West Nile Virus in Chicago

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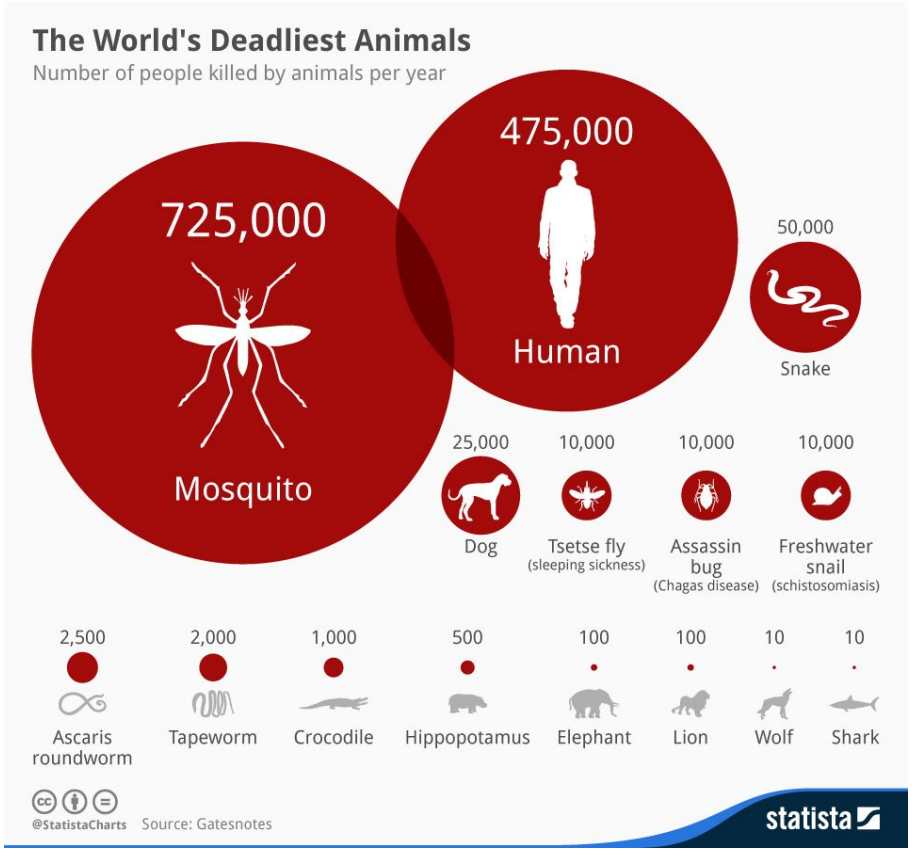
PROBLEM STATEMENT

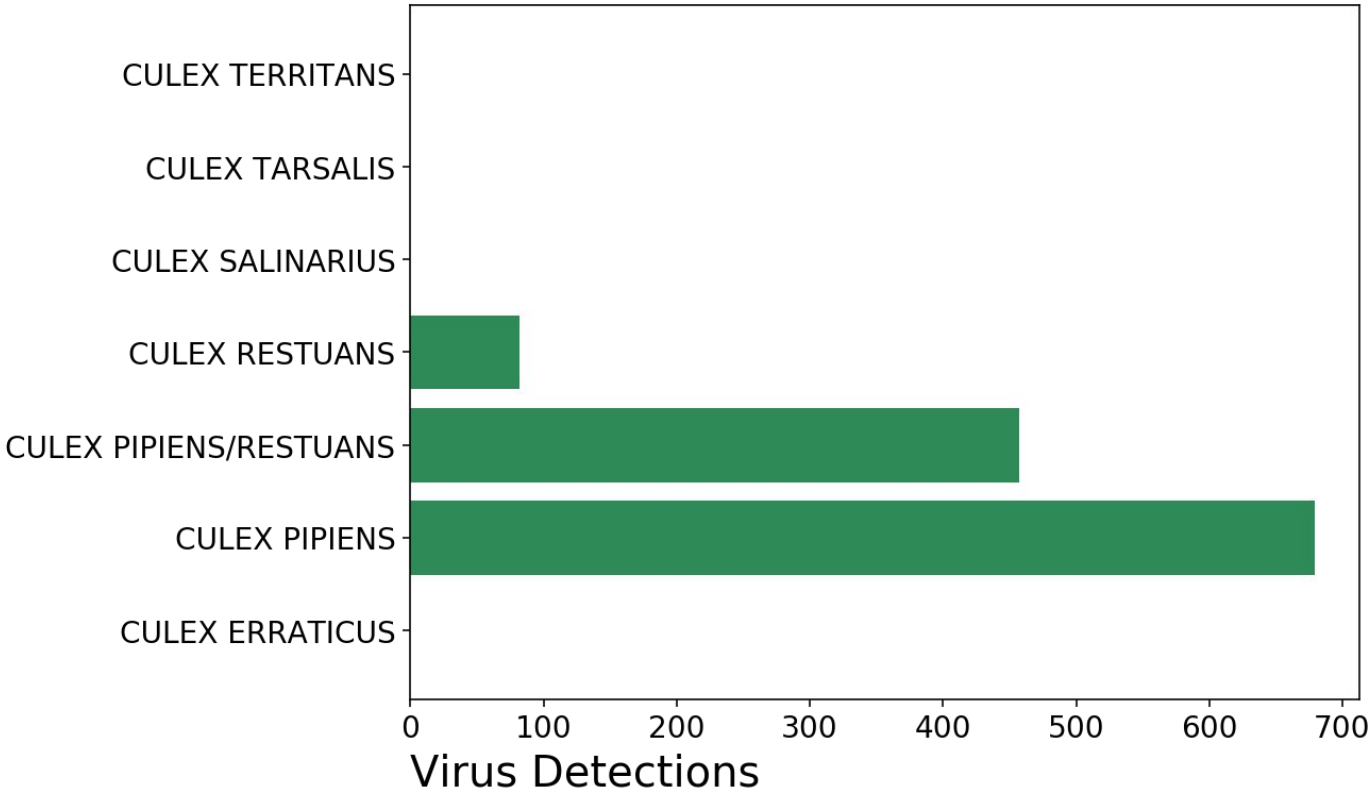
- Predict the spreading of West Nile virus in some years
- Advise the Center for Disease Control with actionable recommendation to address the epidemic

WHAT IS WEST NILE VIRUS

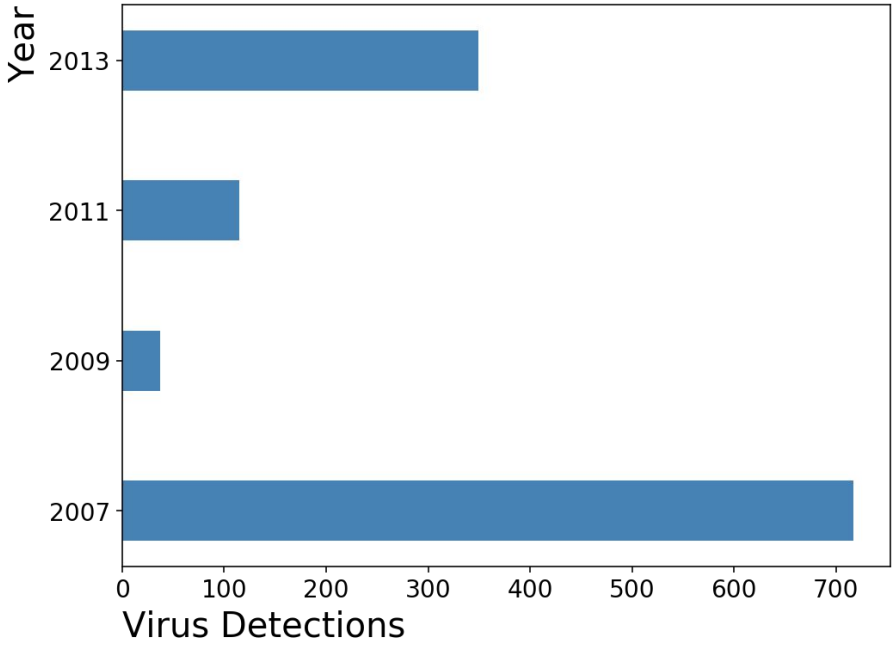
- It is a virus most commonly spread by mosquito bites
- Mosquito season start in summer and last through fall
- There are no vaccines to prevent the virus
- About 1 in 5 people who are infected develop symptoms and a fever
- Around 1 in 150 people who get infected develop a fatal illness

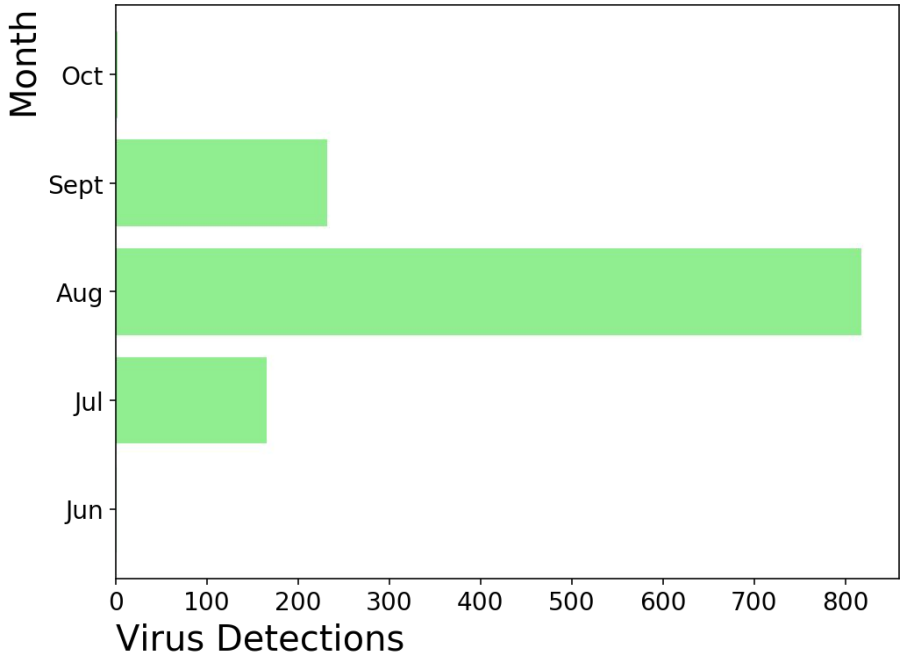


MOSQUITO SPECIES

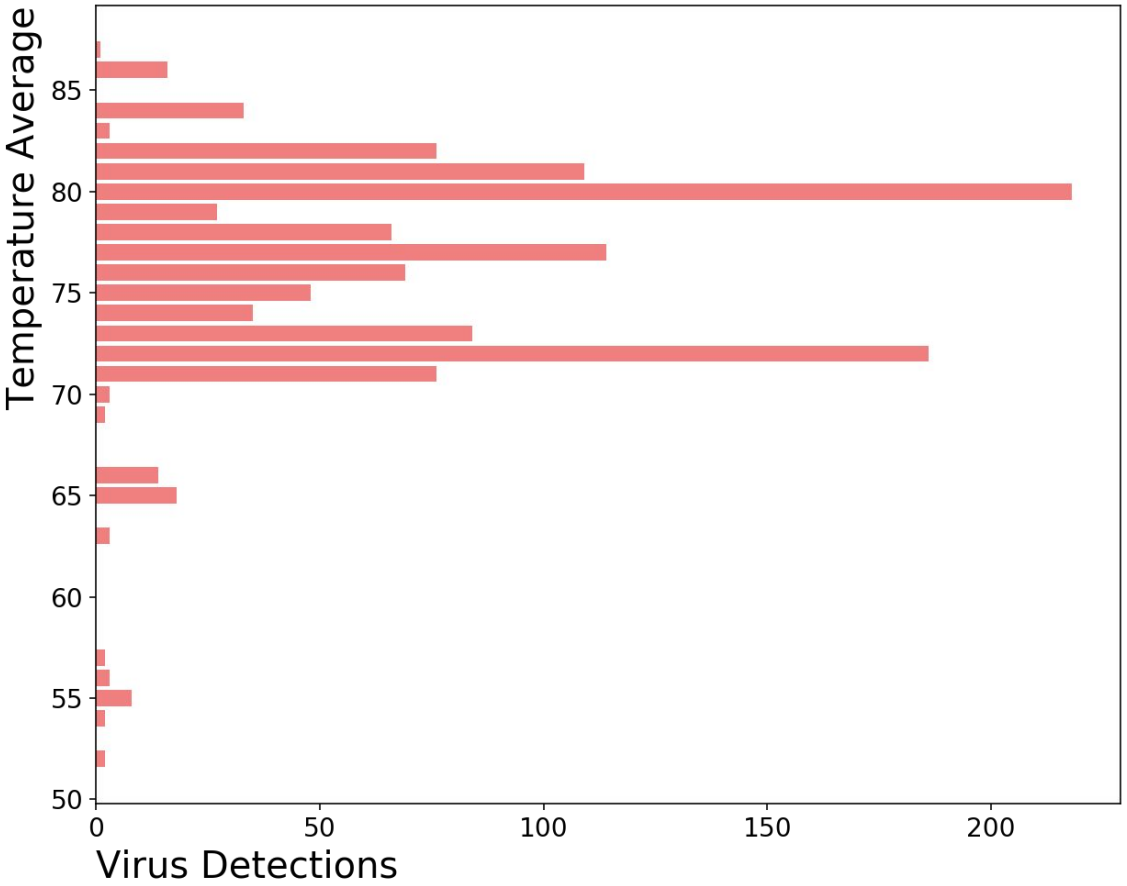


VIRUS PRESENCE OVER ODD YEARS FROM 2007 TO 2013

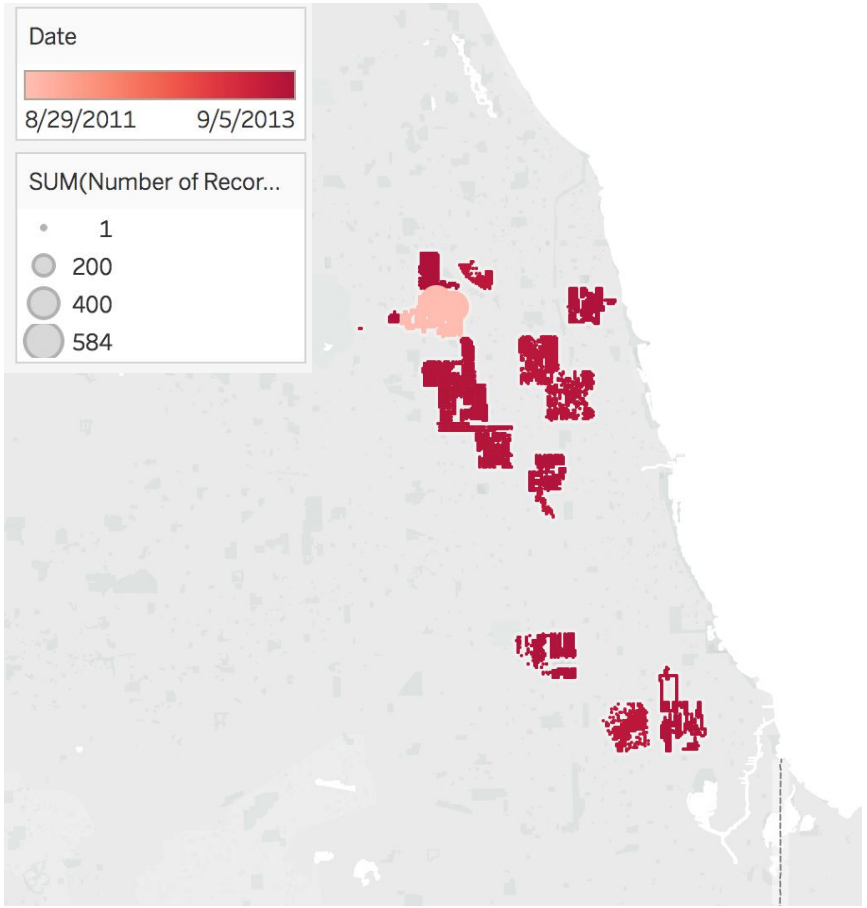




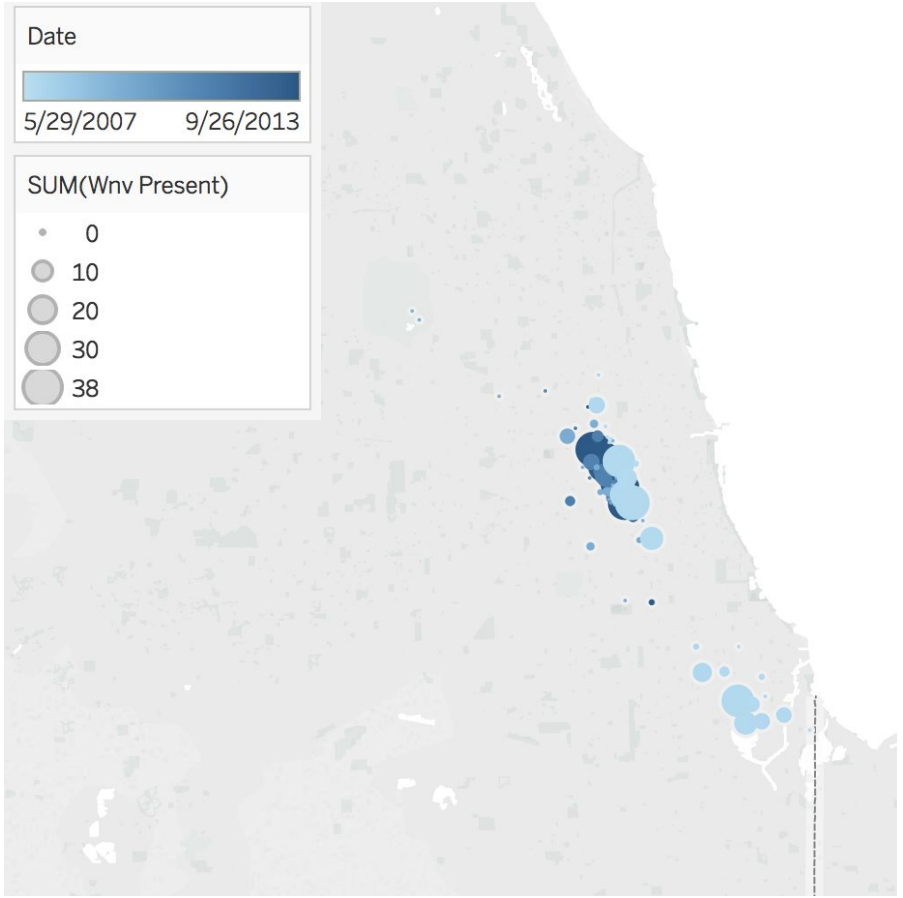
VIRUS DETECTION OVER TEMPERATURE



SPRAY LOCATIONS OVER TIME



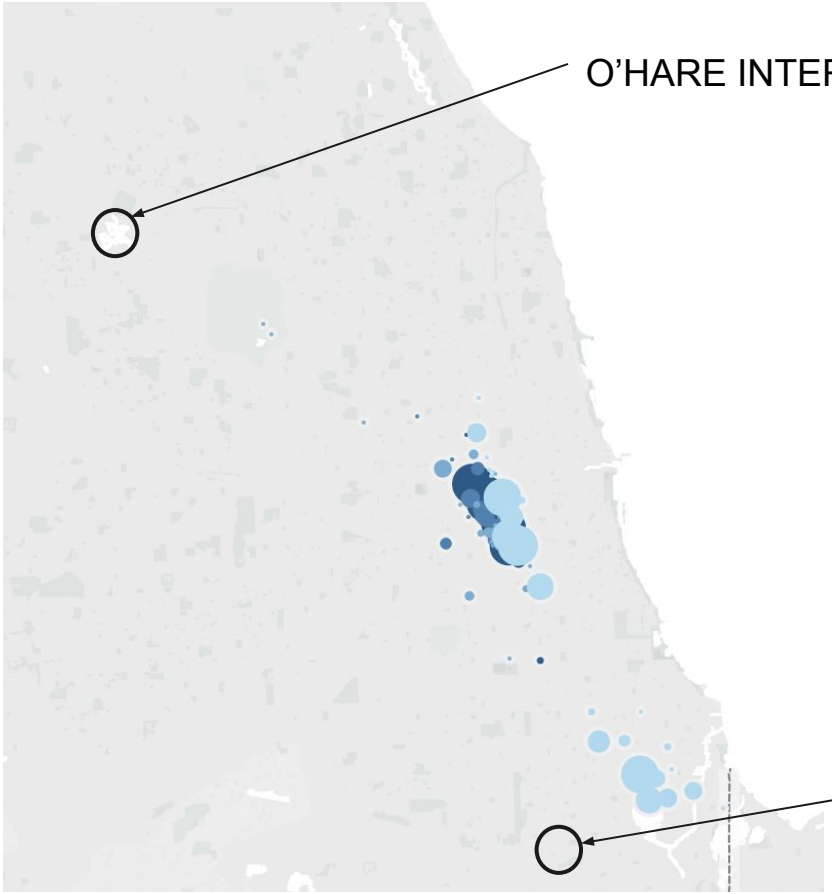
VIRUS DETECTIONS OVER TIME



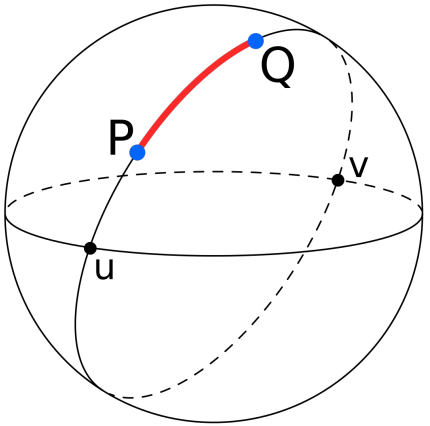
WORKFLOW

- Cleaning weather data
- Merging weather and training data
- Feature engineering
- Class balancing
- Model training and evaluation
- Model selection

MERGING WEATHER DATA WITH OBSERVATIONS



Haversine formula



MODEL SELECTION

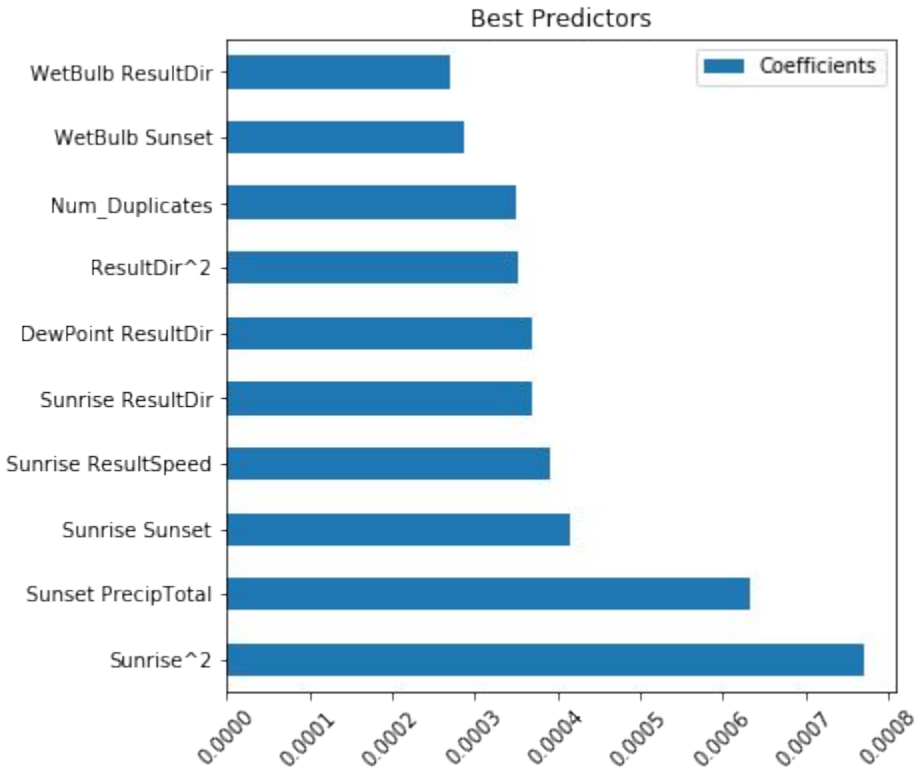
- Pipeline to determine best model
- Models tended to overfit
- SMOTE/Bootstrapping

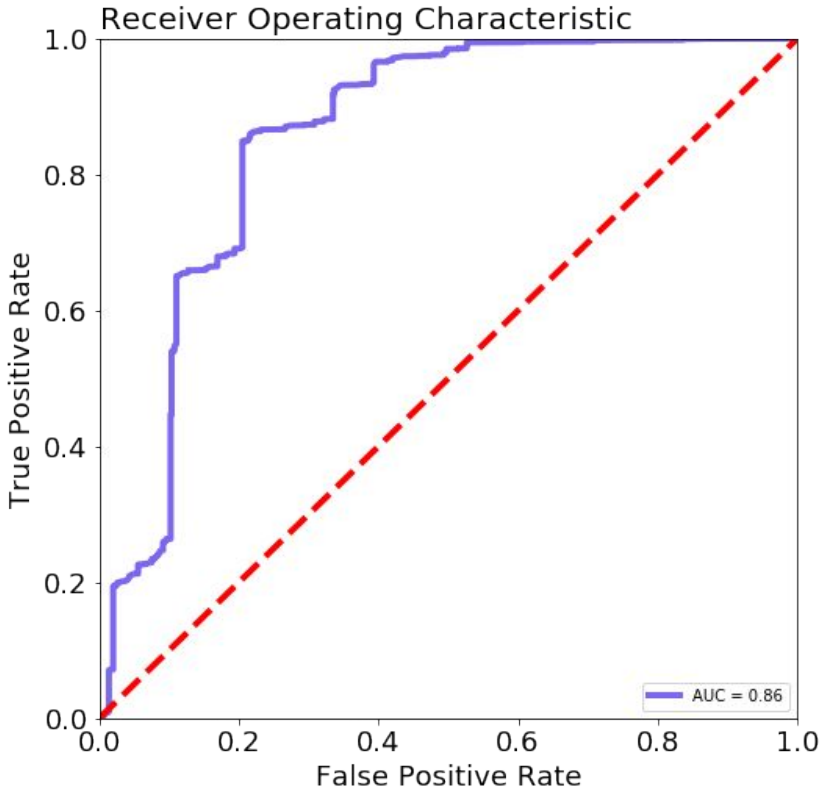
BEST MODEL (Kaggle)

- Logistic Regression (L2) most effective
- Use of polynomial features

Model	AUC-ROC Test Score
Random Forest	.935
Extra Tree	.936
ADA Boost	.877
Bagging Classifier	.936
KNN	.929
Logistic Regression	.860

LOGISTIC REGRESSION



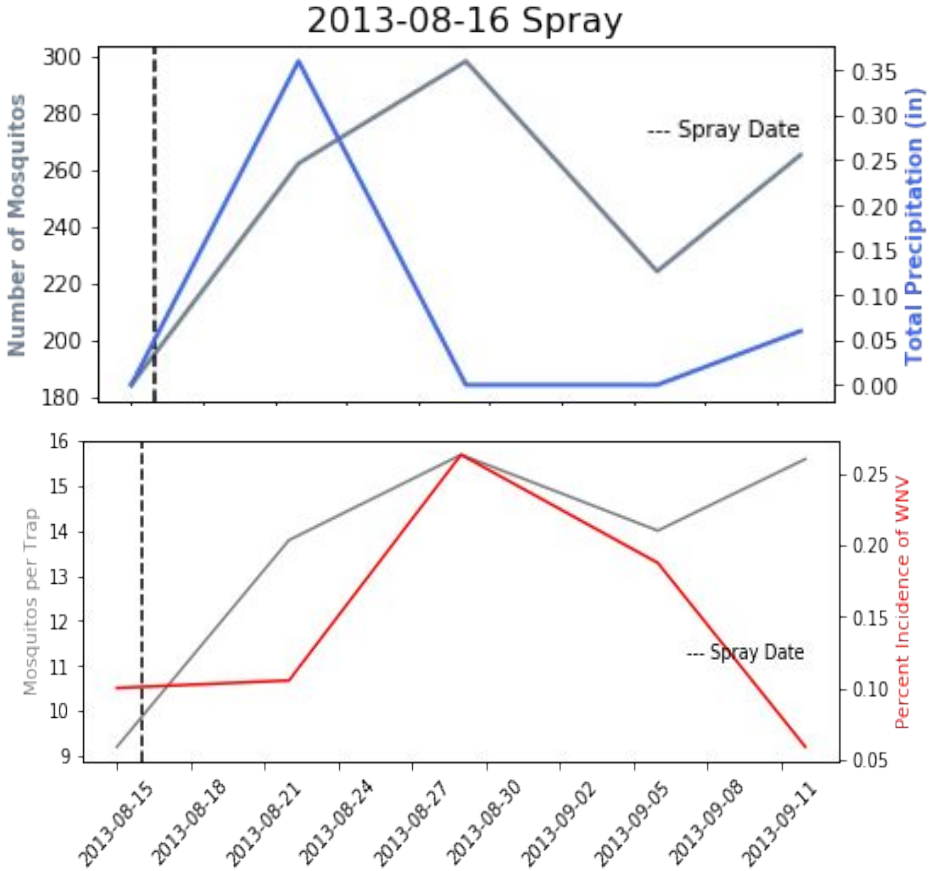


PESTICIDES

- Used in conjunction with other methods of mosquito control
- Pesticides are more effective when deployed aerially
- Little risk to humans but high possible risk to other animals
  - Honey-bees
- Can have unforeseen environmental impacts

SPRAY EFFECTIVENESS

- Spraying has little effect of both mosquito population and West Nile incidence
- Spray is susceptible to weather, especially precipitation
- Findings coincide with previous studies



COST-EFFECTIVENESS

Zenivex™ (etofenprox)
- ~$300 per gallon
- ~$2,250 per square mile
- Not including cost of manpower or equipment

Spray is not shown to be effective (rain and wind deter mosquitos more effectively)

Aerial spraying is more effective but more expensive

Comparison:
- 10 cents per person per day to spray
- 9.2 cents per person per day to supply everyone with bug spray from Amazon

SPRAY RECOMMENDATION

Don’t Spray

Implement other mosquito control methods

- Source Reduction
- Natural Predators
- Insect Traps

FUTURE STEPS

- Use spatial/temporal models to better predict where the virus will show up
  - Compare sprayed areas to other unsprayed areas
- Explore lag effect of weather variables
- Try to predict number of mosquitoes as a factor in West Nile presence
- Gather more observations