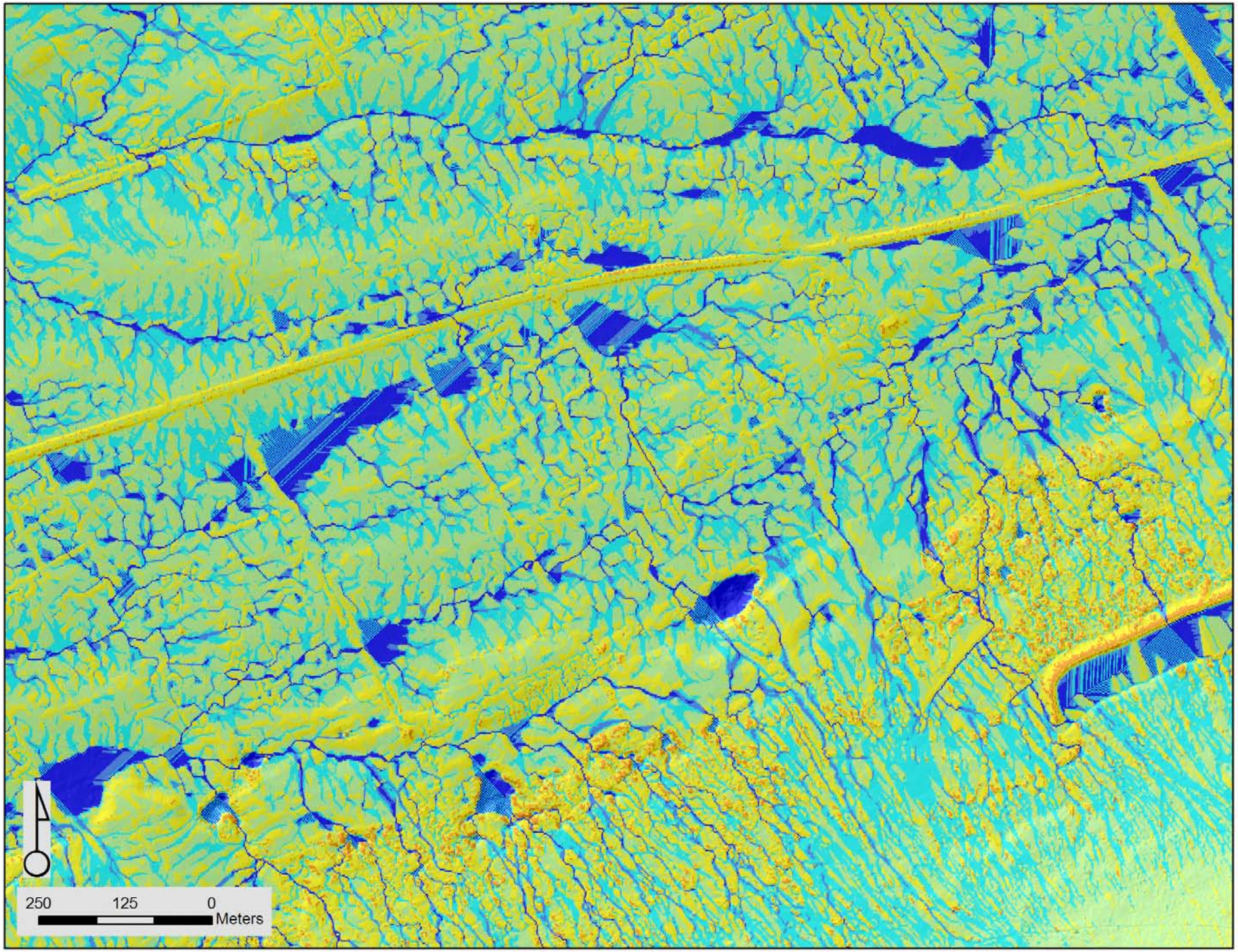
- Agricultural
  - *Prime*: row cropping
  - *Secondary*: pasture or CRP (tertiary?)
  - *Degraded*: abandoned/transitional or eroded lands

Ecological States

- Wildlands
  - Old growth
  - Secondary timber – old growth model
  - Secondary timber – managed for “x”
  - Secondary timber – degraded
  - Rights-of-way
  - Shrub-land natural recovery
  - Shrub-land due to disturbance

An Example…..

250
125
0
Meters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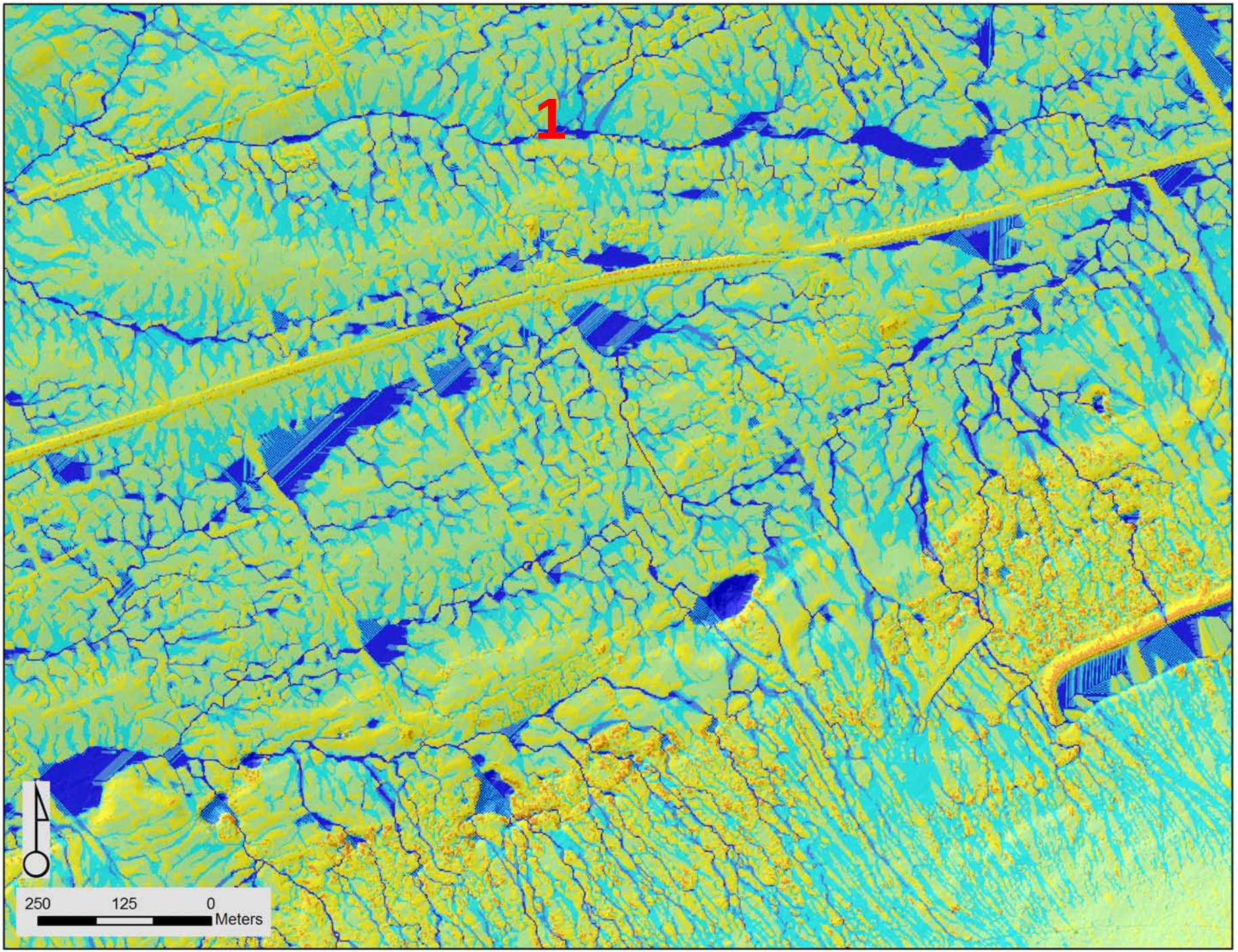
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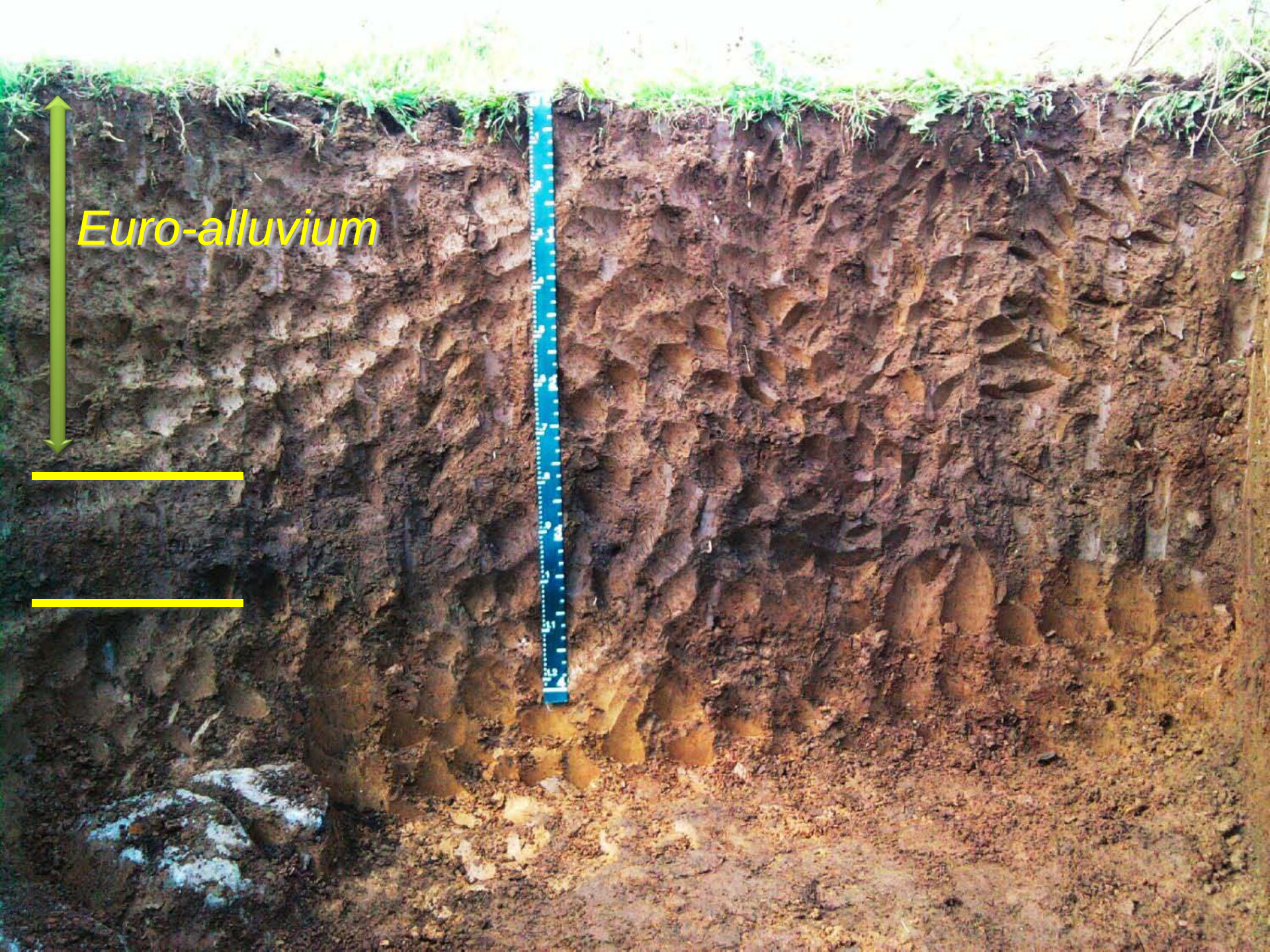
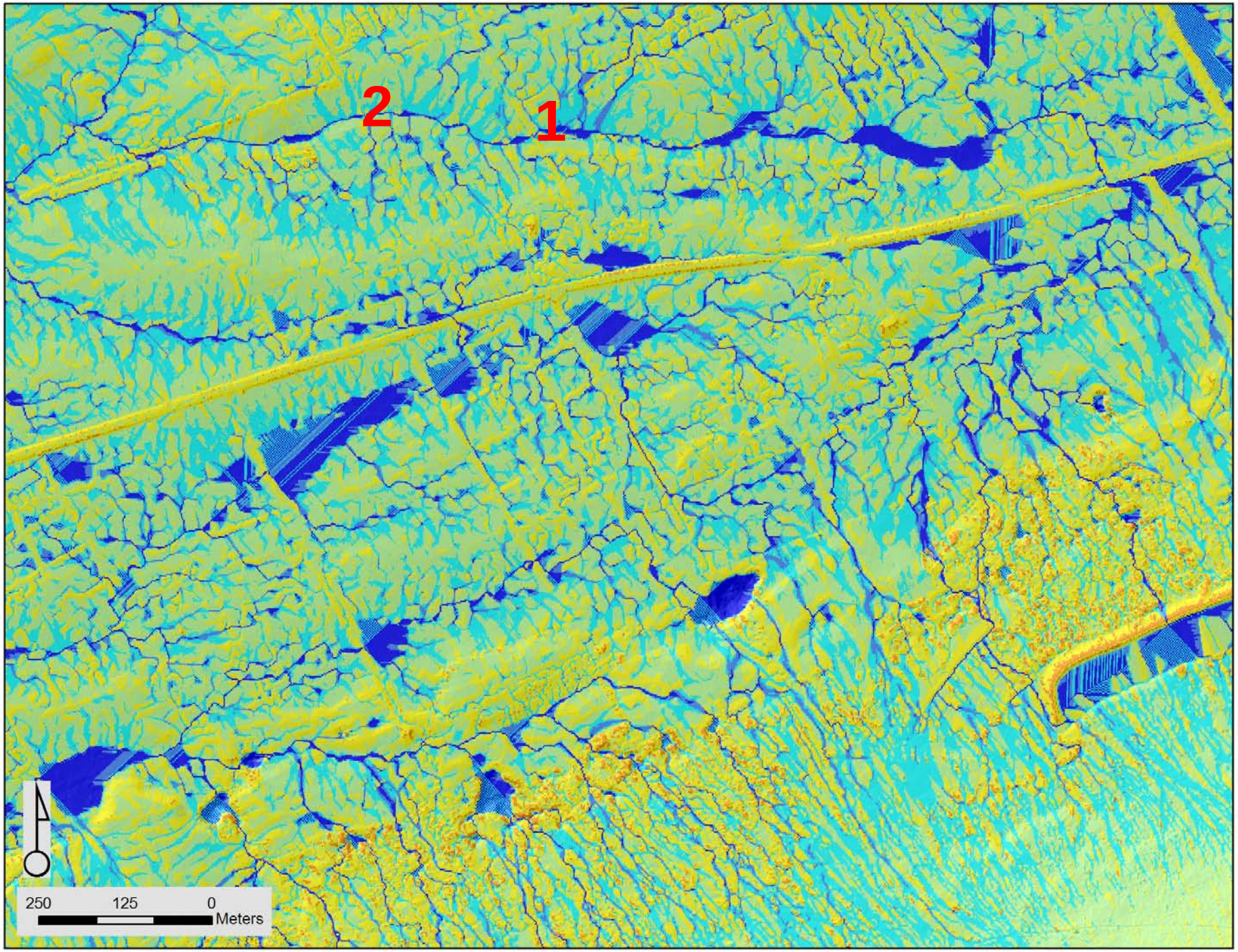

Euro-alluvium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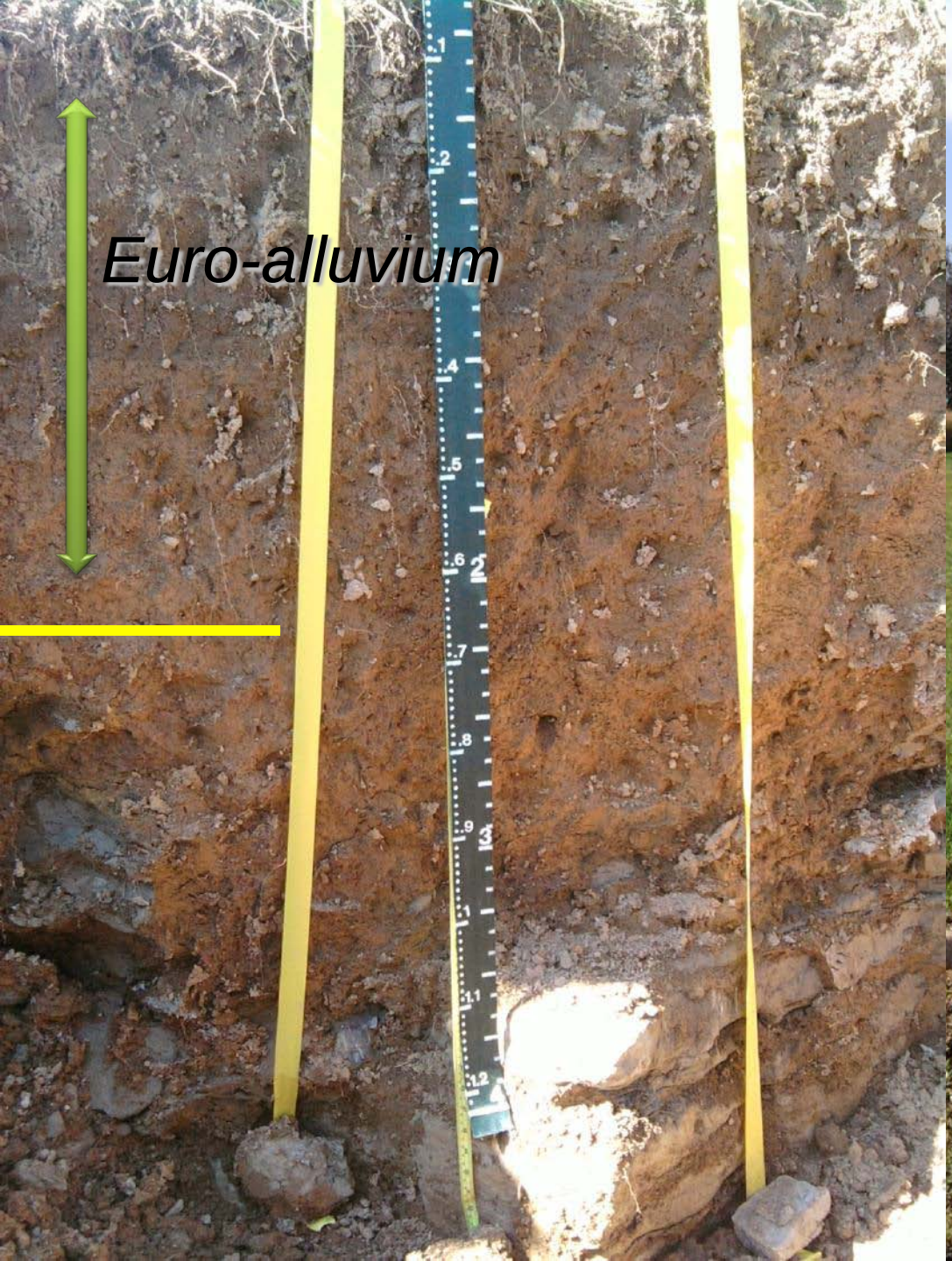
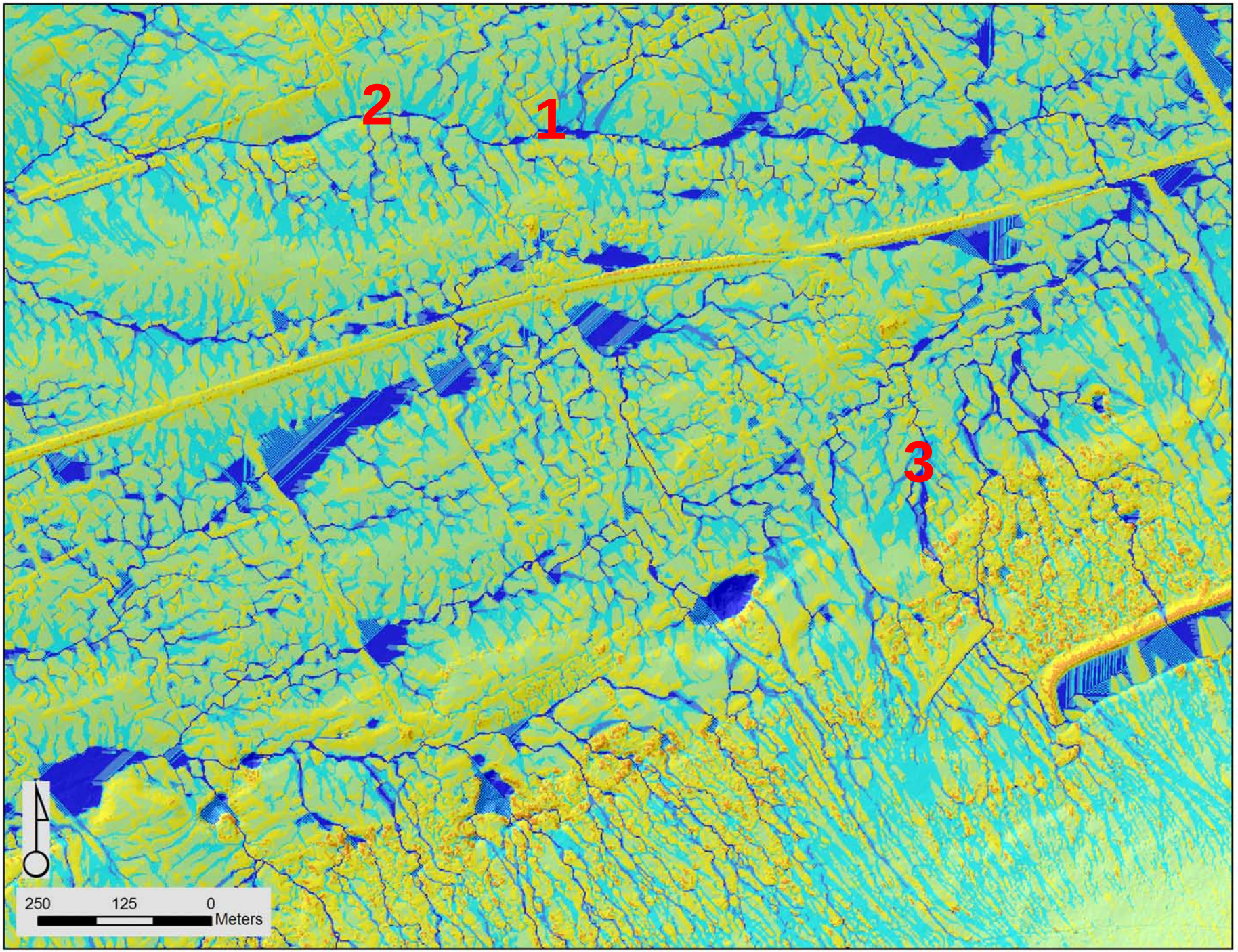

Euro-alluvium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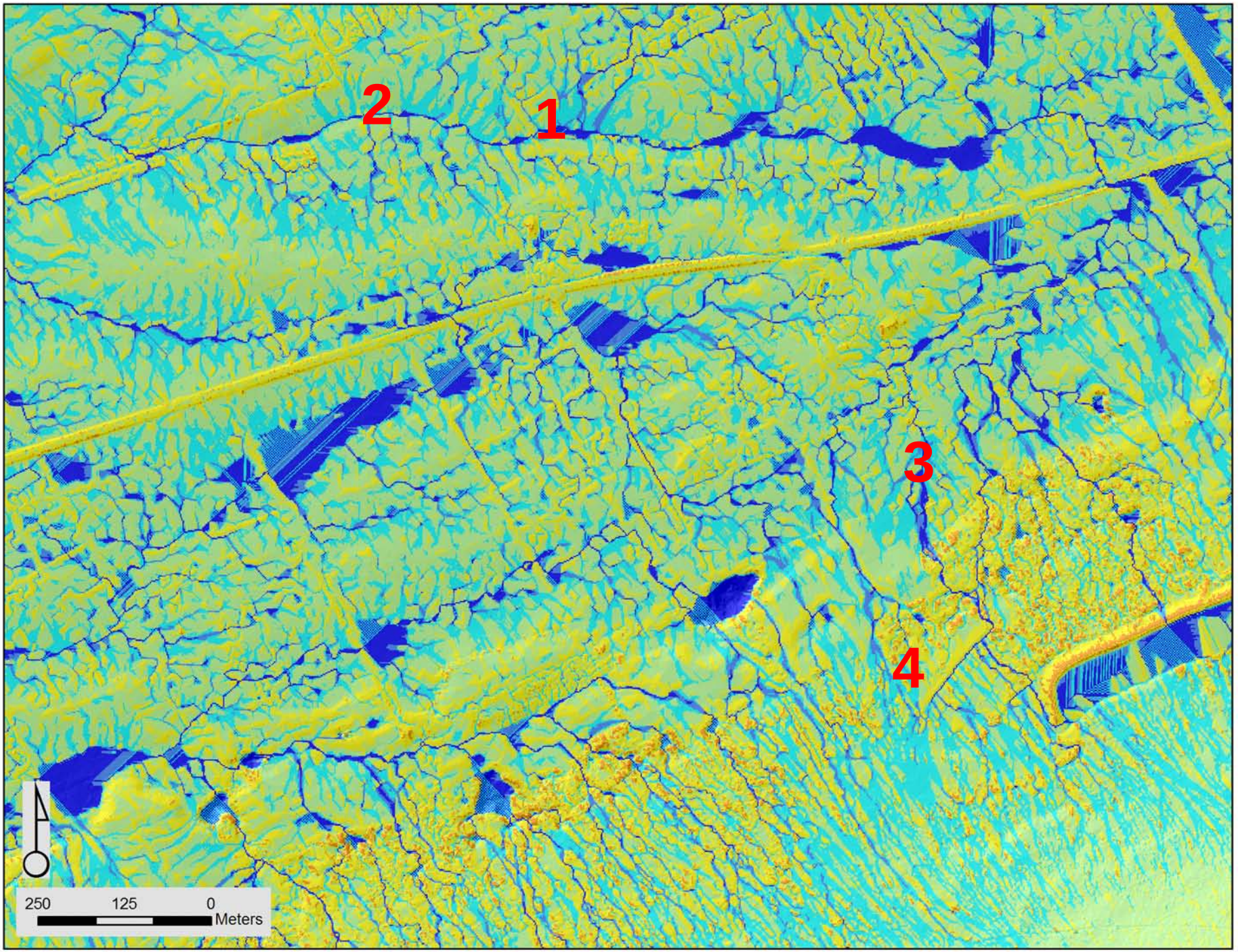
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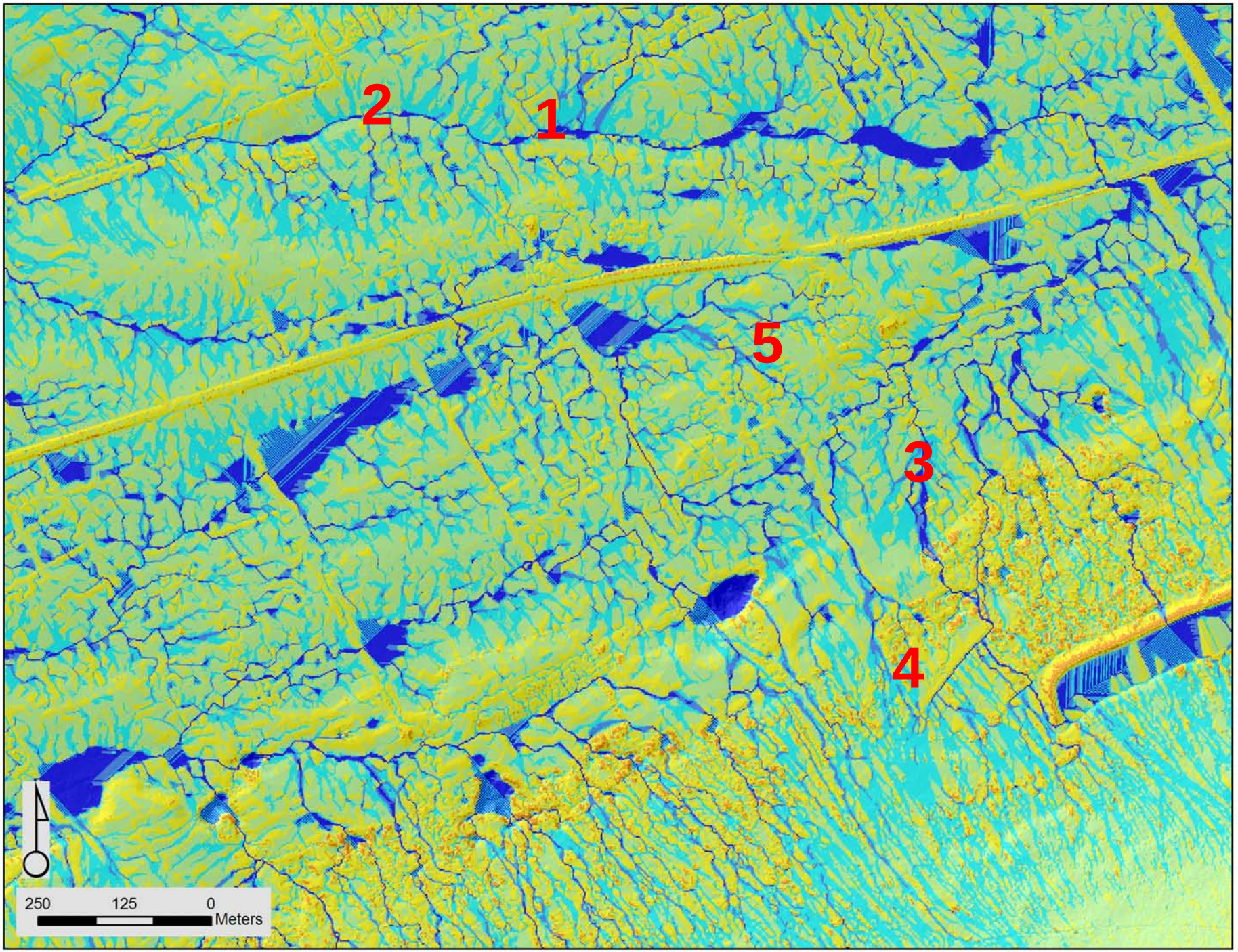
Meters

Poorly drained soil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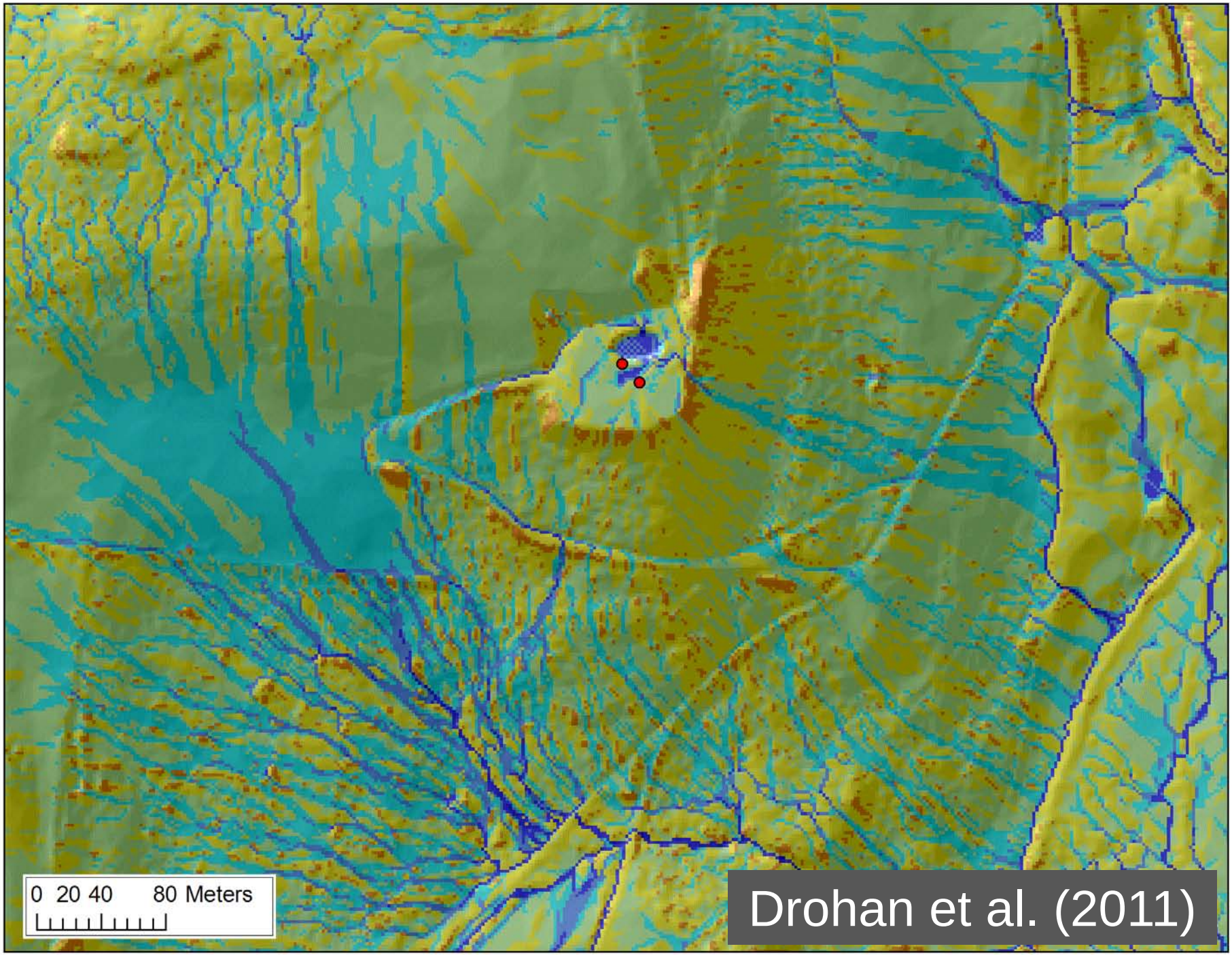
Meters

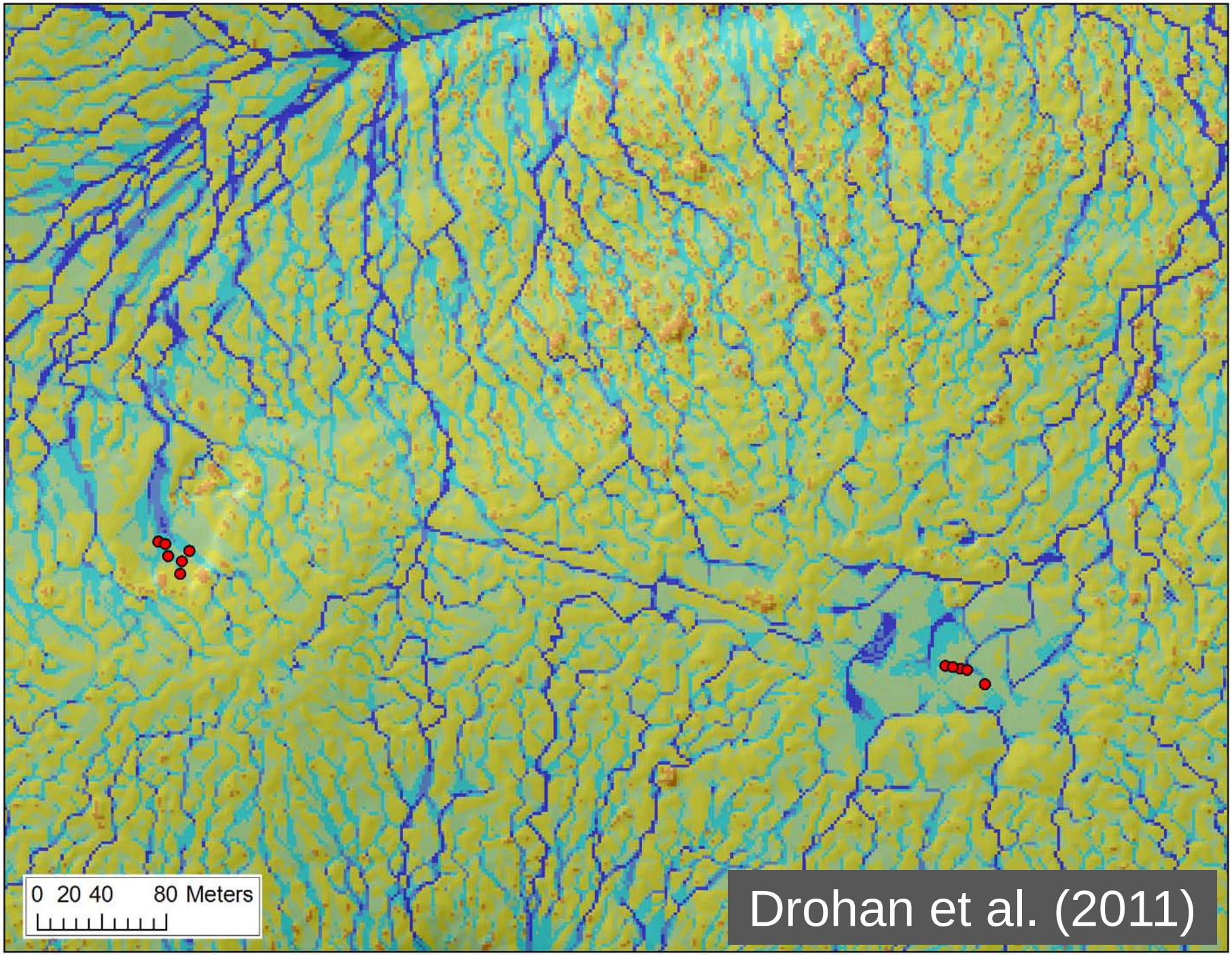
Well drained soil

Well drained soil

Drohan et al. (2011)


0 20 40 80 Meters
Drohan et al. (2011)

0 20 40 80 Meters
Drohan et al. (2011)

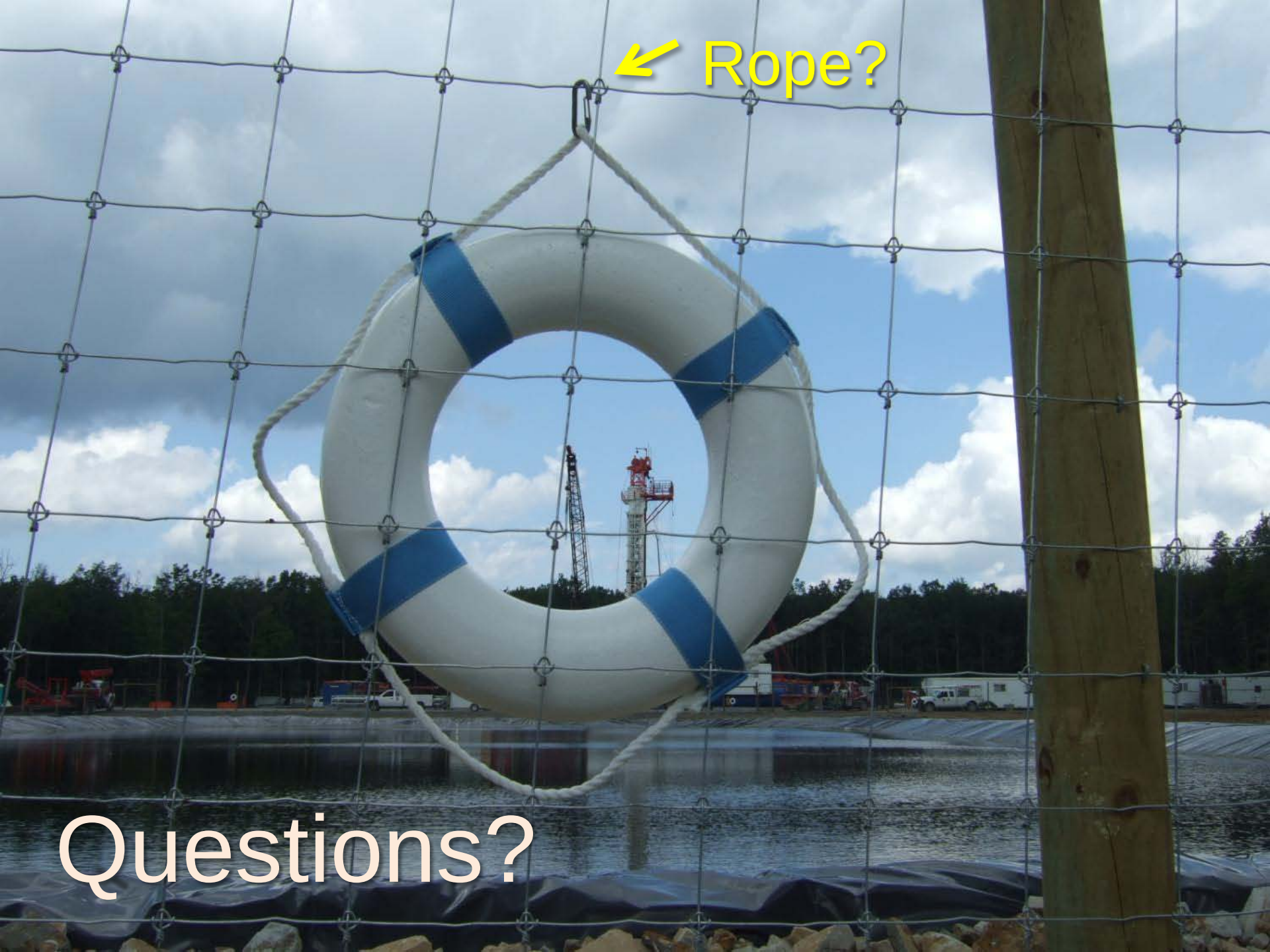

0 20 40 80 Meters
Drohan et al. (2011)

Next Steps

- Continued development and validation
  - Refinement using LiDAR modeling
  - Field visits with DCNR and USFS
- State and Transition Model Assessment
  - Mike Marsicano thesis
  - Cody Fink thesis

Conclusions

- ESD development East of the Mississippi is possible; and not as hard as thought.
- Easy to be a splitter; fall back on “true” native condition, and not the ideal $$$ managed condition.
- ESDs greatly advance soil science communication.
- ESDs nicely link the historical landscape to the present
  - Coming of age for USA soil science
- The speed of change is incredible *and* our biggest problem.


Rope?
Questions?