Florida Department of Environmental Protection

Submerged Lands & Environmental Resources Coordination

Florida Wetland Integrity Dataset (FWID)

Wetland Mapping Consortium
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The Florida Wetlands Integrity Dataset: Analysis of nonrenewable energy data and construction of graph-theoretic networks to quantify landscape integrity

What is “Ecological Integrity”?

- The ecological integrity is a broad concept which is guiding ecosystem management *(Ordóñez & Duinker 2012)*.
- In its broadest definition, ecological integrity refers to the wholeness and proper functioning of an ecosystem *(Angermeier & Karr 1996)*.

Ecological integrity defined as the capability of an ecological system to support and maintain a balanced, integrative, adaptive, healthy community of organisms, which has diversity, composition and functional organization comparable to natural habitats of a kind, within the region (Heckmann et al. 2008; Parrish et al. 2003; Karr & Dudley 1981; Angermeier & Karr 1996).

Ecological Integrity and Degradation of Ecological Integrity

- **The ecological integrity of a natural system degrades, when the system become unable to withstand and recover from disturbances, imposed by nature and/or human *(Parrish et al. 2003*).**

"An ecological system has integrity when its dominant ecological characteristics (e.g., elements of composition, structure, function, and ecological processes) occur within their natural ranges of variation and can withstand and recover from most perturbations imposed by natural environmental dynamics or human disruptions." (Parrish et al. 2003)

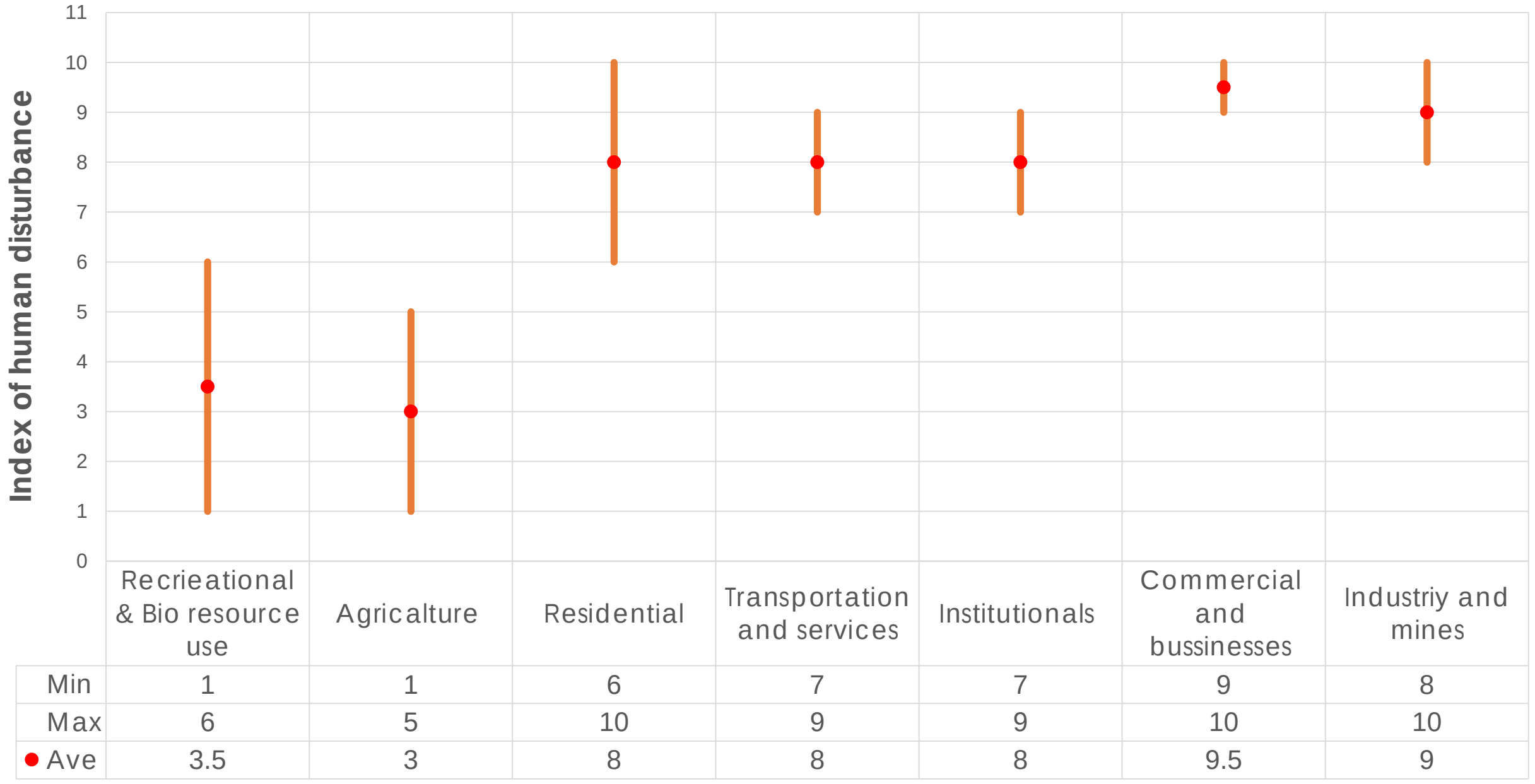
- Although, the importance of the ecological integrity has been long known, the practice of incorporating this important concept into management activities has been a major struggle for environmental managers *(Carignan & Villard 2002).*

- This is mainly due to the **lack of a proper index to measure the magnitude and dimensions of the ecological integrity** *(Reza 2014 ; Parrish et al. 2003).*

Ecological indicators

For the purpose of this project we have developed a **thermodynamic base index** of human disturbance as an **indicator** of ecological status at any location within the landscape, which is based on the **magnitude** of the disturbances imposed to the natural systems relative to **accumulative intensity** of all **nearby human activities**.

- ecological indicators are measurable attributes which can provide proper perception about the ecological state by providing information beyond their own measurement *(Noon, 2003)*.
- Ecological indicators usually used when direct measurement of systems property and responses are too difficult or costly *(Leibowitz et al. 1999).*



	Recrieational & Bio resource use	Agricalture	Residential	Transportation and services	Institutionals	Commercial and bussinesses	Industriy and mines
Min	1	1	6	7	7	9	8
Max	6	5	10	9	9	10	10
● Ave	3.5	3	8	8	8	9.5	9

Assumptions

- The ecological status of the locations close to one another are more alike than the locations that are farther apart *(Nekola and White 1999)*
- Human disturbances imposed to any locations is the summation of all disturbances imposed by any nearby source of human disturbances within specific kernel radius of that location
- The impact of human originated disturbances on nearby locations decreases as the distance from the source increases.

Model concept

Common vector approach to model the ecological status

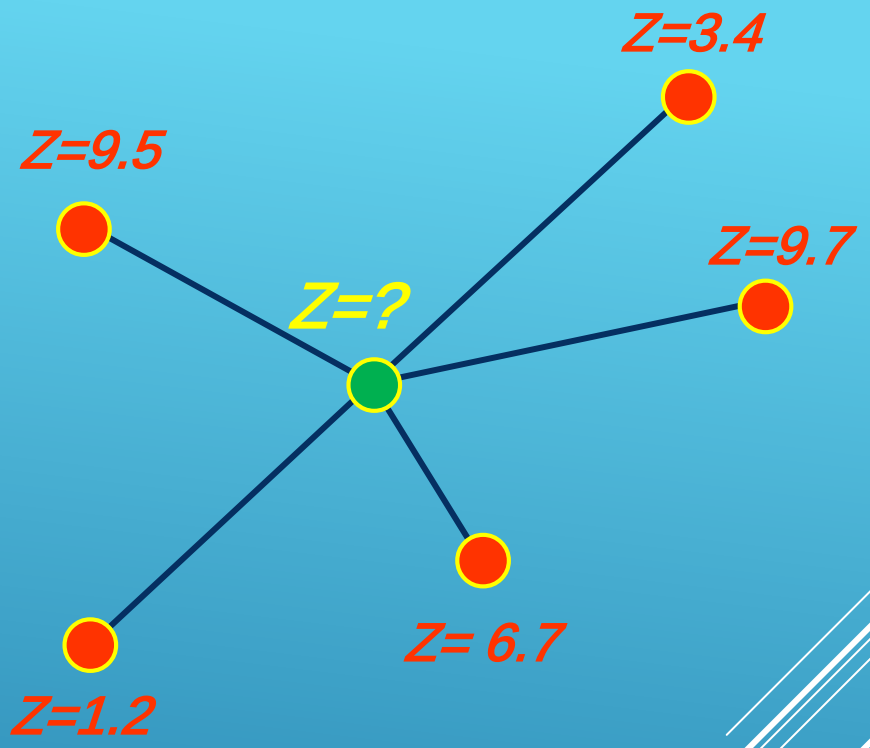
Landscape

Raster approach to model the ecological status

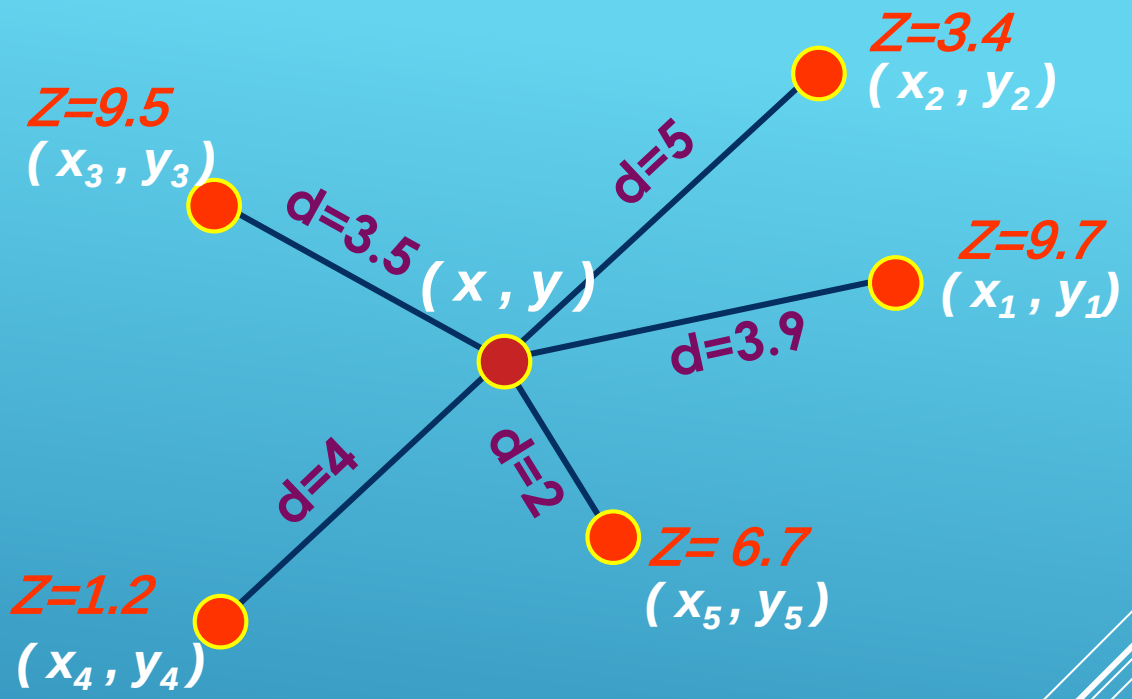
Inverse Distance Weighted Interpolation (IDW)

- The Inverse Distance Interpolation (IDW) method considered for modeling relative ecological integrity status of any location within the state of Florida regarding their relative distance from surrounding sources of human disturbances

- In this process, the IDW estimates cell values in a raster from a set of sample points that have been weighted so that the farther a sampled point is from the cell being evaluated, the less weight it has in the calculation of the cell's value *(ESRI, 2010).*



$$Z(x,y) = \sum_{i=1}^{N} \lambda_i Z_i \quad , \lambda_i = \frac{\left[\frac{1}{d_i}\right]^p}{\sum_{i=1}^{N}\left[\frac{1}{d_i}\right]^p}$$



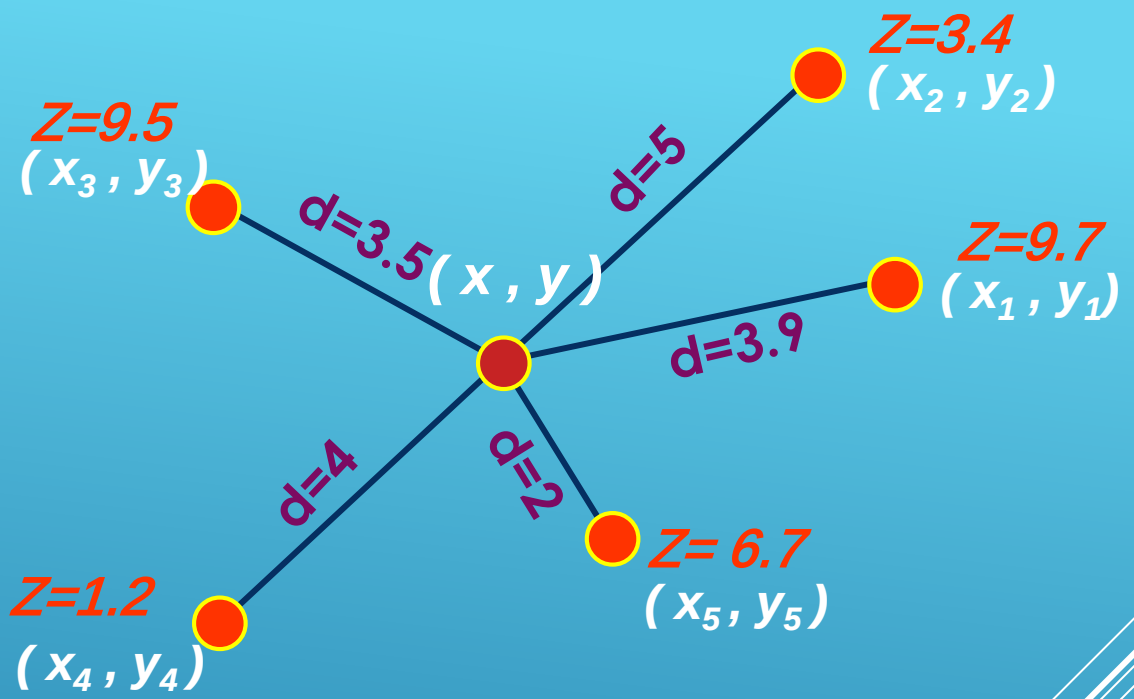
Z (x,y) – Value of the target point at location (x , y)

N - Number of measured sample points

d - Distance between known samples and the target point

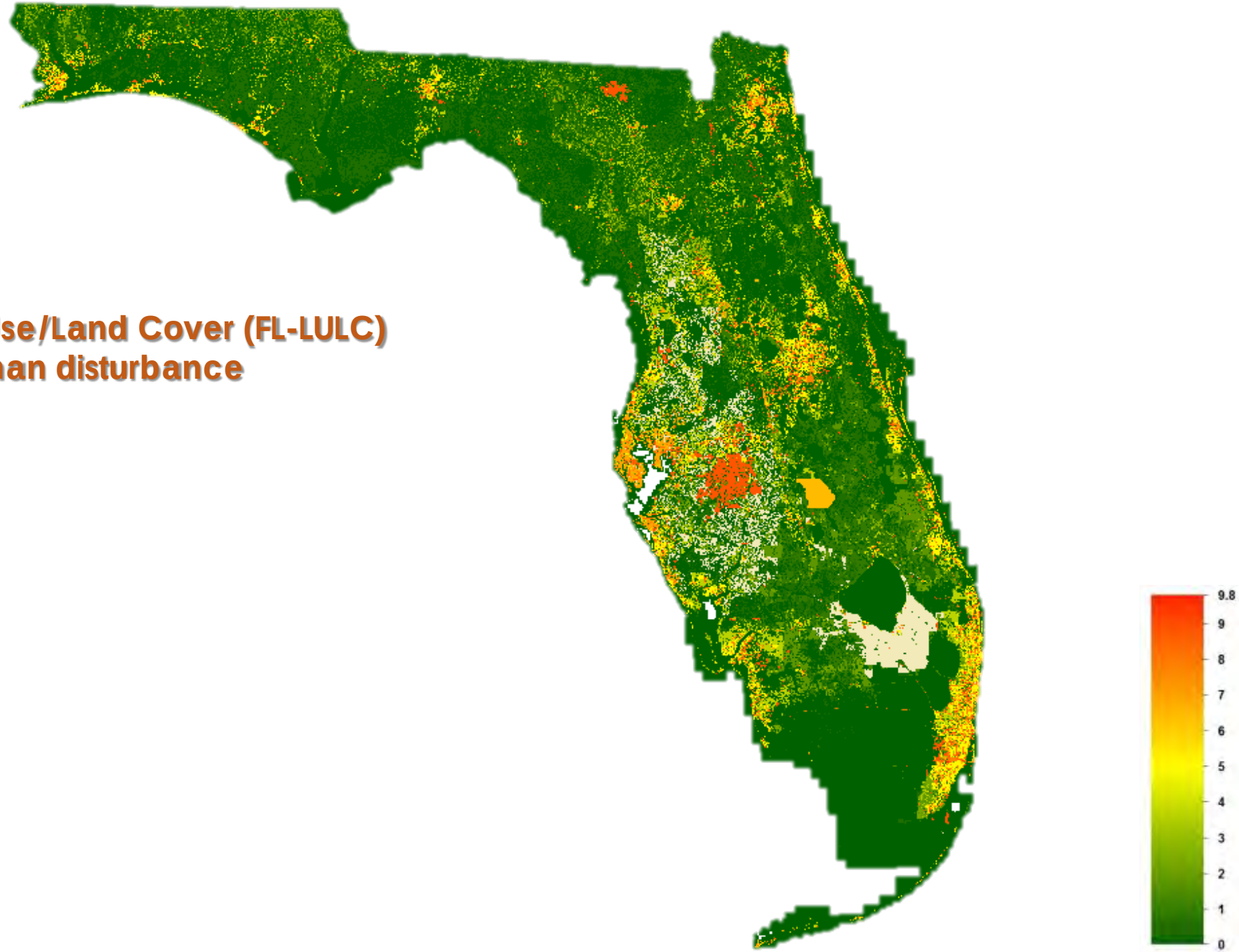
p - Defined exponent for weighting

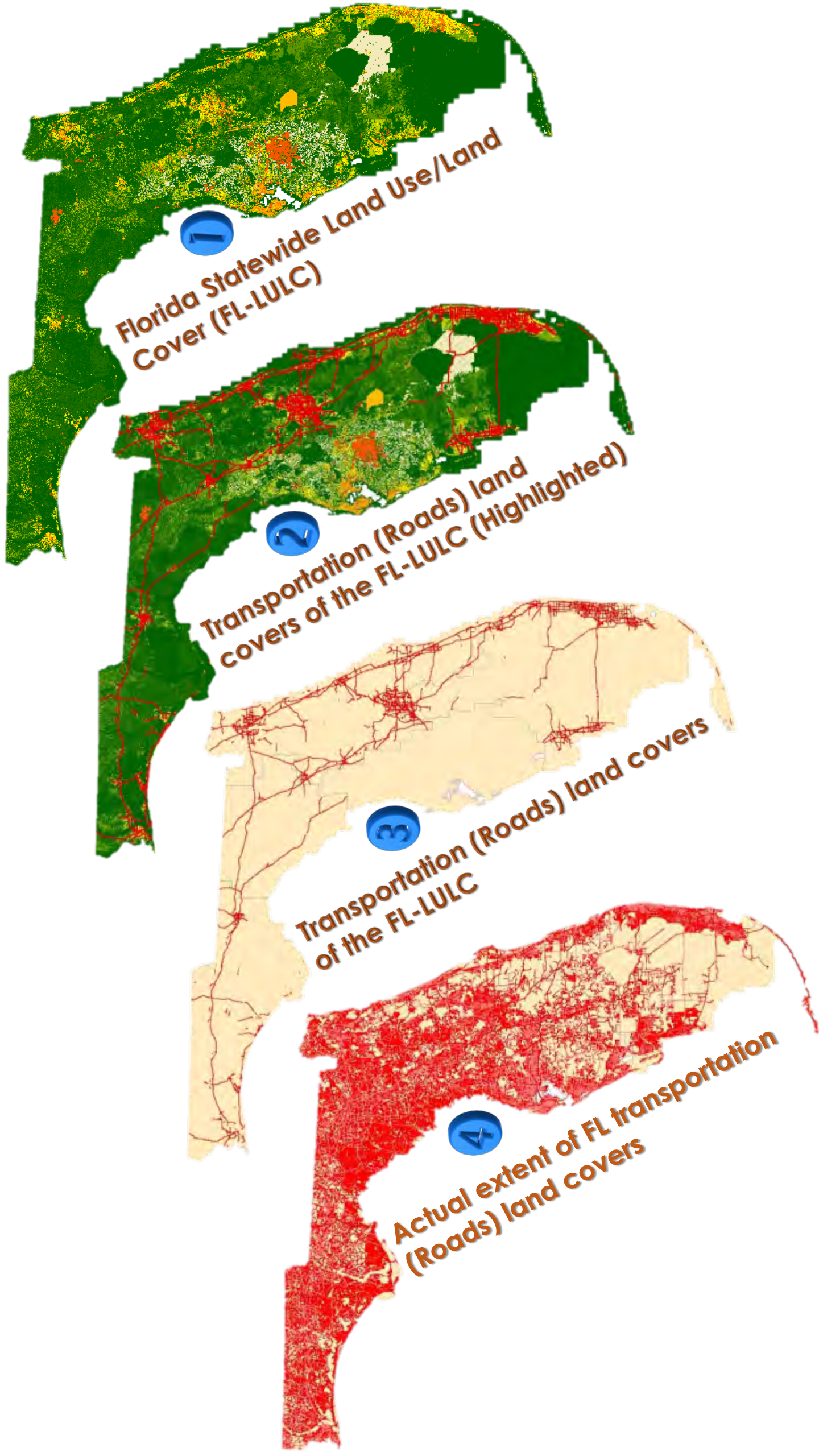
$$Z(x,y) = \sum_{i=1}^{N} \lambda_i Z_i \quad , \lambda_i = \frac{\left[\frac{1}{d_i}\right]^p}{\sum_{i=1}^{N}\left[\frac{1}{d_i}\right]^p}$$

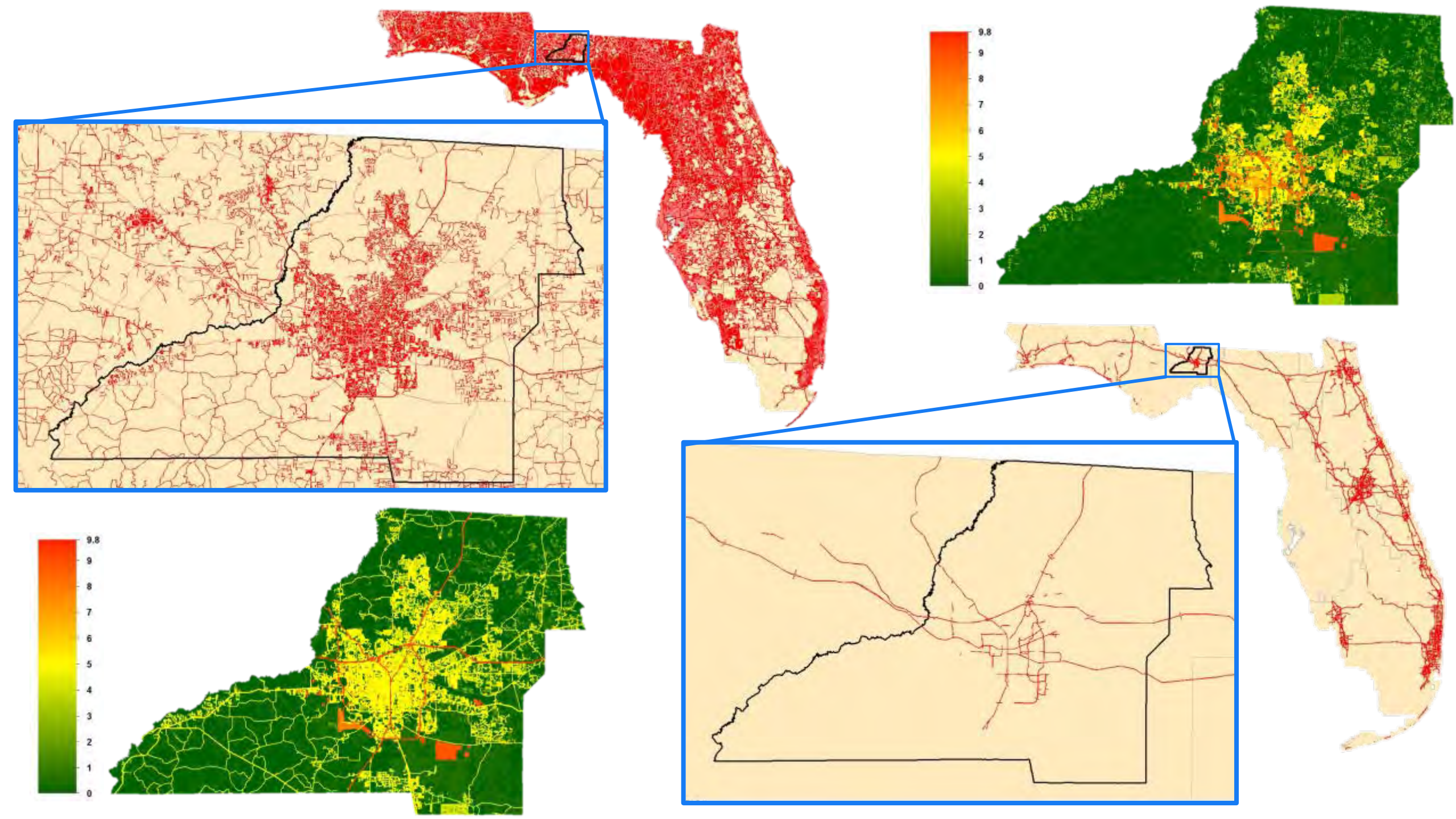


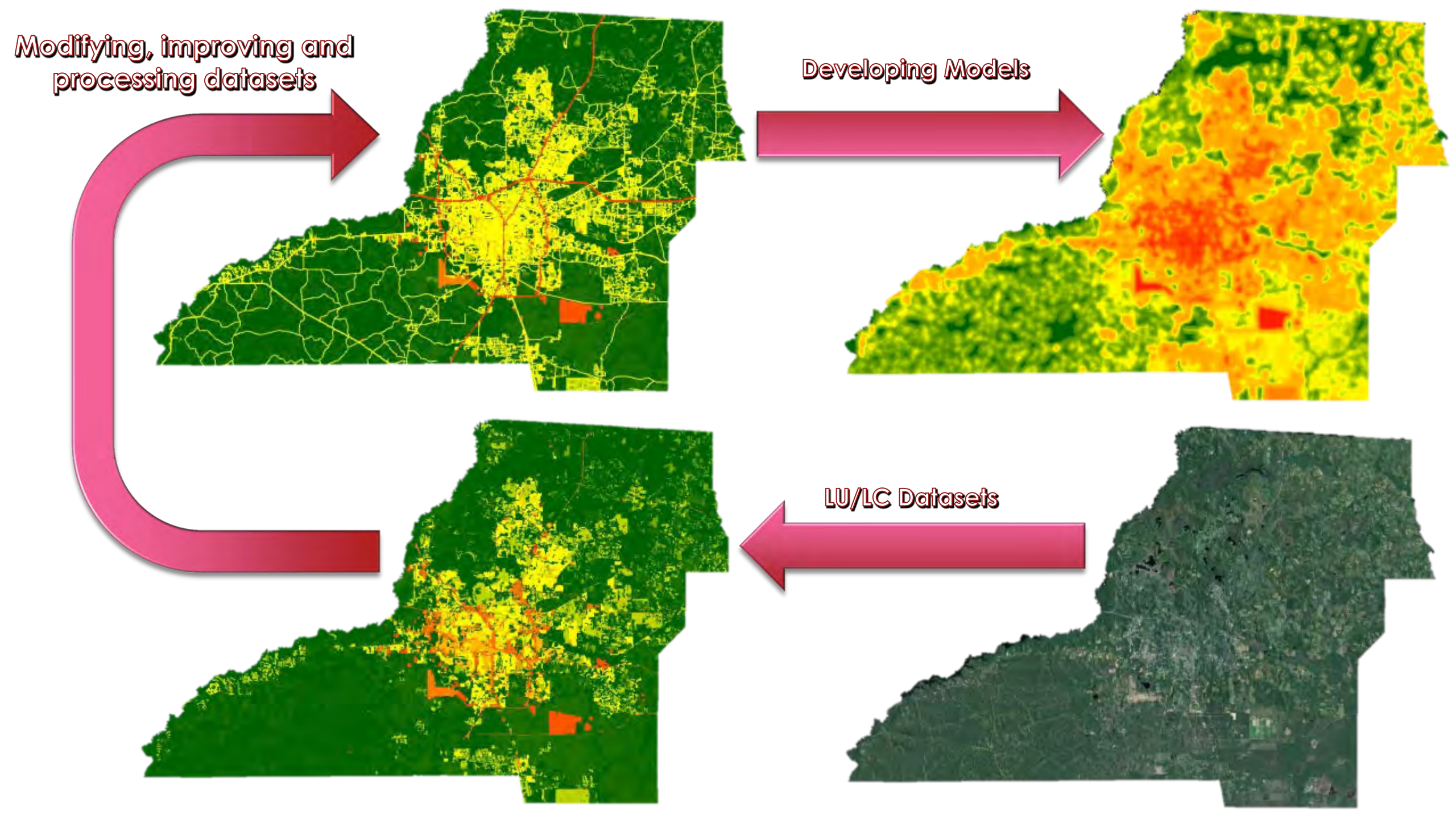
$$= \frac{\frac{9.7}{(3.9)^2}+\frac{3.4}{(5)^2}+\frac{9.5}{(3.5)^2}+\frac{1.2}{(4)^2}+\frac{6.7}{(2)^2}}{\frac{1}{(3.9)^2}+\frac{1}{(5)^2}+\frac{1}{(3.5)^2}+\frac{1}{(4)^2}+\frac{1}{(2)^2}} = 6.6$$

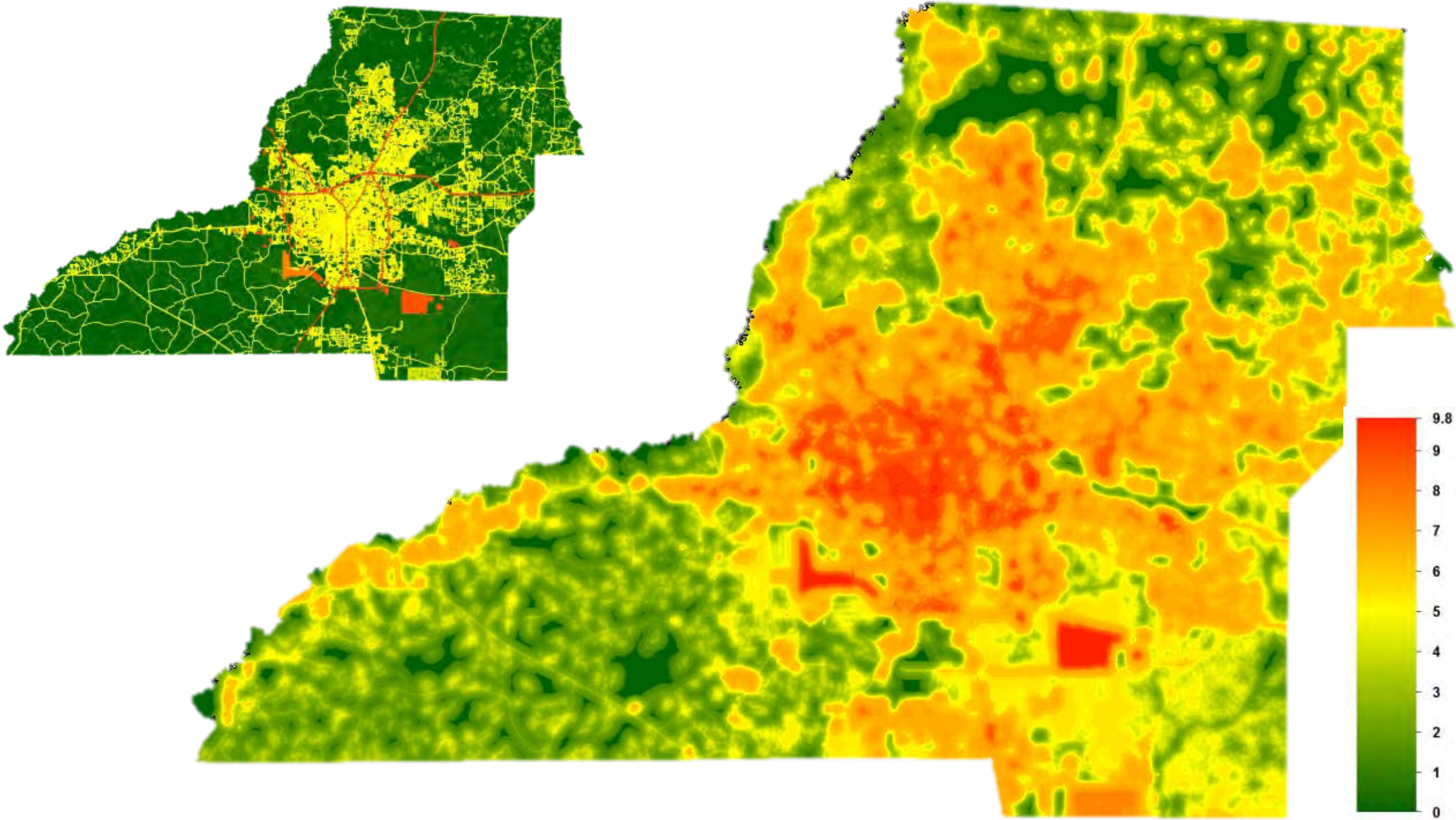
Florida Statewide Land Use/Land Cover (FL-LULC)
Intensity of human disturbance




1
Florida Statewide Land Use/Land Cover (FL-LULC)
2
Transportation (Roads) land covers of the FL-LULC (Highlighted)
3
Transportation (Roads) land covers of the FL-LULC
4
Actual extent of FL transportation (Roads) land covers


9.8
9
8
7
6
5
4
3
2
1
0


Modifying, improving and processing datasets
Developing Models
LU/LC Datasets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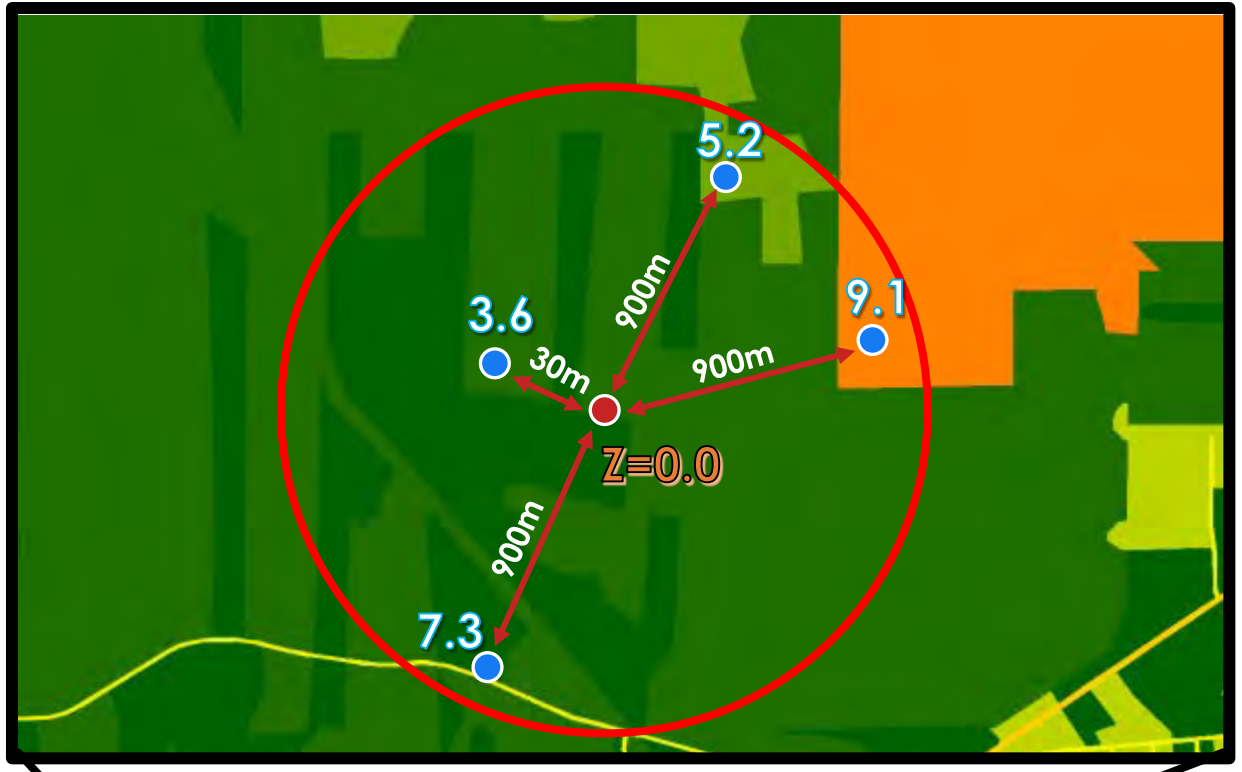

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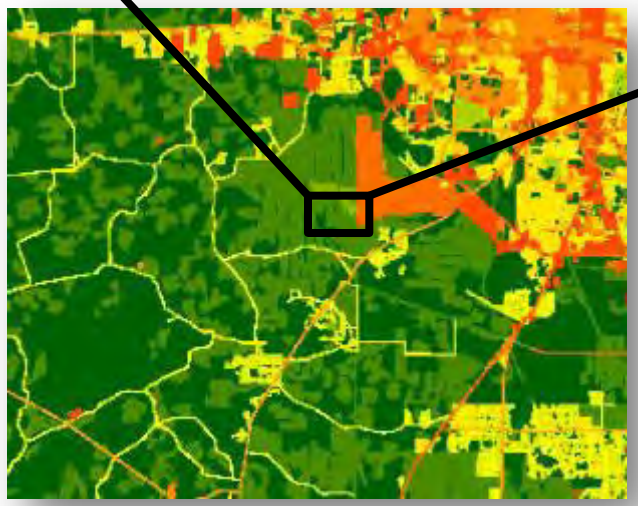
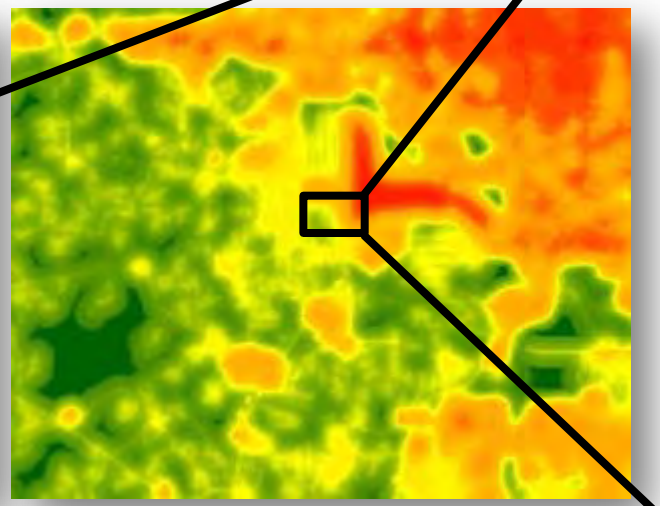
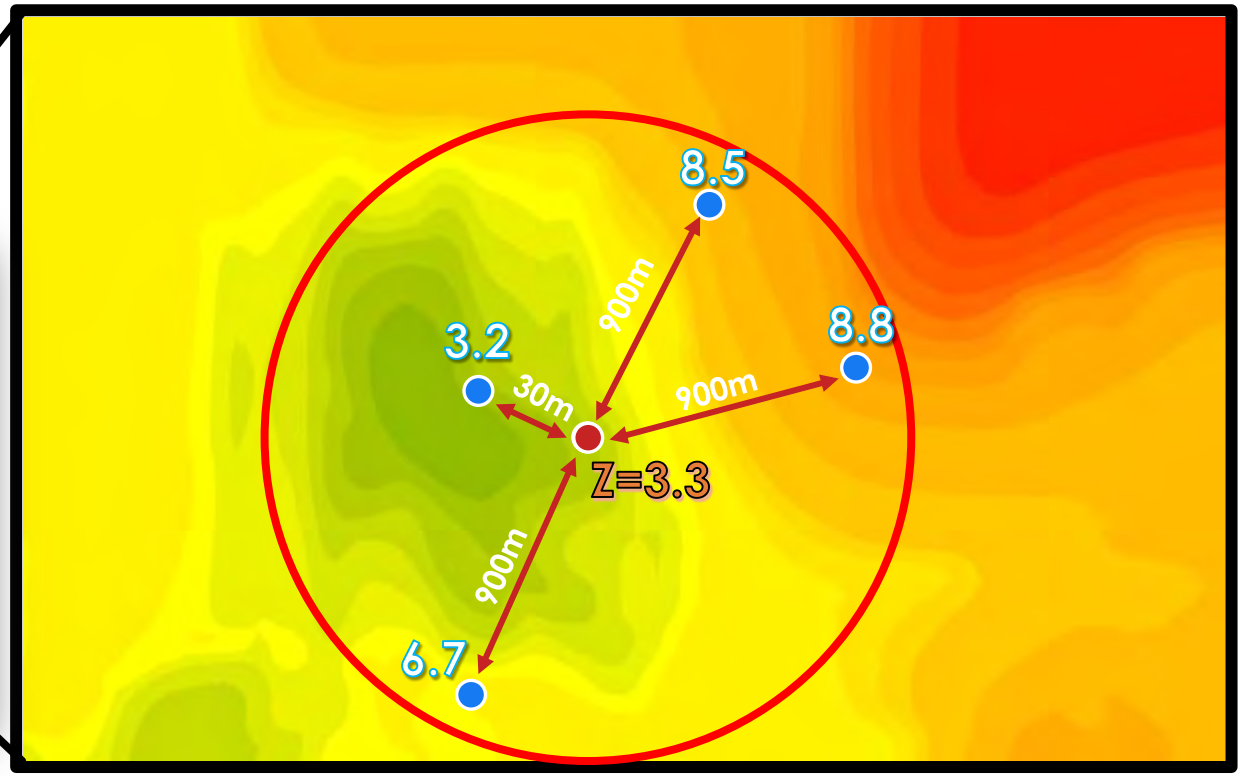
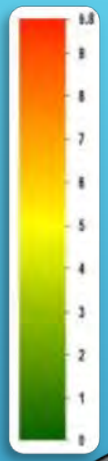
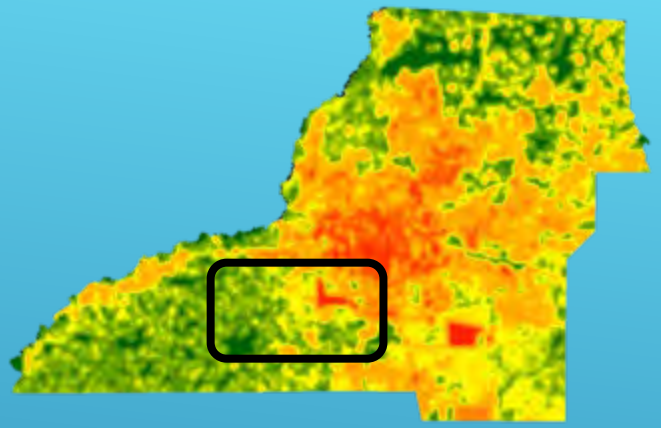
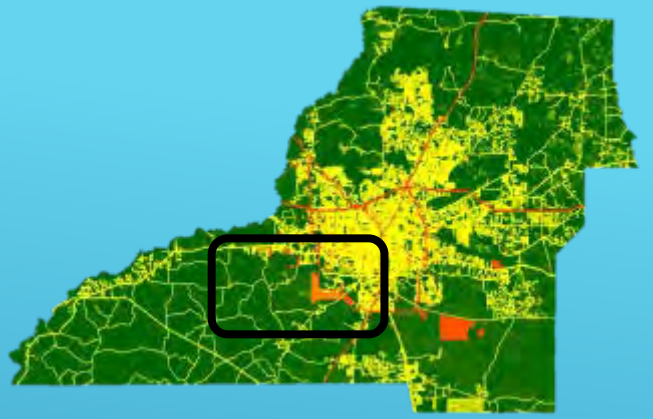


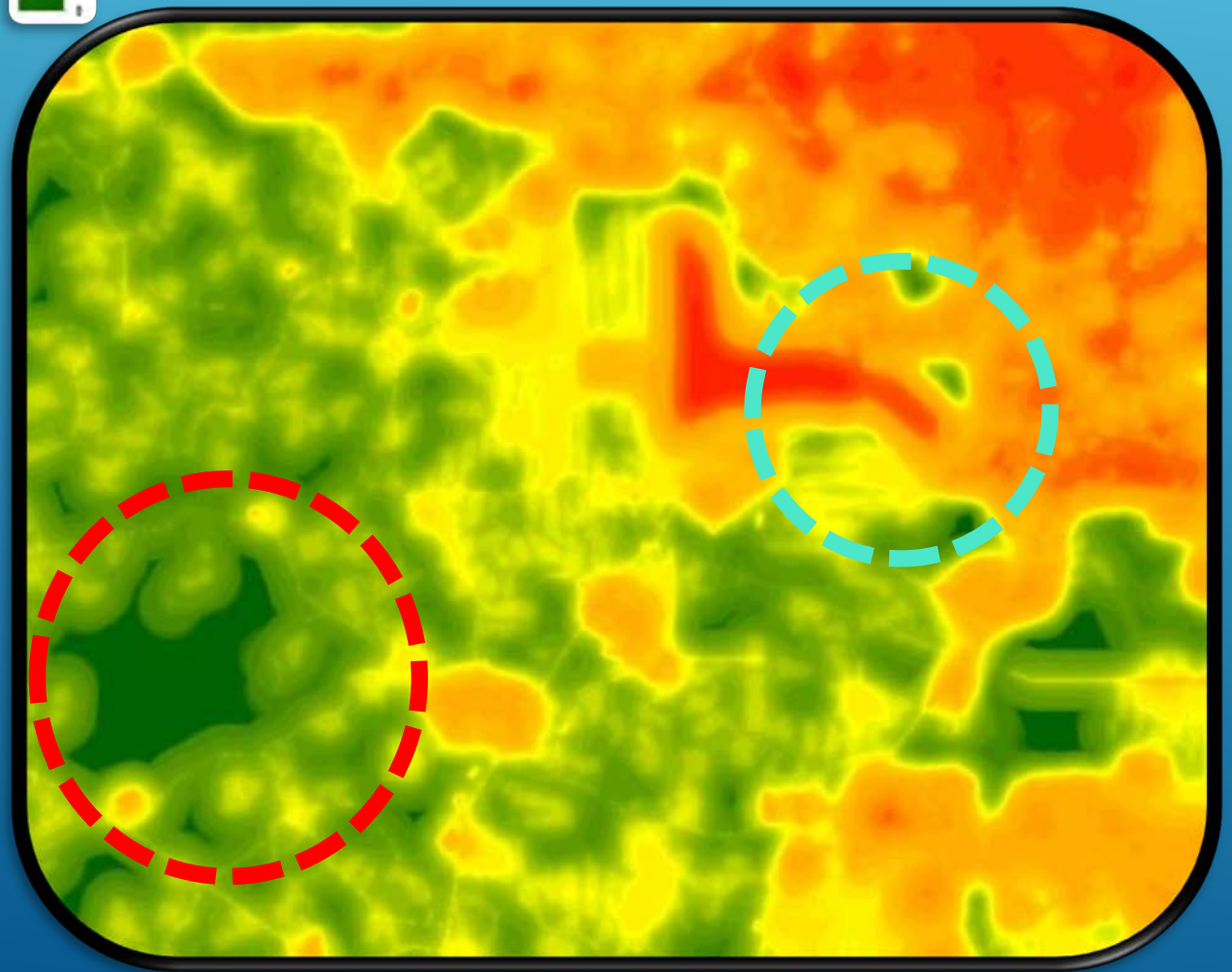


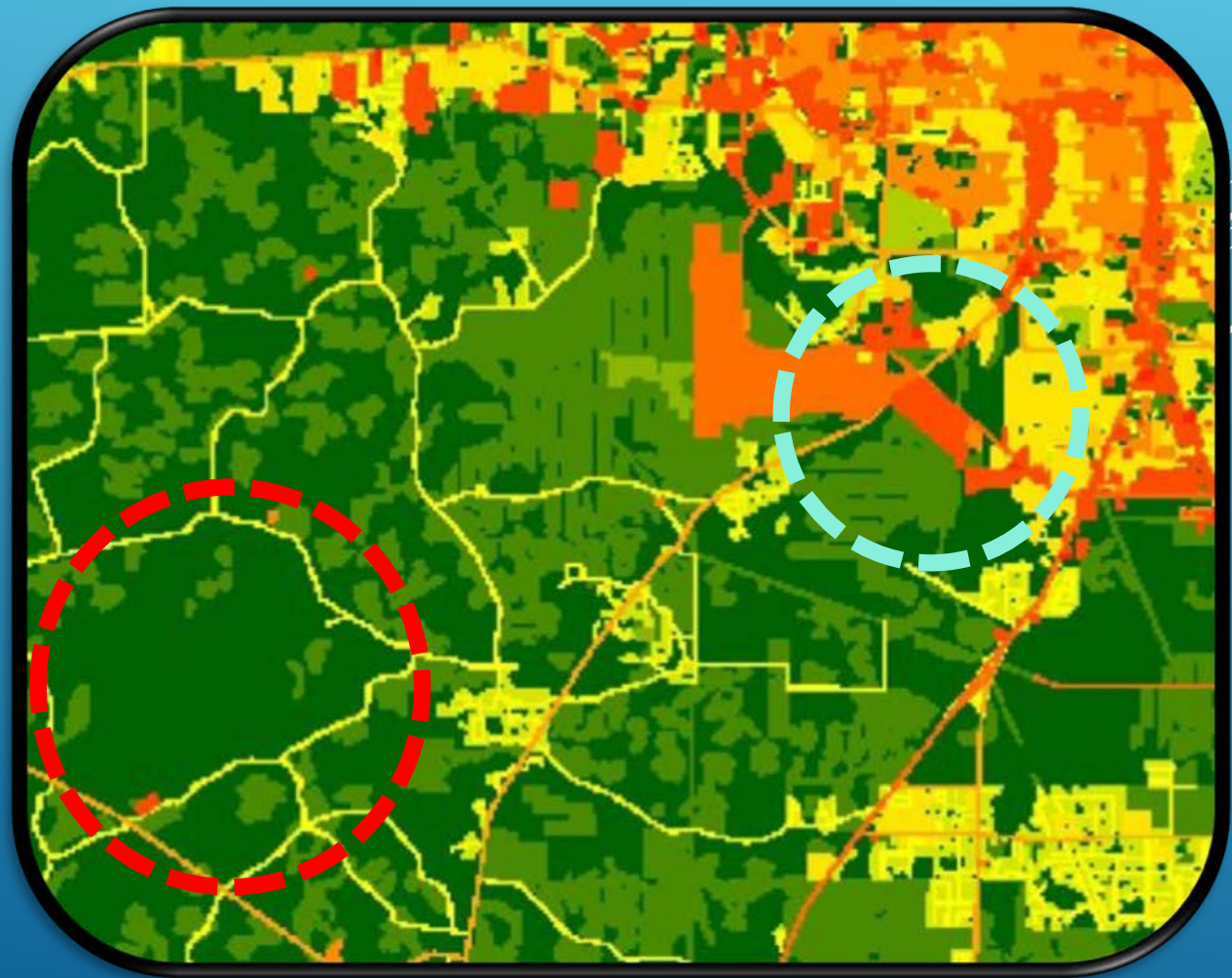












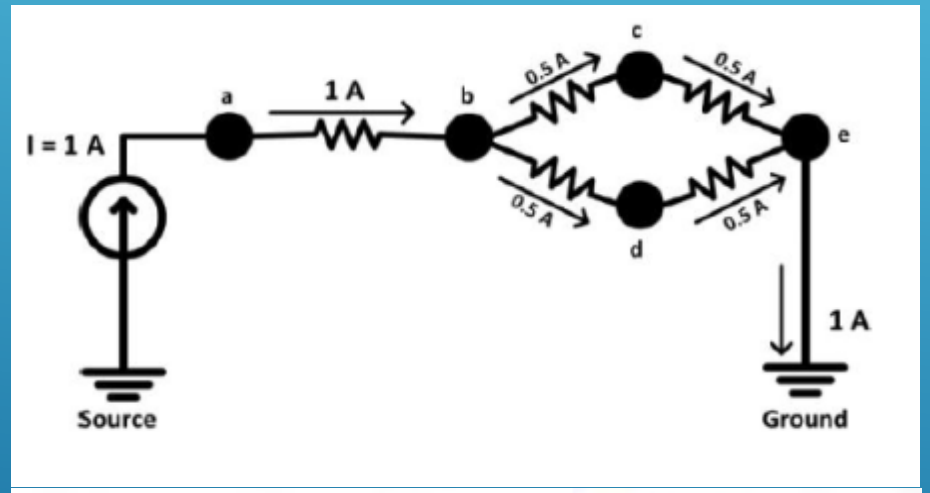
EVALUATING DEPARTURE FROM NATURAL CONDITION

(LANDSCAPE CONNECTIVITY)

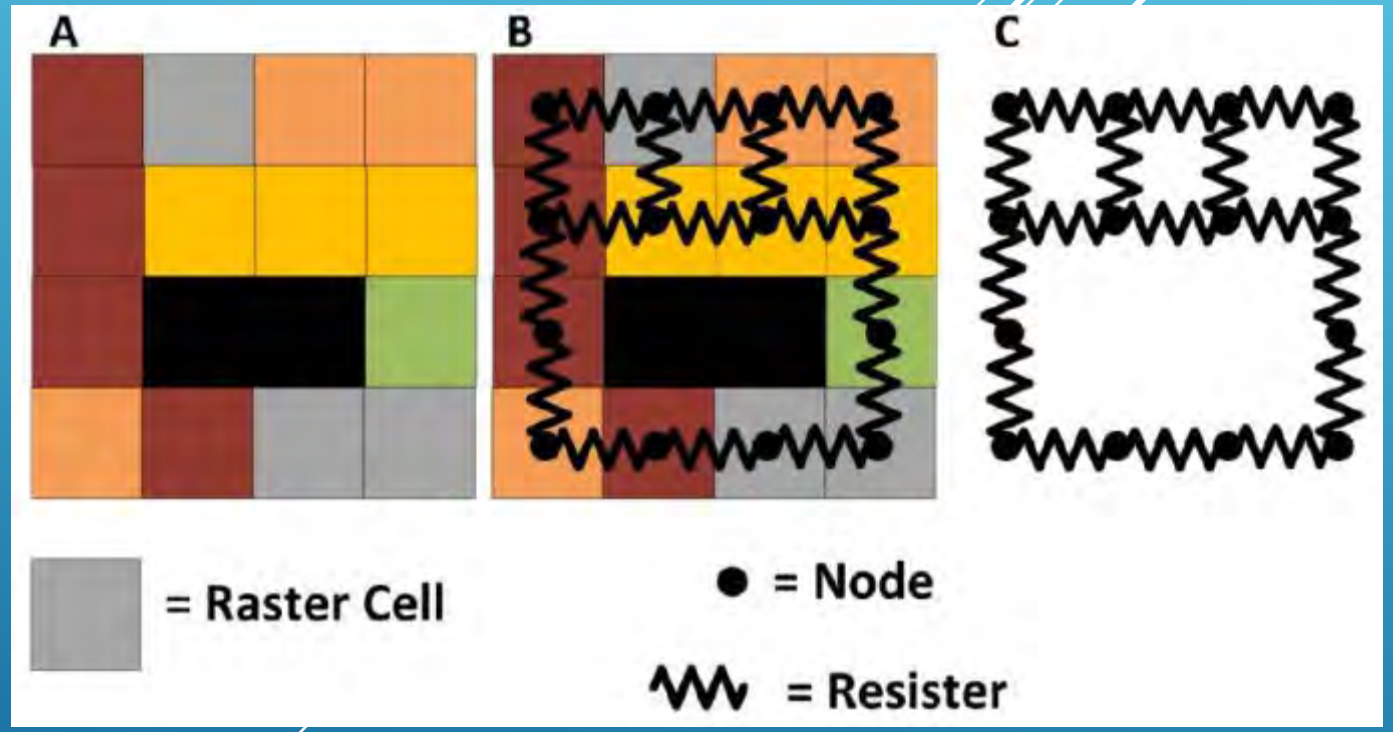
A single best path?
A least-cost corridor?
One directional?

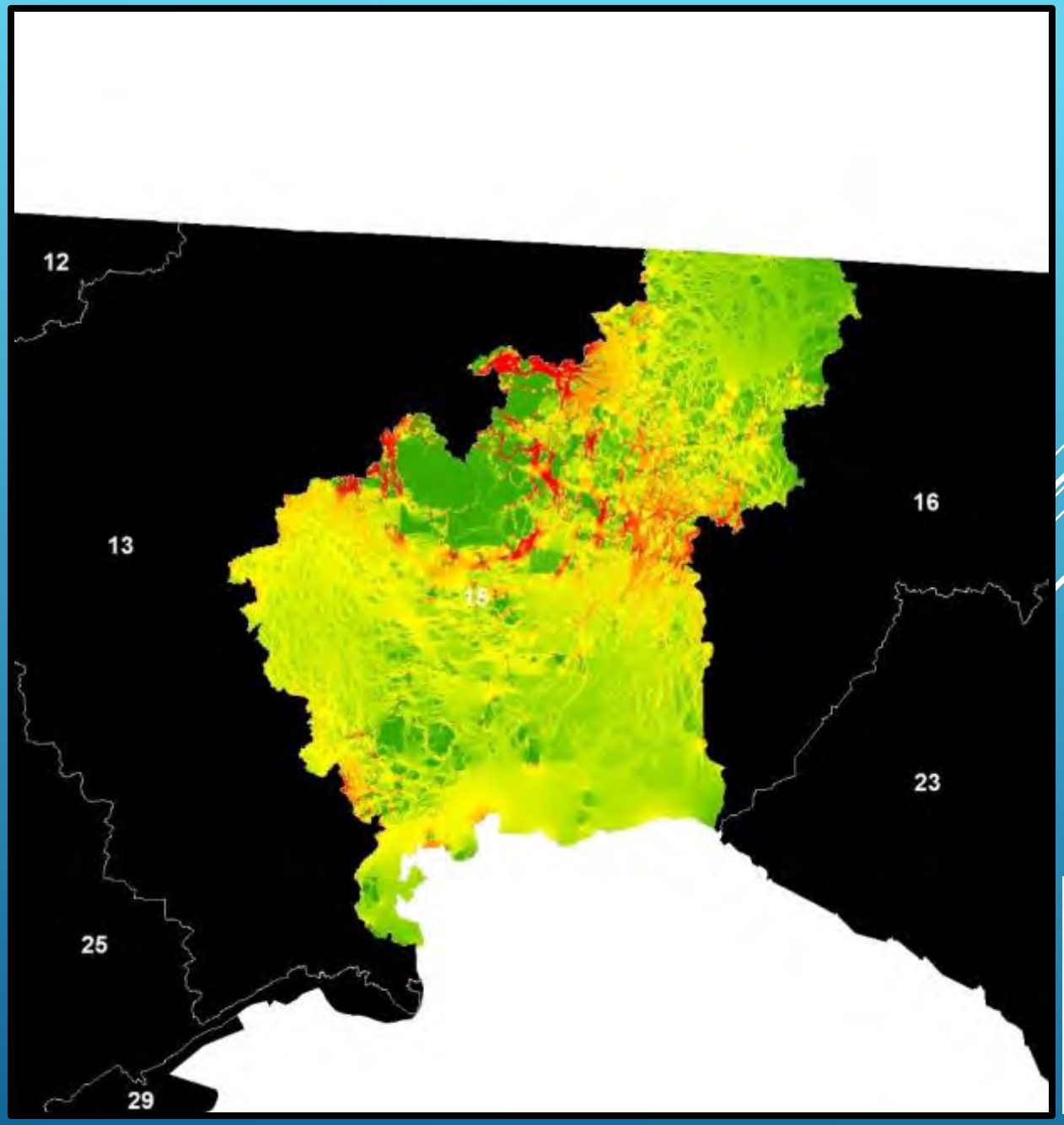
A single best path?
A least-cost corridor?
One directional?

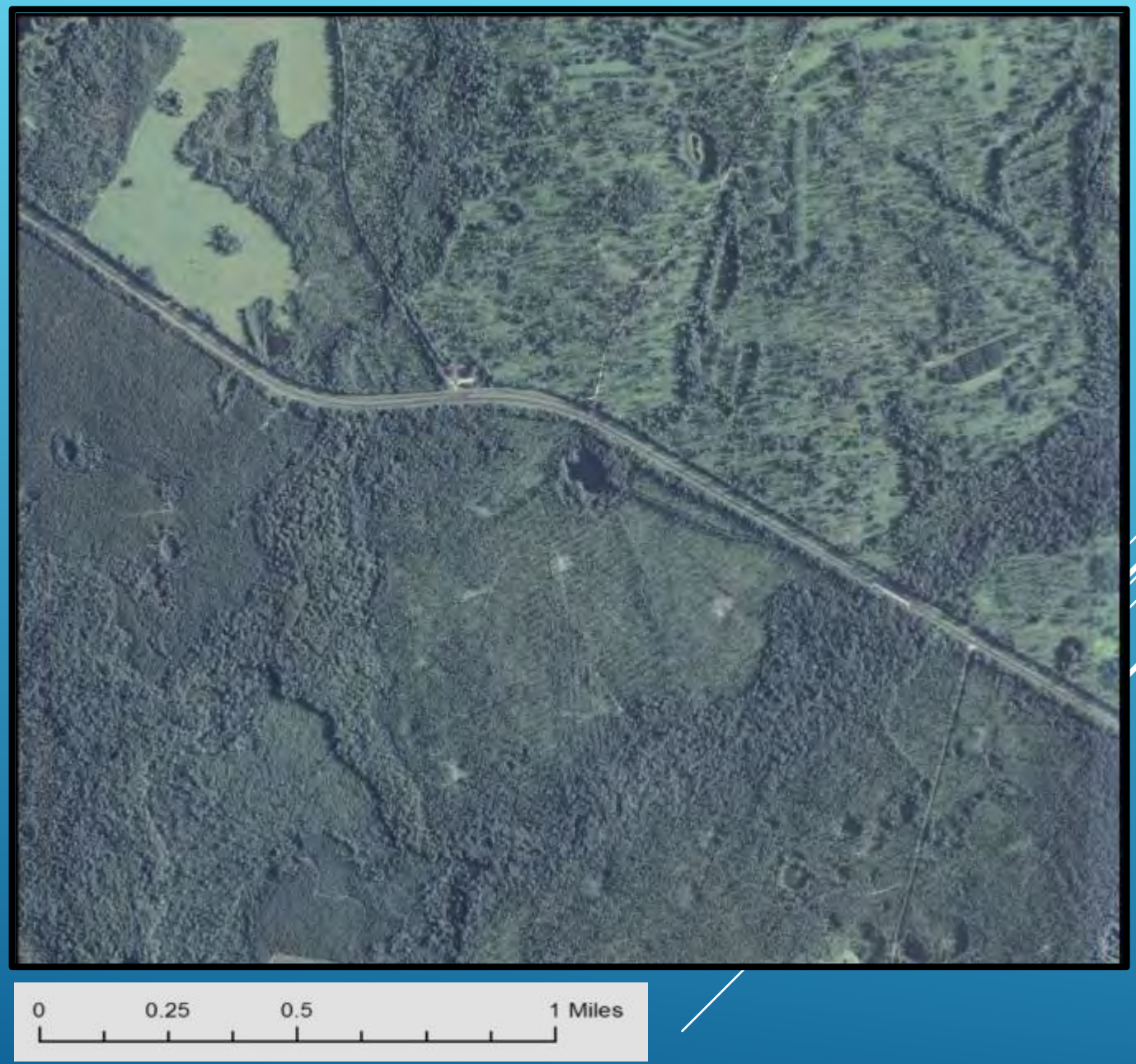
Assessing Wildlife Connectivity via Electrical Circuit Theory

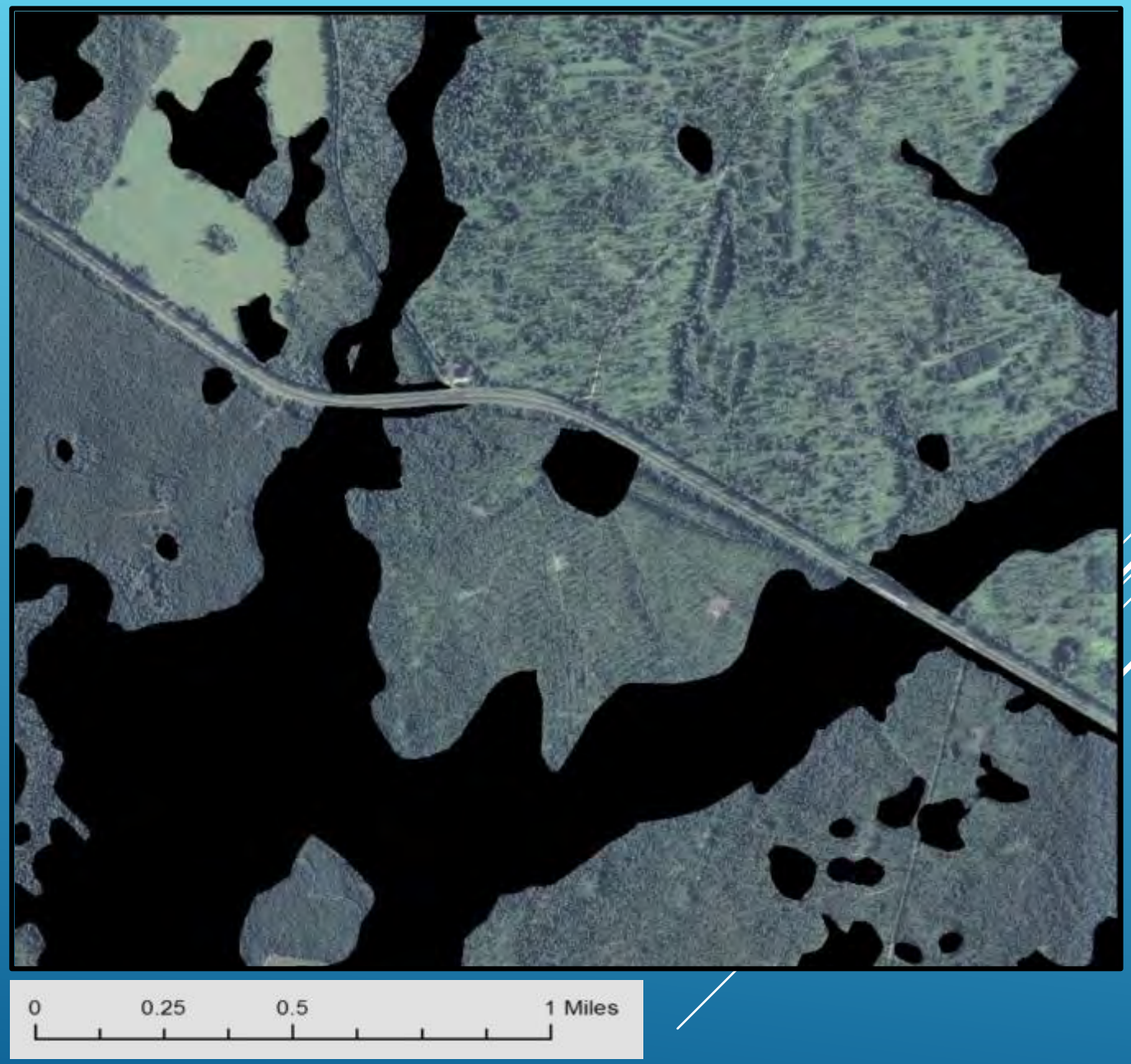


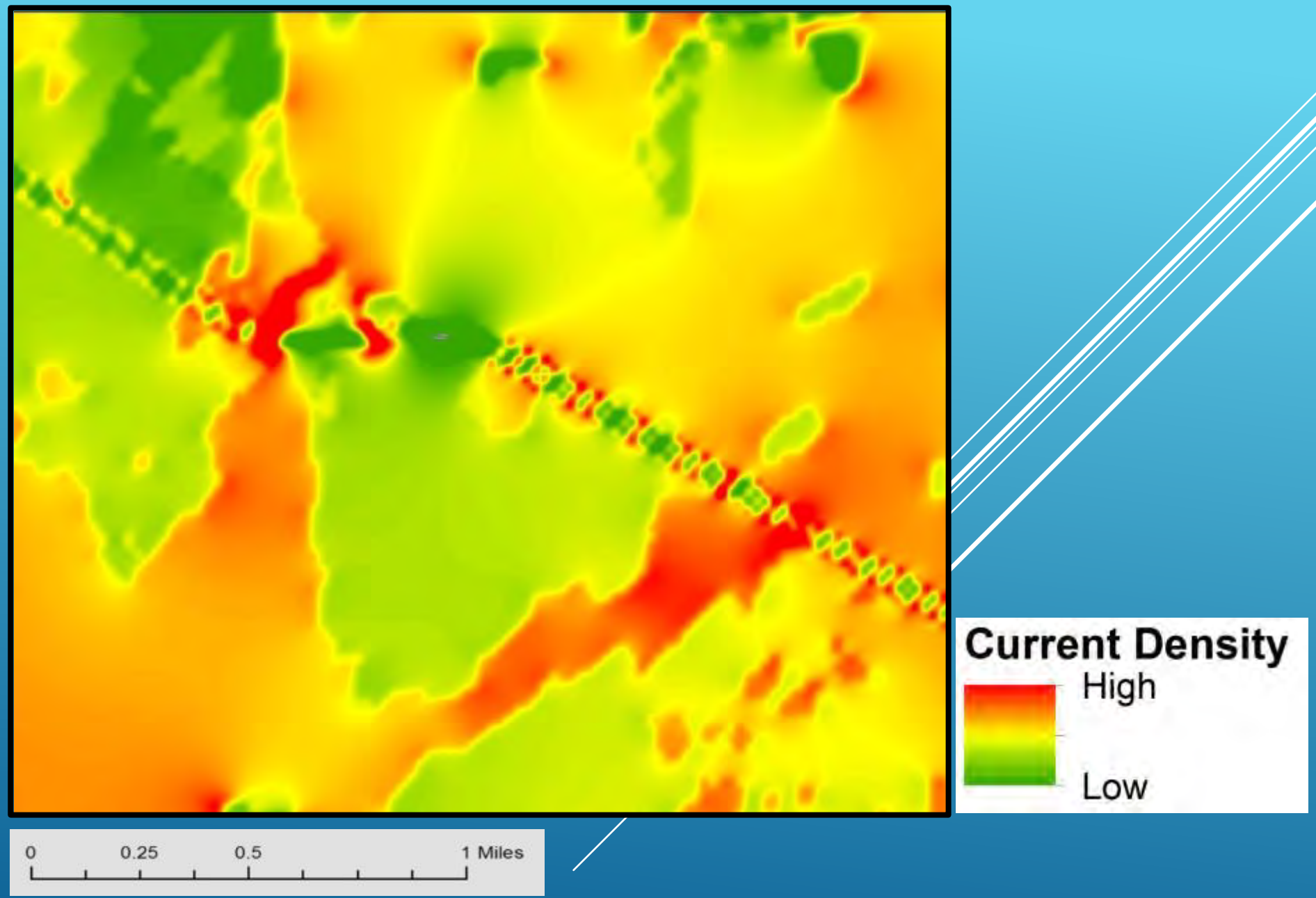
$$C_{CB}(v) = {}^{1}/_{\eta_B} \sum_{s,t \epsilon V} \tau_{st}(v)$$

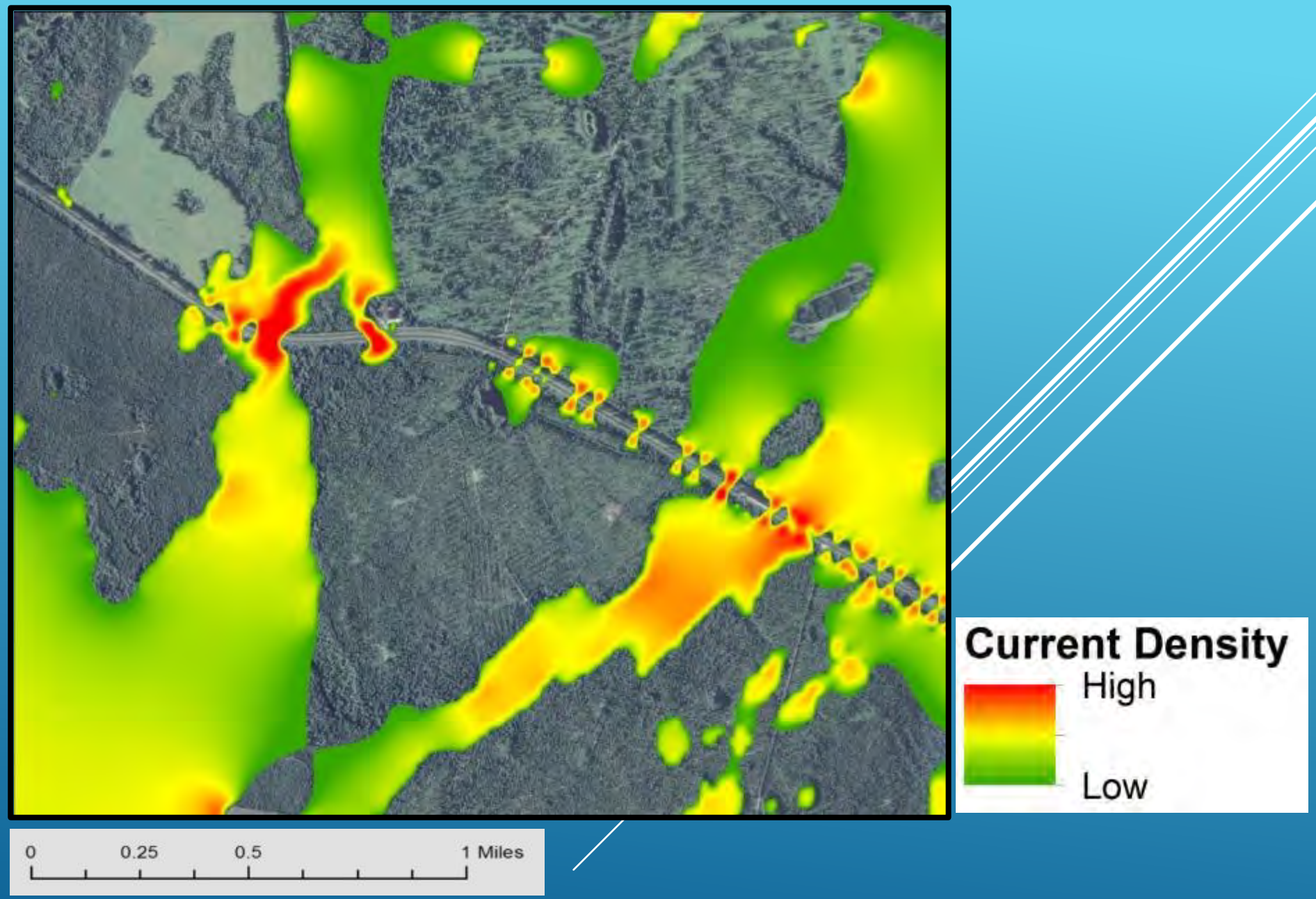


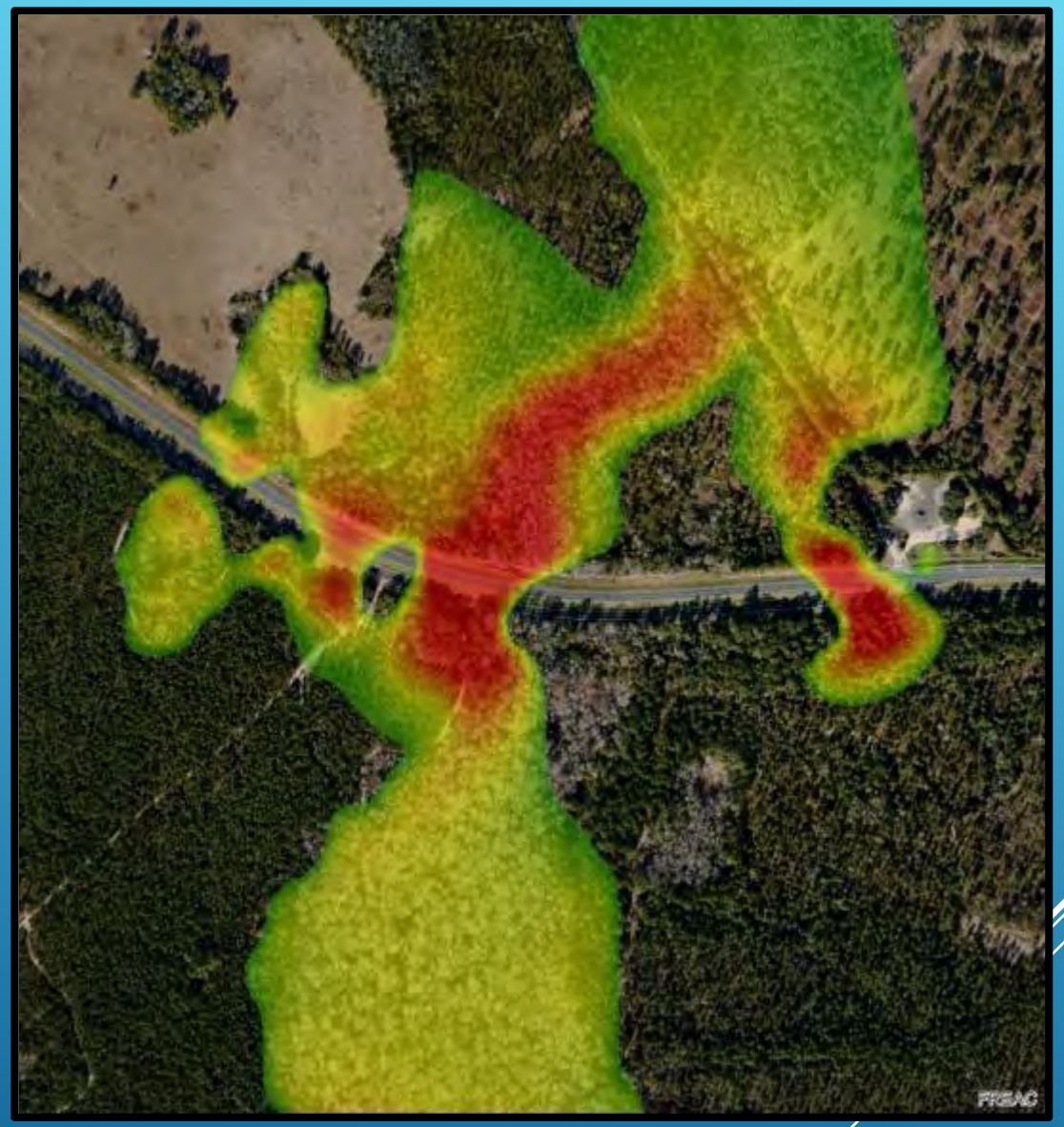

12
13
16
18
23
25
29
Current Density
High
Low

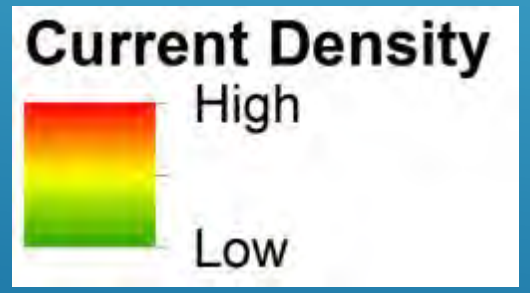

0
0.25
0.5
1 Miles

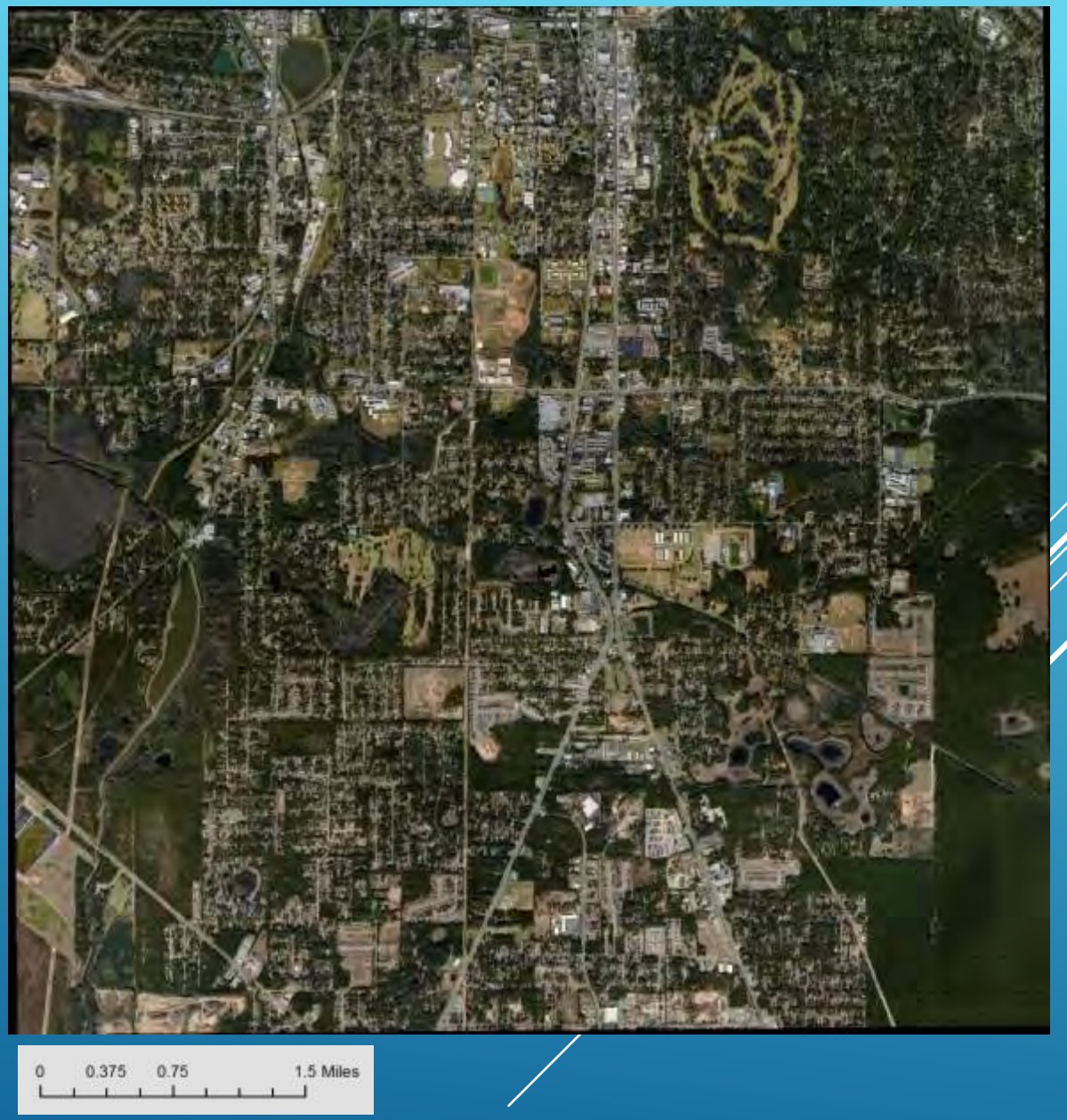

0
0.25
0.5
1 Miles

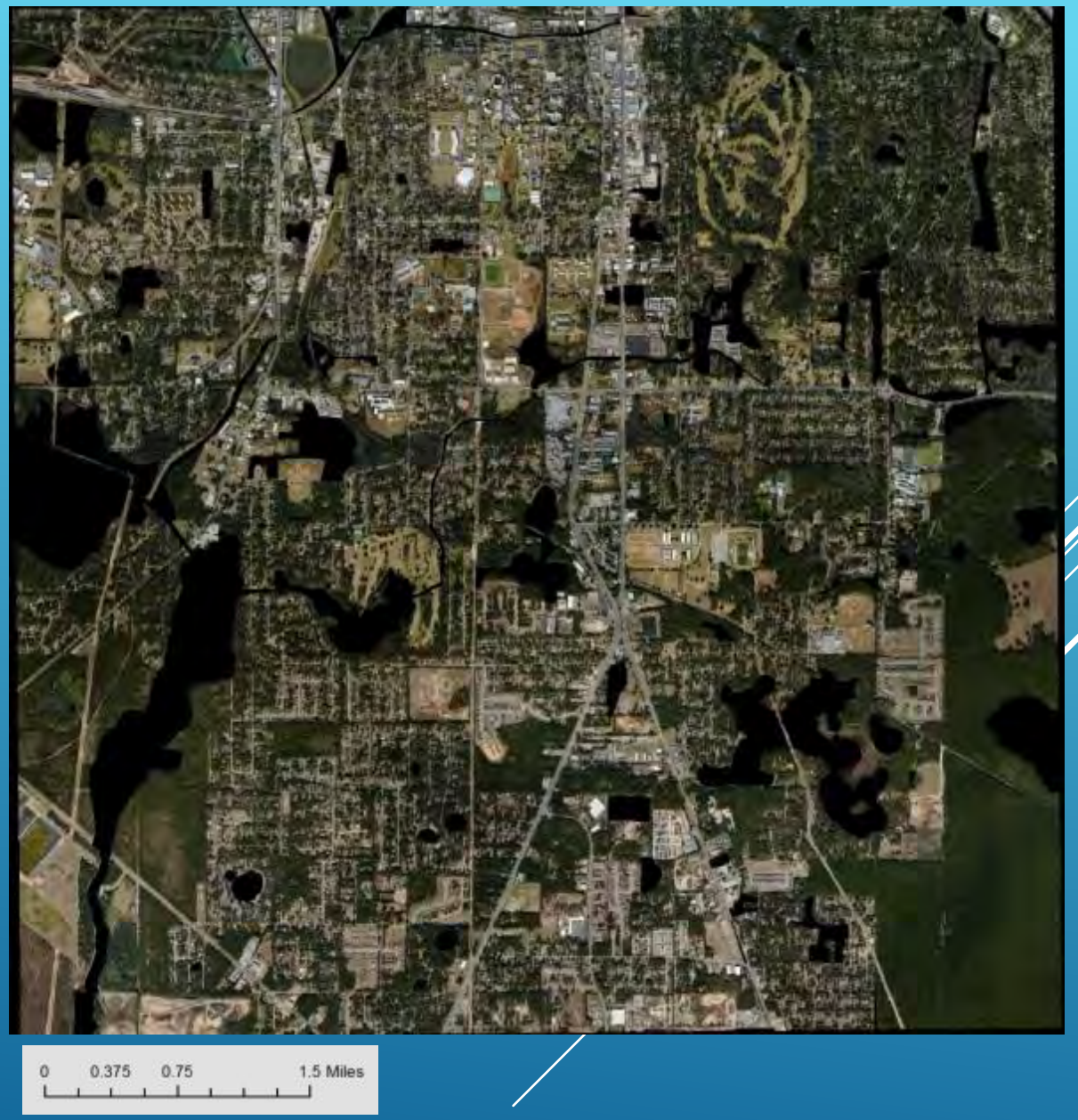

Current Density
High
Low
0
0.25
0.5
1 Miles

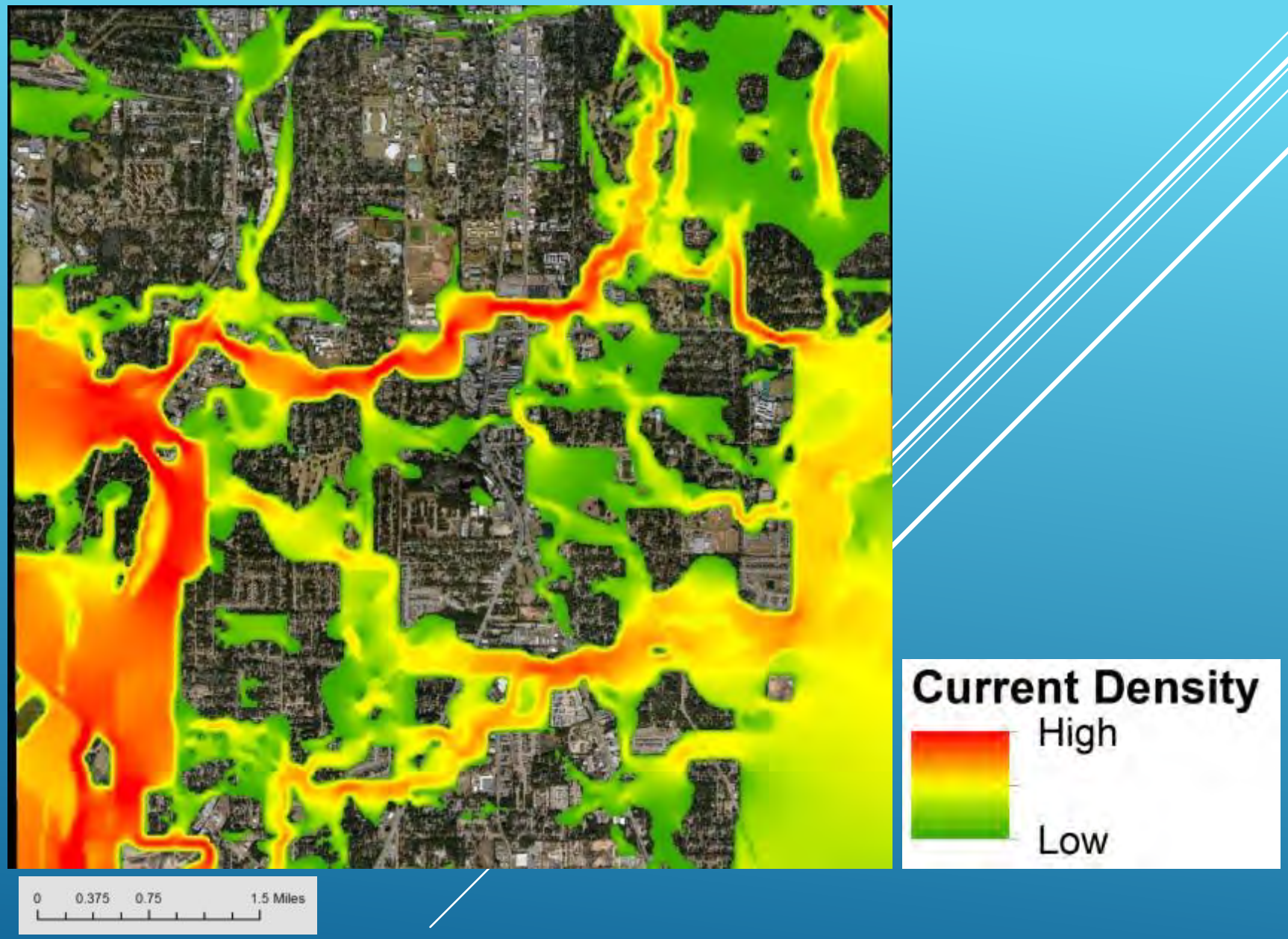

Current Density
High
Low
0
0.25
0.5
1 Miles

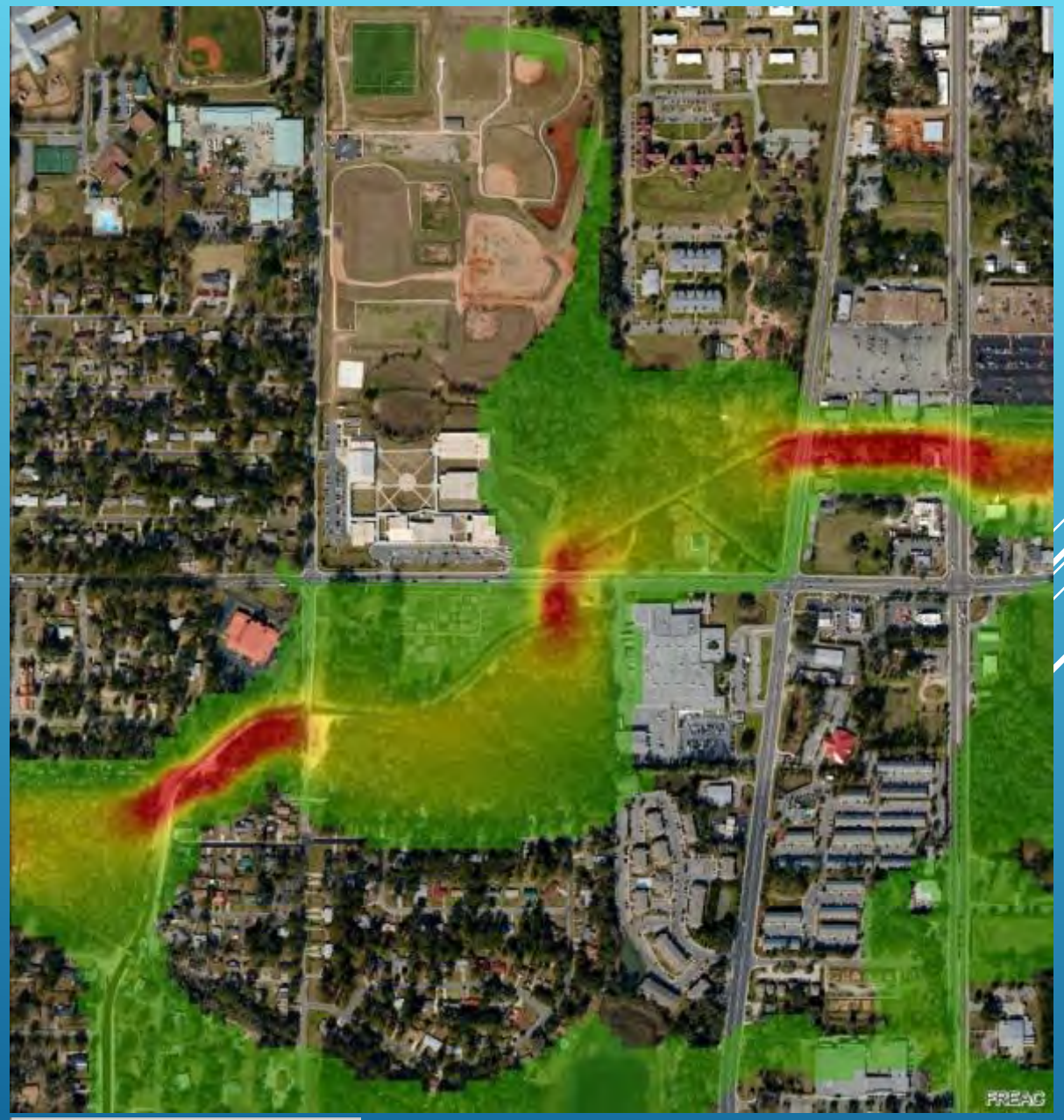

0
0.05
0.1
0.2 Miles


Current Density
High
Low


0
0.375
0.75
1.5 Miles


0
0.375
0.75
1.5 Miles


Current Density
High
Low
0
0.375
0.75
1.5 Miles


0
0.075
0.15
0.3 Miles
Current Density
High
Low

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