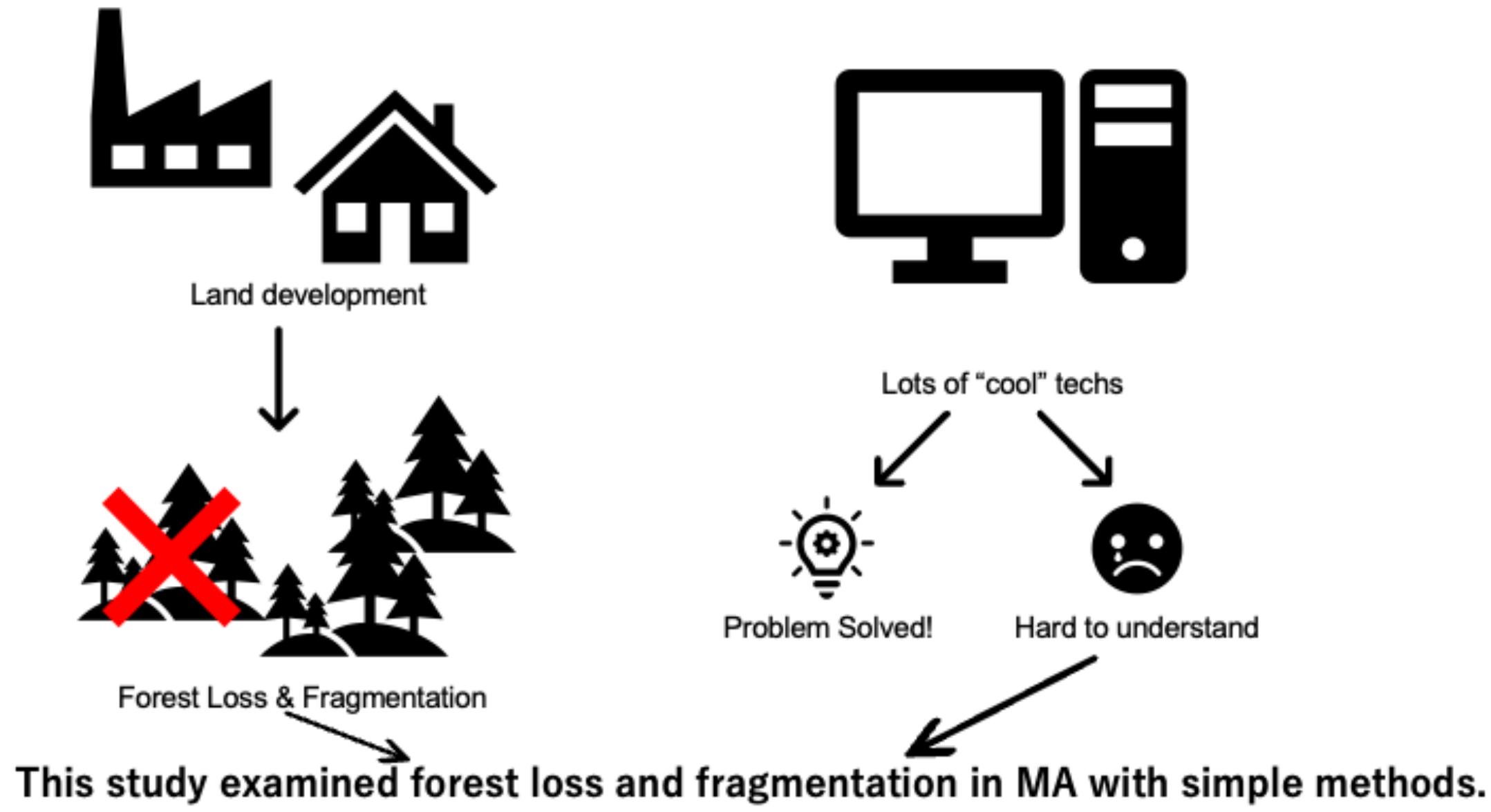


Basic mathematics revealed forest dynamics in MA

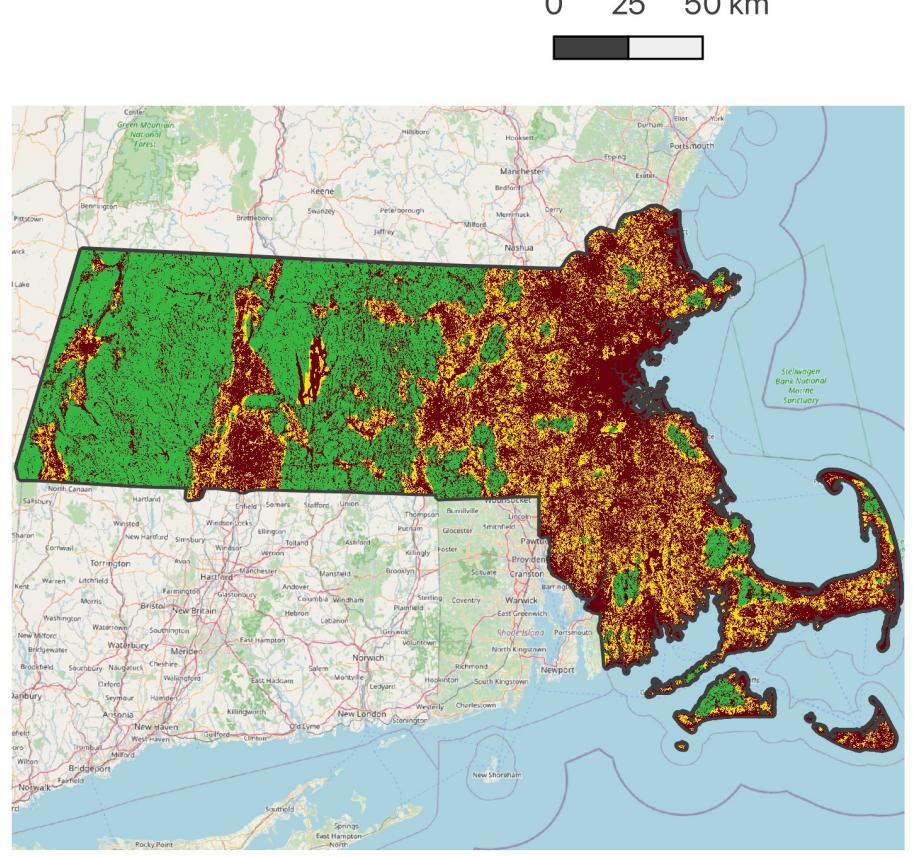
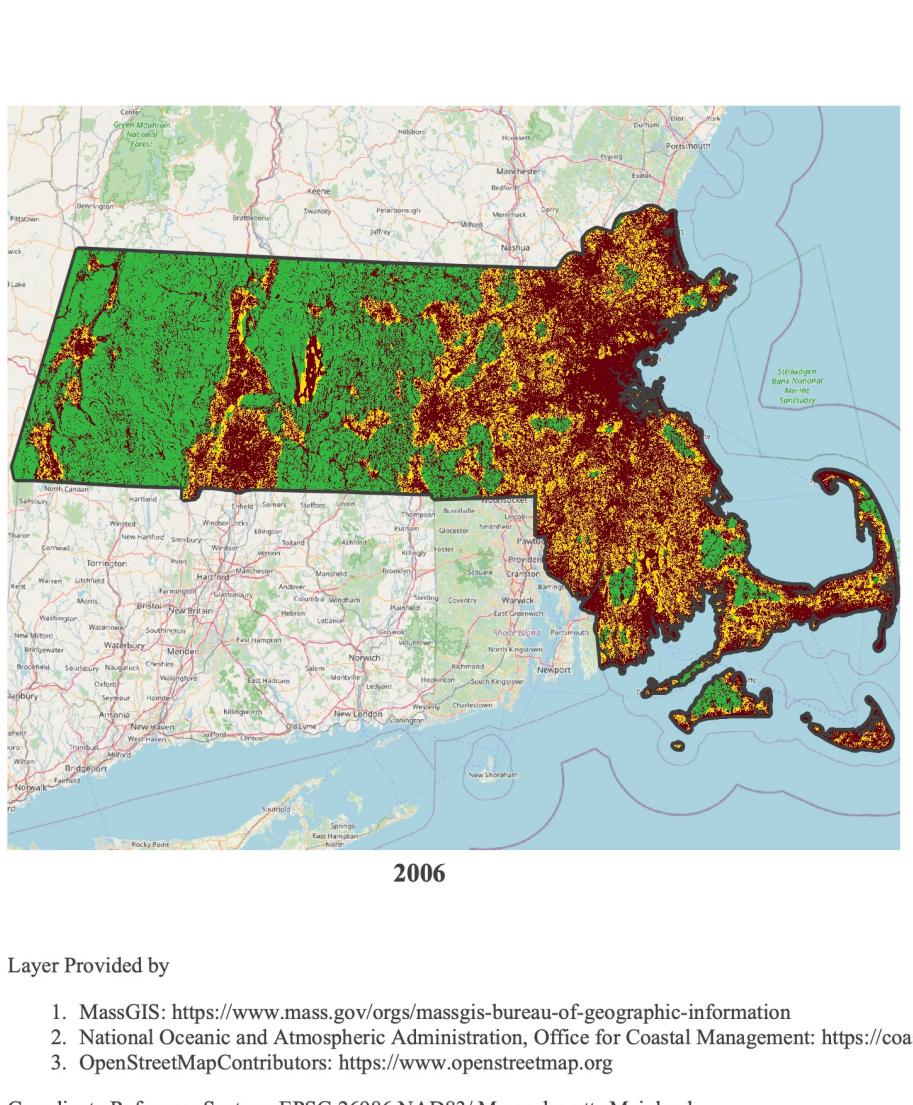
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Forest Category at the Time Points



Glossaries

Foreground Area Density (FAD)^[1]

FAD represents a size of foreground pixels as a ratio to the total number of pixels in a moving window. If a center pixel is not the foreground pixel, then the FAD will NOT be calculated. Otherwise, FAD is calculated for every foreground pixel. The value is rounded to an integer.

Extent & Category Size^[2]

Extent is the total number of pixel in a study area. In my study, each municipality had the extent. Category size is the number of pixels that belonged to the category at a specific time point. Although category size may change between the time points, the extent must be the same.

Gains & Losses of a Category^[2]

Gains are pixels that did NOT belong to the category at the 1st time point but did belong to the category at the 2nd time point. Losses are pixels that did belong to the category at the 1st time point but did NOT belong to the category at the 2nd time point.

Change^[2]

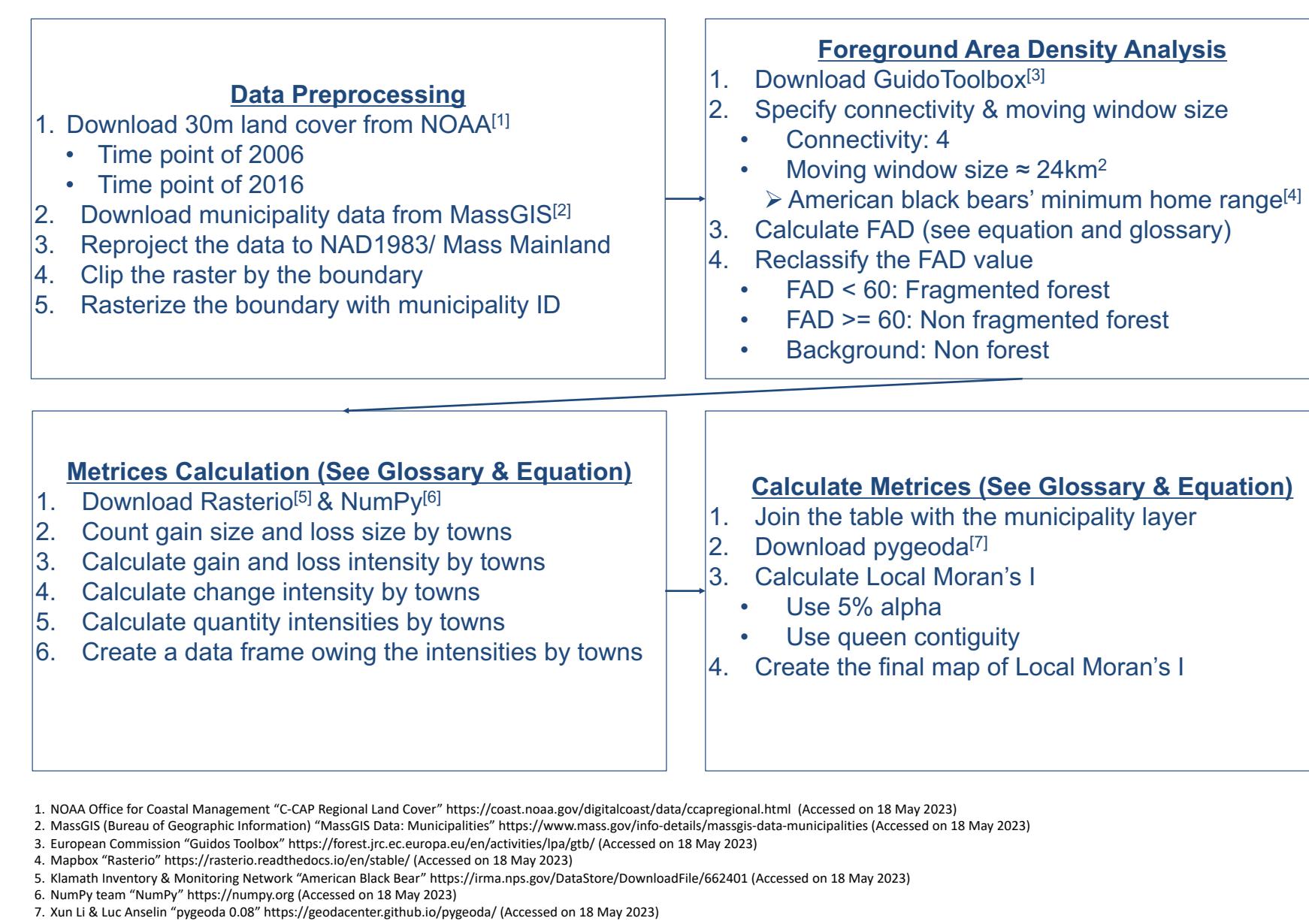
Changes are pixels whose categories were different between the maps at the two time points.

Quantity of a Category (Net Change)^[2]

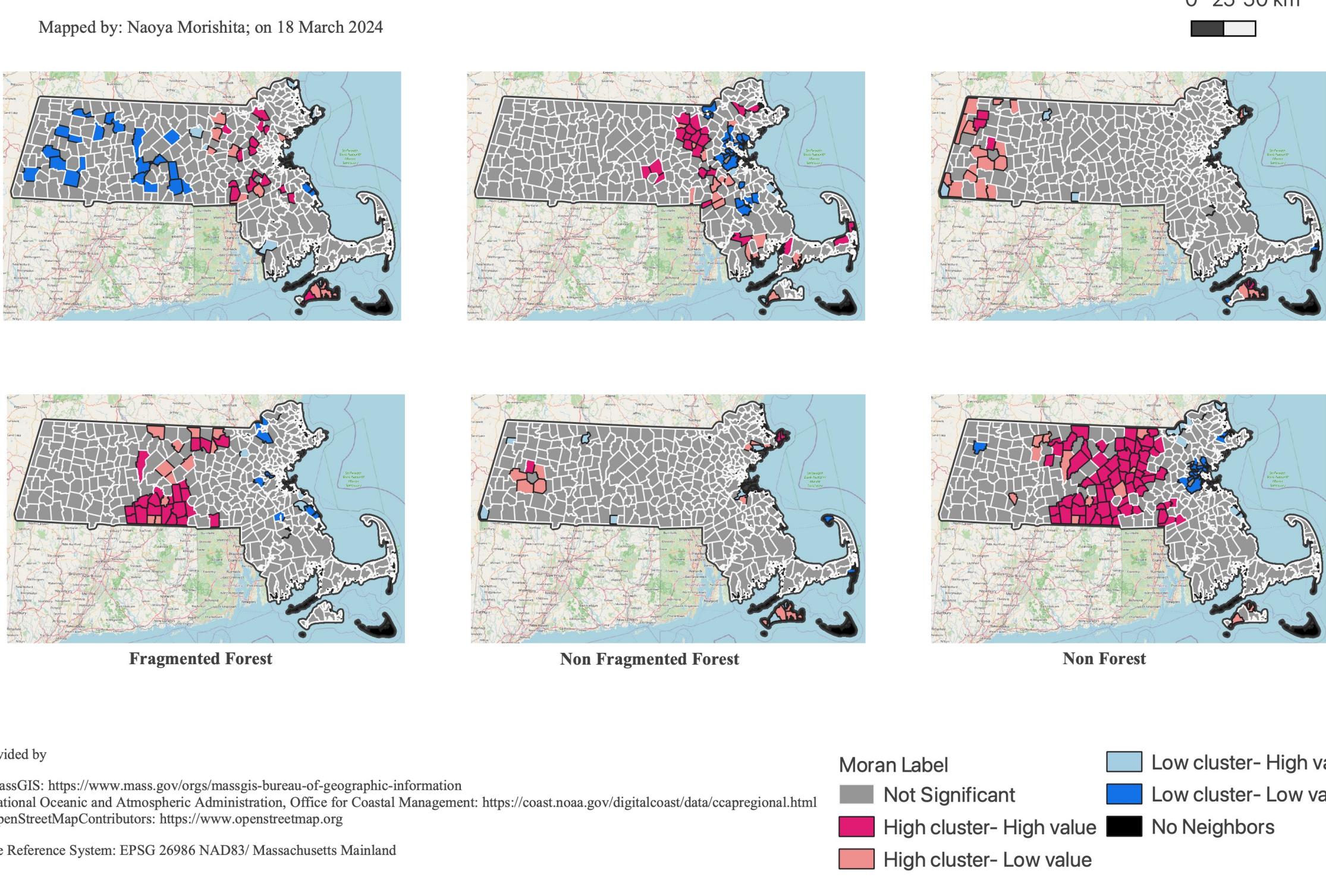
Quantity excludes simultaneous gains and losses for each category. Categories may have either gain quantity OR loss quantity in an extent.

Local Moran's I^[3]

Local Moran's I identifies clusters and spatial outliers that are significantly similar or dissimilar with neighbors. After identifying them, the function produces a map containing high and low clusters and spatial outliers in or around the clusters. Note the high and low is relative to mean of the variable.



Local Moran's I on Net Change Intensities



Key Equations^{[1][2]}

$$\text{FAD} = \# \text{ of Foreground Pixels} / \text{Total } \# \text{ of Pixels}$$

$$\text{Gain Intensity for a Category} = \text{Gain Size} / \text{Category Size at 2}^{\text{nd}} \text{ Time Point}$$

$$\text{Loss Intensity for a Category} = \text{Loss Size} / \text{Category Size at 1}^{\text{st}} \text{ Time Point}$$

$$\text{Change Intensity} = \text{Change Size} / \text{Extent}$$

$$\text{Gain Quantity for a Category} = \text{MAXIMUM}(\text{Gain Size} - \text{Loss Size}, 0)$$

$$\text{Loss Quantity for a Category} = \text{MAXIMUM}(\text{Loss Size} - \text{Gain Size}, 0)$$

$$\text{Gain Quantity Intensity for a Category} = \text{Category's Gain Quantity} / \text{Category Size at 2}^{\text{nd}} \text{ Time Point}$$

$$\text{Loss Quantity Intensity for a Category} = \text{Category's Loss Quantity} / \text{Category Size at 2}^{\text{nd}} \text{ Time Point}$$

Key Findings & Discussion

1. Fragmented forest intensively gained in central MA.

- The clusters overlaps with those of non- forest gains
- It may indicates that forest losses may introduces forest fragmentation.

2. Change intensities were extensive in central MA and in Martha's Vineyard.

- Nonetheless, Worcester, 2nd largest areas belonged to the high- low spatial outlier.
 - This implies that the intensity is significantly dissimilar with and lower than its neighbors.

3. "Outskirts of Boston" belonged to low clusters of quantity intensities of non- forest gain

- This disagrees with a study^[4], arguing that the area lost forests extensively.
- Instead, central MA belonged to the high intensity cluster, but Worcester was also a spatial outlier.
 - Solar panels have been widely installed to central Mass.^[5]
 - These low cluster and outlier may be no longer experience intensive non- forest gains (= forest loss).
 - These areas may have been developed extensively by the time point of 2005.

4. South- central MA belonged to high clusters of the quantity intensities of fragmented forest gain

- A study^[6] argued that forest in and around populous city experienced fragmentation
- However, towns further away from Worcester also belonged to the cluster.

Potential Research Questions in the Future

- How do parameters and MAUP affect the result?
- How do other land covers affect connectivity among habitats?
- What are potential drivers of forest loss and fragmentation in central MA?
- How do fragmentation and forest loss affect actual behavior of wildlife?

Key References

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