THE EFFECTS OF LANDSCAPE CHARACTERISTICS AND CLIMATE VARIABLES ON WEST NILE VIRUS INFECTION RISK IN MASSACHUSETTS

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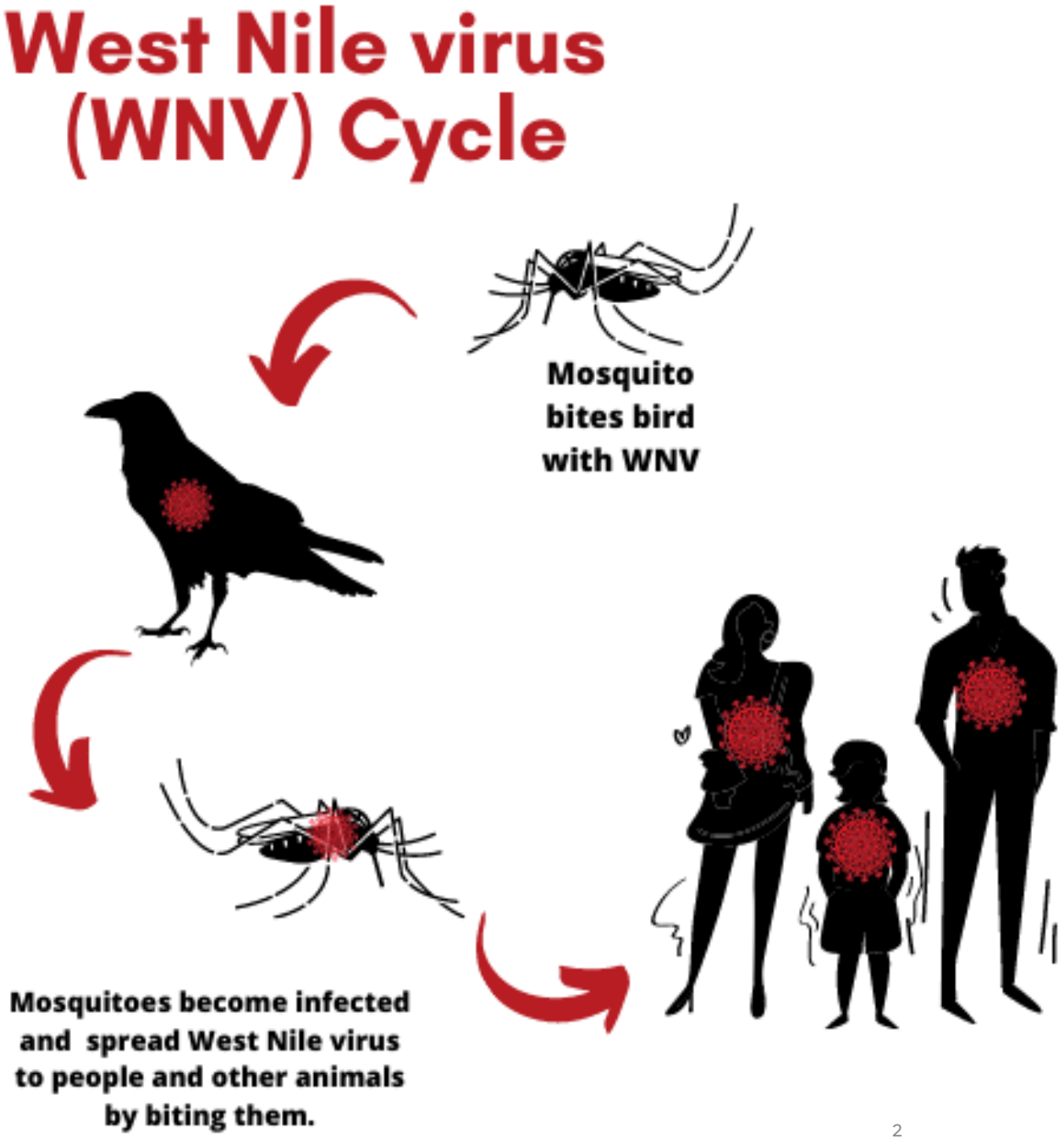
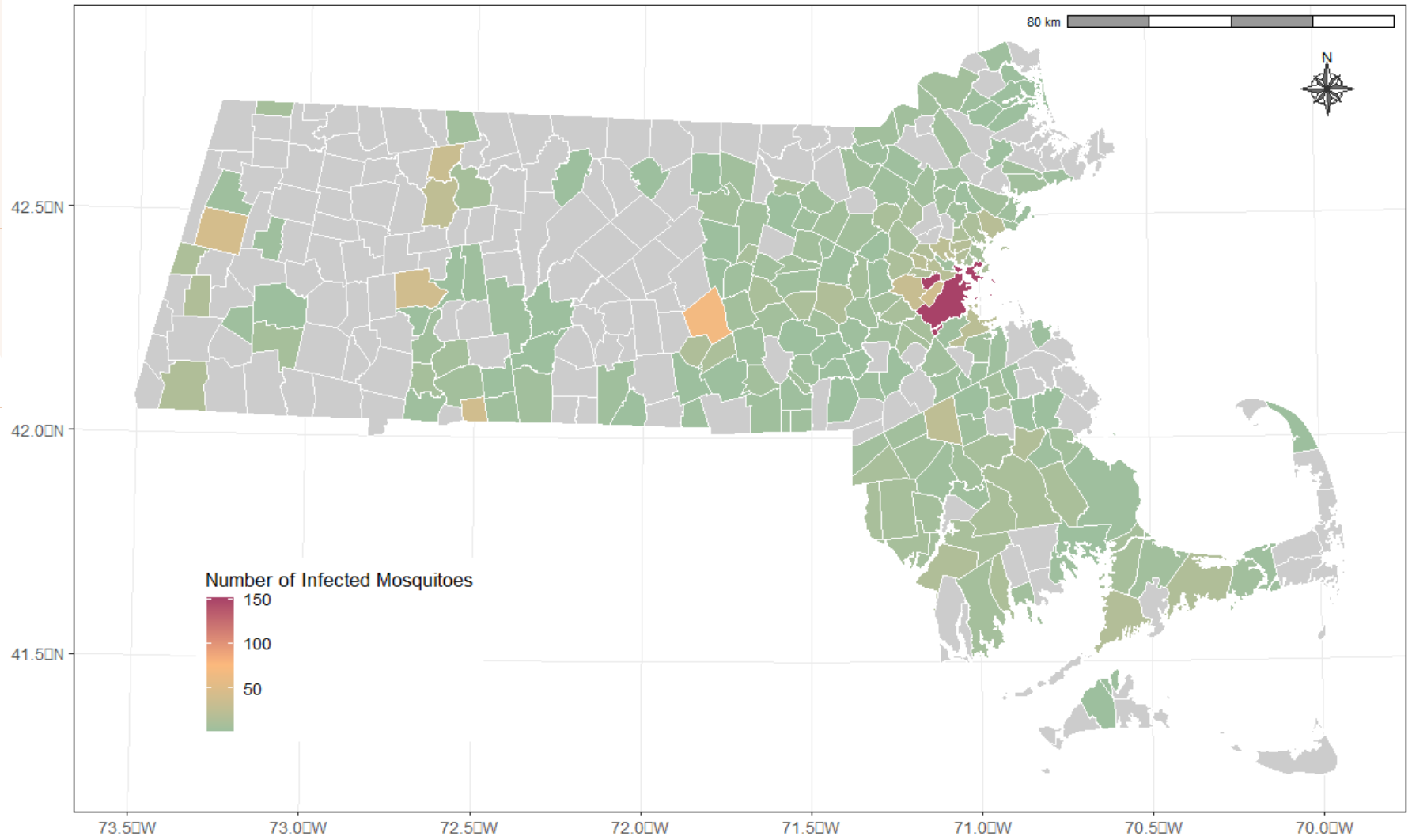
INTRODUCTION



West Nile Virus Transmission Cycle
(source: orange county mosquito and vector control district)

STUDY AREA AND INFECTED MOSQUITOES



Massachusetts Town-Level WNV Infected Mosquito Cases, 2014-2020

OBJECTIVES

Identify Hotspot Areas for WNV

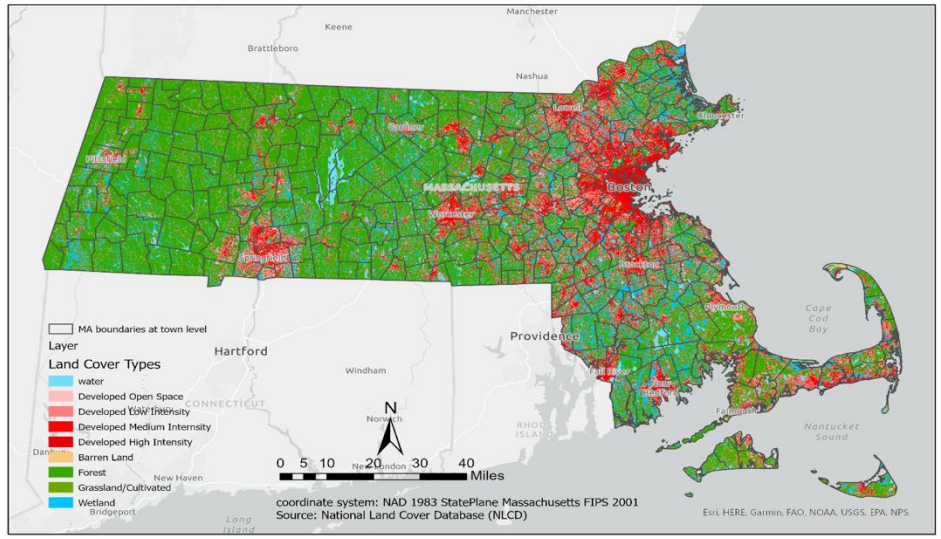
Predict WNV distribution across the state

Find out most correlated variables

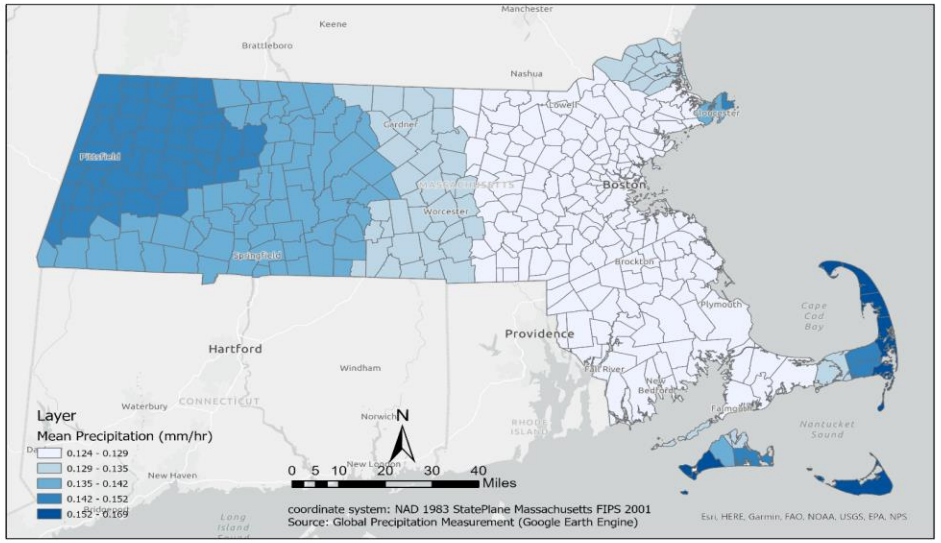
Help mitigate the risk of WNV spreading

DATA

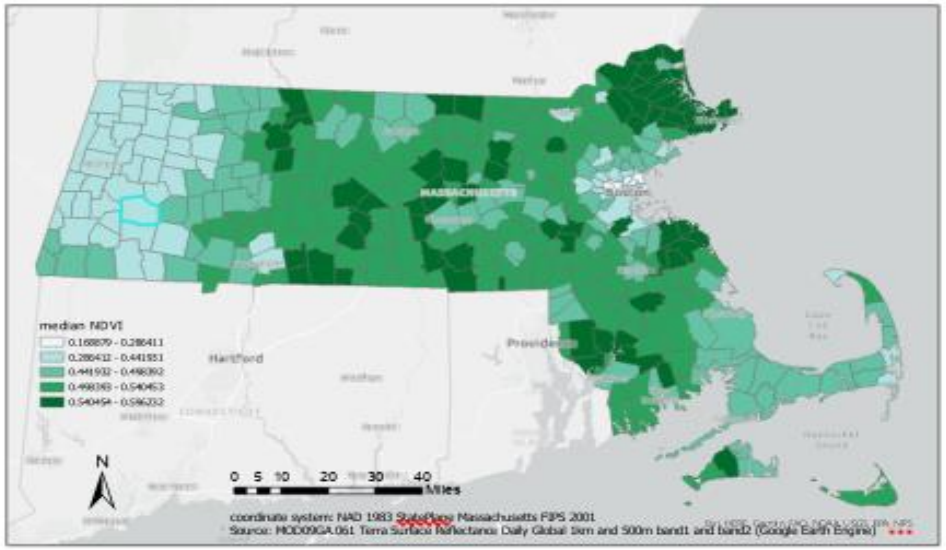
Town-Level Land Cover Map in Massachusetts (2019)



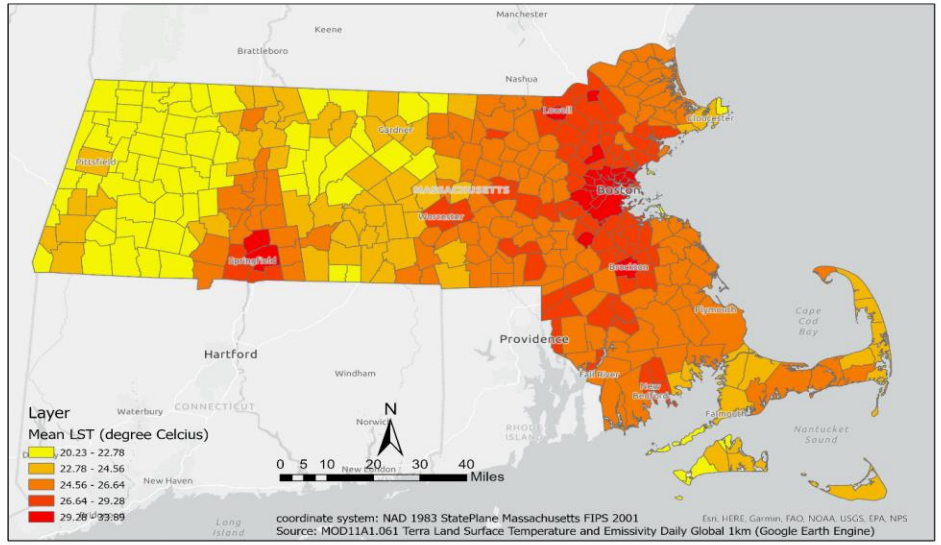
Massachusetts Town-Level Summertime Precipitation Trends, 2014-2020



Median NDVI in Massachusetts at Town Level, 2014-2020



Average Land Surface Temperature (LST) in Massachusetts at Town Level, 2014-2020



METHODS

Model: Random Forest Regression Model

Responce variable: mosquito numbers in 185 towns

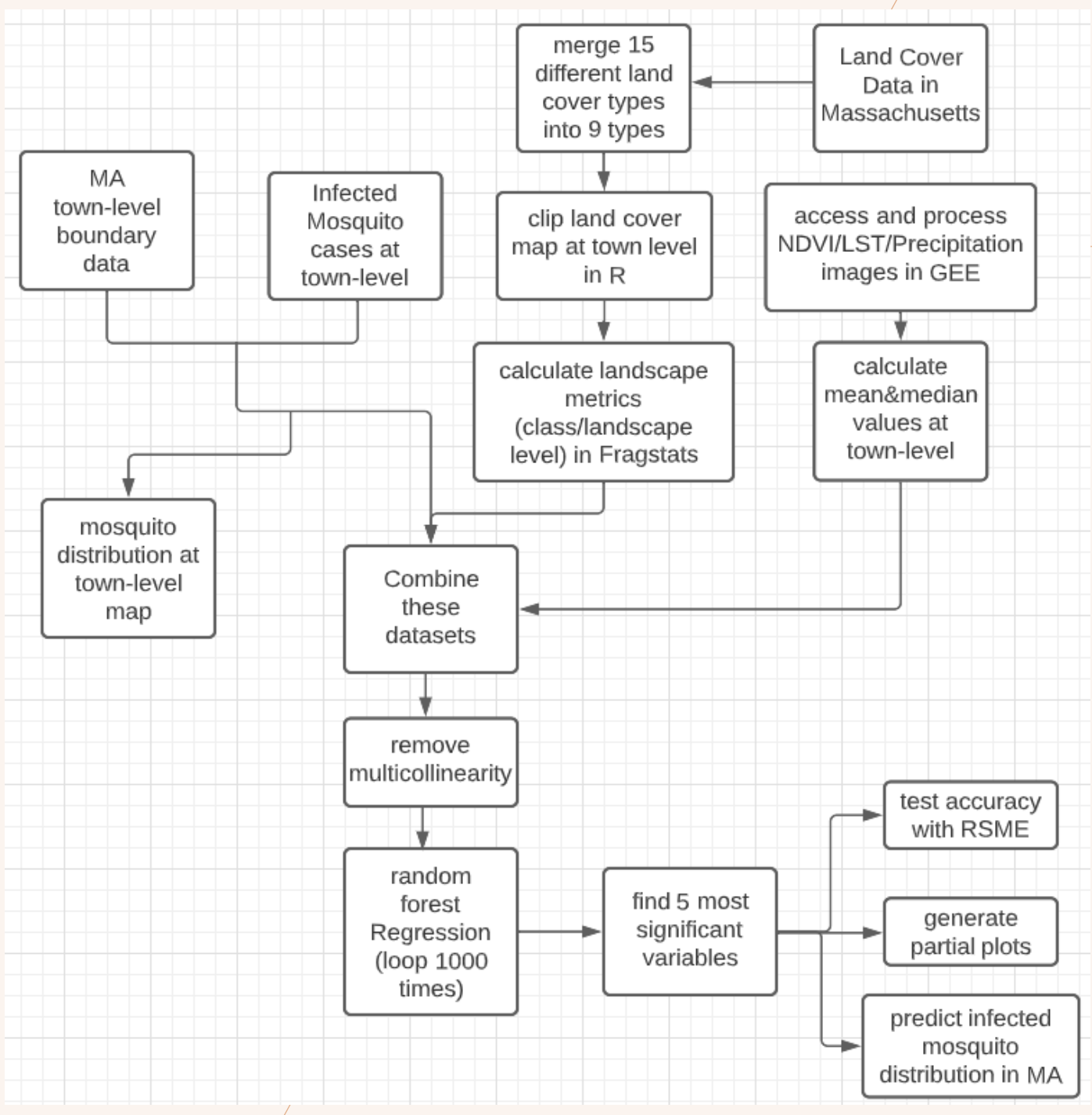
Factors: 78 variables (72 landscape variables + 6 climatic variables) after the multicollinearity removement.

1. Looping the Random Forest model 1000 times to find out 5 most significant factors

2. Train the Random Forest by using these 5 most important factors to reach the lowest RMSE

3. Obtain the importance variable plot and partial dependence plots

4. Generate the Predicted infected mosquito distribution map at the town level



RESULTS

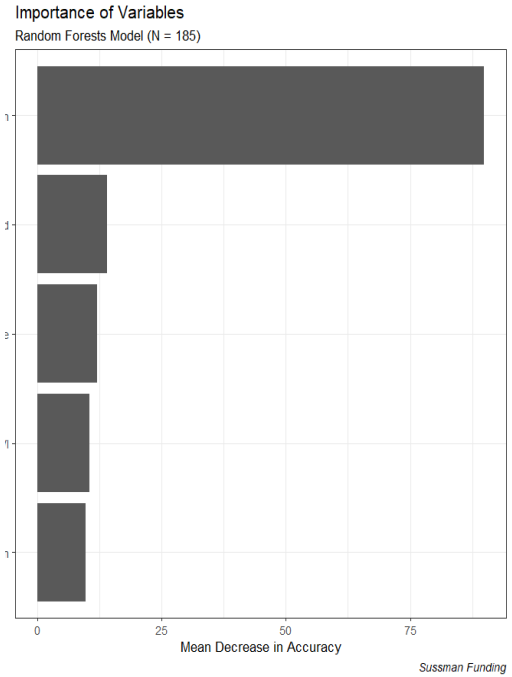
Total Edge of Medium Develop Urban

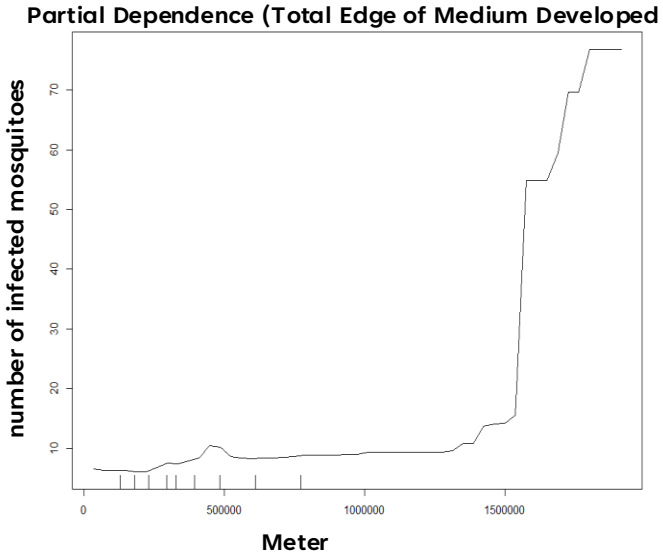
Standard Deviation of Contiguity Index for Grassland

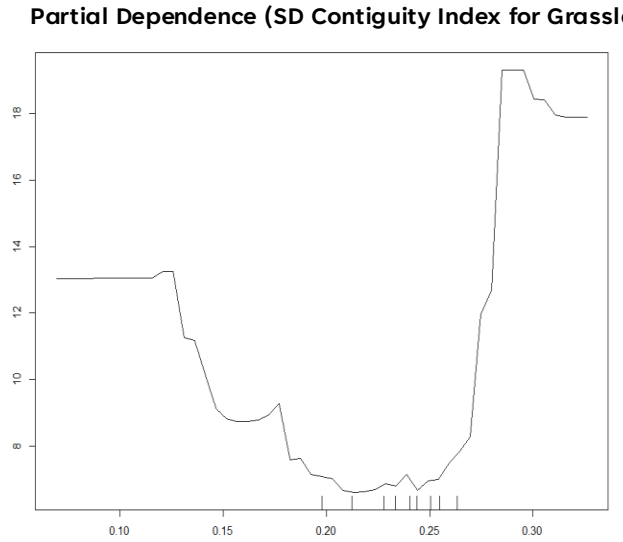
Mean value of Land Surface Termperature

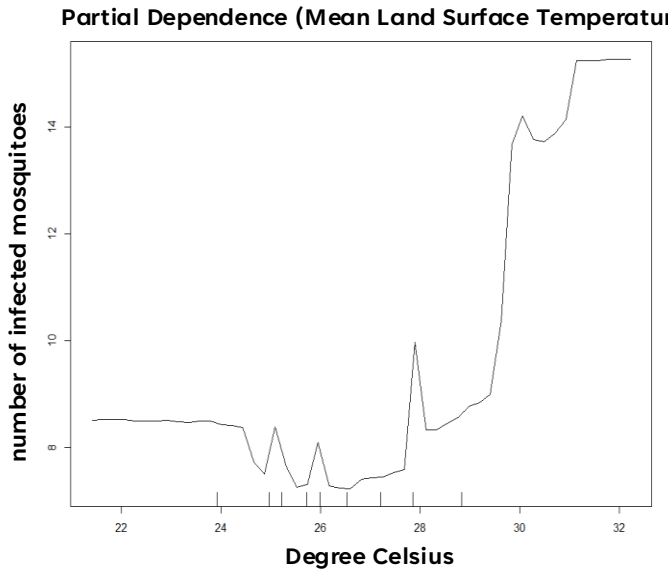
Median value of NDVI

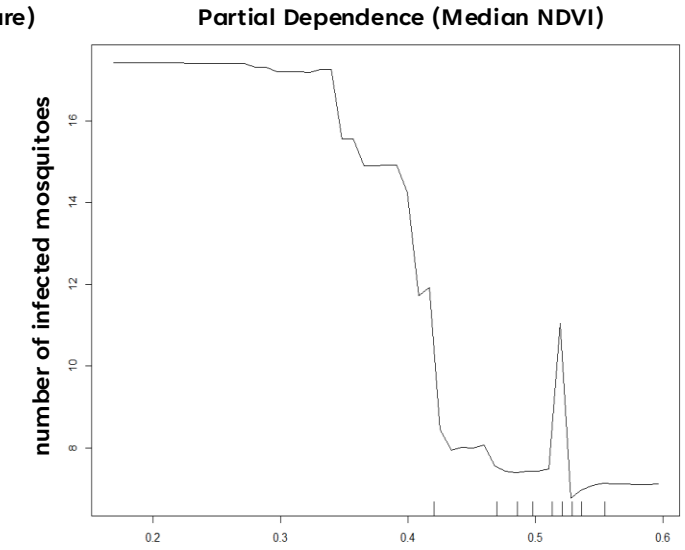
Mean value of Proximity Index of Medium Developed Urban

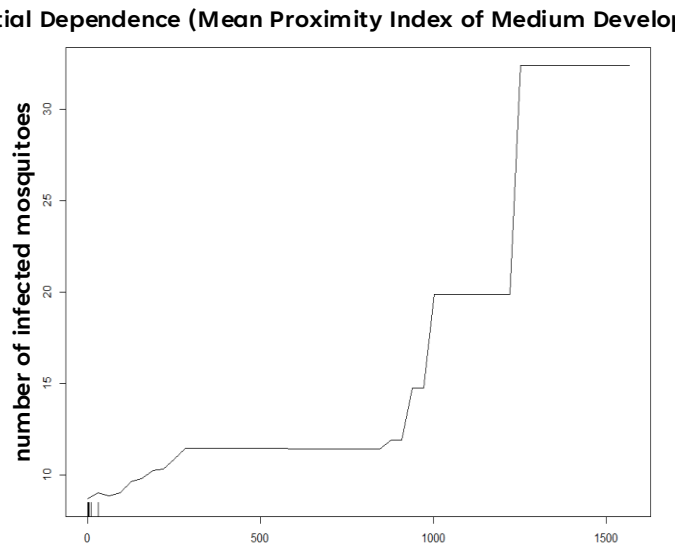






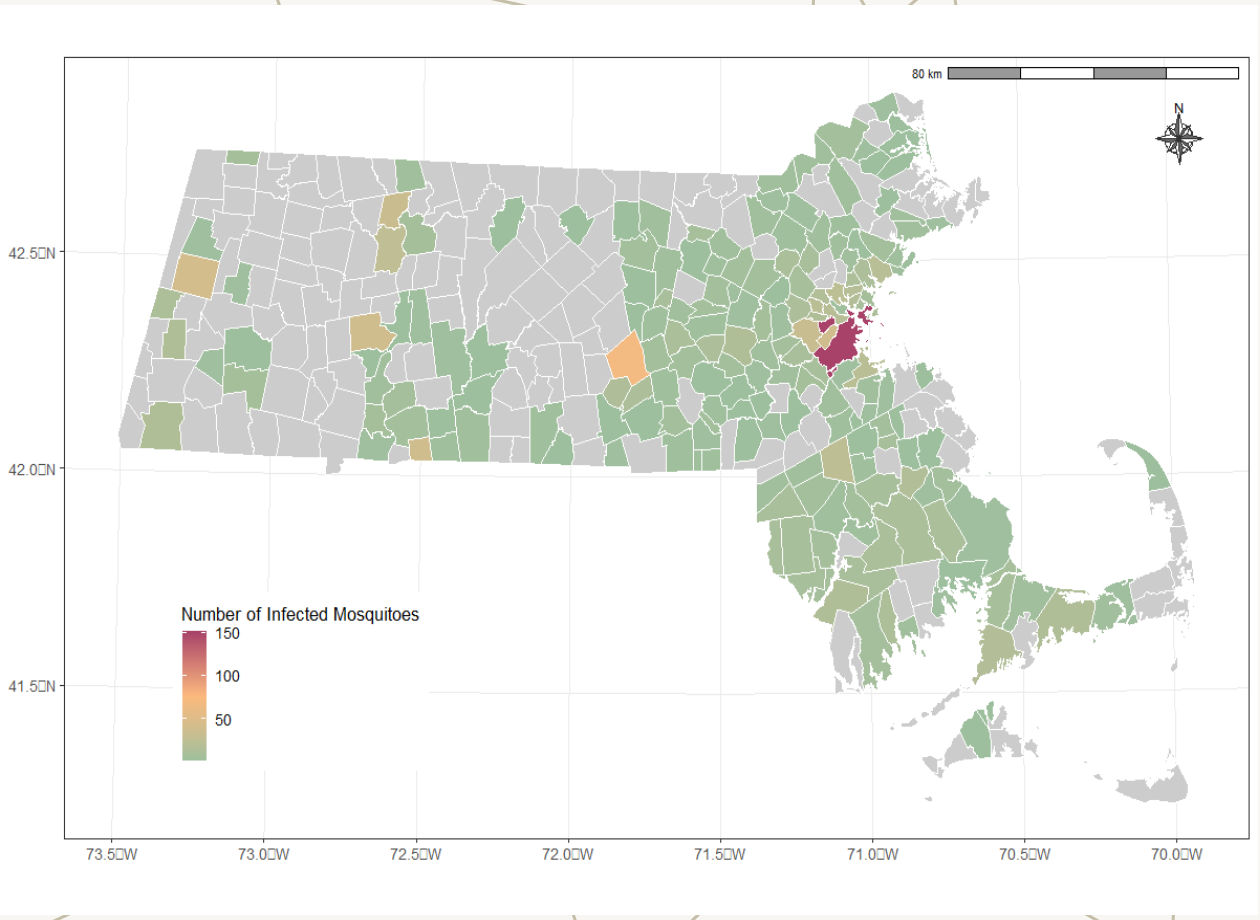




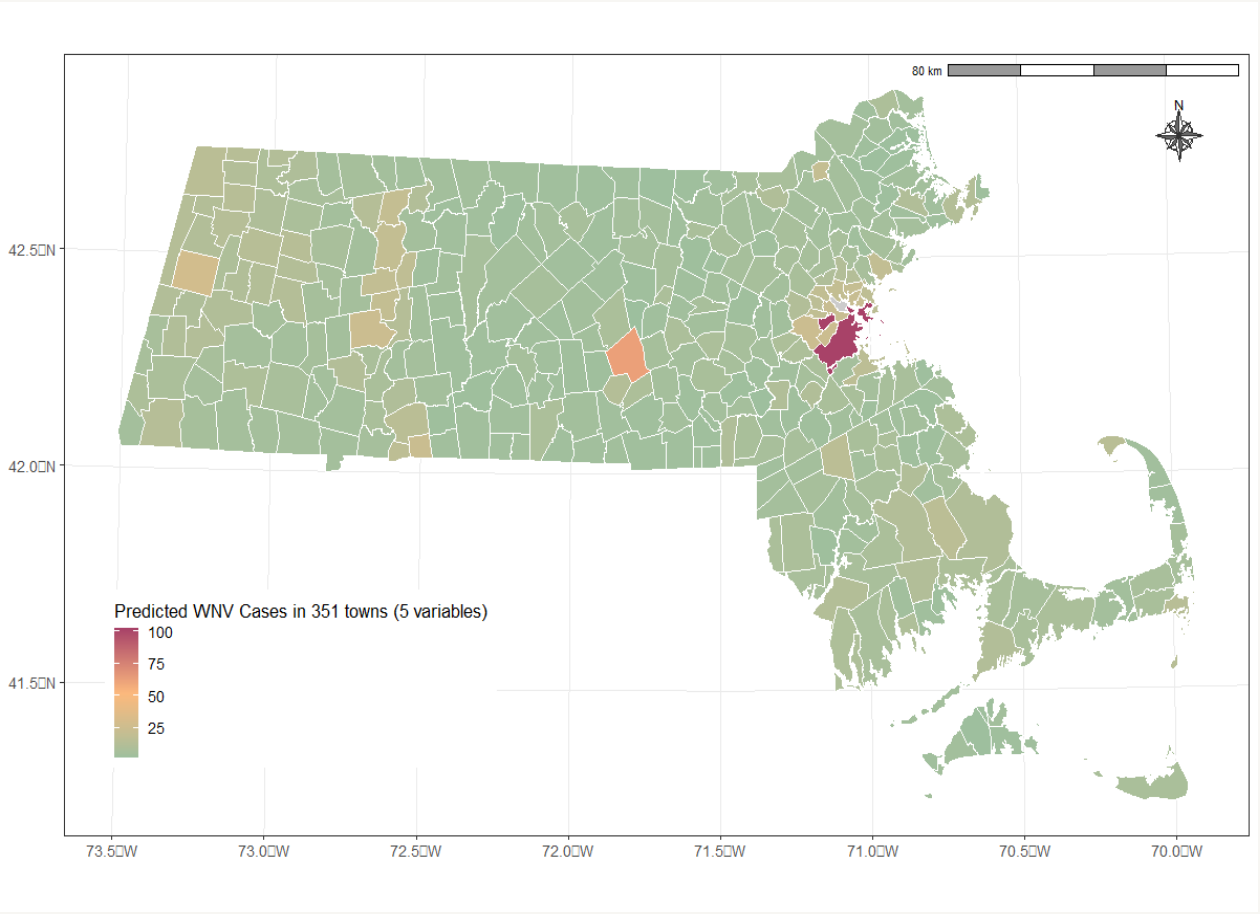


The Rank of Important Variables (left 1) and Partial Plots of 5 Topmost Important Features

RESULTS



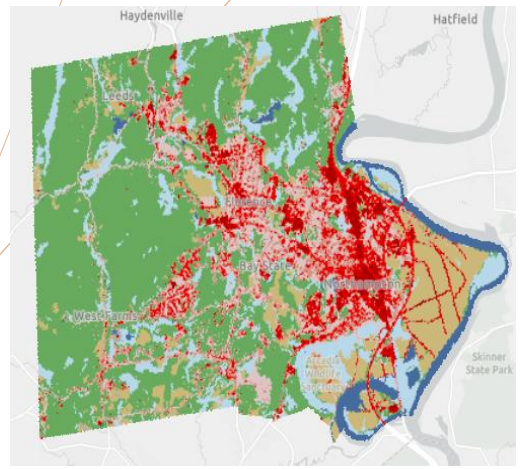
Recorded Infected Mosquitoes in MA at Town Level



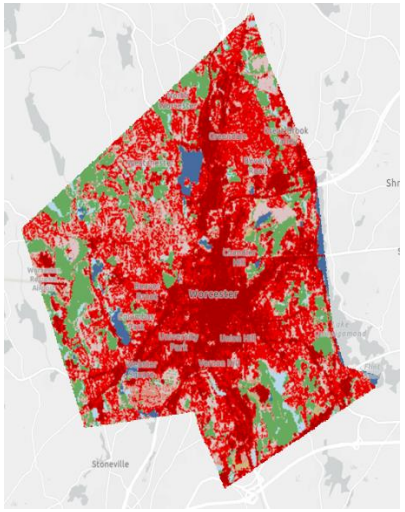
Predicted Infected Mosquitoes in MA at Town Level

RMSE: 5.45

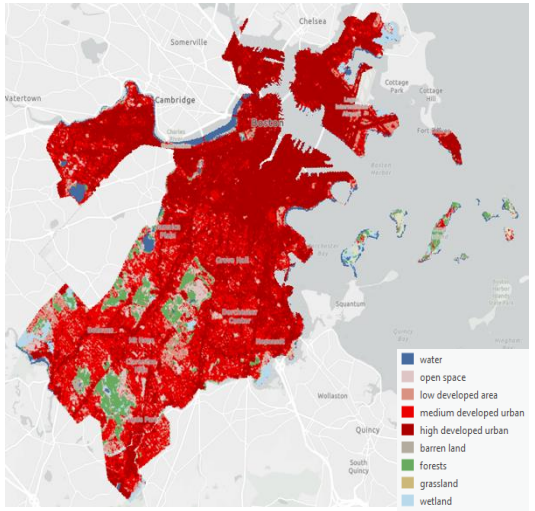
RESULTS



Northampton Town: 38 case (real), 23 cases (predicted)

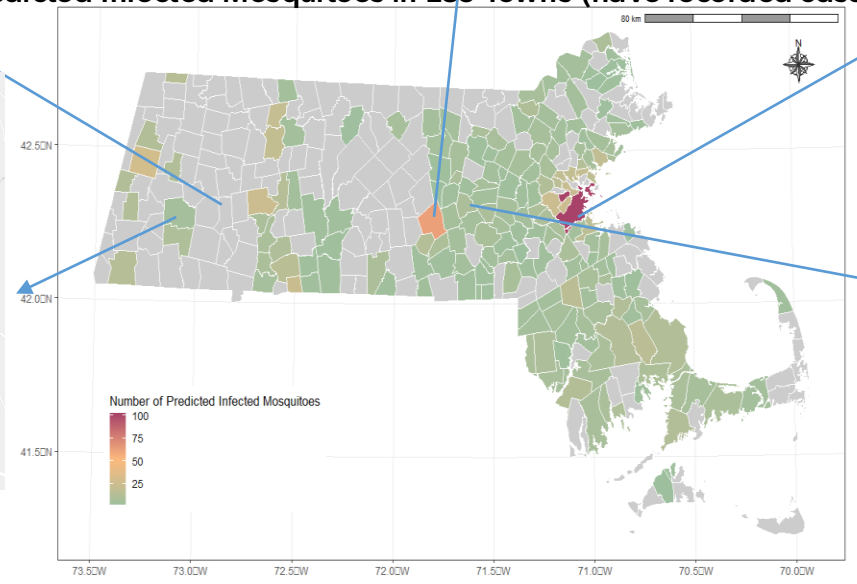


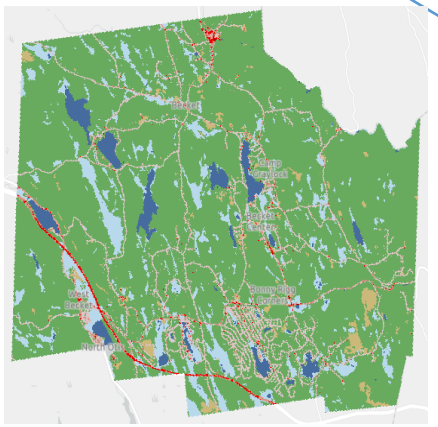
Worcester Town: 68 case (real), 62 cases (predicted)



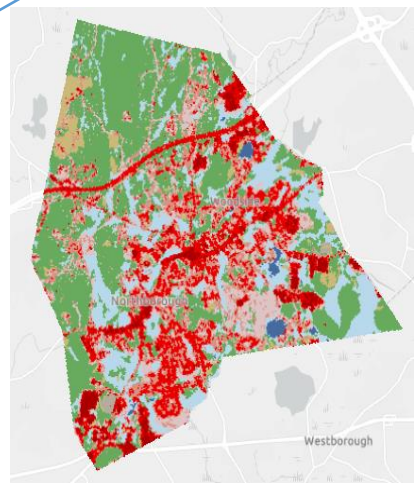
Boston Town: 151 case (real), 102 cases (predicted)

Predicted Infected Mosquitoes in 185 Towns (have recorded cases) in MA





Becket Town: 1 case (real), 5 cases (predicted)



Northborough Town: 10 case (real), 8 cases (predicted)

Predicted Infected Mosquitoes in 185 towns and the land cover maps of 5 towns (Northampton, Worcester, Boston, Becket, and Northborough)

DISCUSSION

- **More total edges of the medium-intensity urban would potentially have more infected mosquitoes.** Medium-intensity urban are more likely to be single-family housing units. Infected mosquitoes would prefer human residential areas.

- **More fragmented patches of grassland or crops would induce more mosquitoes.** High variability of the connectivity of grassland suggests more infected mosquitoes.

- **An increasing land surface temperature would help incubate more infected mosquitoes.** When the land surface temperature reaches 30 degree celsius, it would accelerate the number of infected mosquitoes.

- **The number of mosquitoes are high when NDVI was lower than 0.4 but decreased rapidly thereafter.** This suggests the increasing of forest area would reduce the breeding of infected mosquitoes.

- **More concentrated medium-indensity urbanization is associated with a higher number of infected mosquitoes.** The positive relationship between the proximity index of the medium-indensity urbanization areas and the number of mosquitoes supports this statement.

- **From the predicted map, Boston has higher mosquito numbers**, with more than 100 cases, which are presented in red color. The following cities are cities around Boston and major towns in each county, such as Worcester and Pittsfield. Other towns with fewer mosquitoes are rended in green.

CONCLUSION

- It was observed that mosquitoes infected with West Nile Virus are more commonly found in concentrated urbanized developed areas with irregular shapes, such as the Greater Boston.

- It was found that Infected mosquitoes tend to thrive in areas with higher land surface temperature, lower vegetation coverage, and more grassland patches.

- In order to mitigate West Nile Virus transmission, it is reasonable to focus on developed or urbanized areas because they are suitable areas for both human beings and infected mosquitoes. Increasing forest areas between urbanized towns helps to mitigate the infection rate.

ACKNOWLEDGE

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THANK YOU