



# **WHAT'S all the Buzz about? Vector-borne Diseases and Climate Change**

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# Common Vectors That Transmit Disease



Mosquito



Tick



Mouse



Deer

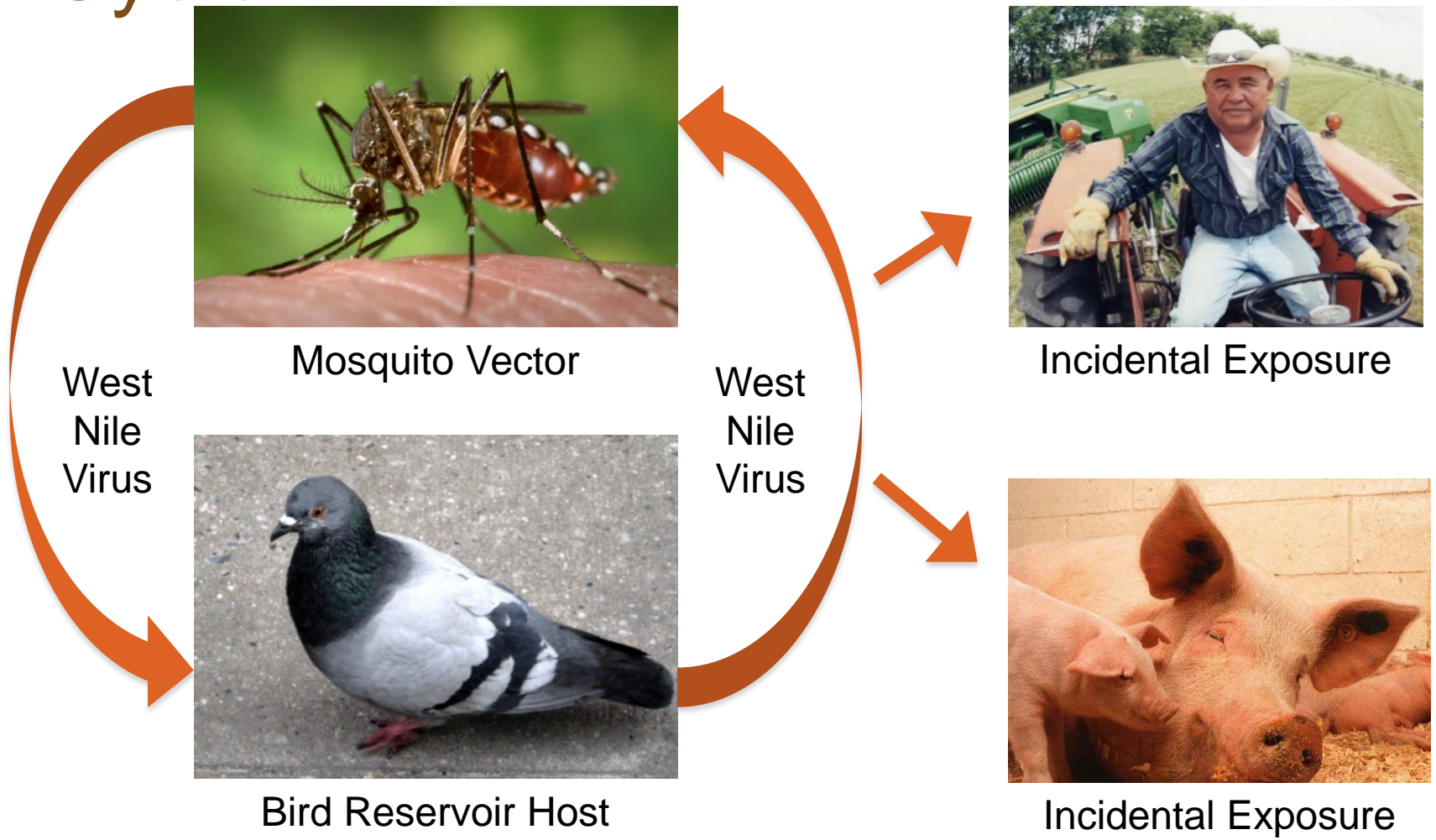
# Examples of Vector-Borne Diseases

- West Nile Virus
- Malaria
- Dengue
- Lyme Disease
- Hanta Virus
- Yellow Fever
- Rocky Mountain Spotted Fever
- Bubonic Plague



Characteristic bull rash caused by Lyme disease

# West Nile Virus Transmission Cycle



# Modeling Vector-Borne Diseases

$$\text{Total \# Infected People} = \frac{\text{\# Uninfected People}}{\text{Total \# People}} \times \text{\# Infected Mosquitoes} + \text{\# Previously Infected People}$$

$$\text{Total \# Infected Mosquitoes} = \frac{\text{\# Infected People}}{\text{Total \# People}} \times \text{\# Uninfected Mosquitoes} + \text{\# Previously Infected Mosquitoes}$$

# Modeling Vector-Borne Diseases

Round of Bites	Total # People	Total # Infected People	Total # Mosquitoes	Infected Mosquitoes Added	Total # Infected Mosquitoes
0	20	0	7		2
1	20		7		
2	20		7		

# Modeling Vector-Borne Diseases

Round of Bites	Total # People	Total # Infected People	Total # Mosquitoes	Infected Mosquitoes Added	Total # Infected Mosquitoes
0	20	0	7		2
1	20	2	7	0.5	2.5
2	20		7		

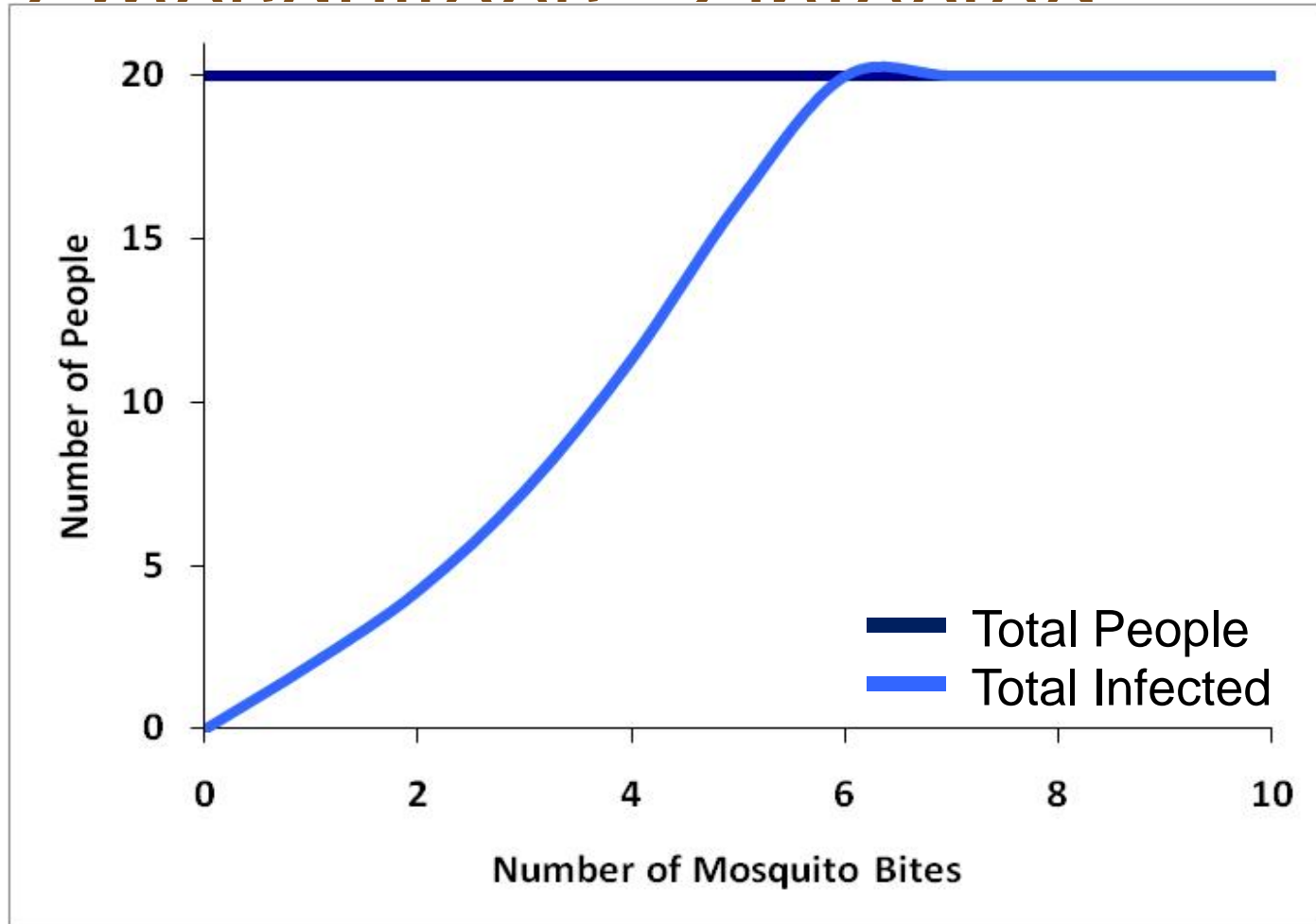
# Modeling Vector-Borne Diseases

Round of Bites	Total # People	Total # Infected People	Total # Mosquitoes	Infected Mosquitoes Added	Total # Infected Mosquitoes
0	20	0	7		2
1	20	2	7	0.5	2.5
2	20	4.3	7	1	3.5



# Example data: 20 people, 0 infected

## 7 mosquitoes, 2 infected



# Modeling Mosquito Transmission of Disease

- Cups with water represent people
- Syringes represent mosquitoes
  1. Mosquitoes will “bite” people by squirting out the liquid
  2. Mosquitoes get a bloodmeal by sucking up from the host’s cup
  3. Afterwards we will use an indicator to find out how many hosts were infected

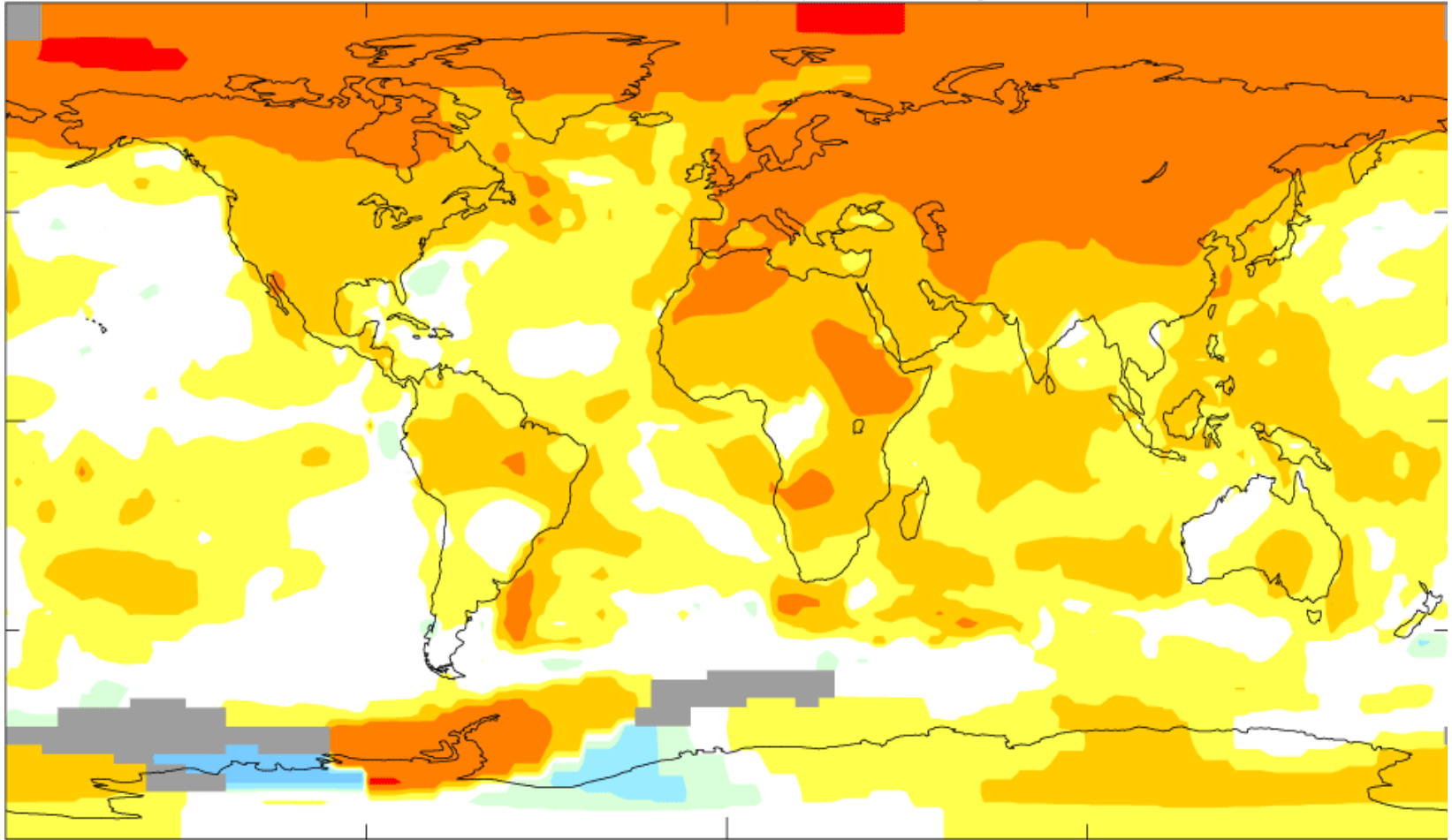
# How well do our numbers match the model?

Round of Bites	Total # People	Total # Infected People	Total # Mosquitoes	Infected Mosquitoes Added	Total # Infected Mosquitoes
0	20	0	7		2
1	20	2	7	0.5	2.5
2	20	4.3	7	1	3.5
3	20	7.3	7	1.3	4.8

Why are our observed results different from the expected results?

# How Weather Affects Vector-Borne Diseases

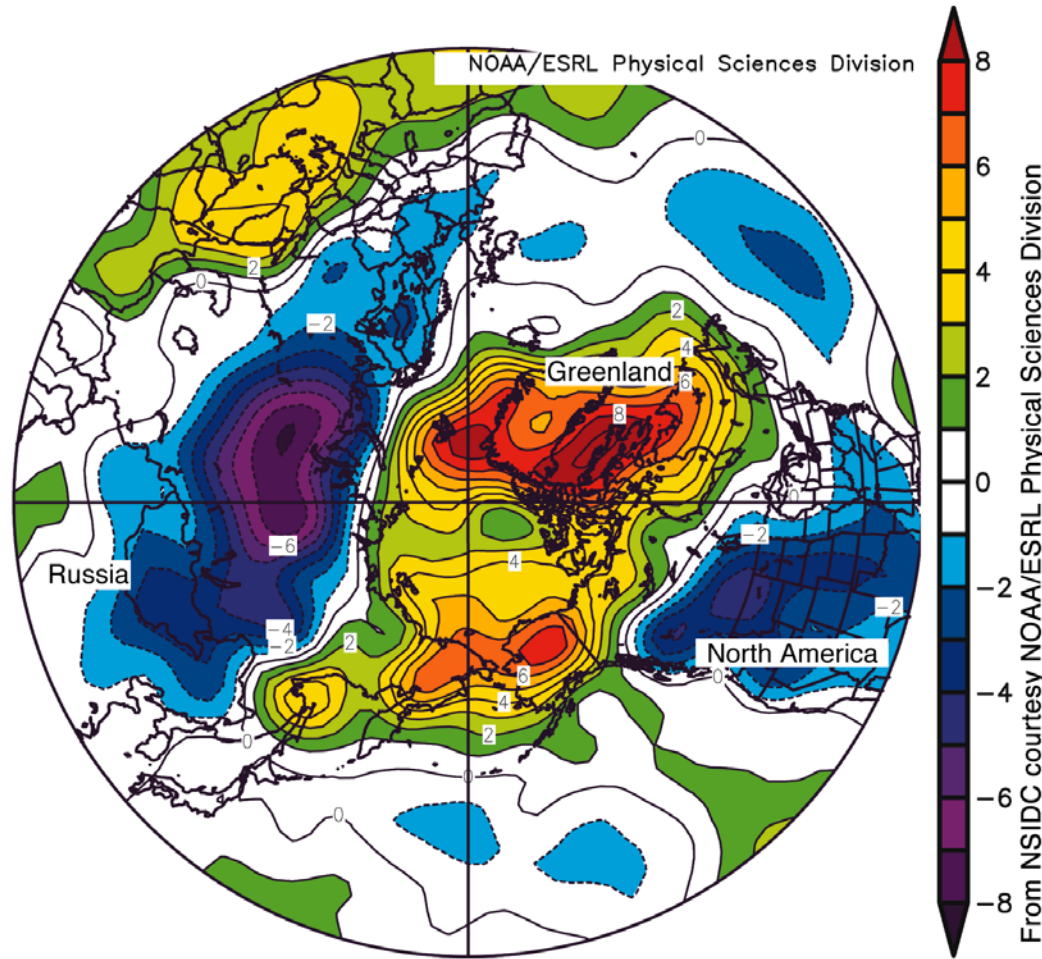
- Temperature
- Humidity
- Surface water
- Tropical and subtropical regions
- Predator patterns



Map image depicting the world's rise in temperature

**NASA**

# Average Air Temperature Anomaly December 2009



**NASA**

# How Weather Affects Vector-Borne Diseases

- Tropical and subtropical regions
- Temperature
- Humidity
- Surface water
- Predator patterns

## Climate Change

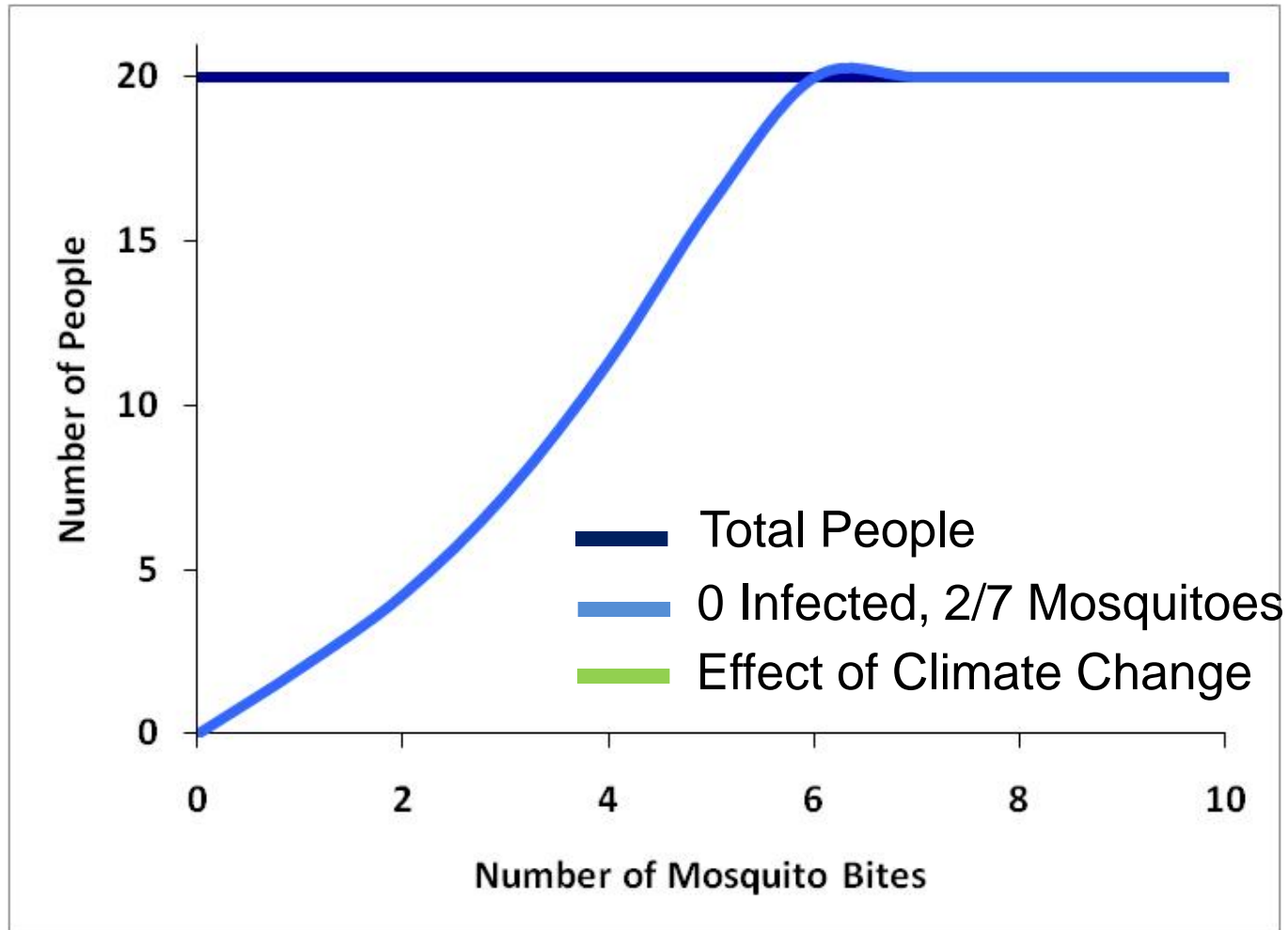
- Larger geographic area where disease is common
- Intensity and duration of outbreaks
- Altered seasonal distributions

# How Climate Change Affects Vector-Borne Diseases

- Mosquitoes develop more rapidly
- Mosquitoes bite more frequently
- Viral load in mosquitoes is higher
- Because more people are infected, more mosquitoes become carriers that transmit disease



# How Will Climate Change Affect the Model?

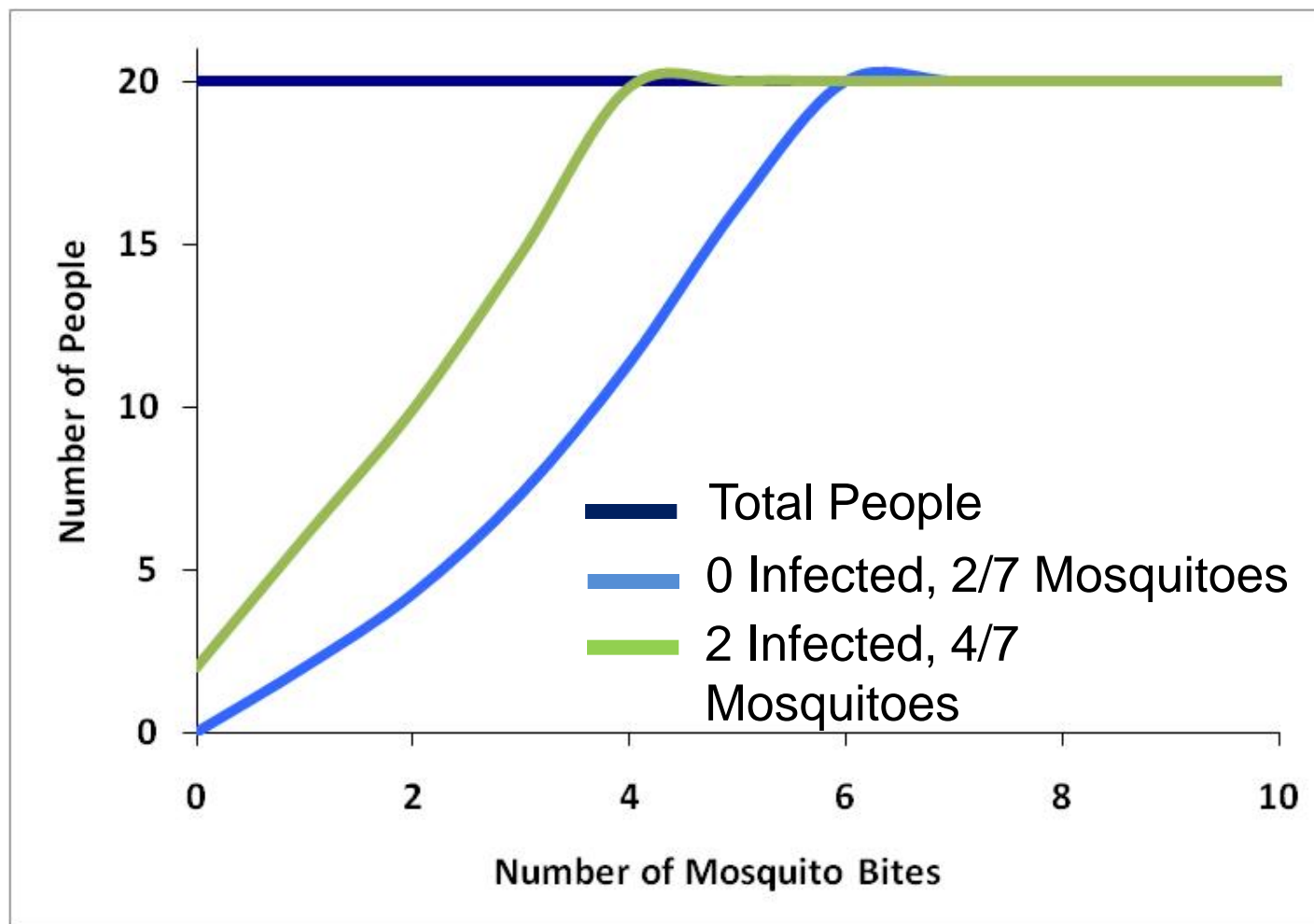


# Modeling Effects of Climate Change on Vector-Borne Diseases

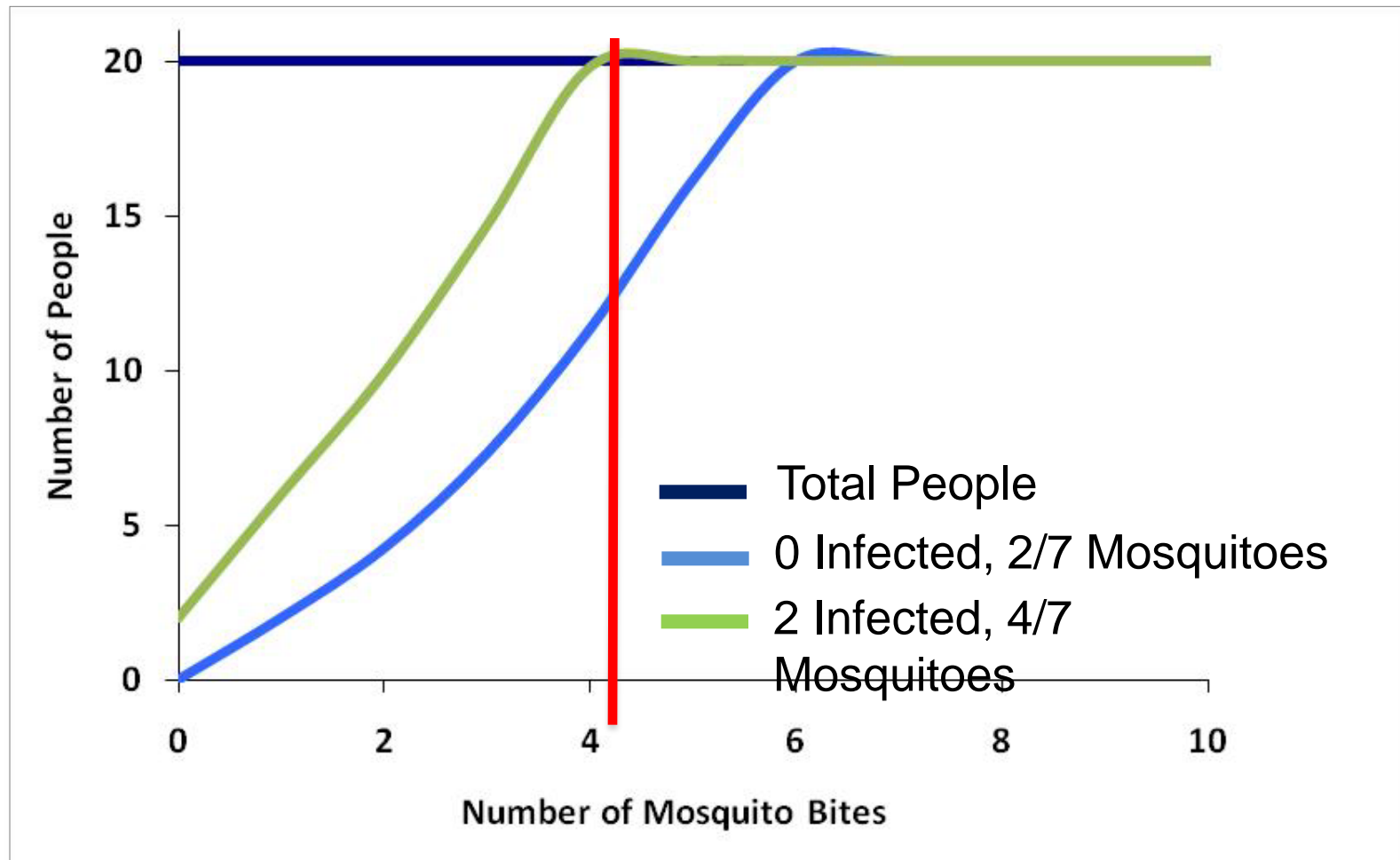
- 2/20 people are infected
- 4/7 mosquitoes are infected
- 4 rounds of bites

What do you anticipate will happen?

# Modeling Climate Change Effects



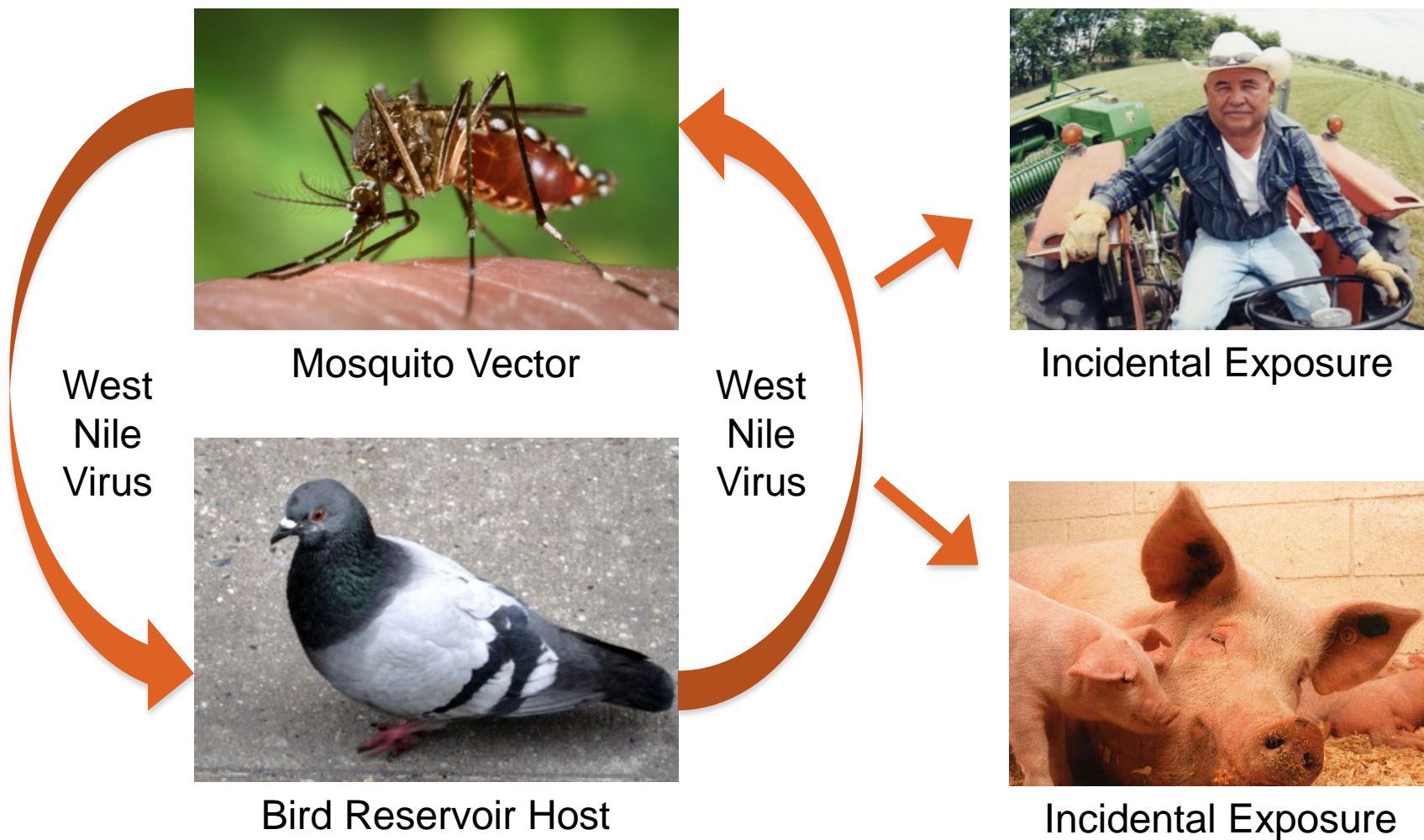
# 2/20 people infected, 4/7 mosquitoes infected



# What Assumptions Does This Model Make?

- Mosquito bites always transmit disease, both to the vector and to the host
- Mosquitoes are equally capable of transmitting disease
- People do not die or are not cured of disease
- There are more people than mosquitoes
- Assumes all people attract mosquitoes similarly

# Vector-Borne Diseases



# Acknowledgements

- Lesson plan was adapted from Attack of the Killer Mosquitoes TAMU peer lesson plan submitted by Nick Anthis, 2004
- US Government Stock Images
  - Public Health Image Library
  - NASA ([www.nasa.gov](http://www.nasa.gov))
  - [www.whitehouse.gov](http://www.whitehouse.gov)