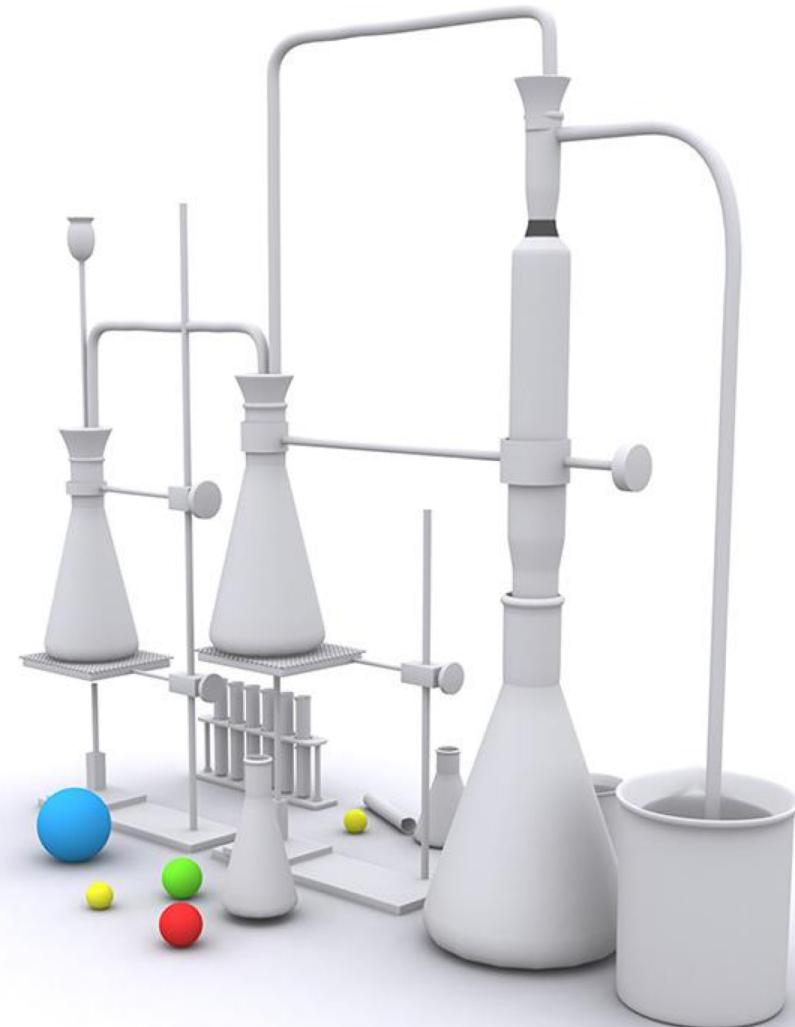


Containing West Nile Virus in Chicago

Done by:
Wilson
William
Su Ying
Chun Wai

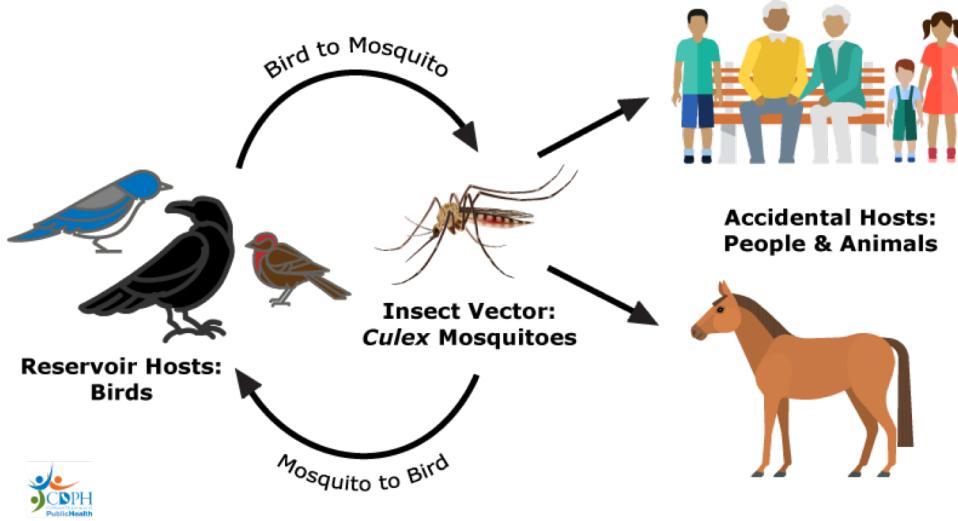


Disease And Treatment Agency, division of Societal Cures In
Epidemiology and New Creative Engineering (DATA-SCIENCE)

Introduction

- **West Nile virus (WNV)** is a single-stranded RNA virus that causes West Nile fever. It is a member of the family *Flaviviridae*, specifically from the genus *Flavivirus*, which also contains the Zika virus, dengue virus, and yellow fever virus. West Nile virus is primarily transmitted by mosquitoes, mostly species of the genus *Culex*. The primary hosts of WNV are birds, so that the virus remains within a "bird–mosquito bird" transmission cycle

West Nile Virus Transmission Cycle



Introduction

- **Agenda**
 - Problem Statement
 - Data and constraints
 - Modelling , Prediction and Results
 - Cost Benefit Analysis
 - Conclusions and Recommendations



Problem Statement



- To predict mosquito hotspots in Chicago using our models.
- Propose solutions to stop and prevent these hotspots from breeding mosquitoes

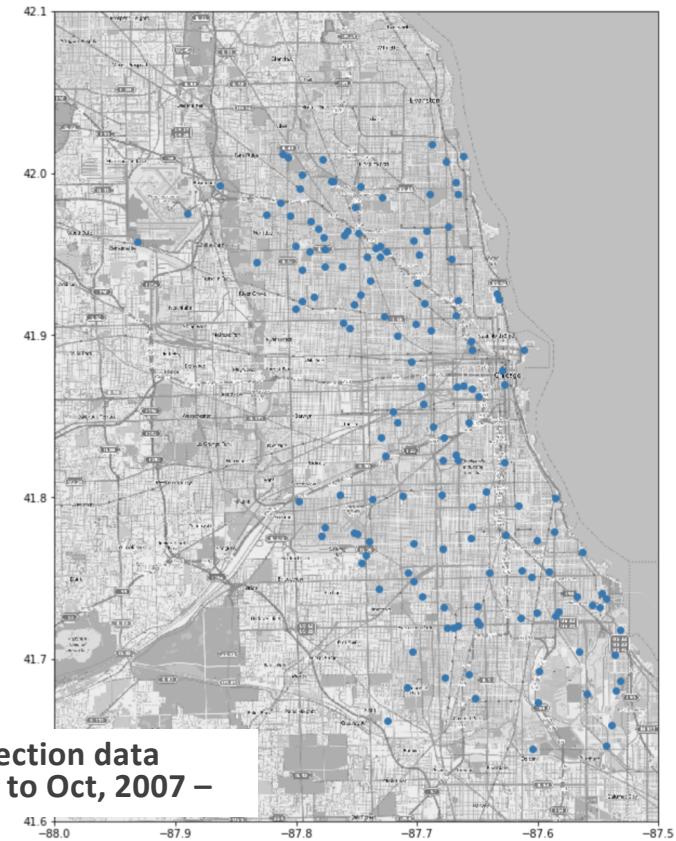
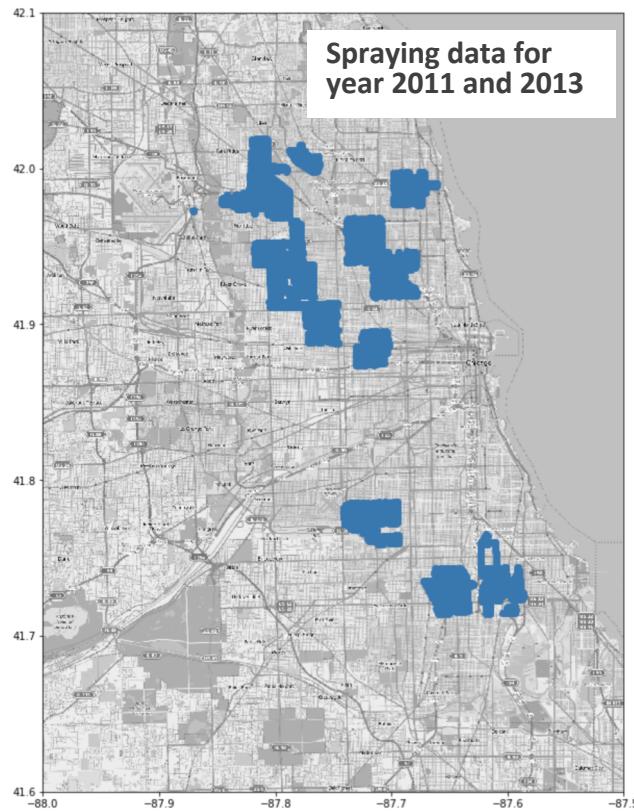


Data and constraints

Datasets:



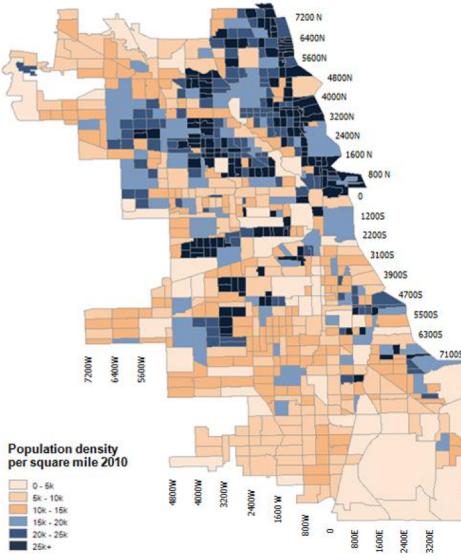
Weather data from
May to Oct , 2007 – 2014



Data and constraints

Constraints:

- Based on this spray data alone, we have no information where spraying were done in 2012 and 2014
- Absence of population density, urban / rural area, infection rates, infected population
- There is no clear link between spraying data & the event of WNV case present in the sprayed locations.



Modelling

Weather:

- New features: weeks, daylight,
 - Using Principal Component Analysis (PCA) for temperature features and also others
 - Hot-coded Weather codes

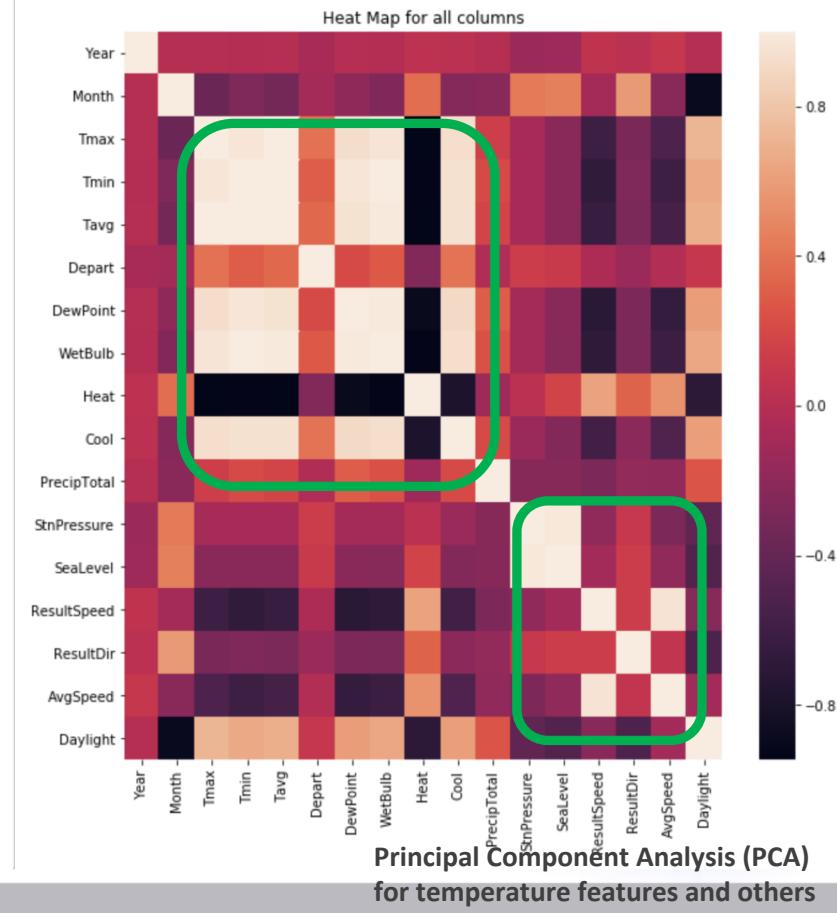
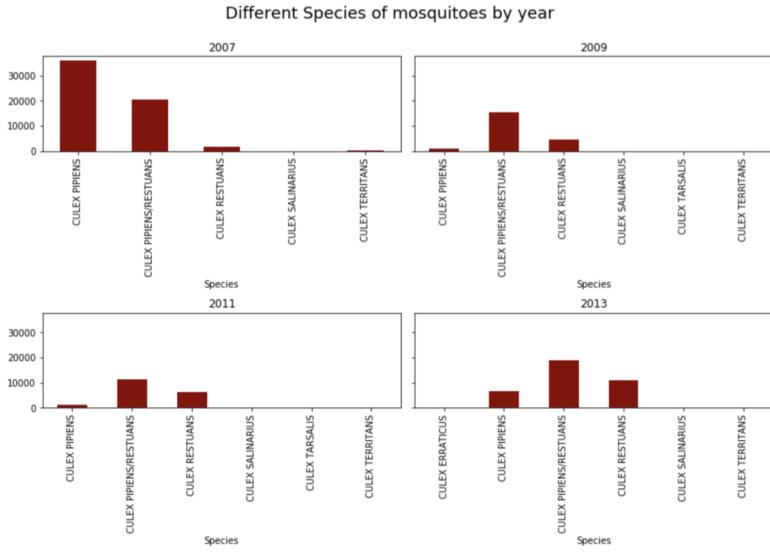


Traps collection data:

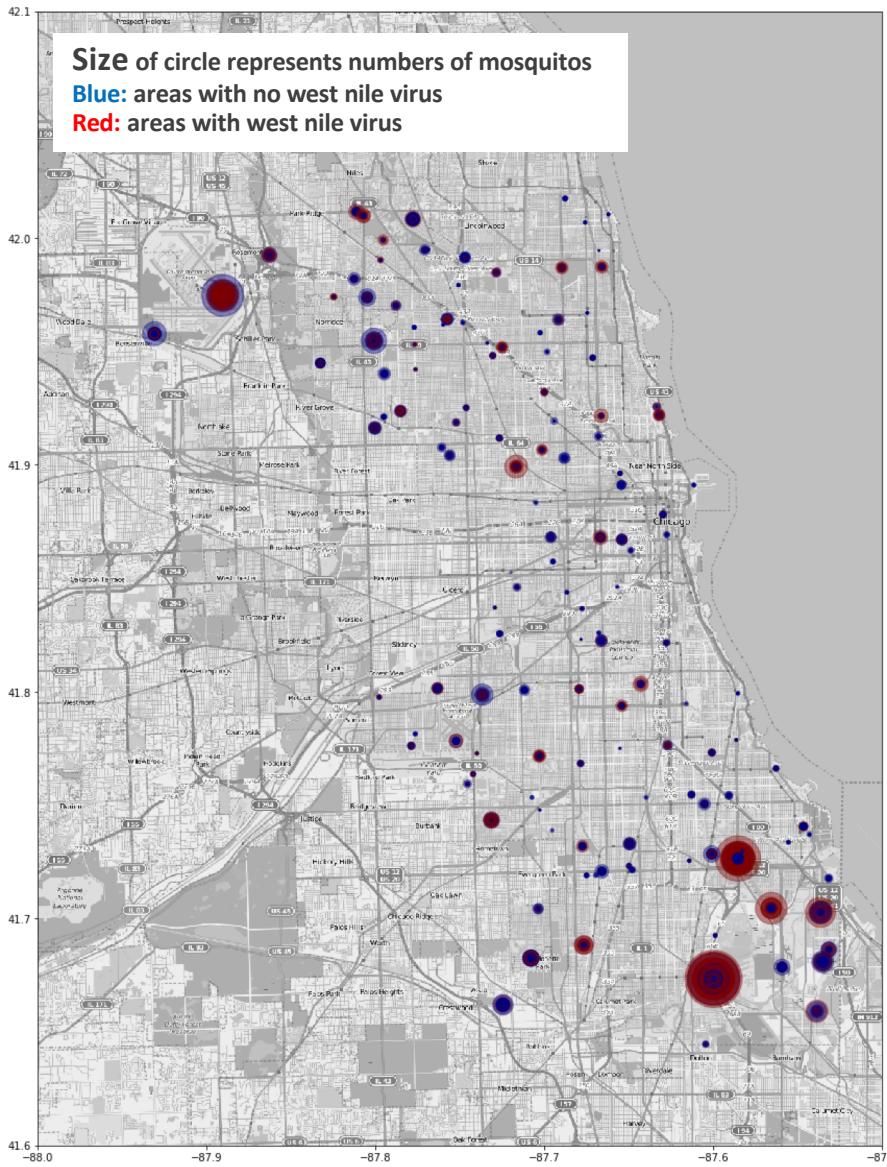
- **Hot-coded species of mosquitoes**

Overall data:

- **Oversample on virus occurrence**



Modelling



Traps collection data:

- From the dataset, we are able to identify certain hotspots and areas with huge numbers of mosquitoes

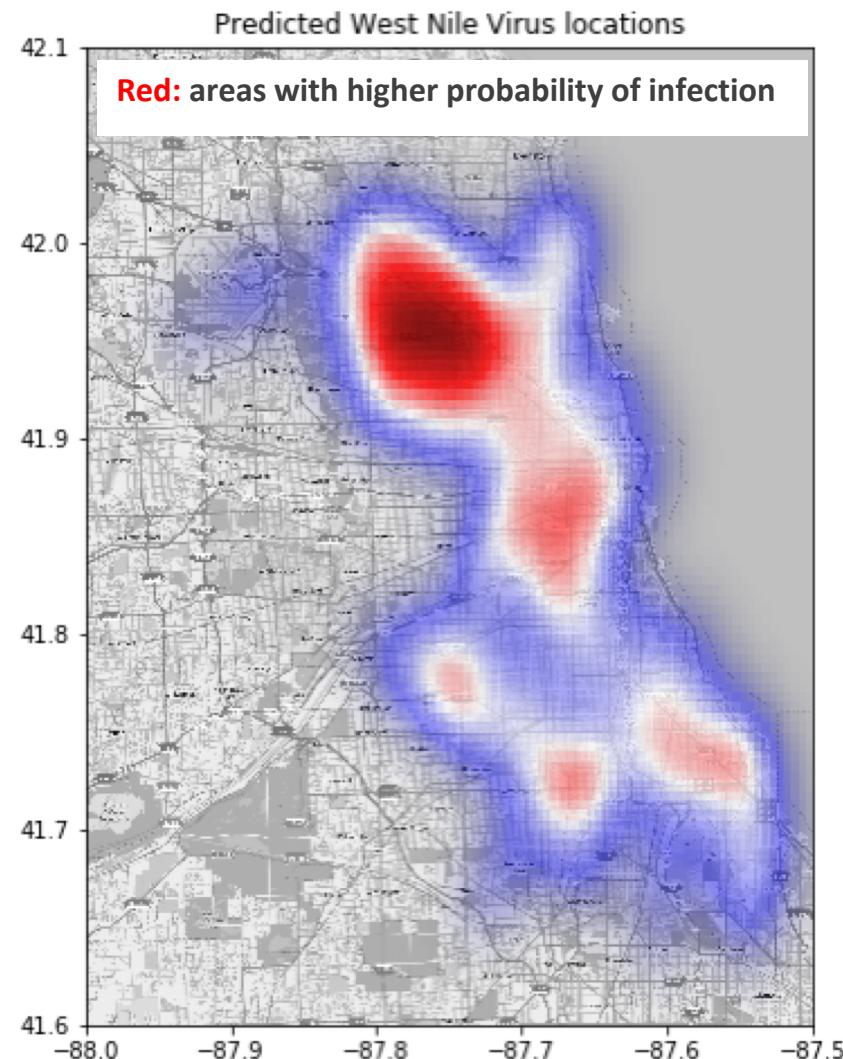
AddressNumberAndStreet	Latitude	Longitude	HNV cases
1000 W OHARE AIRPORT, Chicago, IL	41.974689	-87.890615	66
1200 S DOTY AVE, Chicago, IL	41.673408	-87.599862	41
4100 N OAK PARK AVE, Chicago, IL	41.95469	-87.800991	18
1000 S STONY ISLAND AVE, Chicago, IL	41.726465	-87.585413	16
4600 N MILWAUKEE AVE, Chicago, IL	41.964242	-87.757639	14
8200 S KOSTNER AVE, Chicago, IL	41.743402	-87.731435	11
2400 E 105TH ST, Chicago, IL	41.704572	-87.565666	11
3600 N PITTSBURGH AVE, Chicago, IL	41.944869	-87.832763	11
7000 N MOSELL AVE, Chicago, IL	42.008314	-87.777921	10
6100 W FULLERTON AVE, Chicago, IL	41.923738	-87.785288	10
1000 W OHARE, Chicago, IL	41.957799	-87.930995	10
...
1700 W ADDISON ST, Chicago, IL	41.947227	-87.671457	1
7300 S CICERO AVE, Chicago, IL	41.759346	-87.745602	1
4000 N AUSTIN AVE, Chicago, IL	41.953067	-87.776792	1
Grand Total			551

Prediction and Results

Predictions:

These are the areas with high probability of getting infected with West Nile Virus

- 1000 W OHARE AIRPORT
- 9100 W HIGGINS RD
- 3600 N PITTSBURGH AVE
- 7900 W FOSTER AVE,
- 5200 S NORDICA
- 7000 W ARMITAGE AVENUE
- 6300 W 64TH ST
- 7200 N OKETO AVE
- 5100 N MONT CLARE AVE
- 6100 S MELVINA AVE





To Spray or not to Spray?

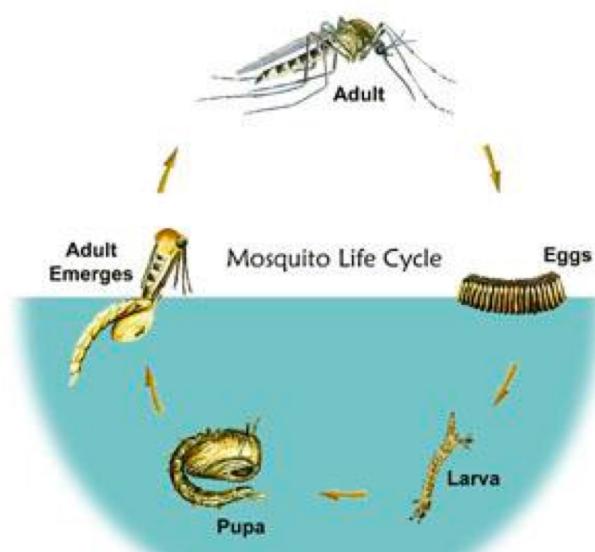
#FightTheBite

Timing

When should mosquitoes be EXTERMINATED

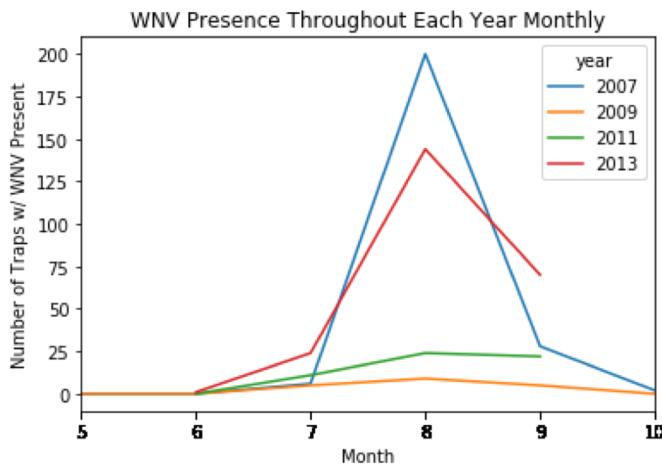
Culex Species- vectors of WNV

- Eggs to Pupa: Between 4-10 days
- Adult (female) lifespan can last from **10 - 50 days**

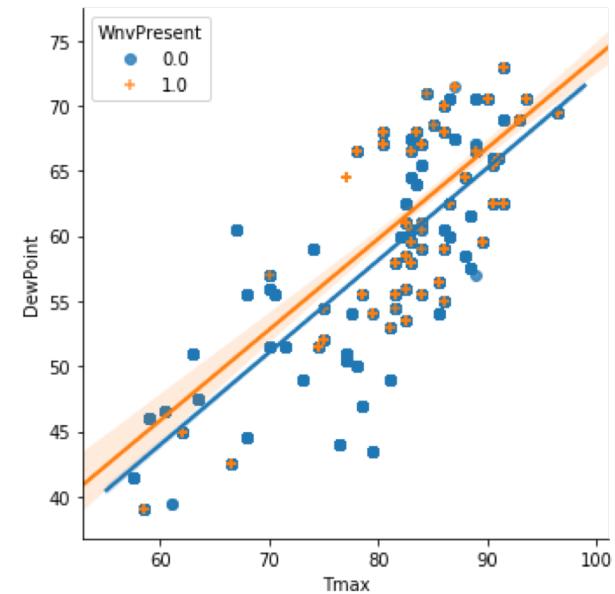


Timing

When to EXTERMINATE the buggers



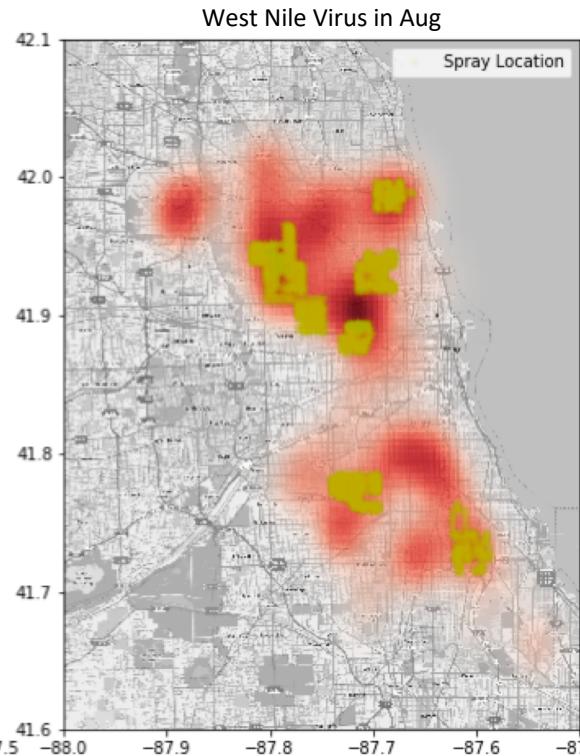
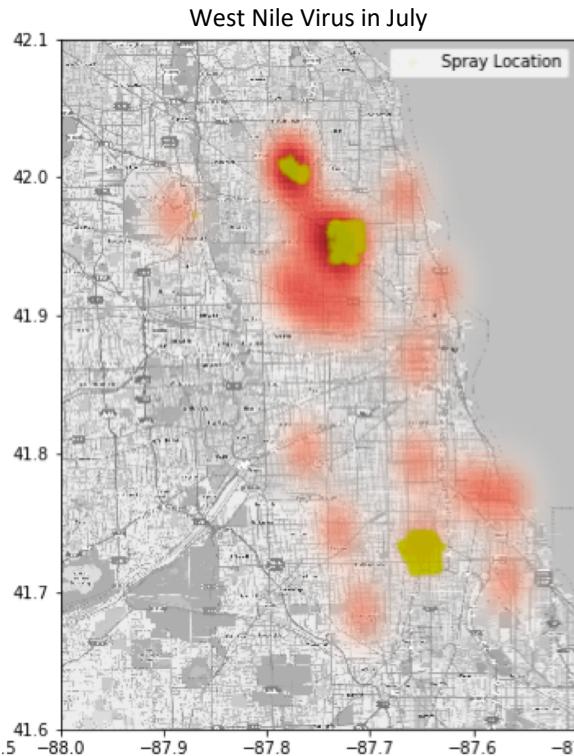
- Spike in WMV usually in Summer months (from Jul to Sep)
- Probably attributed to the higher temperatures, humidity and drier months



Location

Where was the spraying

WNV Zones vs Spray Locations in 2013 (Jul, Aug)



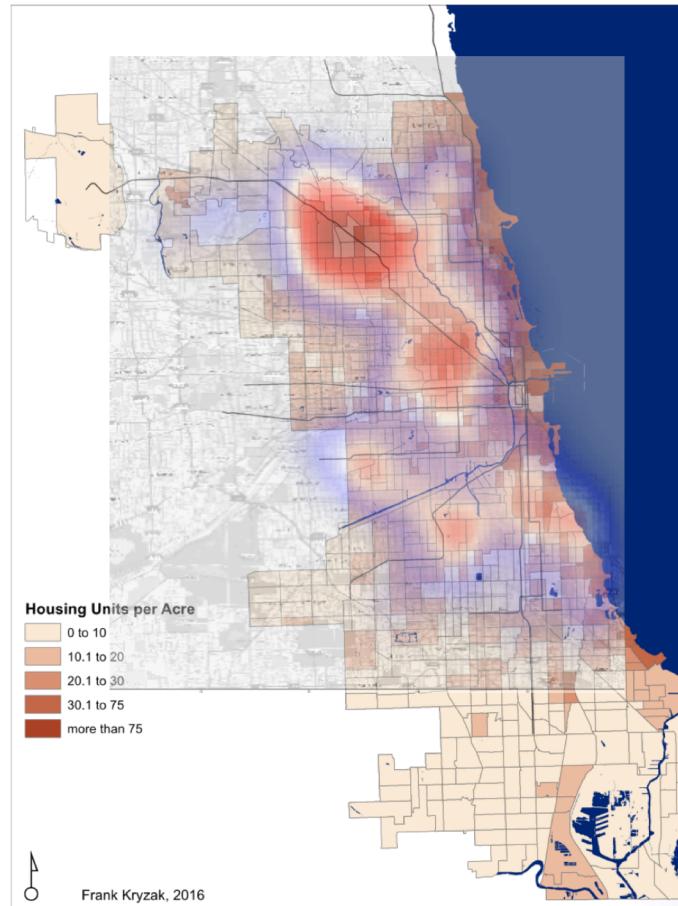
WNV Positive

Spray Locations



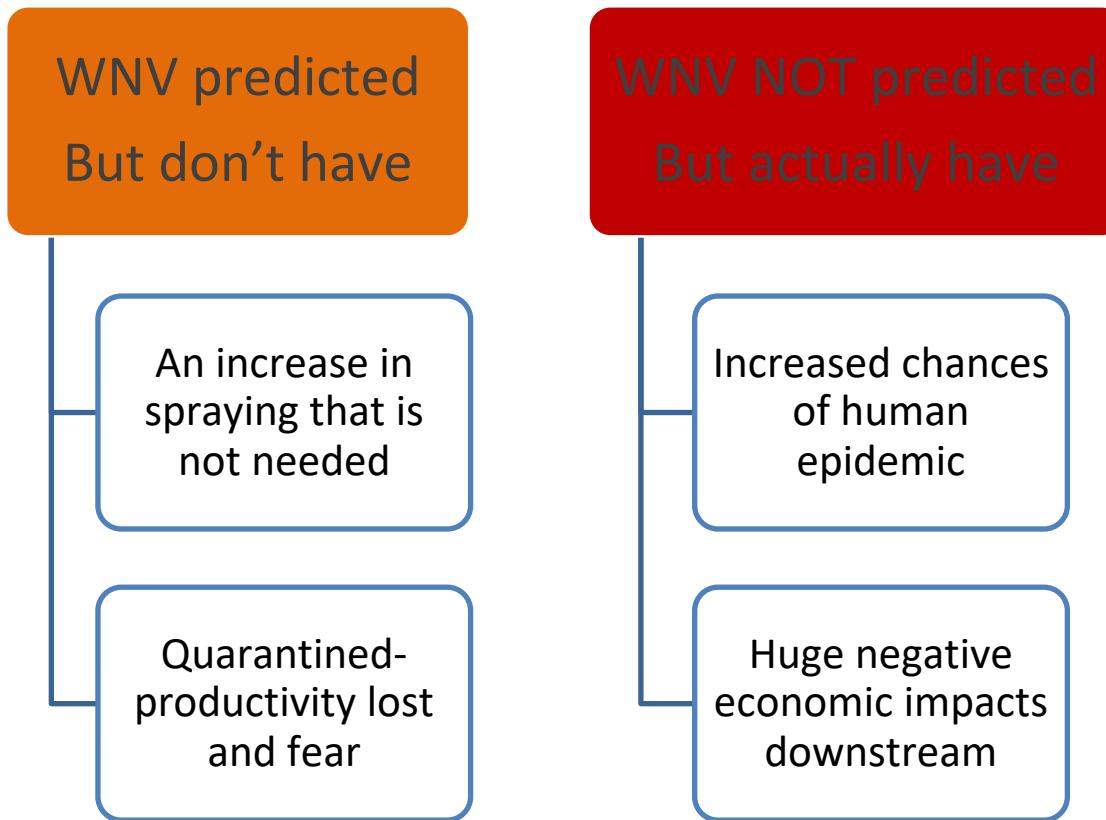
Location

Where do we spray



Confusion Matrix

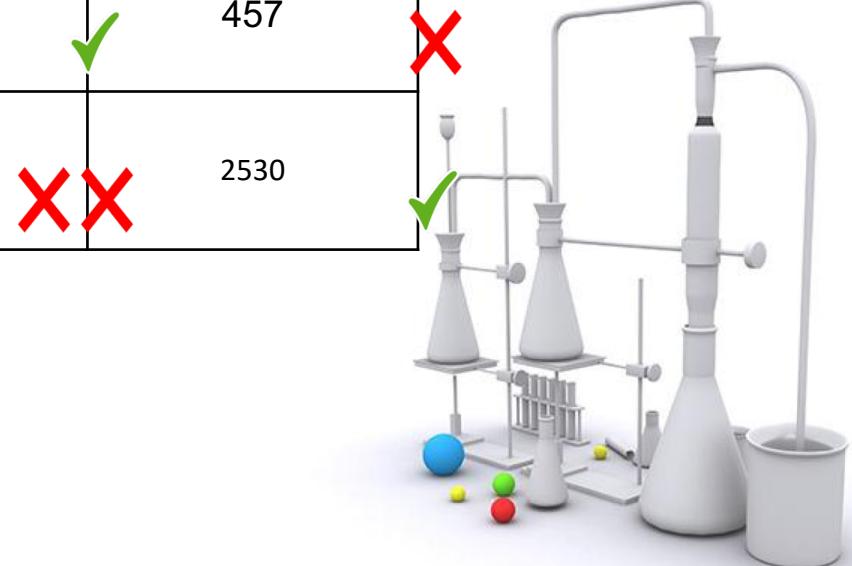
Weighing the Costs of Inaccuracy - False Positive & False Negative



Confusion Matrix

Model Performance

Error Matrix		Actual West Nile Virus	
		WNV Present	WNV Not Present
Our Model Predictions	WNV Present	97	457
	WNV Not Present	68	2530



The Cost - Benefit Analysis

SPRAY 

- ~94 sq miles to spray (40% of total Chicago size)
- Spraying cost of \$11k per sq mile
 - Total \$1.03million to spray
- Reduced WNV by 73 from 117 to 44 cases between 2013 and 2014

DON'T SPRAY



- Each infected person will cost ~\$24k for treatment and productivity loss
 - Total ~\$1.75 million in economic losses
- Intangible losses such as tourism numbers and fear of infection cannot be quantified



The Cost - Benefit Analysis

SPRAY  VS

DON'T SPRAY



\$720,000
Cost Savings

Less Sick people

Num. of Mosquitoes to  66%



Recommendations

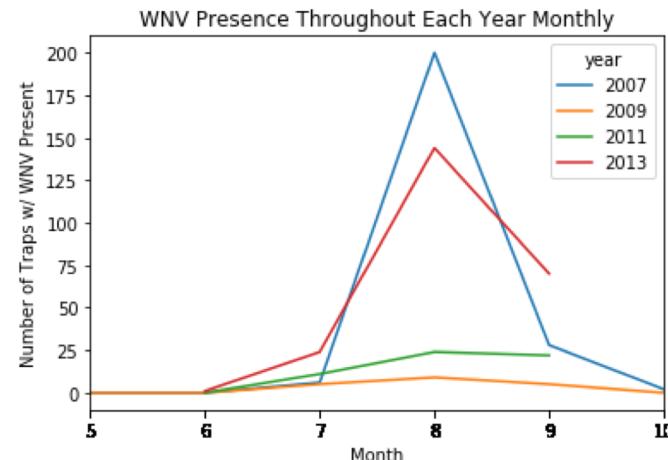
- INTENSE mosquito control measures at all stages of a CULEX mosquito species

- Currently, Chicago's main spraying program is to spray areas when mosquito traps test positive for two weeks in a row
(Too **LATE**?– WNV symptoms only appear after at least 2-14 days)
- Prior to onset of high temperatures and humidity, we should:
 - Focus efforts on larvicing (proven to be effective in eliminating the root of all evil by 92%)
 - Perform initial spraying for predicted affected areas in early July to coincide with the expected rise in adult female mosquitoes

- Employ vector control preventive measures once key indicators are met (e.g. dew point >50, summer temperatures and decreased windspeed)

- Increase public education on mosquito control

- Deployment of WindyGrid in 2016 for situational awareness, incident monitoring, historical data retrieval, and real-time advanced analytics.



DO THE 5-STEP MOZZIE WIPEOUT.

Get rid of stagnant water.





- END -

