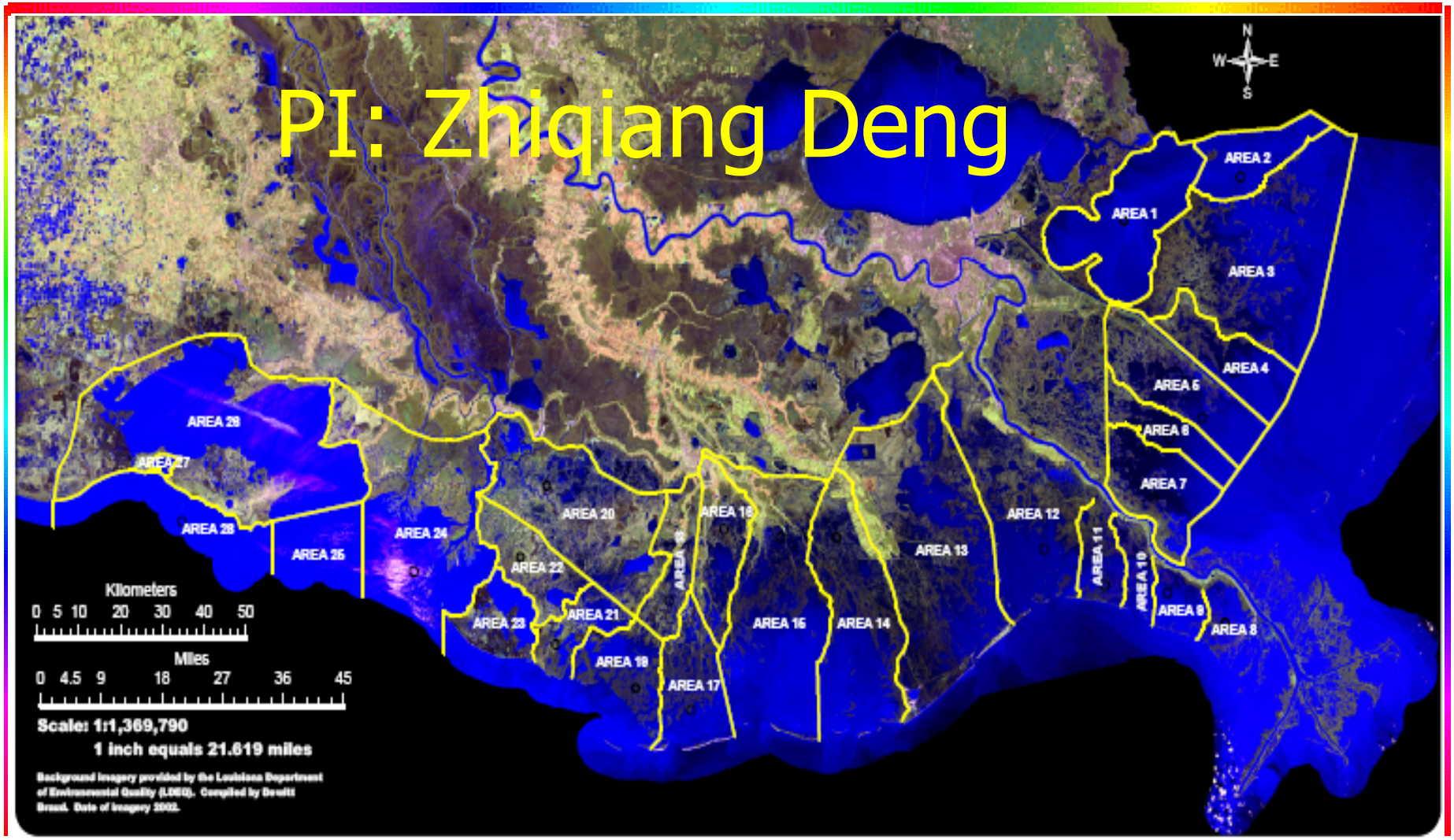
Feasibility Study of Satellite-Assisted Detection and Forecasting of Oyster Norovirus Outbreaks



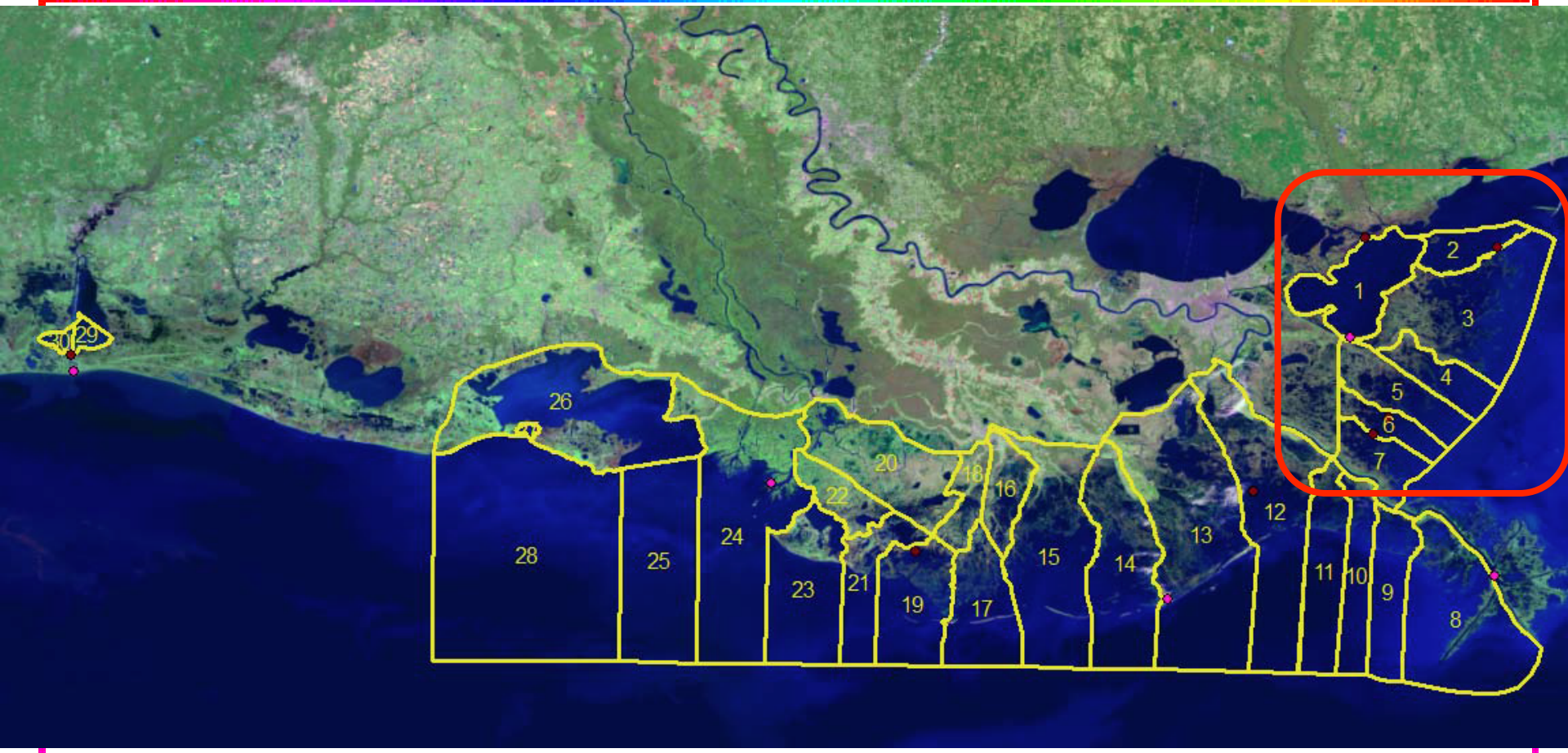
Feasibility Study of Satellite-Assisted Detection and Forecasting of Oyster Norovirus Outbreaks

- **Project Team:**
  - **PI: Zhiqiang Deng (Louisiana State University)**
  - **Collaborators:** Raoult Ratard, Erin Delaune, and Susanne Straif-Bourgeois, Lance Broussard, Gordon Leblanc, Chris Lemaire, Stephen Martin, Robert Dellsperger (LDHH)
- **Primary End-User Organization:** Louisiana Department of Health and Hospitals (LDHH)
  - Infectious Disease Epidemiology Section
  - Molluscan Shellfish Program
- **Project Period:** 04/18/2011-04/17/2013 ➔ 04/17/2014

Outline

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

Study/Project Area



Map showing 30 Louisiana oyster growing areas extending from LA/MS border to LA/TX border

Goal and Objectives

- **Goal:** Overall goal of this project is to provide daily predictions of oyster norovirus outbreak risks.
- **Objective 1:** Construct/Apply retrieval algorithms that link NASA **MODIS Terra and Aqua data** to water quality indicators (such as SST, turbidity, 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 probabilistic model for detection and forecasting of norovirus disease outbreak risks.

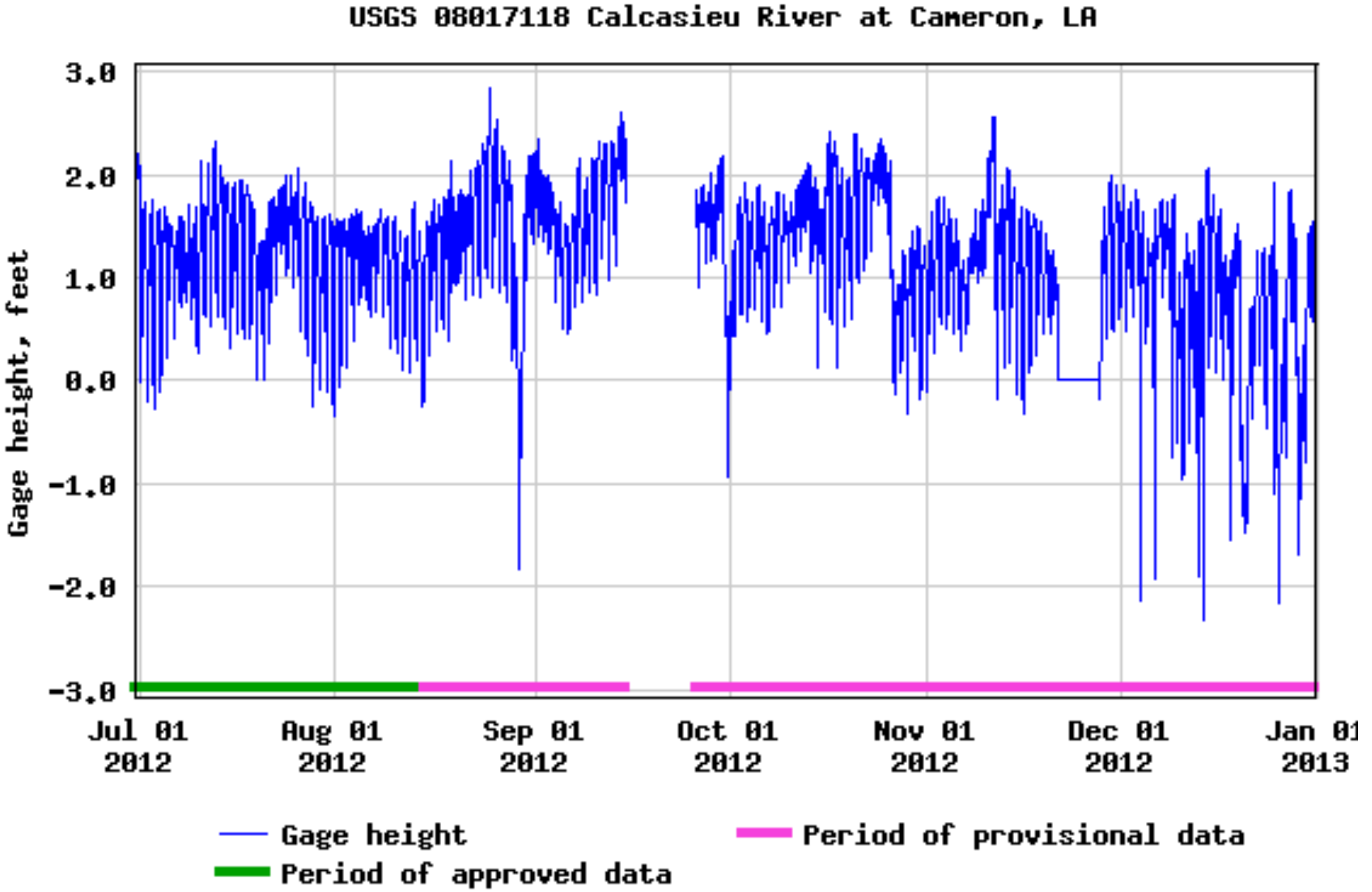
Major Milestone

- Development of a probabilistic model for prediction of oyster norovirus outbreak risks.
- Independent Environmental variables (oyster norovirus indicators) involved in the model:
  - Water temperature: NASA MODIS Data
  - Rainfall (Daily Rainfall, cumulative rainfall in last 21 days (3 weeks)): NASA TRMM Data
  - Salinity: NASA MODIS Data (CDOM➔salinity)
  - Gauge height (daily change, minimum): USGS data
  - Wind: NOAA Data

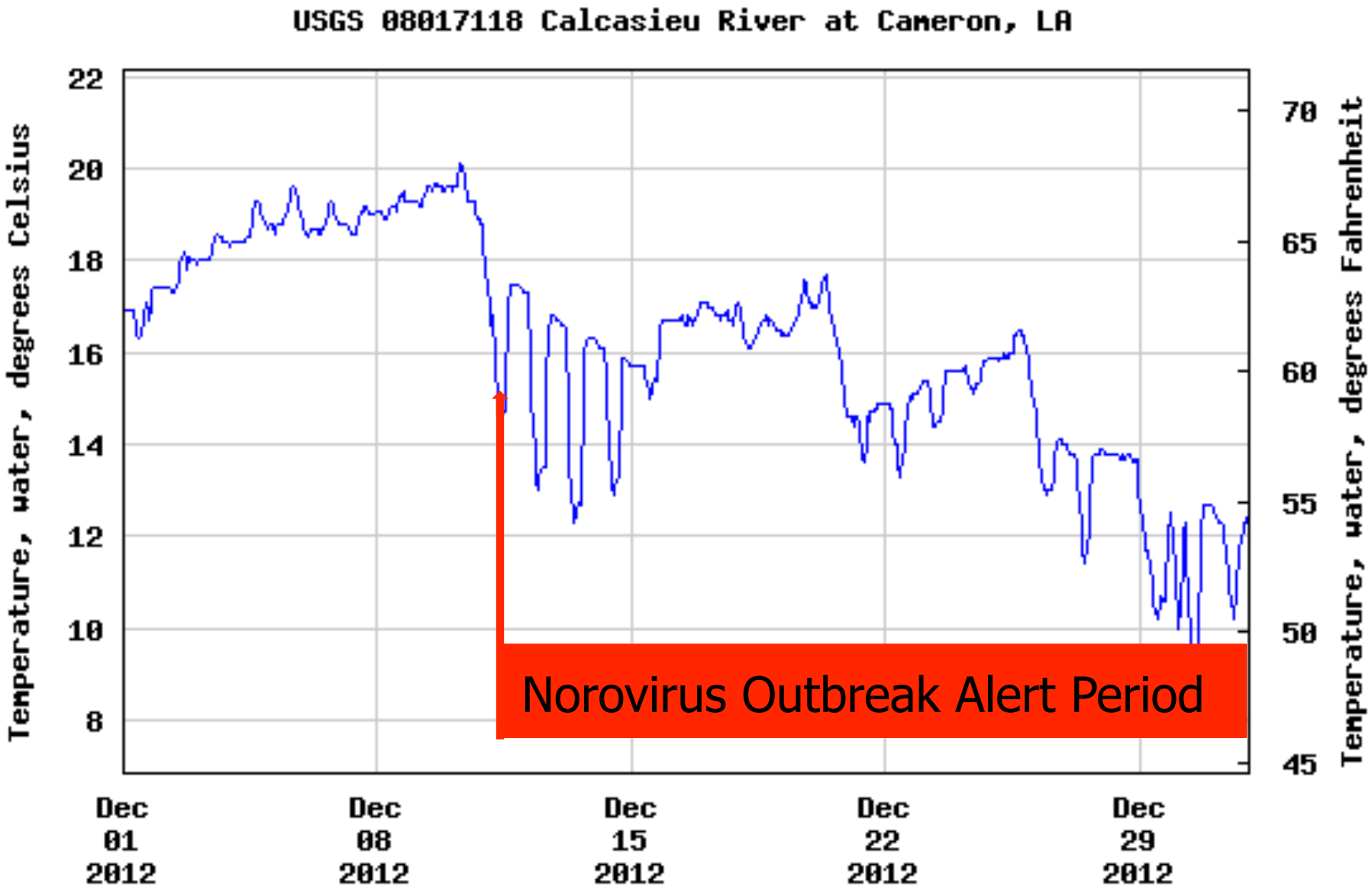
Major Milestone

- Development of a probabilistic model for prediction of norovirus disease outbreak risks.
  - Forecasting Model
  - Nowcasting Model
- The models are able to provide answers to the following three types of questions (where, when, and what) on oyster norovirus outbreaks:
  - When will next norovirus outbreak occur?
  - Where will next norovirus outbreak occur?
  - What will be the outbreak risk or probability?

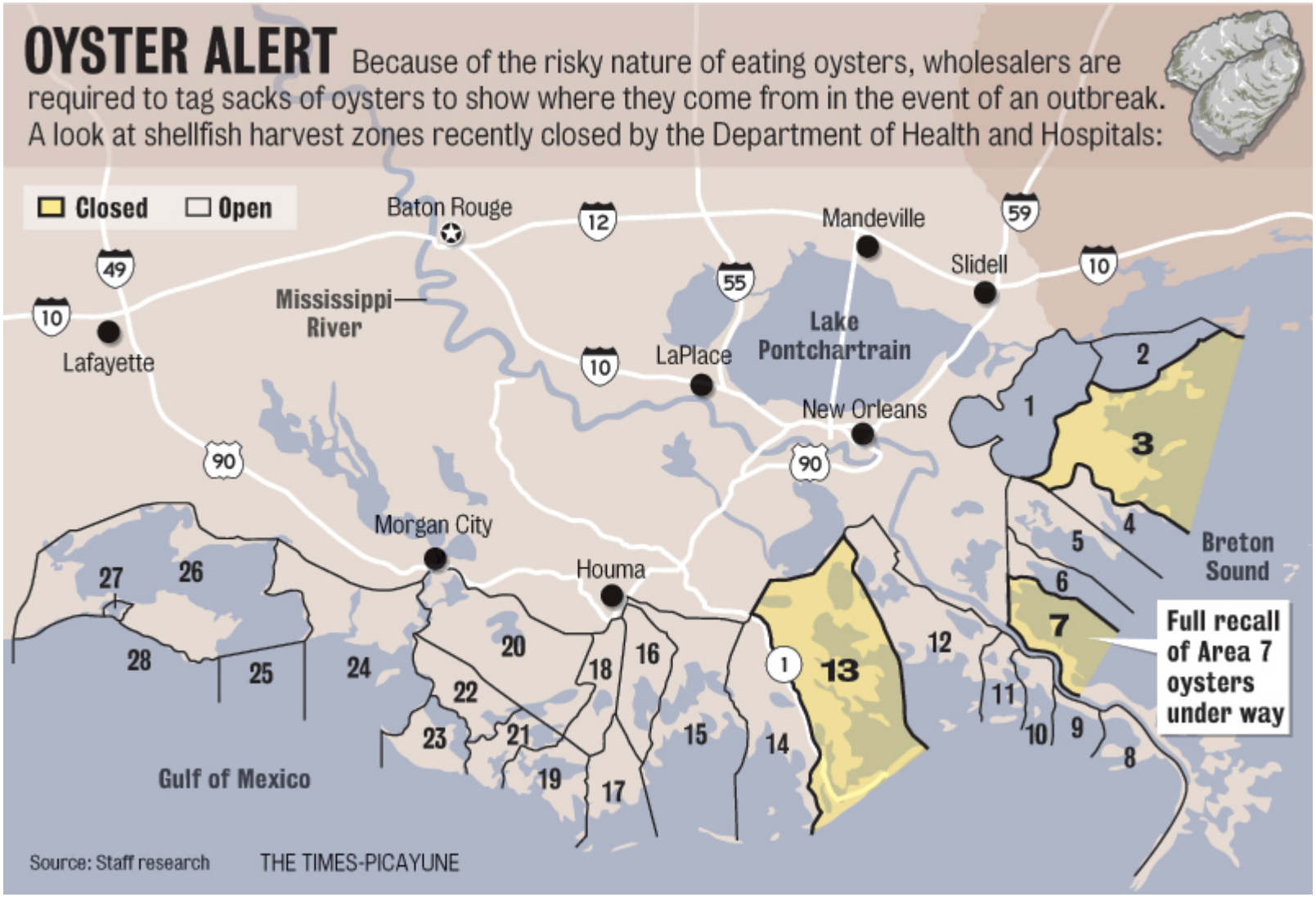
Forecasting Model



Forecasting Model



2010 Outbreaks (Shutdown of Louisiana oyster grounds is largest in 10 years)

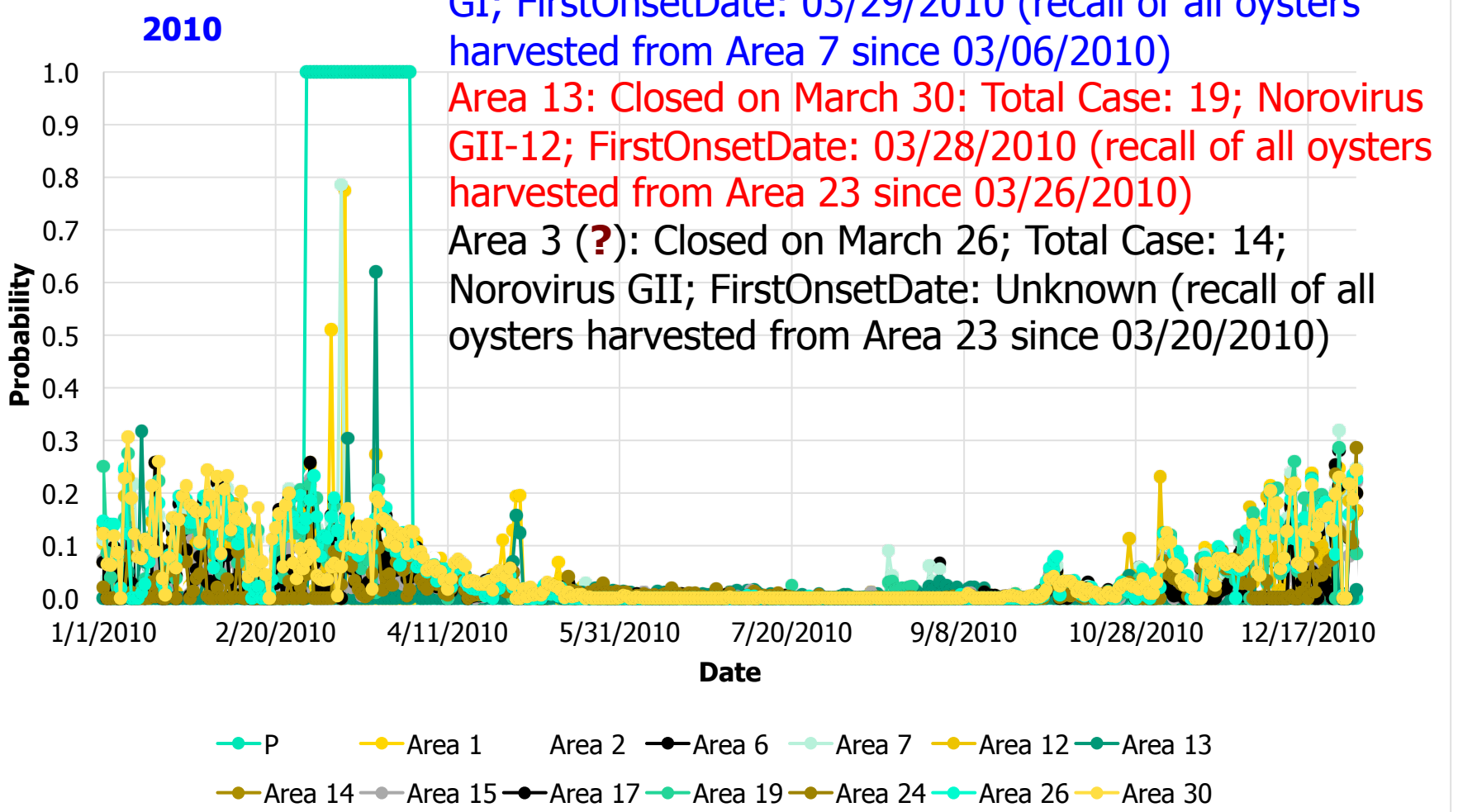


Nowcasting of Oyster Norovirus Outbreak Risks

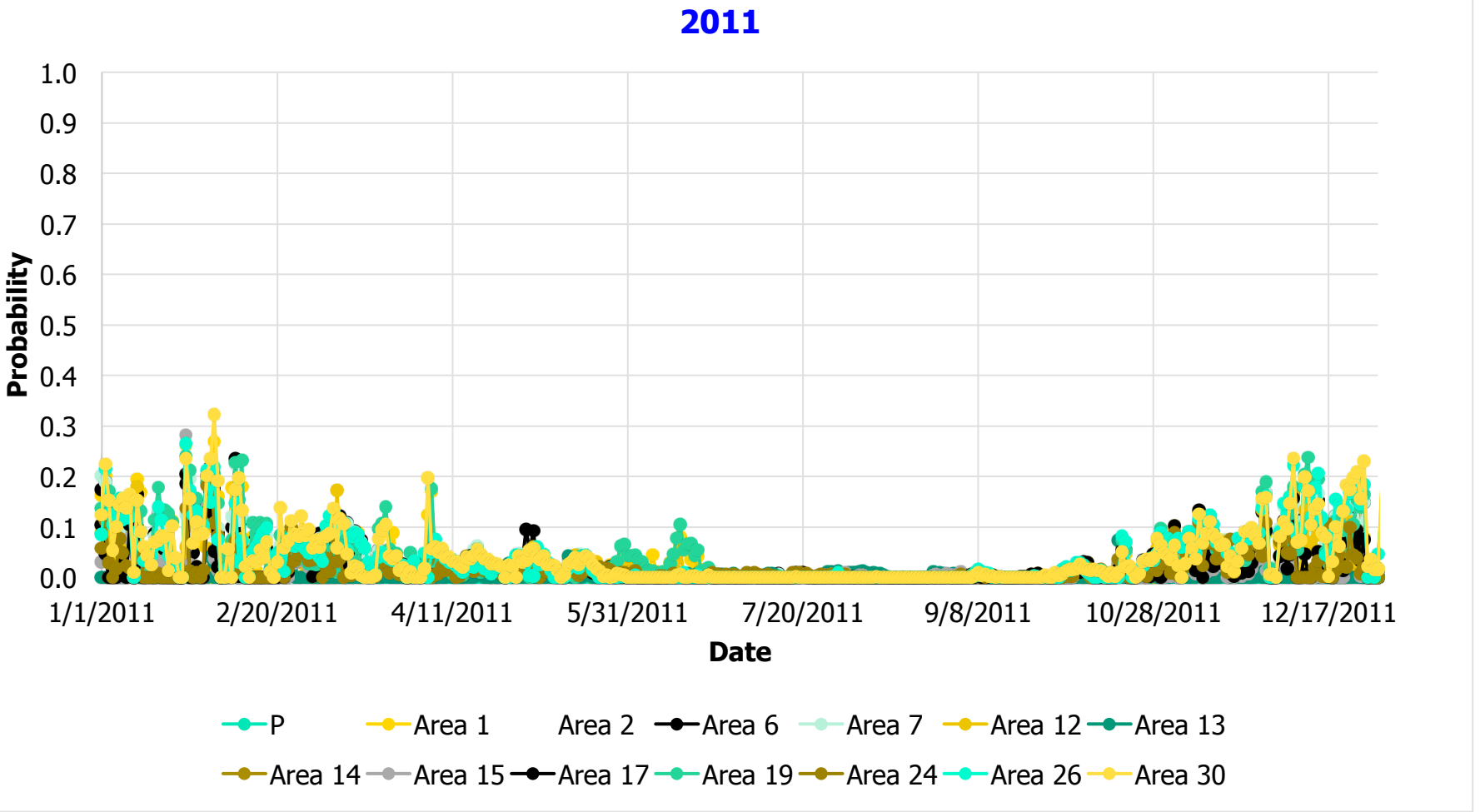
Area 7: Closed on March 24; Total Case: 14; Norovirus GI; FirstOnsetDate: 03/29/2010 (recall of all oysters harvested from Area 7 since 03/06/2010)

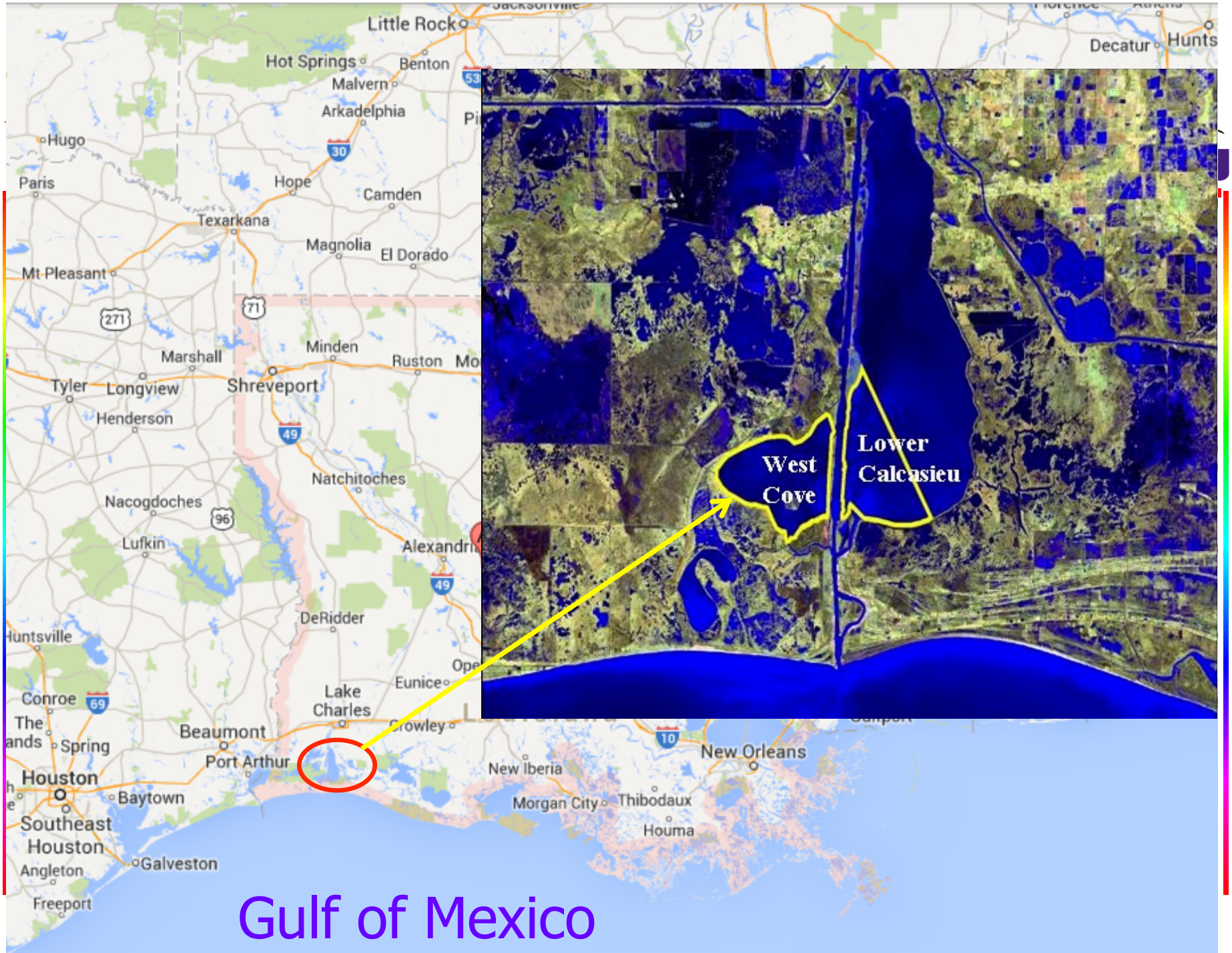
Area 13: Closed on March 30: Total Case: 19; Norovirus GII-12; FirstOnsetDate: 03/28/2010 (recall of all oysters harvested from Area 23 since 03/26/2010)

Area 3 (**?**): Closed on March 26; Total Case: 14; Norovirus GII; FirstOnsetDate: Unknown (recall of all oysters harvested from Area 23 since 03/20/2010)

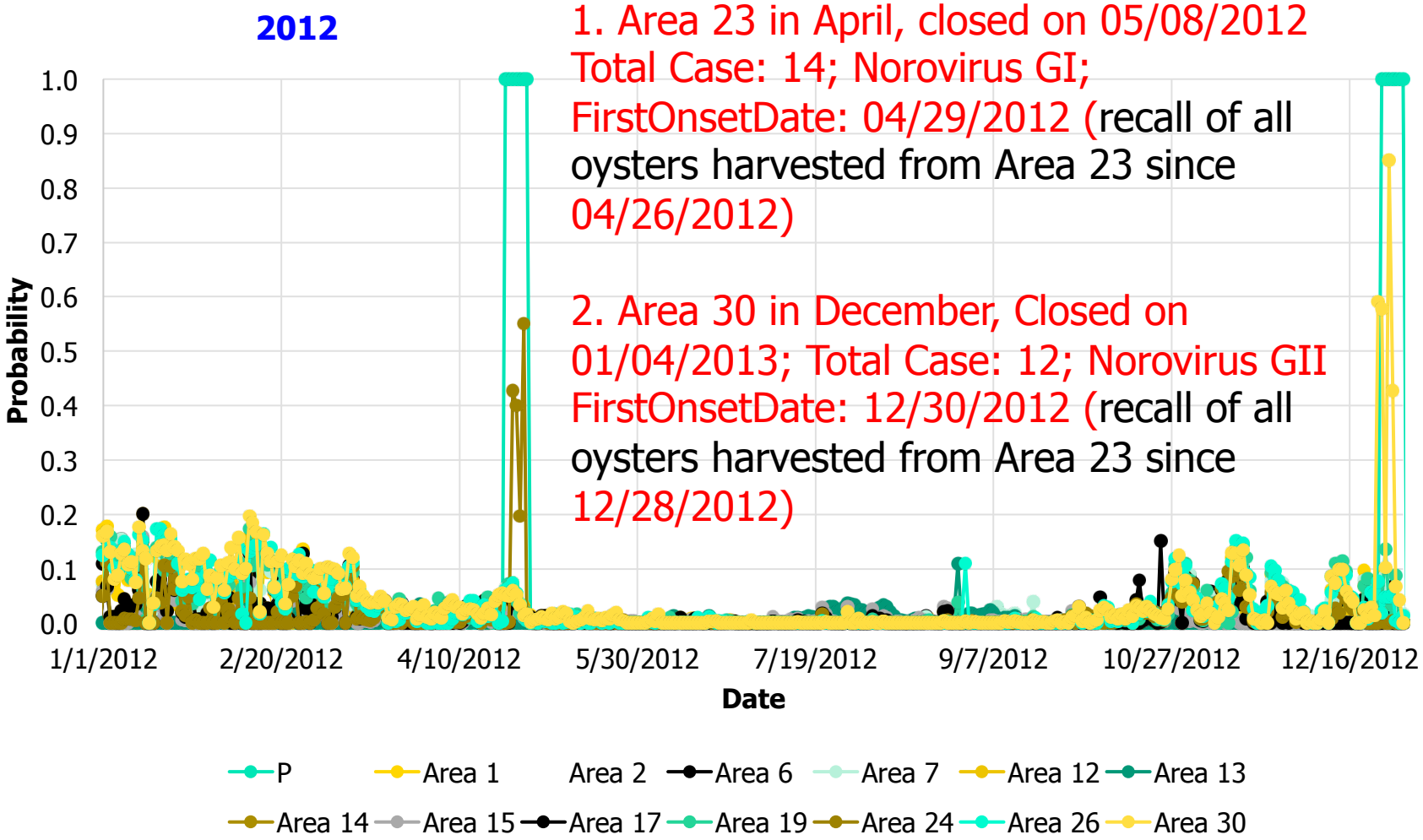


Nowcasting of Oyster Norovirus Outbreak Risks




Little Rock
Hot Springs
Benton
Malvern
Arkadelphia
Hugo
Paris
Hope
Camden
Texarkana
Magnolia
El Dorado
Mt Pleasant
Marshall
Minden
Ruston
Tyler
Longview
Shreveport
Henderson
Natchitoches
Nacogdoches
Lufkin
DeRidder
Eunice
Lake Charles
Conroe
Spring
Beaumont
Port Arthur
Houston
Baytown
Southeast Houston
Angleton
Galveston
Freeport
New Iberia
Morgan City
Thibodaux
Houma
New Orleans
Decatur
West Cove
Lower Calcasieu
Gulf of Mexico

Project – 1: Nowcasting of Oyster Norovirus Outbreak Risks



Oyster stomach pains might be thing of past; LSU model predicts outbreaks

By Benjamin Alexander-Bloch, NOLA.com | The Times-Picayune
on January 18, 2013 at 1:33 PM, updated January 19, 2013 at 1:30 AM

Print

Predicting Gulf of Mexico oyster contamination before it occurs? An LSU scientist is using NASA satellites and a spate of environmental data to help do just that.

"We were able to predict the recent outbreak several weeks before it occurred," Zhi-Qiang Deng said. "This is the first time in the world that scientists have been able to predict a norovirus outbreak in advance."

In December, Deng and his research team predicted the Cameron Parish oyster norovirus outbreaks before they occurred - 16 days beforehand, to be exact.

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Bacon Barbecue Oysters recipe

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It might sound a bit like something from "Minority Report," the Tom Cruise science fiction film in which

Project Impacts

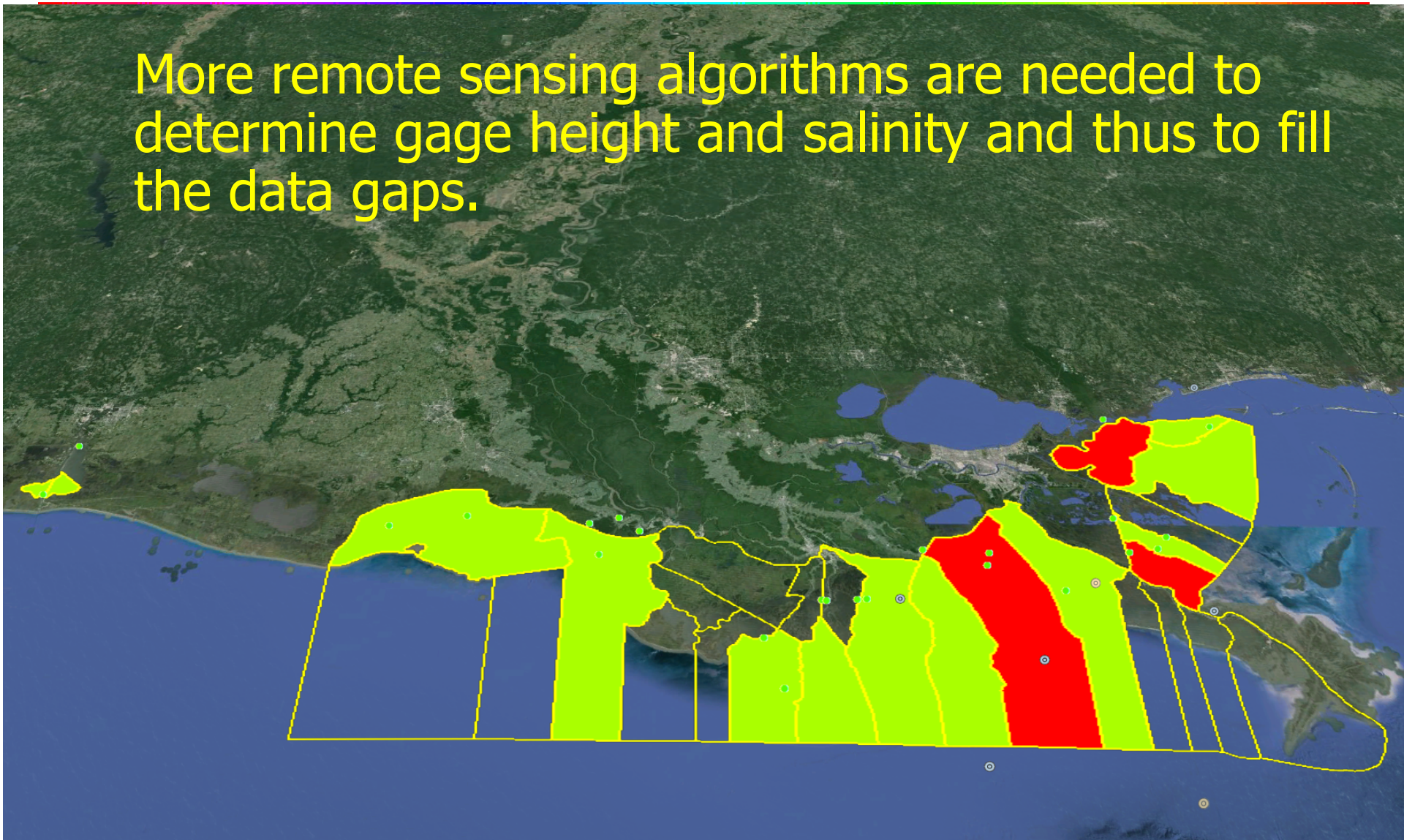
Upcoming Plans

- Validate the model using field sampling data.
  - **Event-based Sampling:** When the model produces another ‘alert’, the project team will immediately sample both oyster meat (tissue) and water samples every two days for a minimum of 5 weeks. The samples will be analyzed for viruses, vibrios, toxic algae(red tide) and any other toxin producing organisms.
- Submit journal manuscripts.

Costing Status, Risks and Challenges

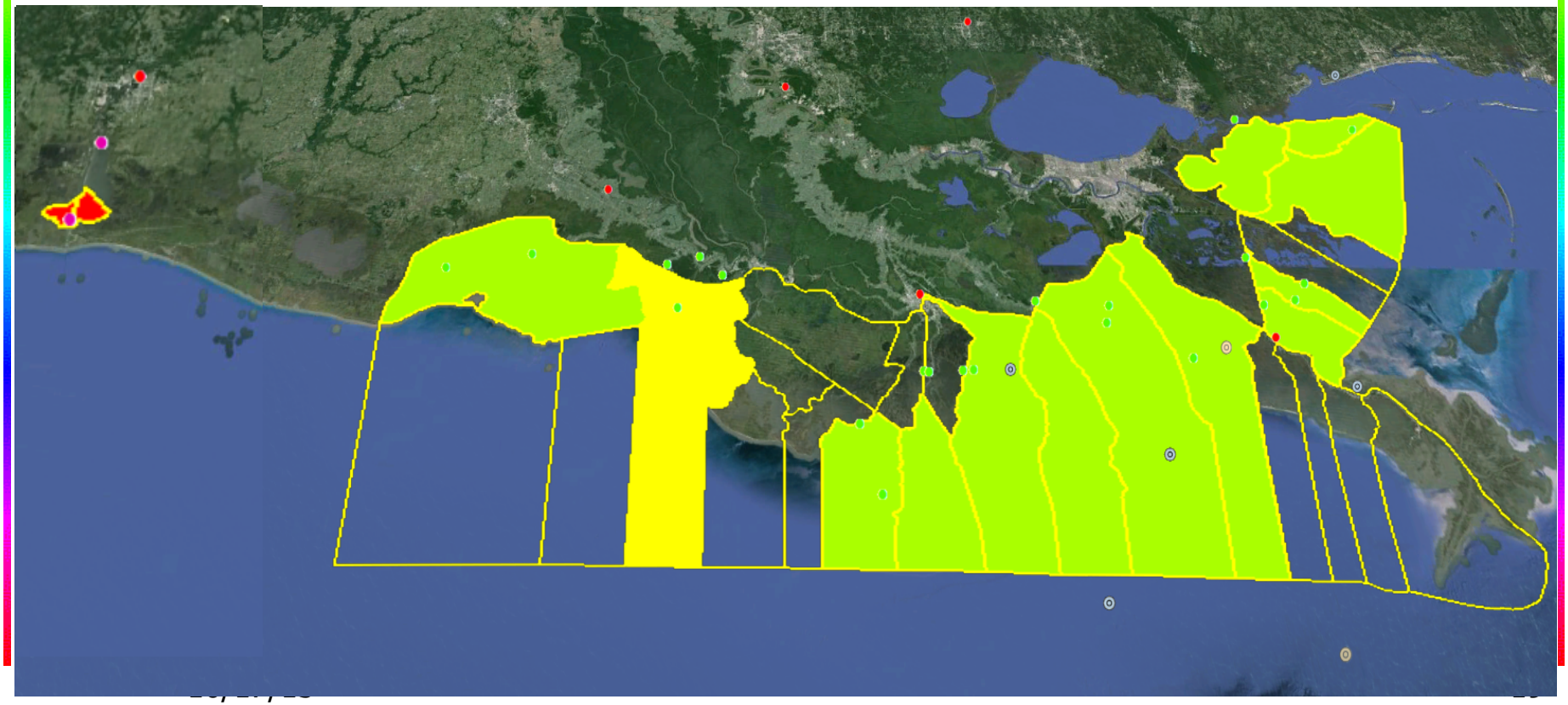
- Costing Status: 60% of funds have been expended.
- Risks and Challenges:
  - No oyster norovirus data corresponding to outbreaks
  - Norovirus outbreaks don't occur regularly;
  - Extension of our study areas from 1-7 to 30 has significantly increased our workload particularly related to data collection and processing, causing the delay in our project schedule.

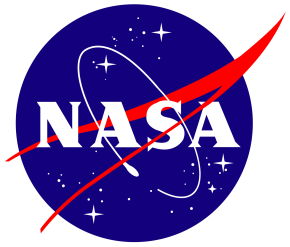
Google Earth Map for 2010 (KMZ File)



Google Earth Map for 2012 (KMZ File)

More data are needed to determine the threshold probability for norovirus outbreaks





Thanks !

Questions ?

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