Gulf Monitoring Network:
Long-Term Water Quality Monitoring

NWQMC
November 29, 2012

Steve Wolfe
Gulf of Mexico Alliance, Water Quality Team
Florida Institute of Oceanography

What makes the Gulf of Mexico Unique?

- ~ 1/3 of seafood production in US
- ~ 90% of the nation's oil/gas
- Billions of $$ to economy through tourism and commercial/ recreational fishing
- Dynamic ecosystems spanning 600,000 square miles, thousands of miles of shoreline, bayous, and bays

www.gulfofmexicoalliance.org

DWH brought attention to the Gulf, raised to a national level

-lack of baseline data,

-need to prepare for the next spill,

-need for holistic restoration

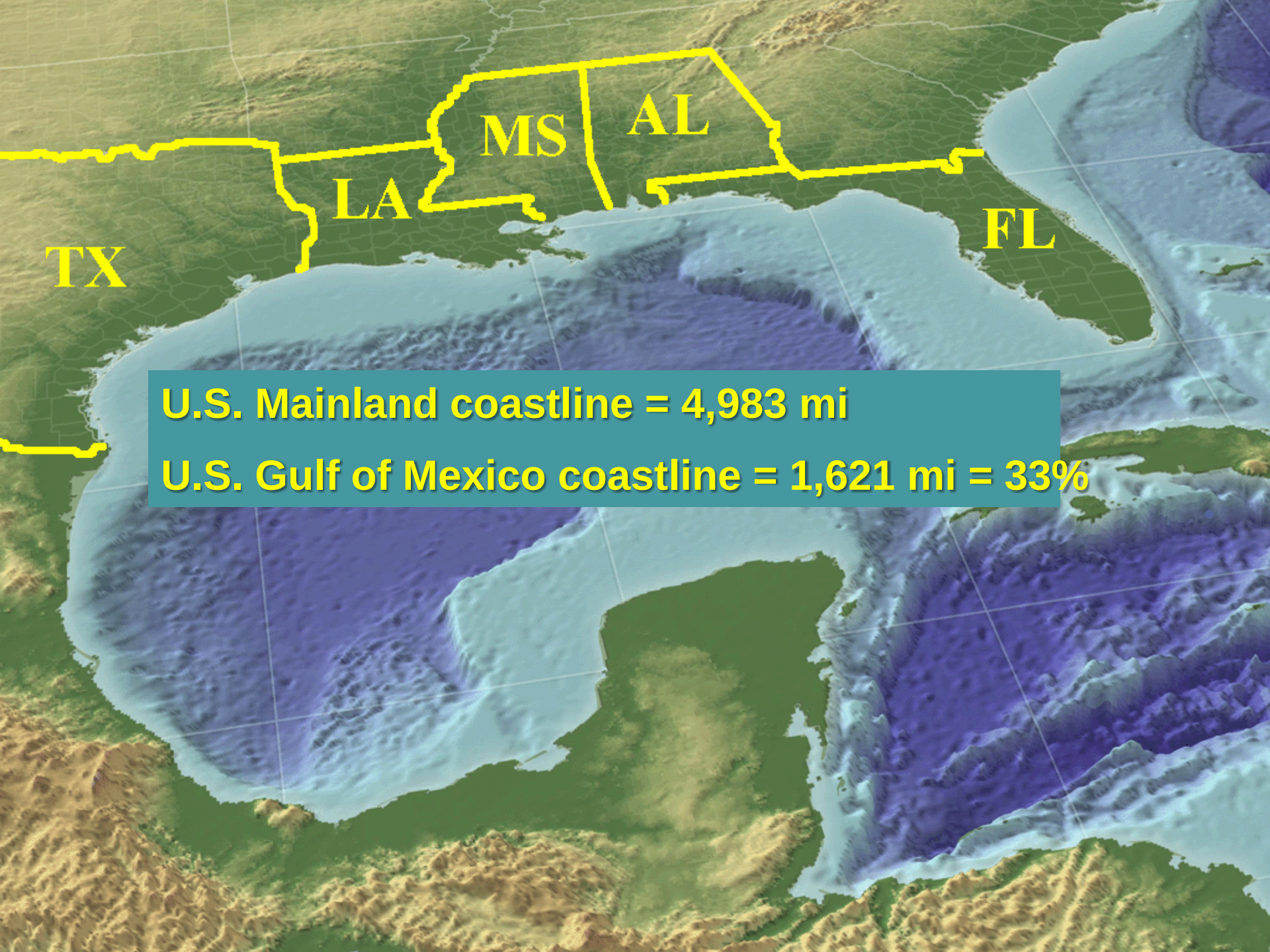
Long-term restoration: coordinate monitoring

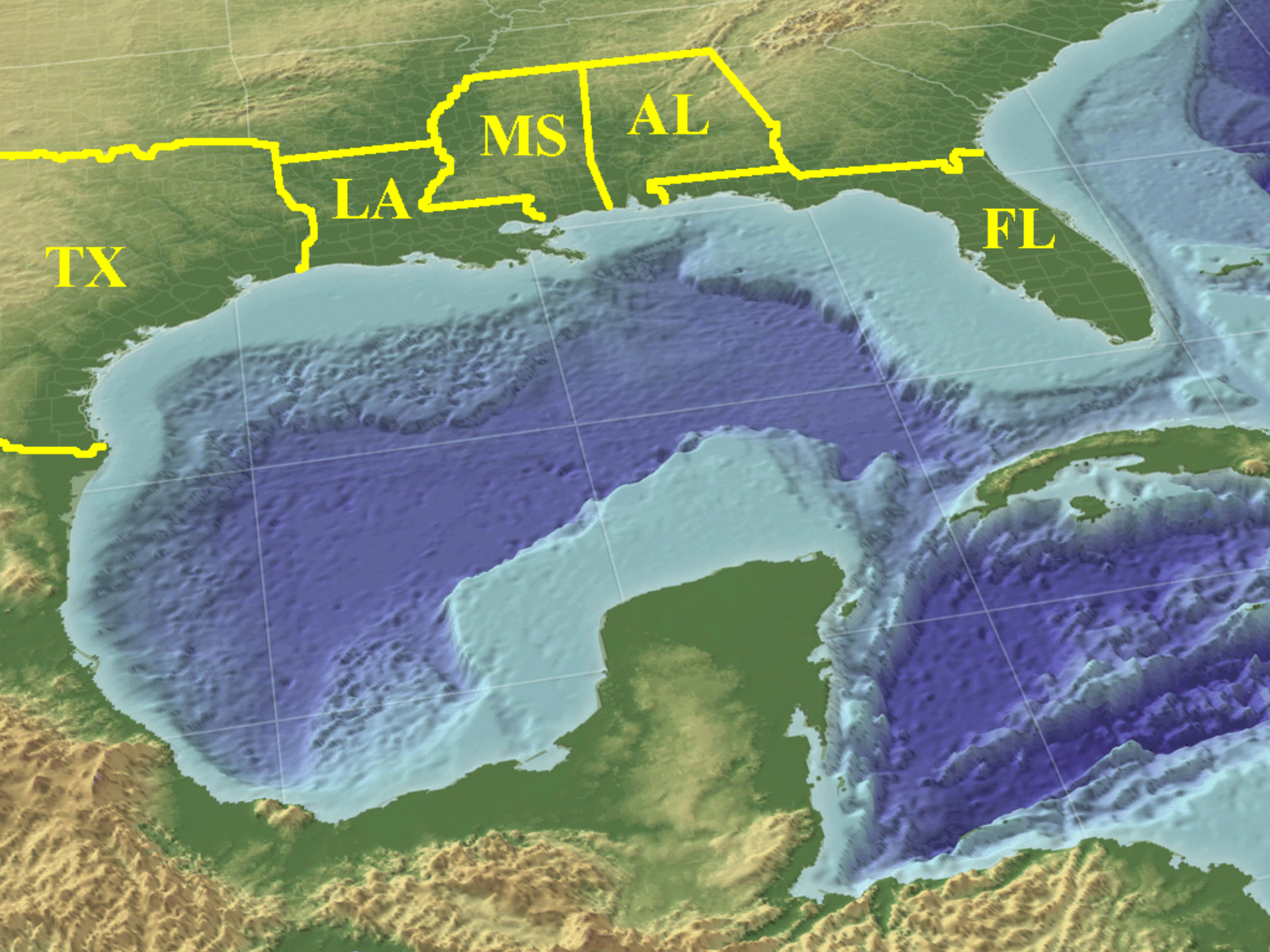
- Mabus Report "America's Gulf Coast": ***Long-term restoration and recovery beyond the oil spill***
- Gulf Coast Ecosystem Restoration Task Force: ***Gulf of Mexico Regional Ecosystem Restoration Strategy***
- Gulf of Mexico Alliance: ***Governors' Action Plan***

Opportunity

- Develop holistic monitoring plan
- Build on and support existing efforts
- Need for coordination:
  - GOMA/GOMRI
  - GCERTF
  - NRDA
  - GCOOS
  - Hypoxia Task Force

•Feds
•States
•Local Gov
•NGOs


TX
LA
MS
AL
FL
U.S. Mainland coastline = 4,983 mi
U.S. Gulf of Mexico coastline = 1,621 mi = 33%


TX
LA
MS
AL
FL

Gulf of Mexico Figures

- < 20 m (shallow & intertidal) = ~38%
- < 180 m (continental shelf) = ~22%
- 180 - 3,000 m (continental slope) = ~20%
- > 3,000 m (abyssal areas) = ~20%

- Mean depth = ~1,615 m
- Deepest (The Sigsbee Deep) = ~ 4,000 m

Why is GOMA overseeing design of GMN?

- **WQ-4.1:** Improve data comparability across the Gulf of Mexico.
- **WQ-4.2:** Coordinate the collection and management of information about monitoring programs across the Gulf of Mexico and improve data dissemination tools to deliver information to resource managers.
- **WQ-4.3** Design a framework for a water-quality monitoring network for the Gulf of Mexico adequate to address Gulf Alliance needs.

  4.3.1 Identify the monitoring network objective, needs, and design.
- **WQ-4.4:** Improve the knowledgebase needed to properly manage water quality in coastal waters.

GMN development process

1. Identify a structure to organize the development and implementation; *
2. Identify the most important GOMA water quality monitoring issues for the Gulf; *
3. For each of those issues, identify and rank the highest priority questions (that monitoring can address); *
4. Design the minimum monitoring system necessary to address the priority questions; +

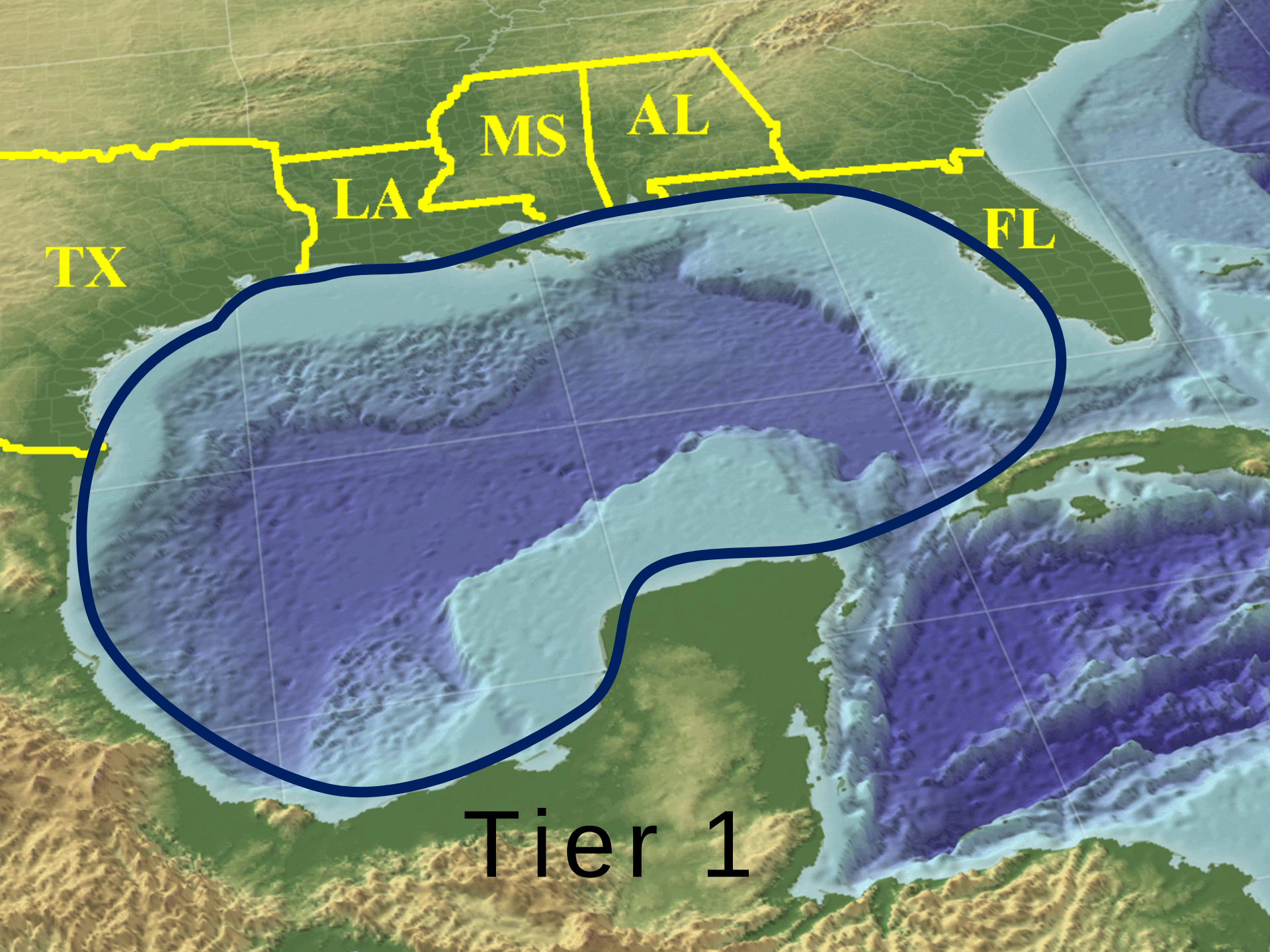
GMN development process

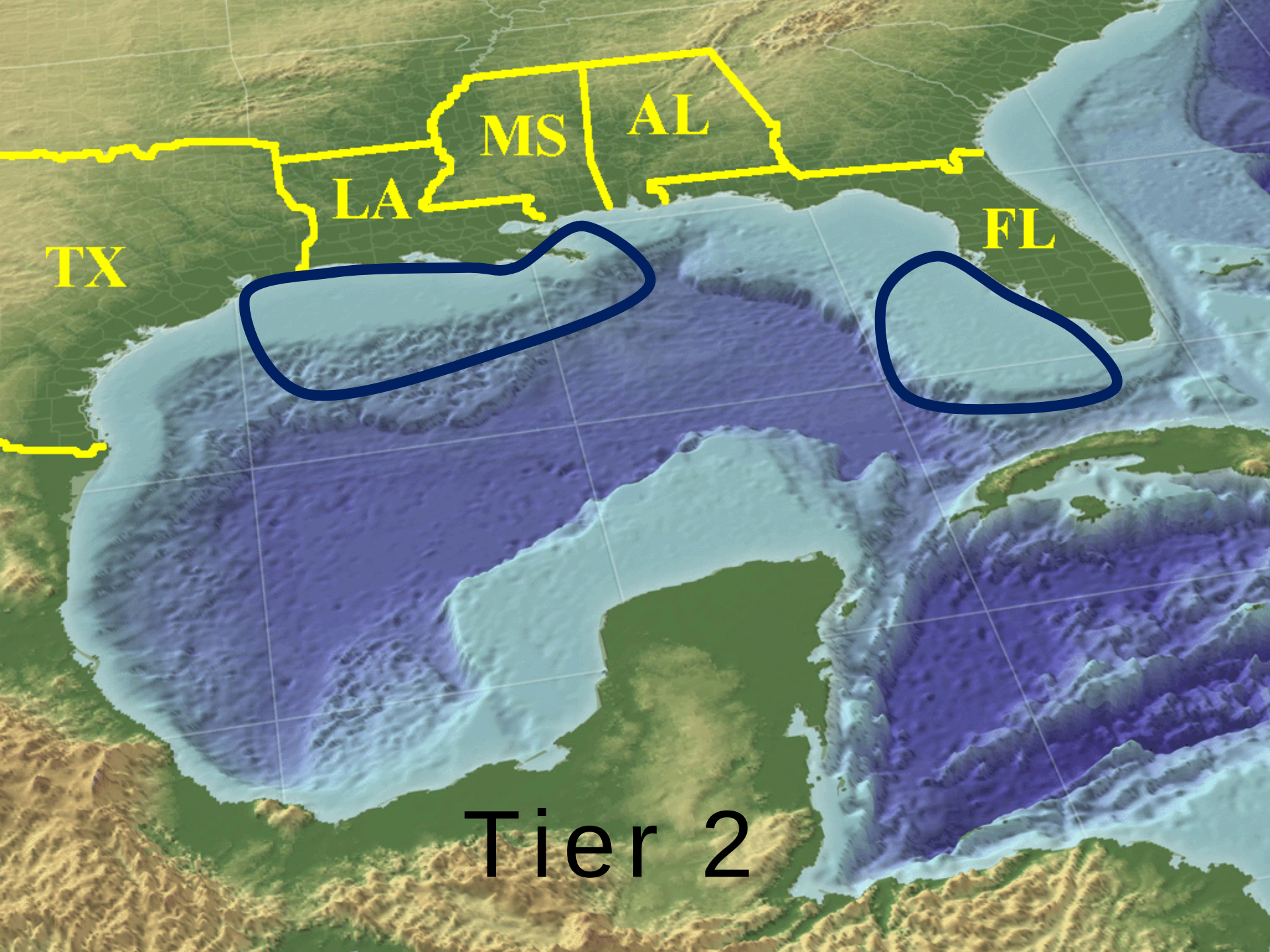
5. Perform a “gap analysis” comparing the necessary monitoring to that already in existence;
6. Prepare an implementation plan, including funding estimates, for putting a monitoring network in place in the Gulf to address GOMA priorities;
7. Implement.

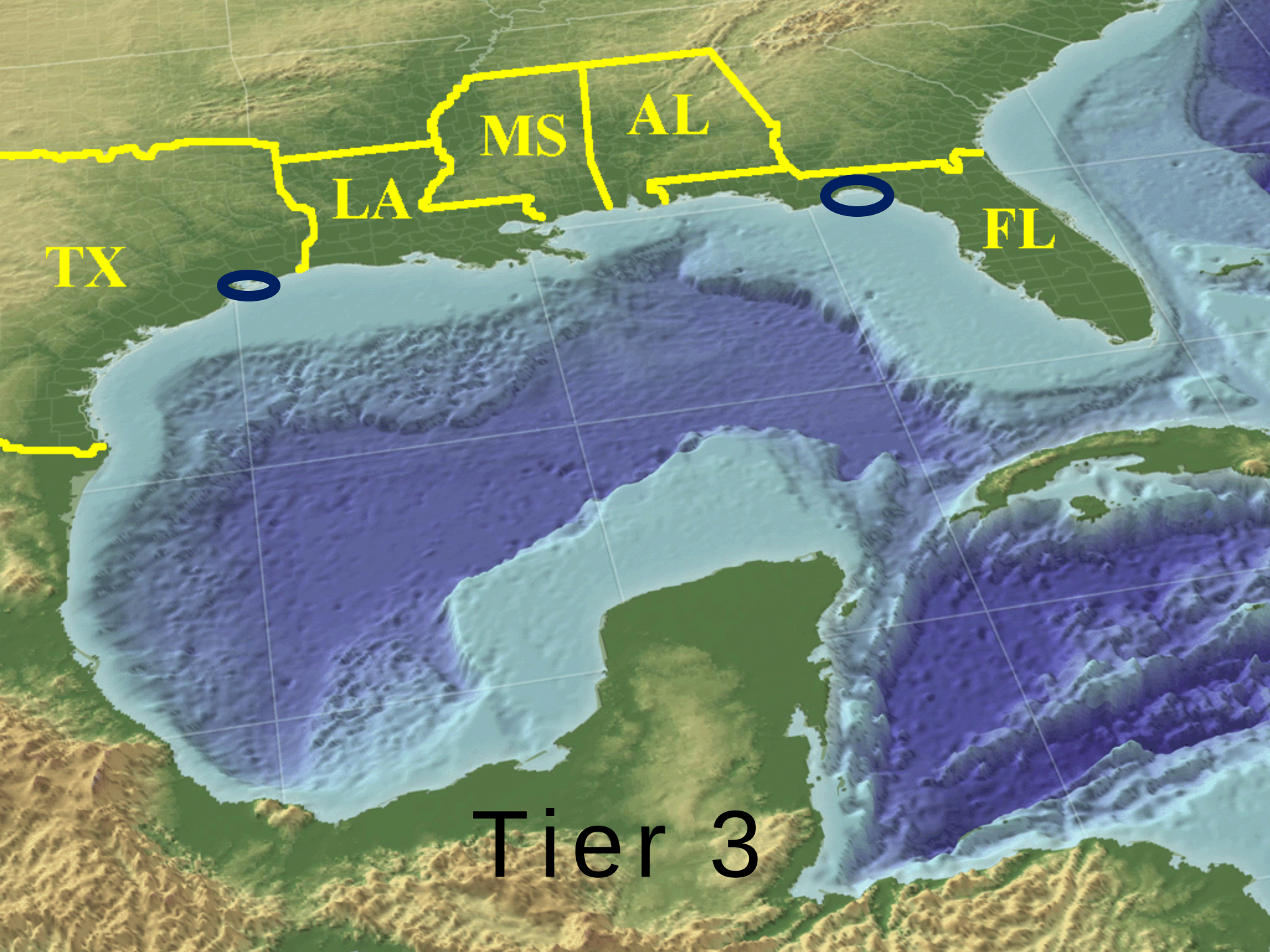
- *The process has been expedited by potential funding for portions of the GMN from RESTORE Act penalties.*

GOMA Monitoring Framework

- Monitoring to address questions requiring **Gulf-wide** monitoring.
- Monitoring to address questions requiring **regional** monitoring
- Monitoring to address questions requiring monitoring at the scale of an **estuary or similar-sized coastal segment.**
- Monitoring to address questions about **site-specific** problems (*not in scope of GOMA*)


MS
AL
LA
FL
TX
Tier 1


MS
AL
LA
TX
FL
Tier 2


MS
AL
LA
TX
FL
Tier 3

GOMA water quality monitoring priorities:

1. Nutrients.
2. The GOMA human health priorities (of equal rank): Harmful algal blooms (HABS), pathogens, and mercury in seafood.

Note: many other monitoring needs exist, and GMN is intended to accommodate those systems plus provide underlying structure on which they can be based.

GMN design approach

1. Design monitoring system to address priority *nutrients* questions at each scale.
2. Modify these designs to accommodate GOMA human health priorities: HABS, pathogens, and mercury.

Also, accommodate monitoring designs from HTF for Gulf Hypoxic Zone and HABIOS design for HABs into GMN.

Priority Nutrient-Monitoring Questions

- Priority questions that can be addressed by WQ monitoring were generated by GOMA Nutrient Team in collaboration with Gulf Hypoxia Task Force (HTF) and Gulf Coast Ecosystem Restoration Task Force (GCERTF).
- Includes added input from WQ Team's HABs Workgroup (in blue)

Gulf-wide scale

(In order of priority)

- Which biological/chemical/physical indicators are most susceptible to nutrient enrichment in the Gulf of Mexico?
- What is the spatial and temporal variation and trends in nutrient concentrations within the Gulf of Mexico?
- How do circulation patterns in the Gulf of Mexico affect nutrient concentrations?

Regional scale
(In order of priority)

- What is the spatial and temporal variation and trends of nutrient loadings and concentrations within the region?
- Which biological/chemical/physical indicators are most susceptible to nutrient enrichment within the region?
- What is the long term trend in biological/chemical/ physical responses to nutrients in the region?
- What is the relationship between nutrient loadings and the development of hypoxic zones within the region?

- continued-

Regional scale
(In order of priority)
concluded

- What are the trends in the size, frequency, and duration of hypoxic water within the region?
- Are nutrients contributing to harmful algal blooms (HABs) within the region?
  - Need to develop monitoring system that includes measurements of nutrient fluxes (upwelling, runoff, groundwater, recycled nutrients) to determine role of nutrient sources in promoting bloom formation, sustenance, and expansion.

Estuary or Coastal-Segment scale - High Priority

- What is the spatial and temporal variation in nutrient (carbon, nitrogen, phosphorus, silicate) concentrations in the estuary or coastal segment?
  - For HABs physiology, it is essential to collect data on the nutrient species (i.e., NO_2, NO_3, NH_4, PO_4, SIO_2, urea, etc.).
  - Need to include micro-nutrients (vitamins, minerals, CDOM, etc.)
  - Need to include measurements of nutrient flux and extend from freshwater through brackish regions.

Estuary or Coastal-Segment scale - High Priority

- What is the long term trend in nutrient loading to the estuary or coastal segment?
- Which biological/chemical/physical indicators are most susceptible to nutrient enrichment in the estuary or coastal segment?
- What is the long term trend in nutrient export from the estuary or coastal segment?
  - Retention is an important factor for HABs.

Estuary or Coastal-Segment scale – Medium Priority

- Are nutrients contributing to harmful algal blooms (HABs) within the estuary or coastal segment?
  - Since nutrients are linked to phytoplankton dynamics, it may be more important to look at anthropogenic loading or watershed loading.
- What is the temporal variation in nutrient loading to the estuary or coastal segment?
  - HABs respond to nutrient fluxes rapidly, and therefore require near-real time sampling frequencies.
- What is the long term trend in biological or chemical responses to nutrients in the estuary or coastal segment?

Estuary or Coastal-Segment scale – Low Priority

- Is groundwater a significant source of nutrients to the estuary or coastal segment?
- Which nutrient(s) is limiting the biological/chemical/physical response within the estuary or coastal segment?

Nutrient Monitoring Design Workshop: participant affiliation

- State agencies = 11
- Federal agency = 8
- Mexico = 1
- Academic researchers = 4
- NGO researchers = 3
- Total = 27

Workshop participants Expertise

- Monitoring
- Hydrodynamics/modeling
- Nutrients source, fate, transport
- Ecosystems

Monitoring strategy
All locations, all scales

- Construct hydrodynamic/WQ models
- Use satellite remote sensing to validate model hydrodynamics and interpolate between physical sampling locations
- Use fixed stations with continuous monitoring at key points to calibrate and validate models
- Collect information between continuous monitoring stations to understand nutrient processing, detect changes in processing, and further calibrate and validate models.
- Design minimum monitoring system needed to address priority questions.

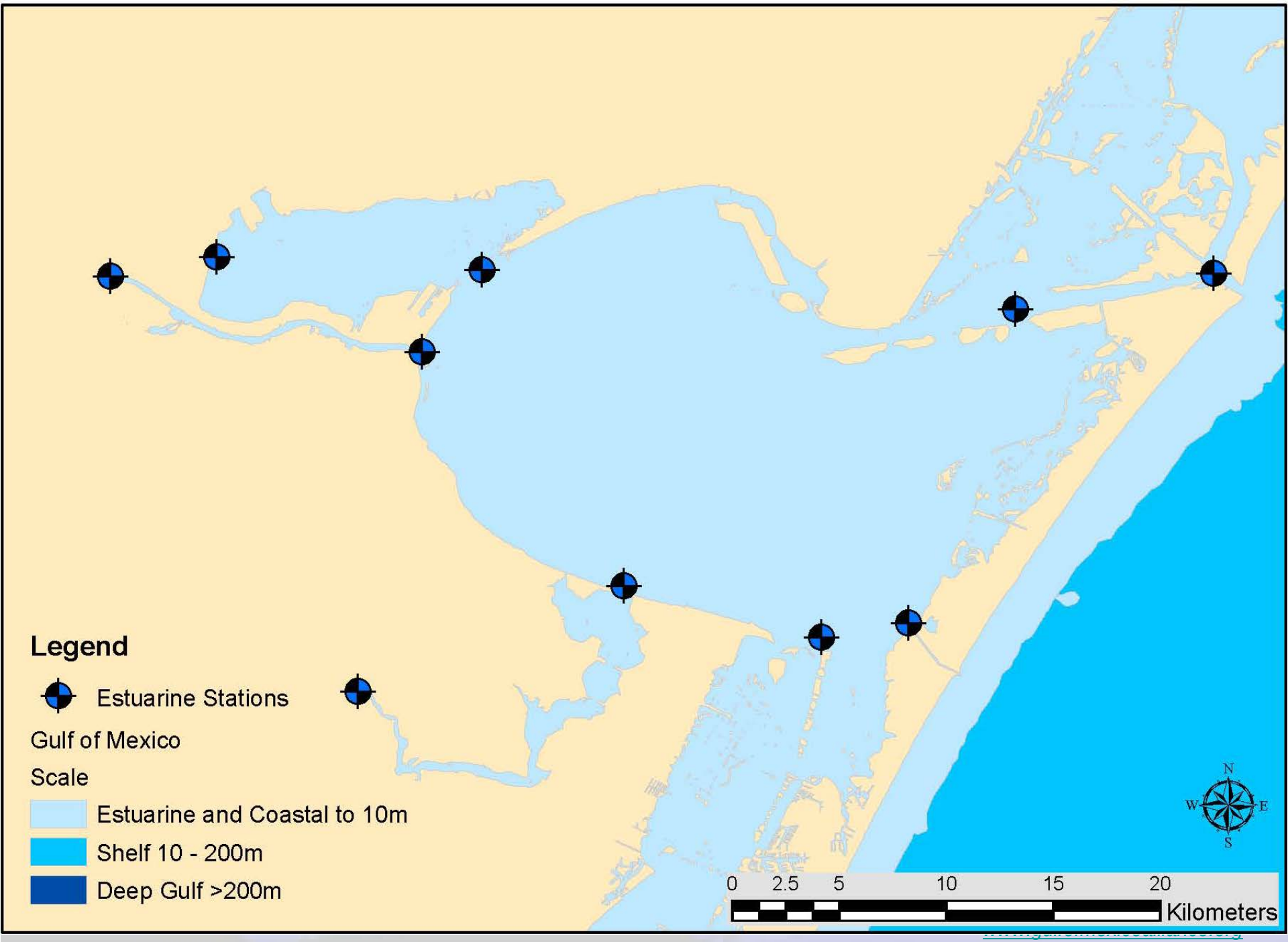
Application of strategy

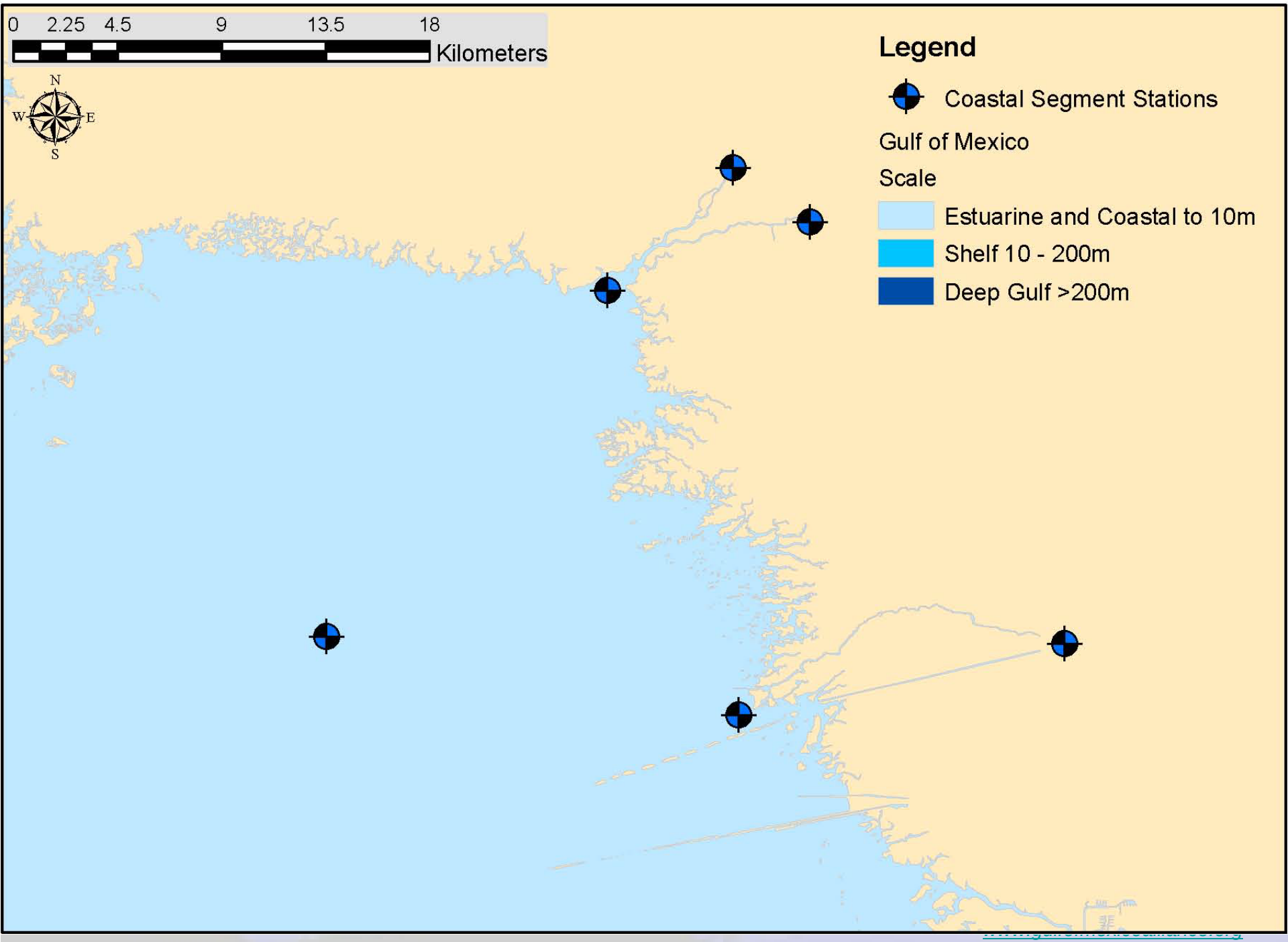
- Designs in estuaries and “similar-size coastal segments” should be developed locally, incorporating design templates to ensure consistent design elements across Gulf.

Application of strategy

The essential design concept at all scales is for the monitoring system to accomplish two goals:

1. to estimate nutrient fluxes between different key parts of the Gulf system, and
2. to support understanding of the nutrient processes occurring between flux points to understand the relationship between nutrient fluxes and endpoints of concern.


Legend
Estuarine Stations
Gulf of Mexico
Scale
Estuarine and Coastal to 10m
Shelf 10 - 200m
Deep Gulf >200m
N
W
E
S
0 2.5 5 10 15 20
Kilometers


0 2.25 4.5 9 13.5 18
Kilometers
N
W
E
S
Legend
Coastal Segment Stations
Gulf of Mexico
Scale
Estuarine and Coastal to 10m
Shelf 10 - 200m
Deep Gulf >200m

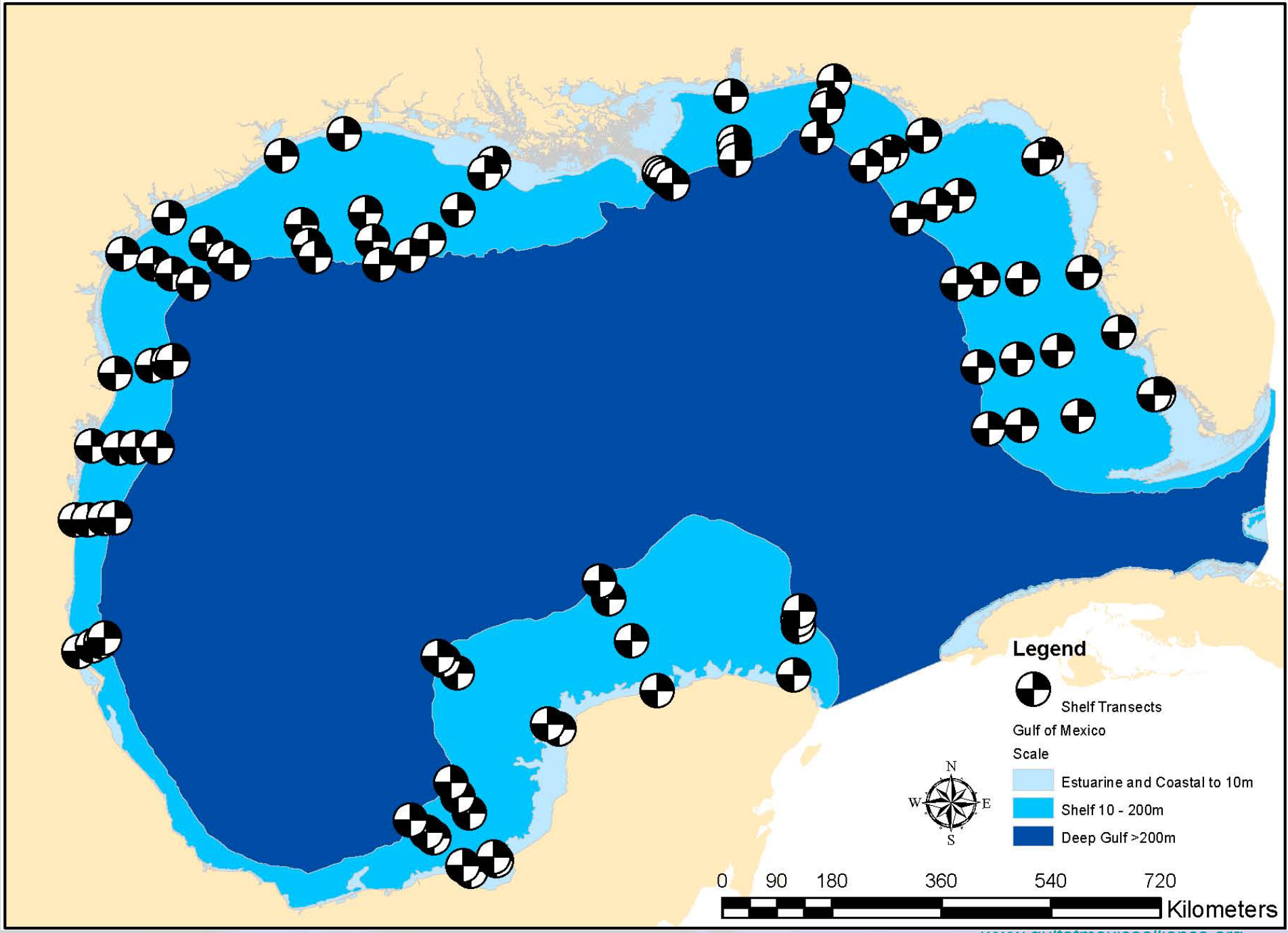
Application of strategy

- Because the systems act much differently, separate monitoring designs for continental shelf and deep Gulf waters are required. These combine to provide boundary nutrient information to estuary and coastal segment models.

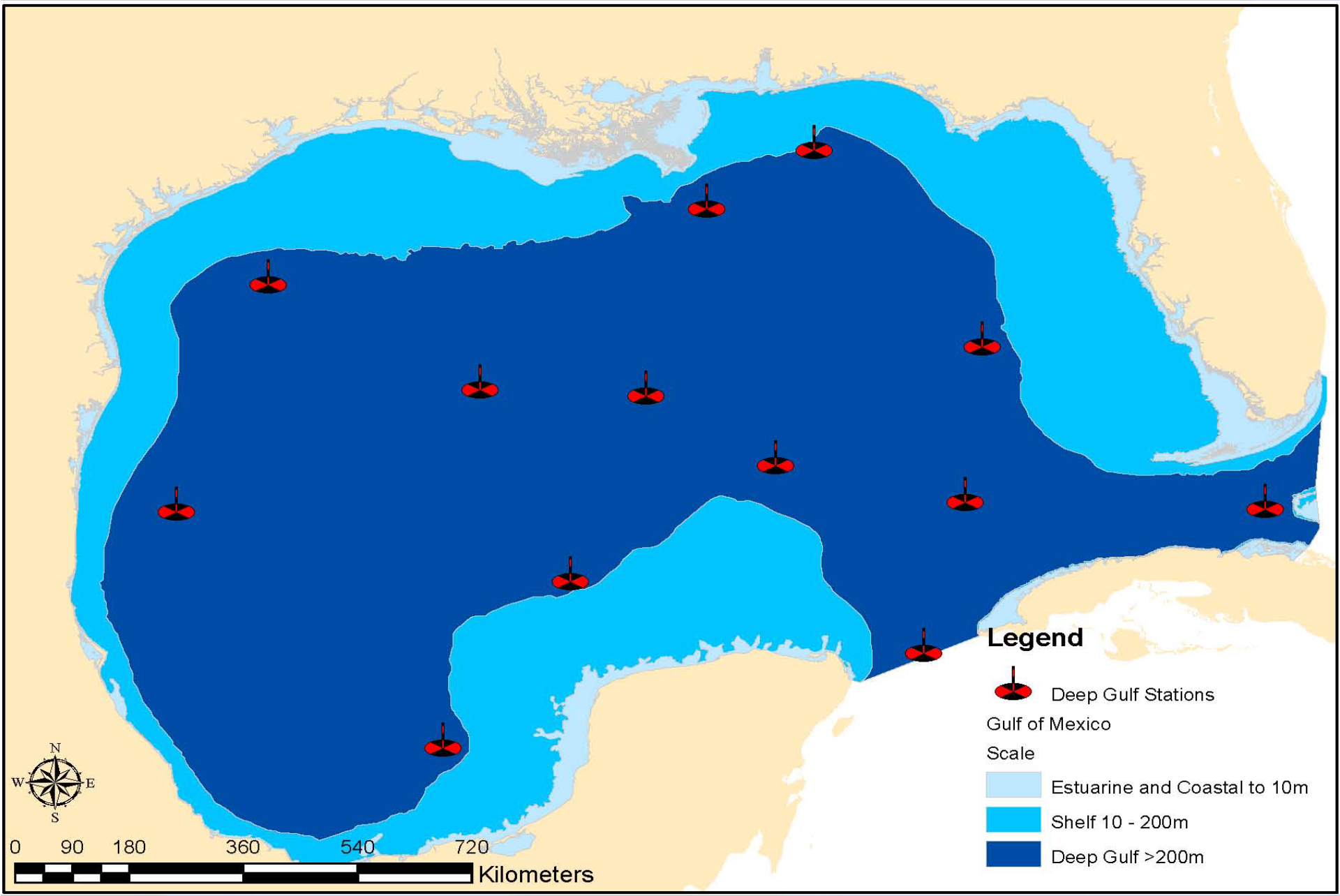
Application of strategy

The essential design concept at all scales is for the monitoring system to accomplish two goals:

1. to estimate nutrient fluxes between different key parts of the Gulf system, and
2. to support understanding of the nutrient processes occurring between flux points to understand the relationship between nutrient fluxes and endpoints of concern.



www.gulfofmexicoalliance.org



www.gulfofmexicoalliance.org

- Workshop to add human health monitoring to nutrients design planned for February 2013.
- Continue to build coalition of Gulf monitoring programs.
- Present plan seeking funding to establish Gulf monitoring trust fund to RESTORE funding pathways. Proceeds from trust fund to provide permanent support for long-term Gulf monitoring.

Questions?