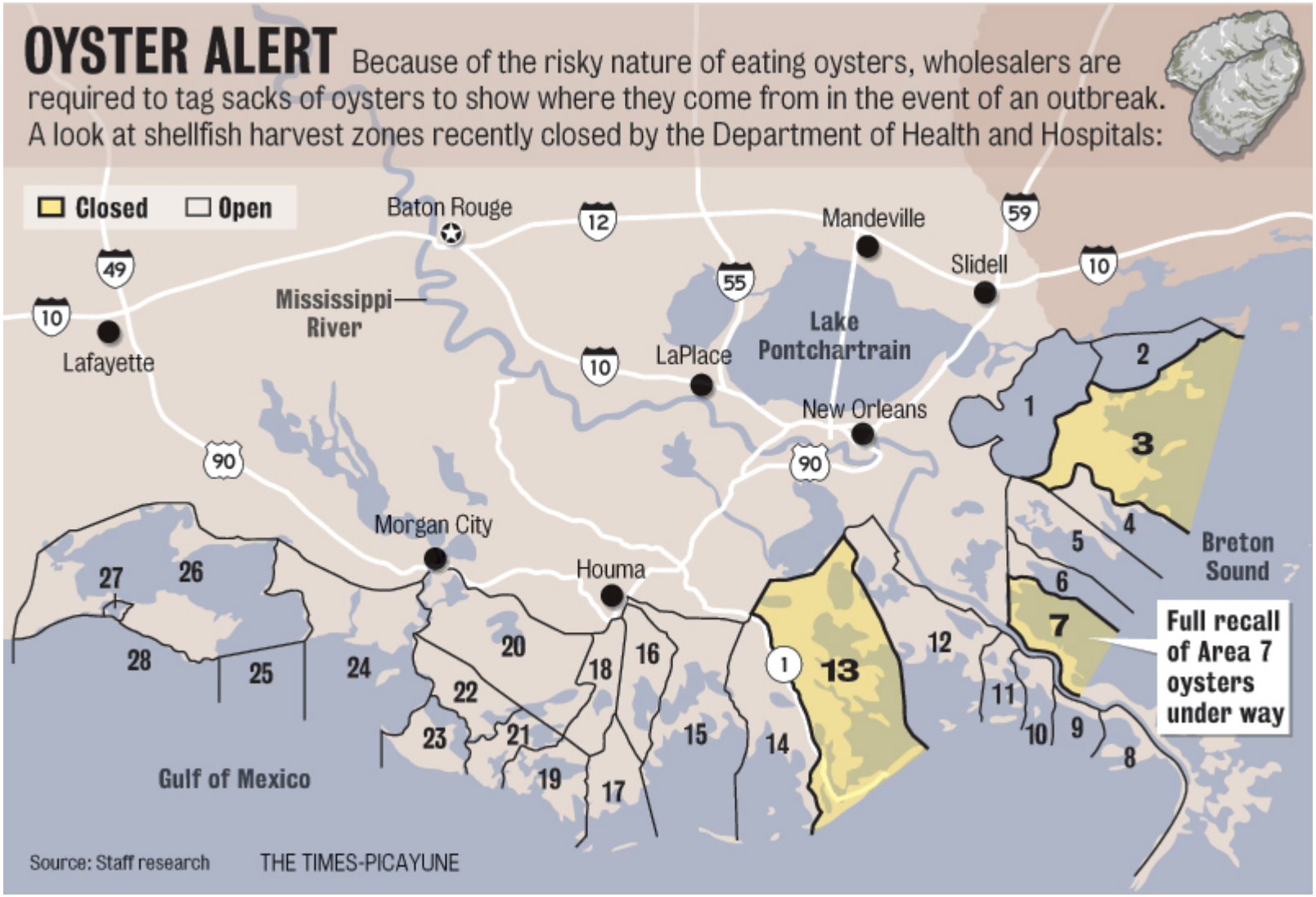
Feasibility Study of Satellite-Assisted Detection and Forecasting of Oyster Norovirus Outbreaks

- **Project Team:**
  - **PI: Zhiqiang Deng (Department of Civil & Environmental Engineering, Louisiana State University, Baton Rouge, LA)**
  - **Collaborators:** Gordon Leblanc, Chris Lemaire, Stephen Martin, Robert Dellsperger (Louisiana Department of Health and Hospitals)
- **Primary End-User Organization:**
  - Louisiana Department of Health and Hospitals: Molluscan Shellfish Program
- **Project Period:** 04/18/2011-04/17/2013

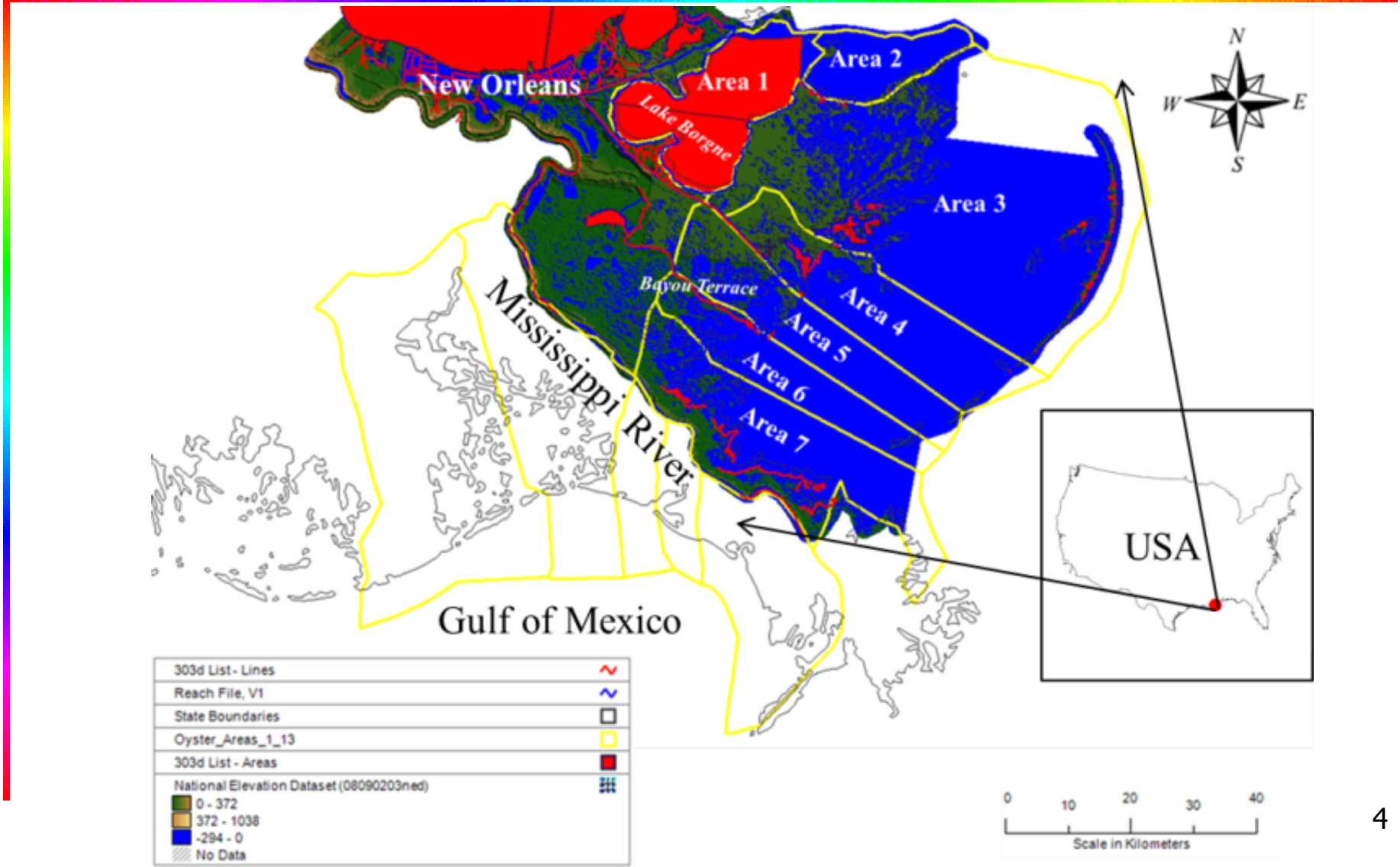
Outline

- Project Area & Background
- Goal and Objectives
- Milestones and Impacts
- Upcoming Plans
- Costing Status, Risks and Challenges

Shutdown of Louisiana oyster grounds is largest in 10 years (Sunday, April 04, 2010)



Project Area



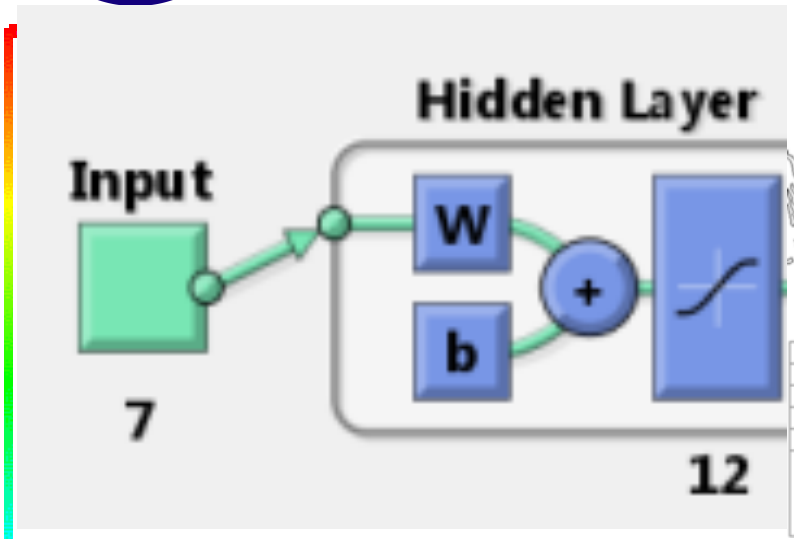
Goal and Objectives

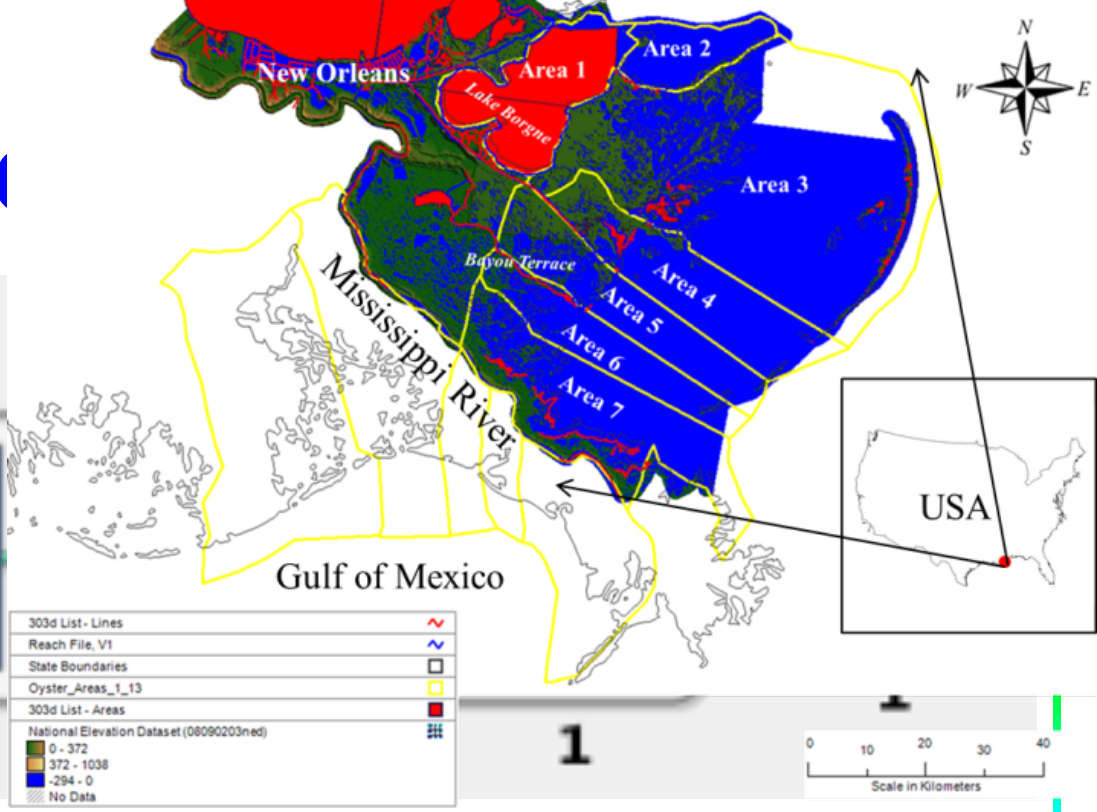
- **Goal:** Overall goal of this project is to provide daily predictions of oyster norovirus outbreak risks.
- **Objective 1:** Construct retrieval algorithms that link NASA **MODIS Terra and Aqua data** to water quality indicators (such as SST, TSS, solar radiation, and salinity) controlling norovirus disease outbreaks in oyster growing waters;
- **Objective 2:** Develop an Artificial Neural Network (ANN) model for predicting fecal coliform (norovirus indicator organism) levels in oyster growing waters;
- **Objective 3:** Develop a Bayesian model for detection and forecasting of norovirus disease outbreak risks in a probabilistic fashion.

Milestone - 1

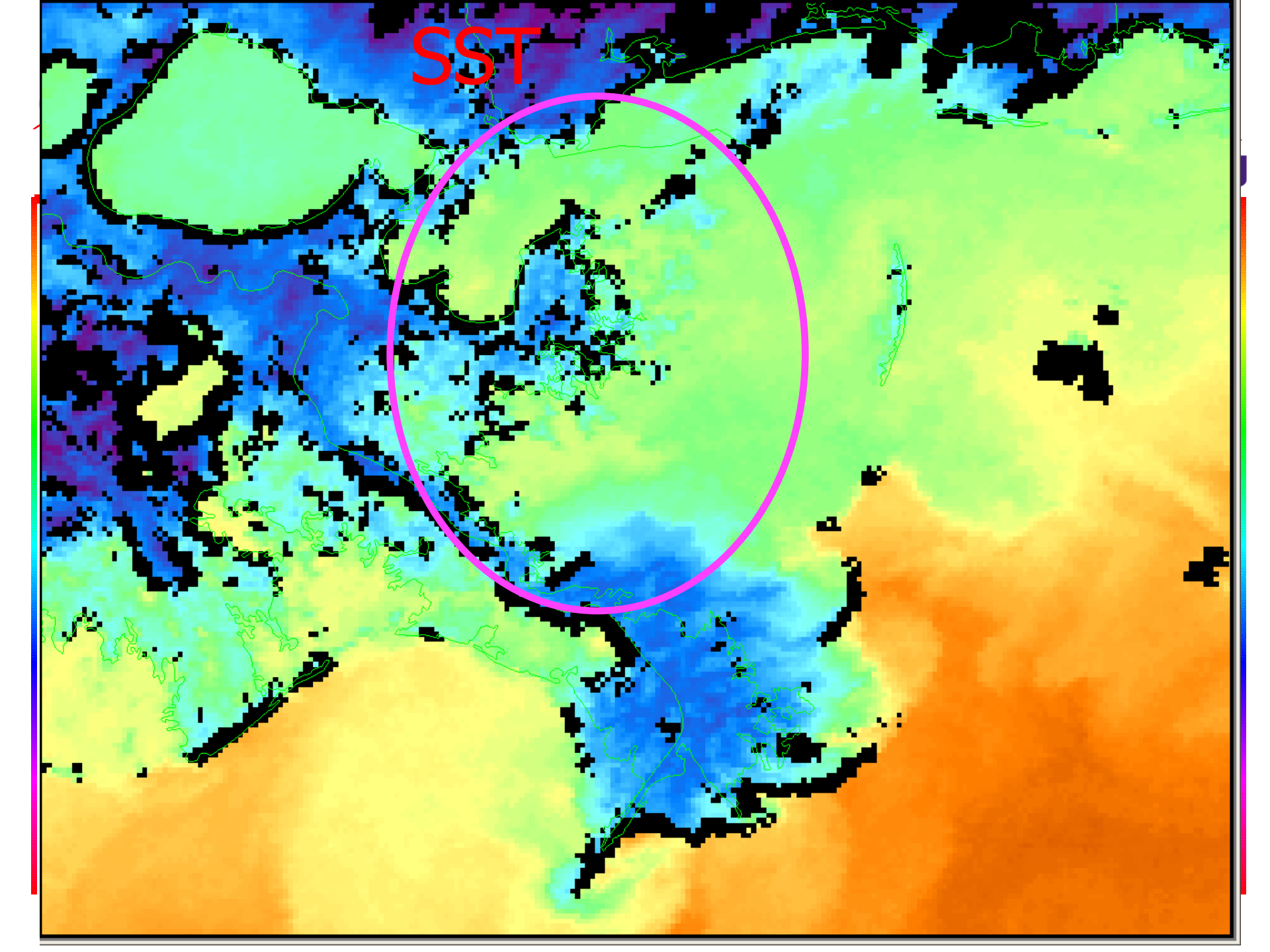
- Development of ANN model for predicting fecal coliform levels in the oyster harvesting areas and completion of a journal manuscript.
  - "Artificial Neural Network Models for Predicting Fecal Coliform Bacteria Levels in Oyster Harvesting Waters along Louisiana Gulf Coast."

Mil

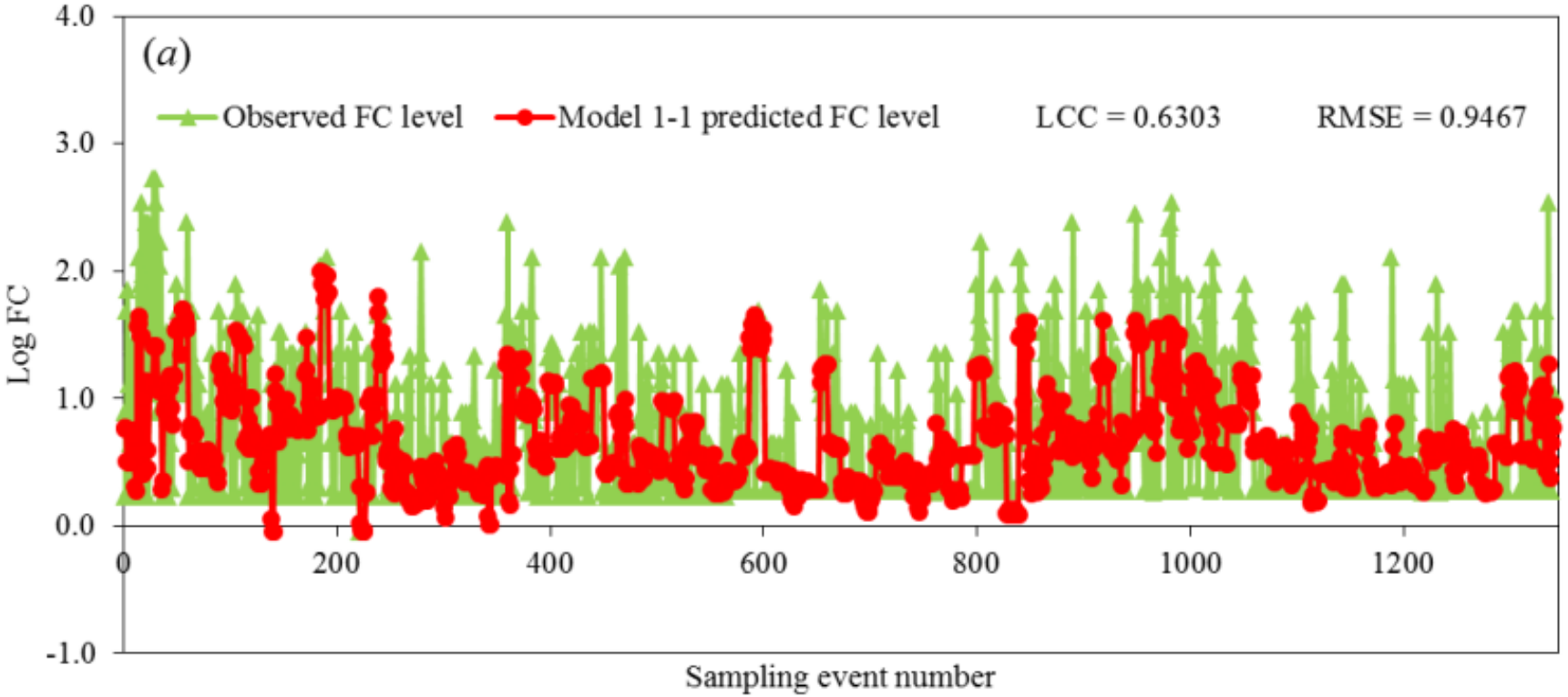




- Water temperature: NASA MODIS Data
- Salinity: NASA MODIS Data
- Solar radiation: NASA MODIS Data
- Rainfall: NOAA Data
- Tide: NOAA Data
- Wind speed and direction: NOAA Data


SST

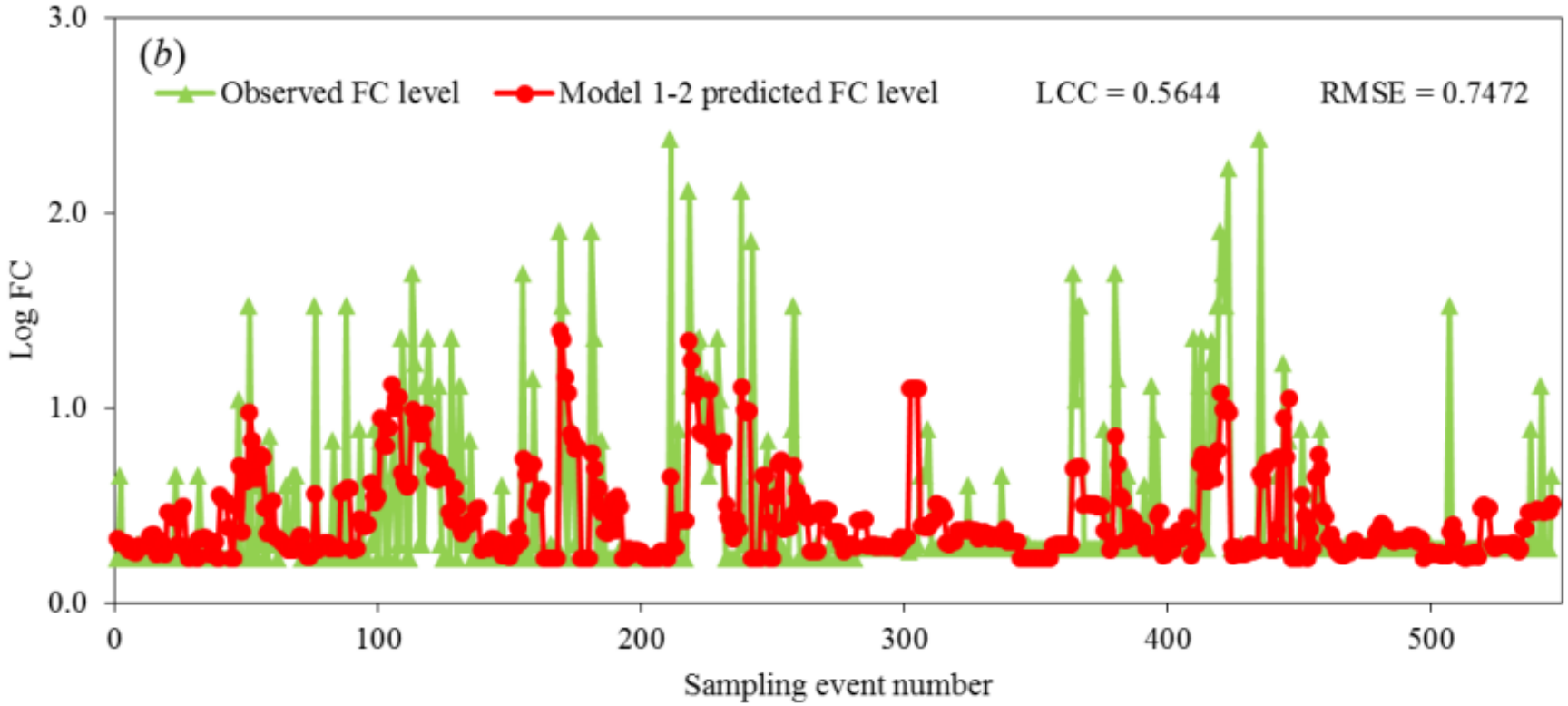
ANN Model For Area 1



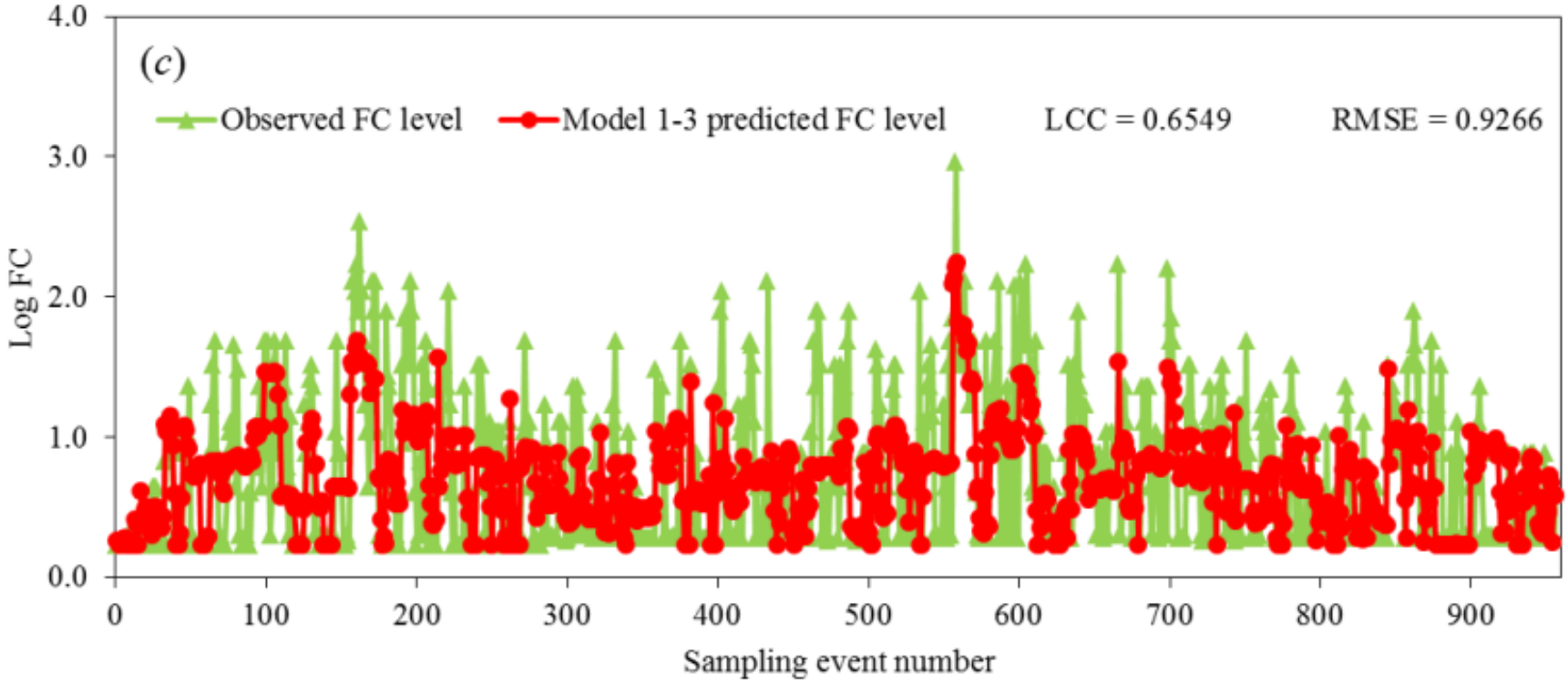
Data: 2001 – 2011: 60% for model development and 40% for testing

Model Development Data: 60% of data for model training, 20% for validation, and 20% for independent testing.

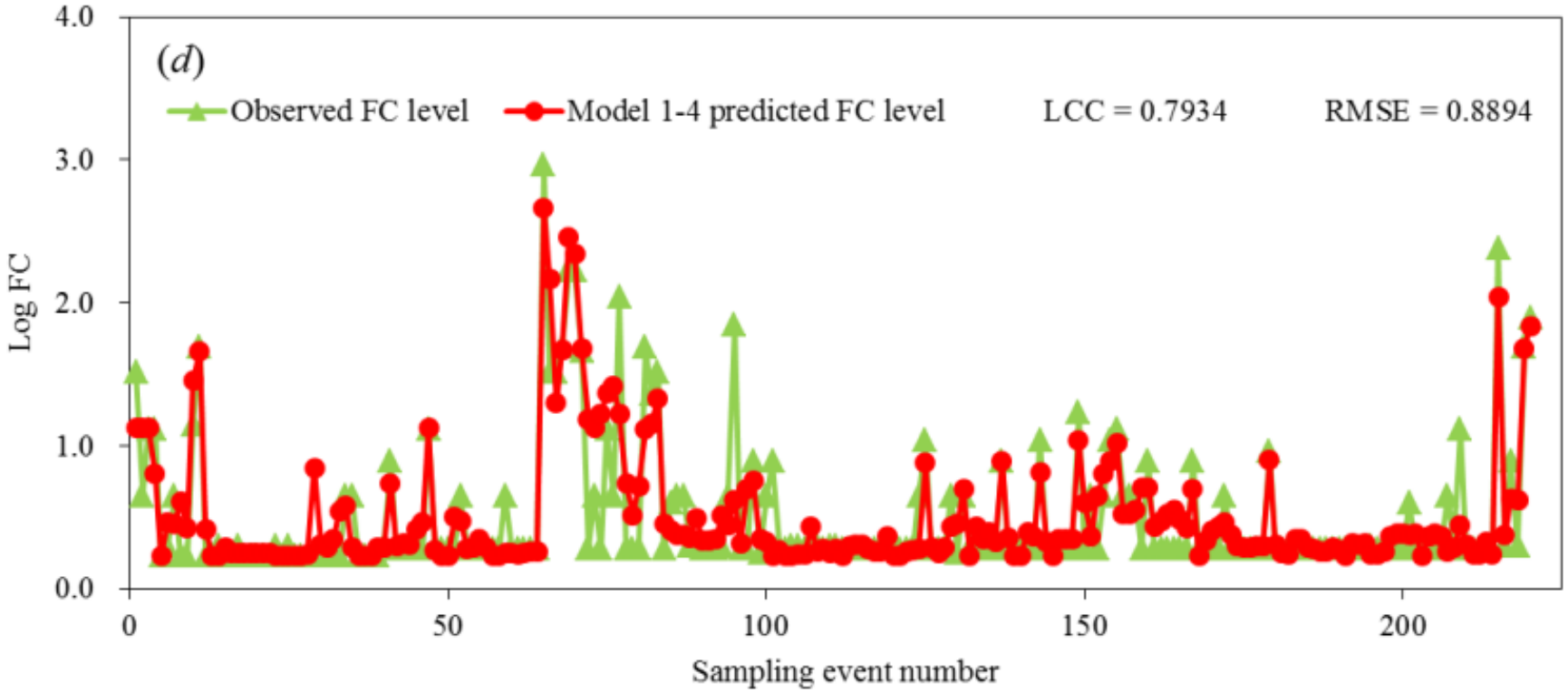
ANN Model For Area 2



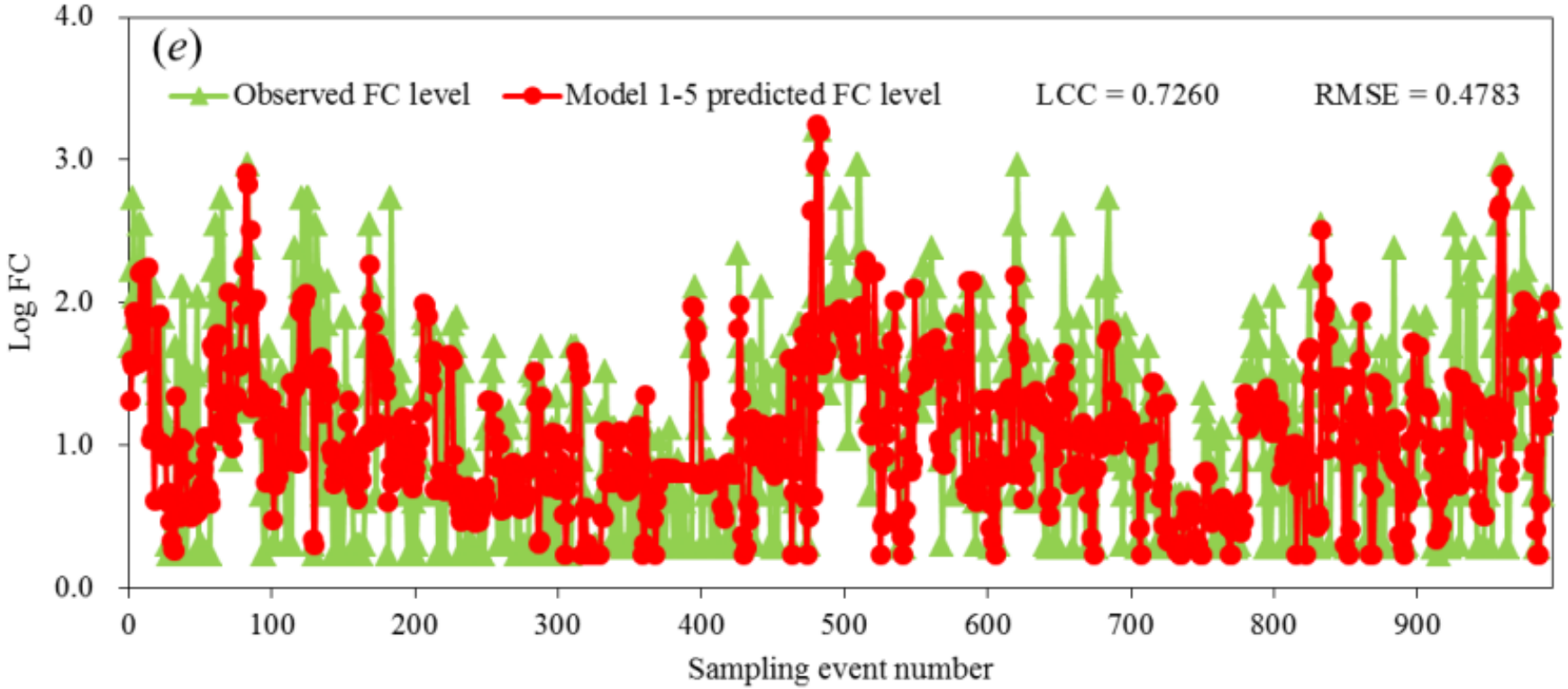
ANN Model For Area 3



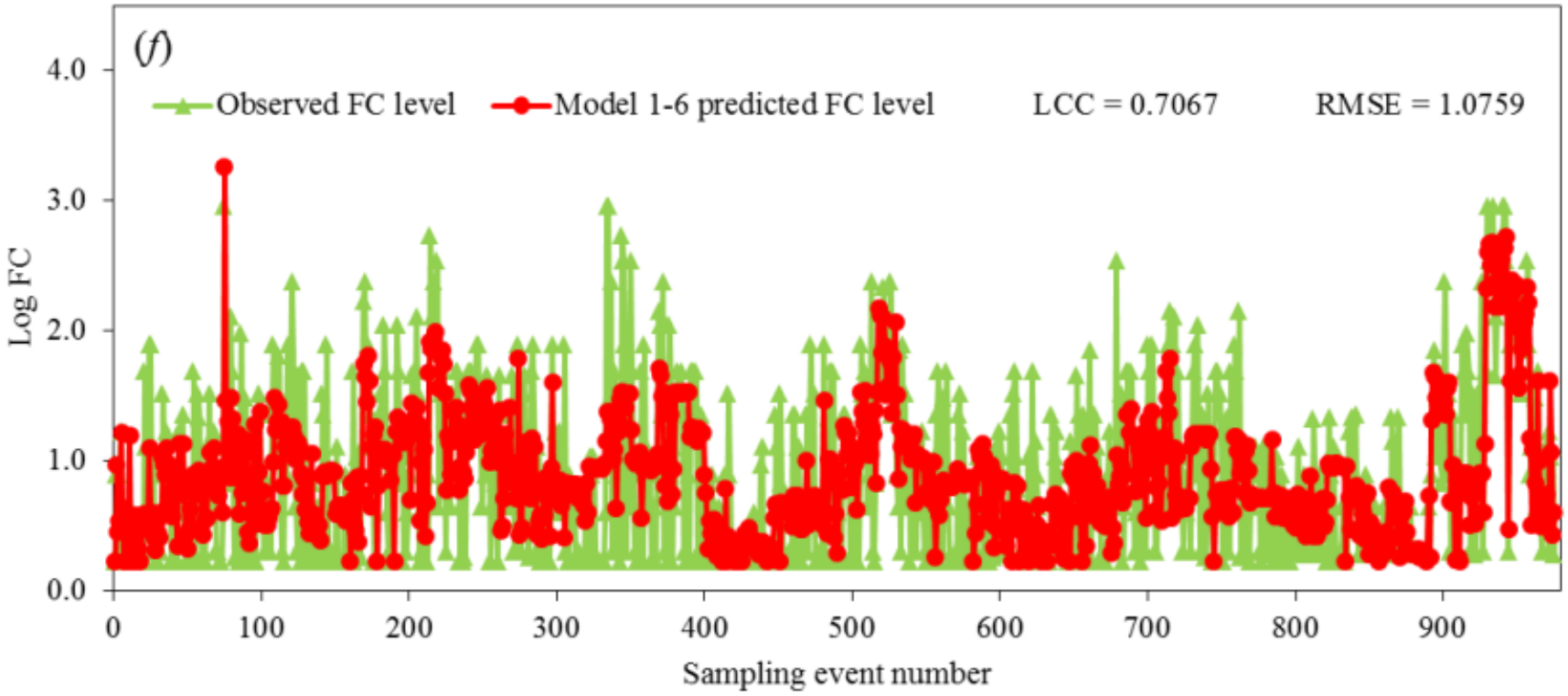
ANN Model For Area 4



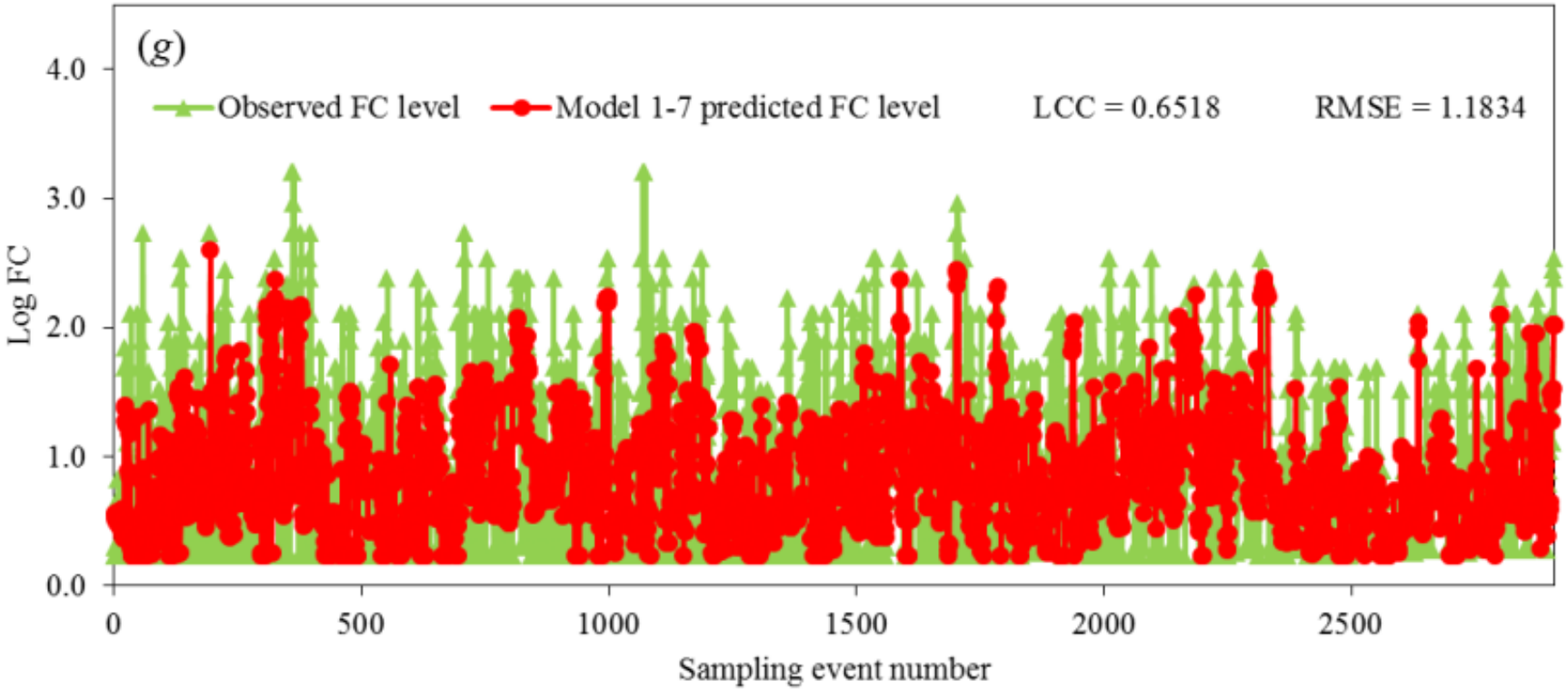
ANN Model For Area 5



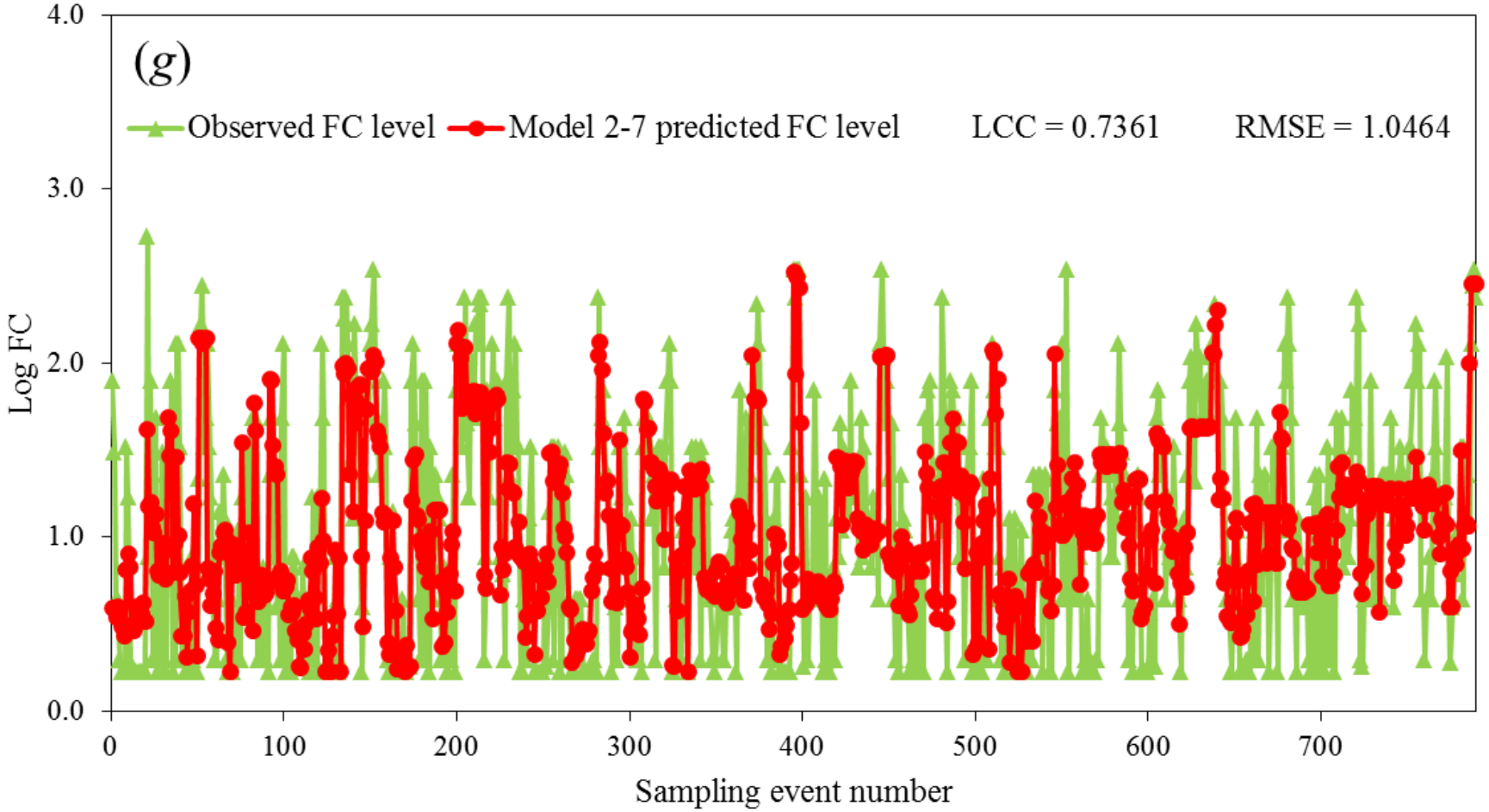
ANN Model For Area 6



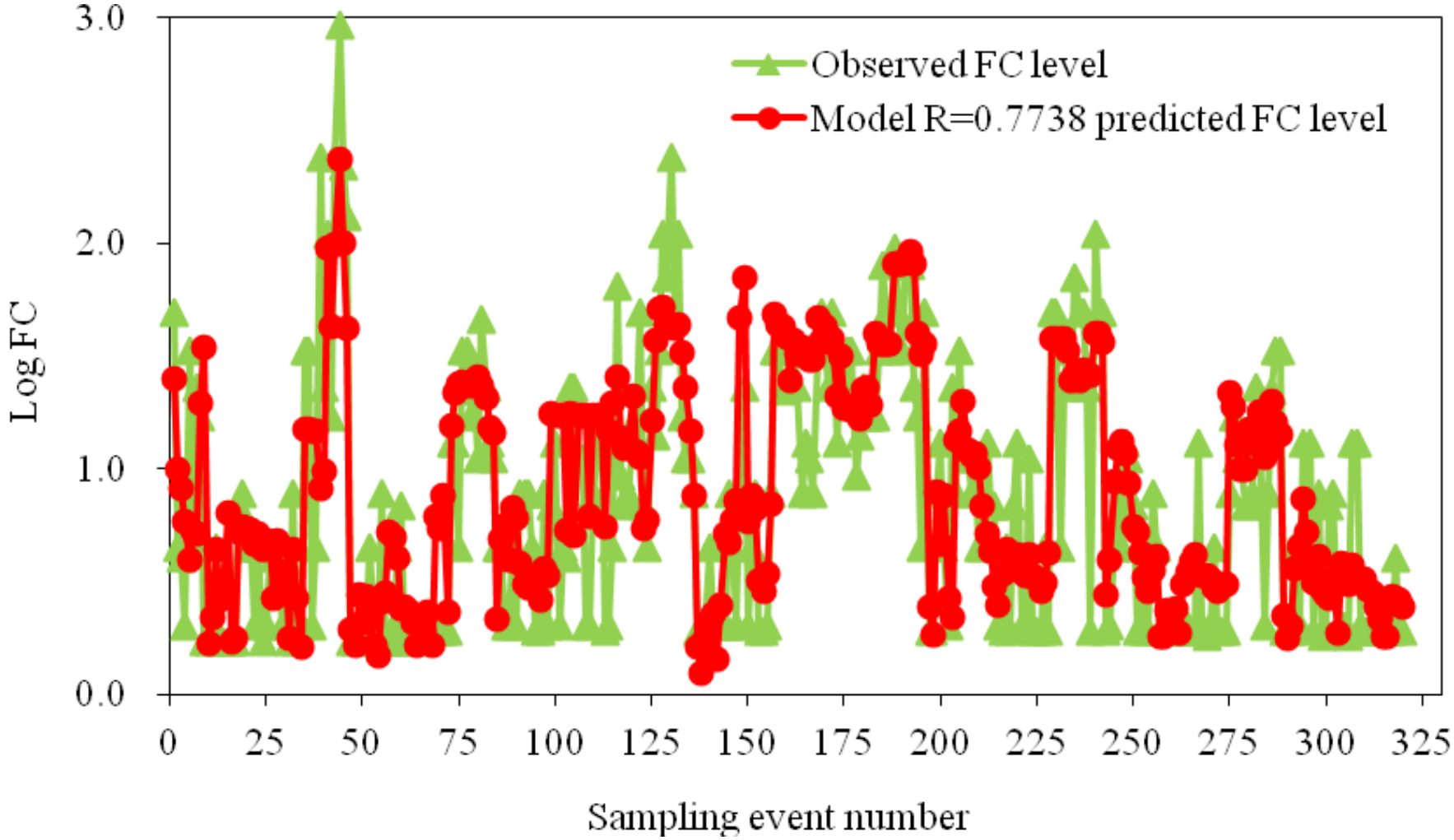
ANN Model For Area 7



Comparison between Model 2-1 predicted and observed fecal coliform levels in winter 2001-2007.



Comparison between the log-transformed *fecal coliform* levels predicted using the ANN model (linear correlation coefficient R = 0.7738) against the fecal coliform data, observed in 2005 – 2008



Milestone – 2

- Development of Bayesian model for detection and forecasting of norovirus disease outbreak
- Journal Paper: Wang, J. and Deng, Z. (2012). "Detection and forecasting of oyster norovirus outbreaks: Recent advances and future perspectives." Marine Environmental Research, 80, 62-69.
  - Seasonality of norovirus outbreaks: November – May.
  - Independent Variables: Norovirus outbreaks are controlled by multiple environmental factors such as low tides and heavy rainfalls.

Milestone – 2

- Norovirus outbreaks typically occur 10 – 14 days after a major lower tide event which increases the exposure of oysters to contaminated fresh water discharges
- Heavy rainfall-induced stormwater runoff or river discharges carry noroviruses to oyster growing waters and play an important role in controlling norovirus outbreaks.
- Stormwater runoff during low tides may significantly reduce salinity.

nola.com
Everything New Orleans

LSU researcher hopes to forecast potential virus outbreak in oysters

Published: Sunday, May 27, 2012, 1:00 AM Updated: Sunday, May 27, 2012, 12:41 PM

The Associated Press By

Weather data, satellite imagery and computer modeling could provide tools to forecast a norovirus outbreak in oysters in the Gulf of Mexico, an LSU researcher says.

Daniel Erath/The Times-Picayune

New research hopes to predict and prevent norovirus outbreak from oysters.

LSU associate professor Zhiqiang Deng is working on a computer model that obtains information from the state Department of Health and Hospitals, weather and satellite images from the National Aeronautics and Space Administration and information from other federal agencies.

The Advocate reports the goal is to spot conditions that contribute to the formation of norovirus outbreaks along the coast and try to forecast where they will occur.

Norovirus can cause a "stomach flu-like" illness that usually starts about a day or two after eating or drinking something with the virus. Symptoms include nausea, vomiting, diarrhea and stomach cramping, and sometimes people have a low-grade fever, chills, headache, muscle ache and fatigue, according to health officials. Symptoms can last a day or two.

The norovirus can contaminate oysters, which happens mostly in winter months. Heavy rains that wash fecal coliform into the water or boaters who dump fecal matter overboard can lead to the norovirus forming in the water. That virus can then be passed to feeding oysters and transferred to humans when eaten.

Deng said he hopes a forecast model would help regulators predict where and when an outbreak might occur so officials could prevent consumption of oysters from such areas instead of waiting until people get sick.

npacts

LSU

This project has been featured in numerous local, national and international media outlets, including The Advocate, Gulf Coast Rising News, The Washington Examiner, The Times-Picayune Breaking News , USA Today, Geospatial World News, Aquahoy, ...

news

Researcher hopes to spot virus potential in oysters in Gulf of Mexico

By: ASHLEY ROBERTS | Alabama's 13
Published: May 27, 2012

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Information from: The Advocate, http://theadvocate.com

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KING5.com

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Posted on May 27, 2012 at 5:31 PM

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The Sun Herald

Next Story >

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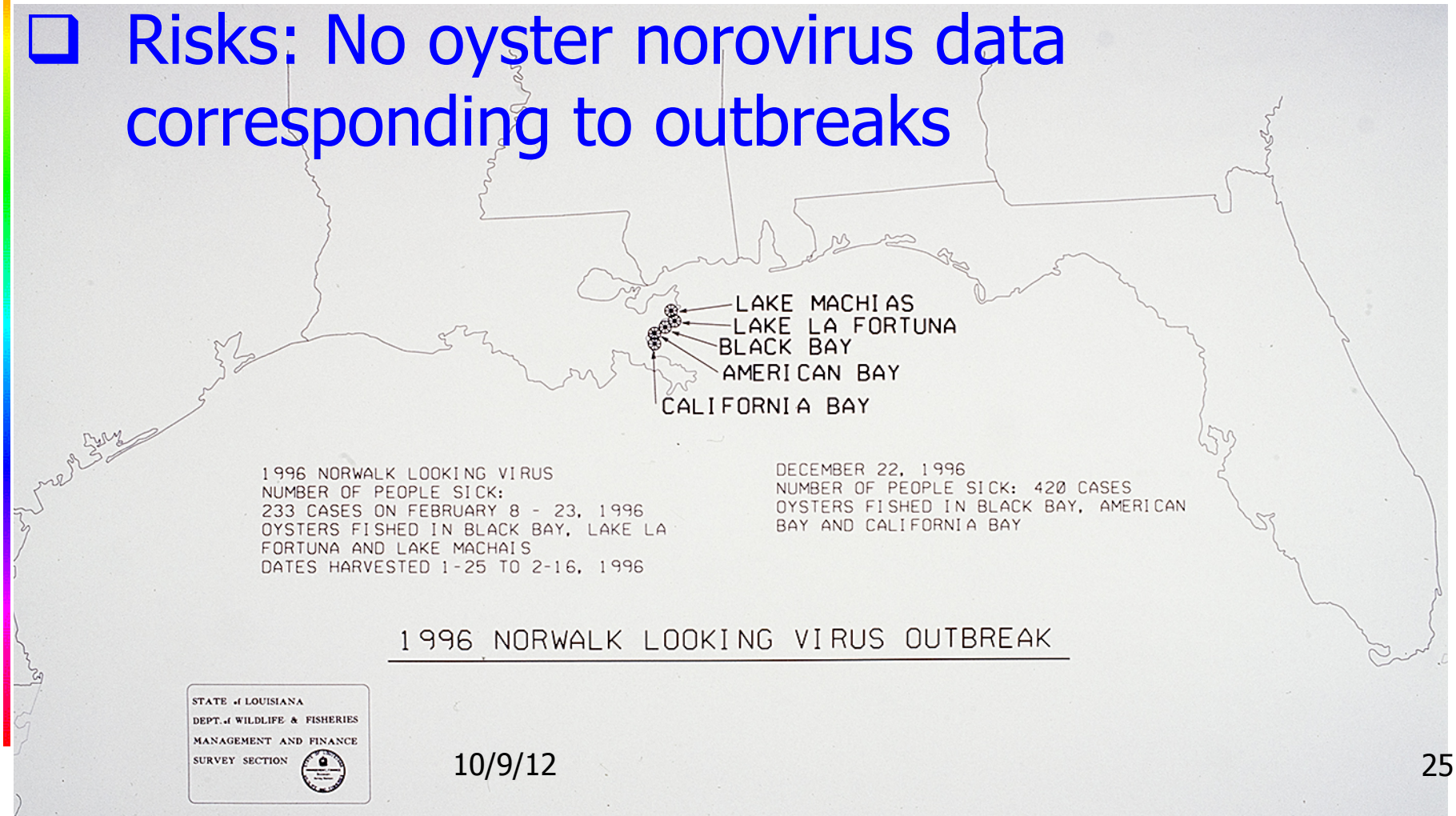
Upcoming Plans

- Develop Bayesian model for detection and forecasting of norovirus disease outbreaks.
- Complete the development of remote sensing algorithms for solar radiation and salinity.
- Submit journal manuscripts.

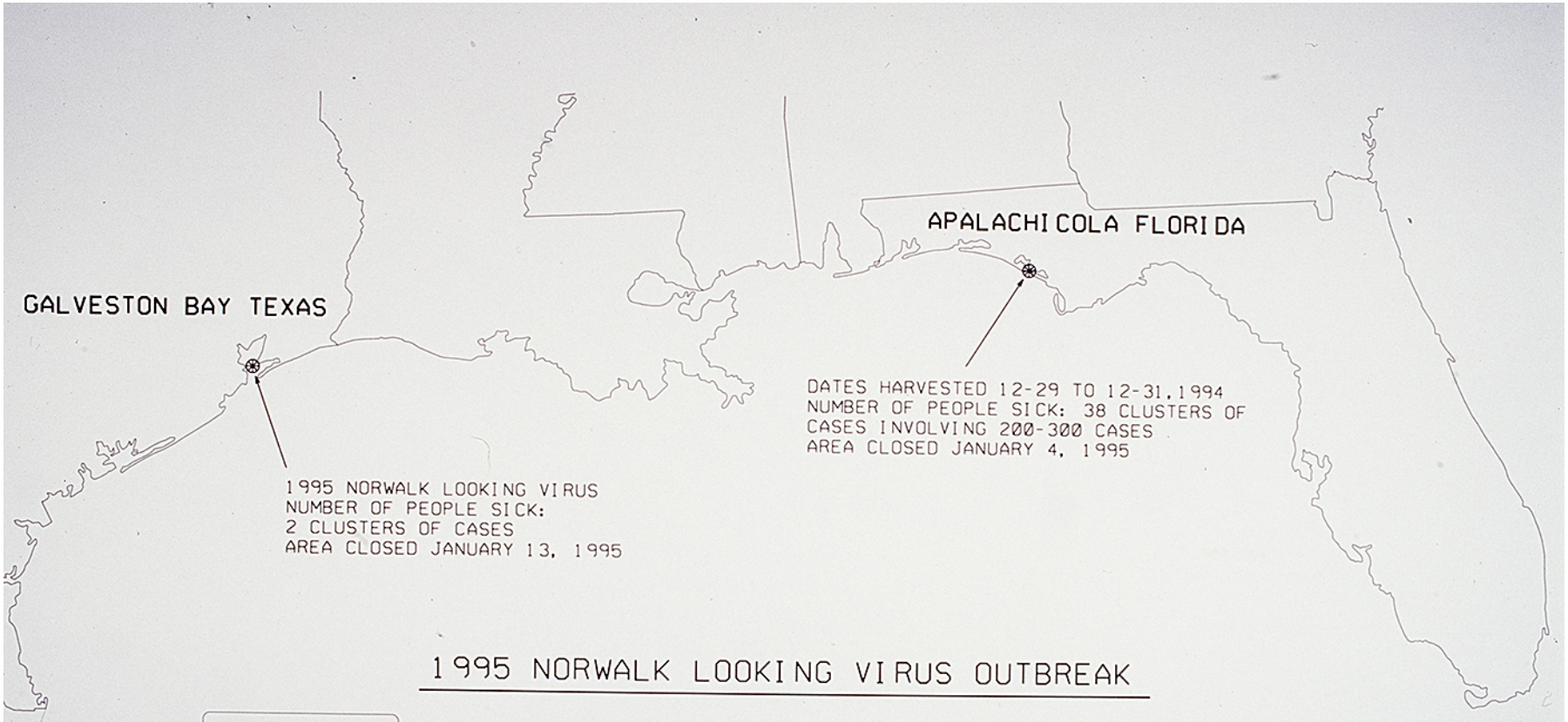
Costing Status, Risks and Challenges

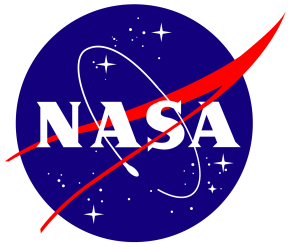
- Costing Status: 50% of funds expended.
- Risks: No oyster norovirus data corresponding to outbreaks



Risks and Challenges

- Challenges:
  - No norovirus standard for outbreaks
  - Uncertainties in norovirus outbreaks





Thanks !