



Synthesis and Integrated Modeling of Long-term Data Sets to Support Fisheries and Hypoxia Management in the Northern Gulf of Mexico

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Approach

- Historical data synthesis
 - Over 3 decades of available data
 - Multiple collecting agencies
- Data-driven, probabilistic modeling
 - Geostatistical space-time modeling of hypoxia.
 - Bayesian hypoxia model (simple mechanistic).
 - Spatial regression modeling of fisheries data
 - Time series analysis of ecological indicators
- Less emphasis on mechanistic detail

Goals

- New metrics to characterize the year-to-year and intraseasonal variability in hypoxia.
- Evaluation of hypoxia effects on regional fisheries (penaeid shrimp, menhaden) and ecological indicators.
- Improved predictive capabilities and tools for hypoxia and fisheries management.
- Better integration of hypoxia information into fisheries stock assessments and ecosystem analyses.

Outline

1. Hypoxia modeling.
2. Fisheries and ecological indicators.
3. Outreach and application.

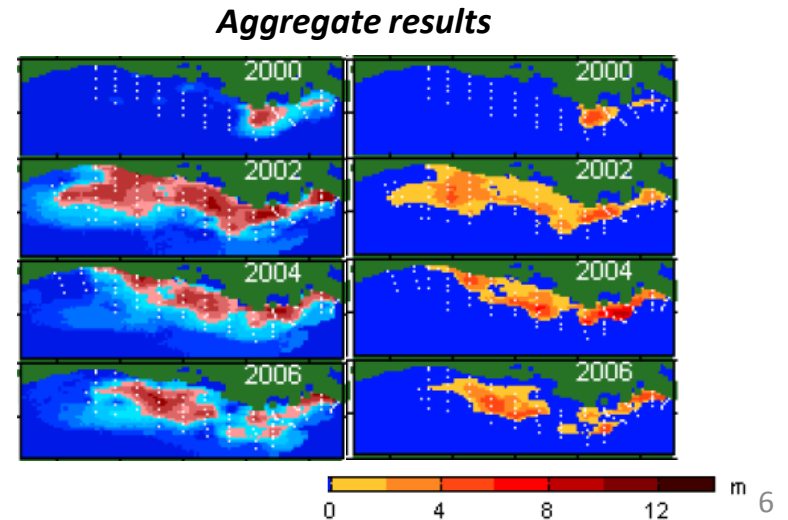
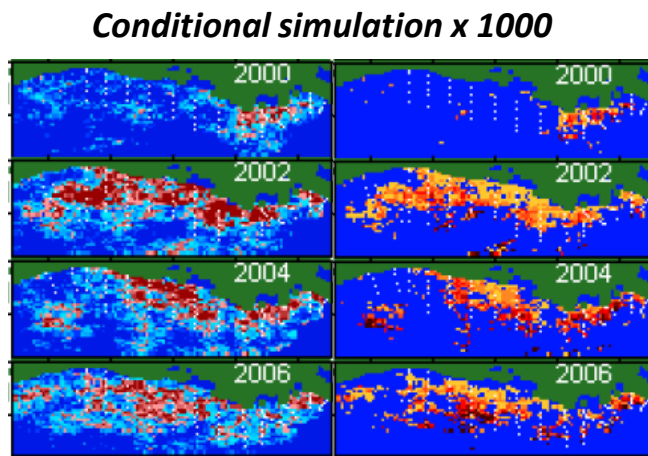
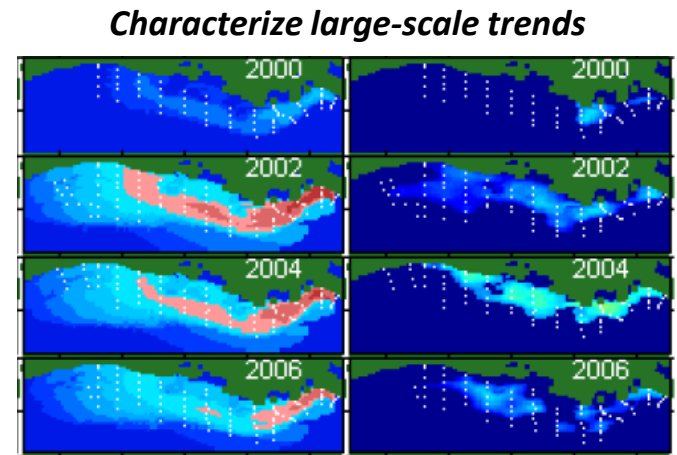
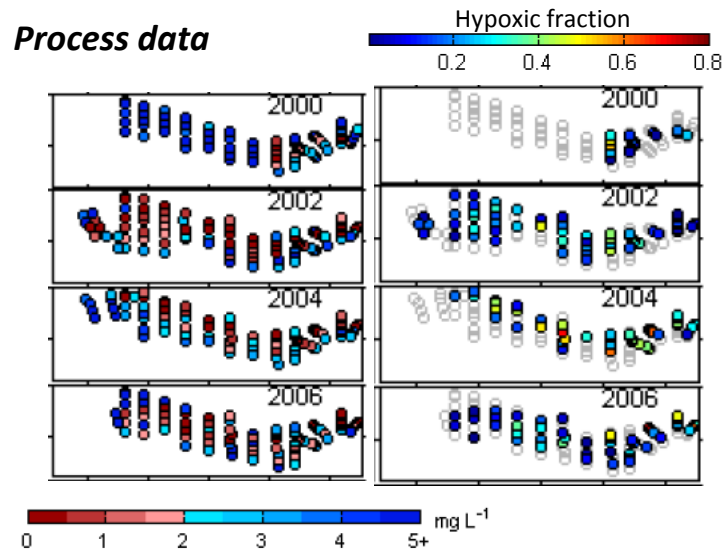
Geostatistical hypoxia modeling

- Background
 - In 2013, we provided revised mid-summer hypoxia estimates:

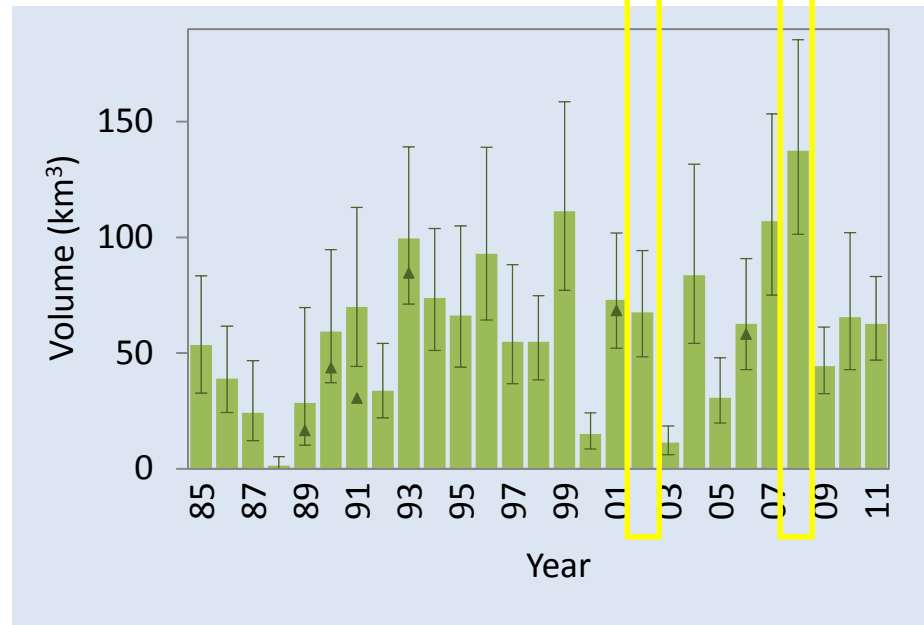
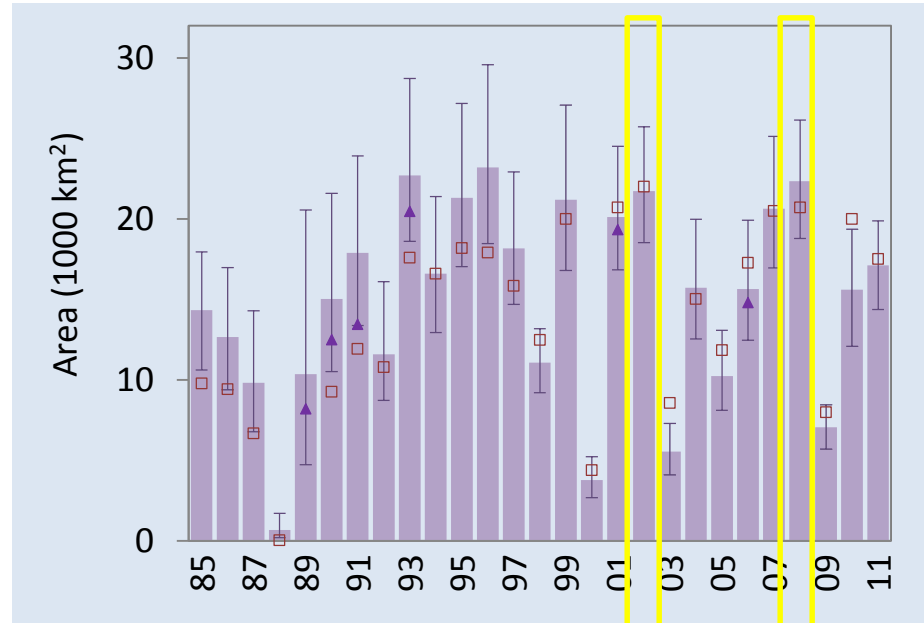
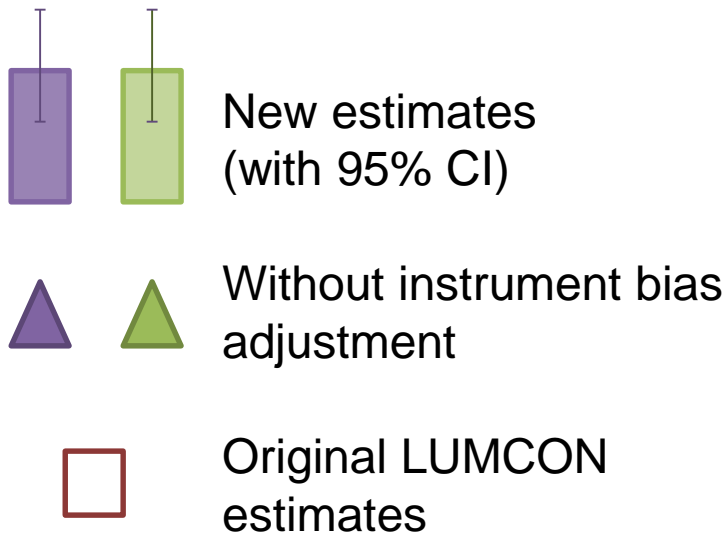


- Address biases due to cruise size
- Address biases due to sampling equipment
- Quantify uncertainty
- Estimate thickness and volume (in addition to area)

Geostatistical hypoxia modeling



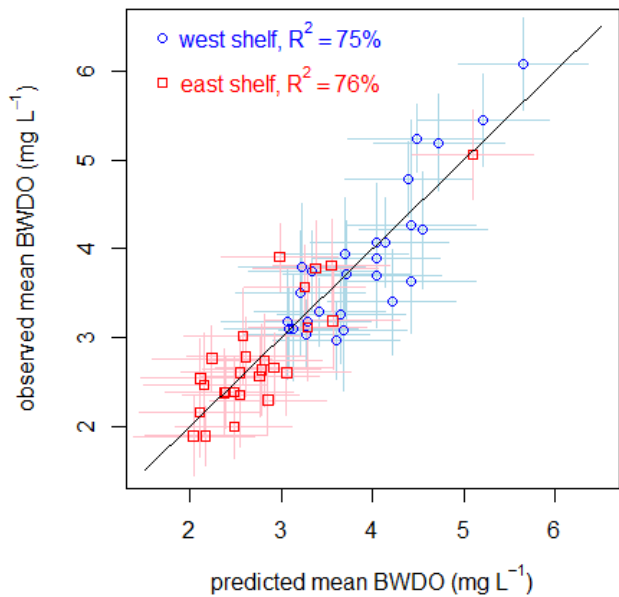
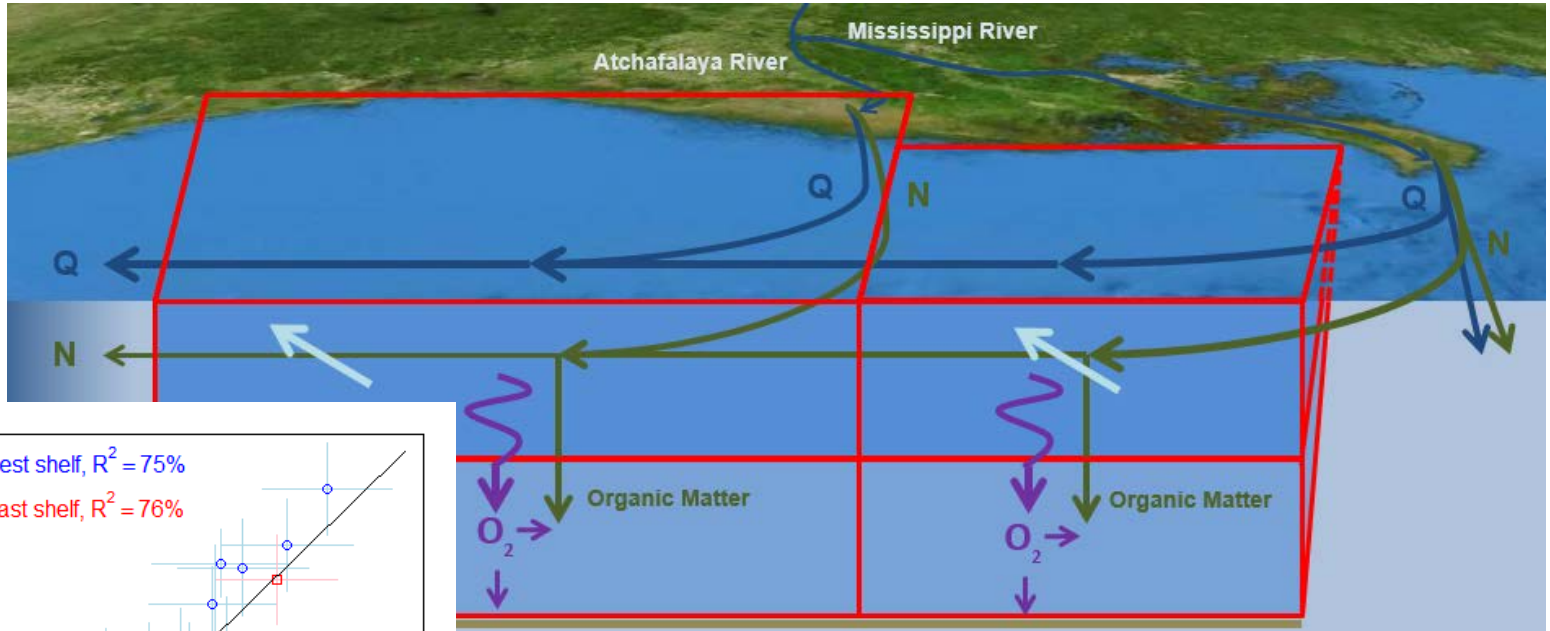
Hypoxic Extents 1985-2011



Geostatistical hypoxia modeling

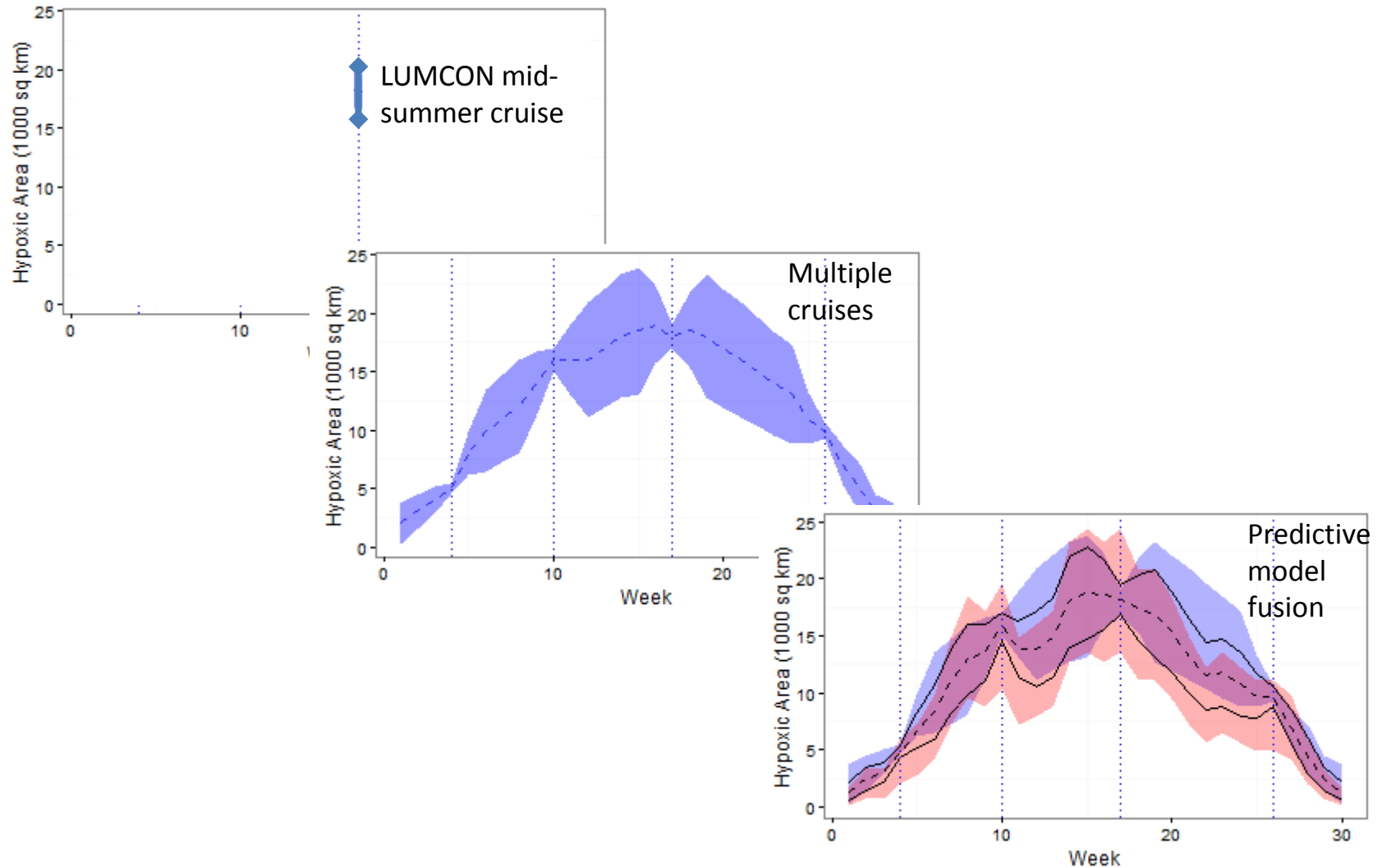
- Limitations
 - Existing work only provides mid-summer (LUMCON cruise) hypoxia estimates.
- Future work:
 - Space-time geostatistical modeling, incorporating additional cruises by NOAA, TAMU, LUMCON, etc.
 - Use forecasting model output to further address temporal gaps.
 - Develop metrics to characterize severity of hypoxia over entire summer.

Predictive modeling



No outlier years

Expanding temporal coverage



Updated hypoxia metrics

- Different thresholds: 1, 2, 3 mg/L
- Duration of hypoxia
- Area and volume
- Temporally specific
 - June, July, August, etc.
- Spatially specific
 - East shelf, west shelf
 - Near shore, outer shelf

Geospatial Regression Models of Commercial Fisheries

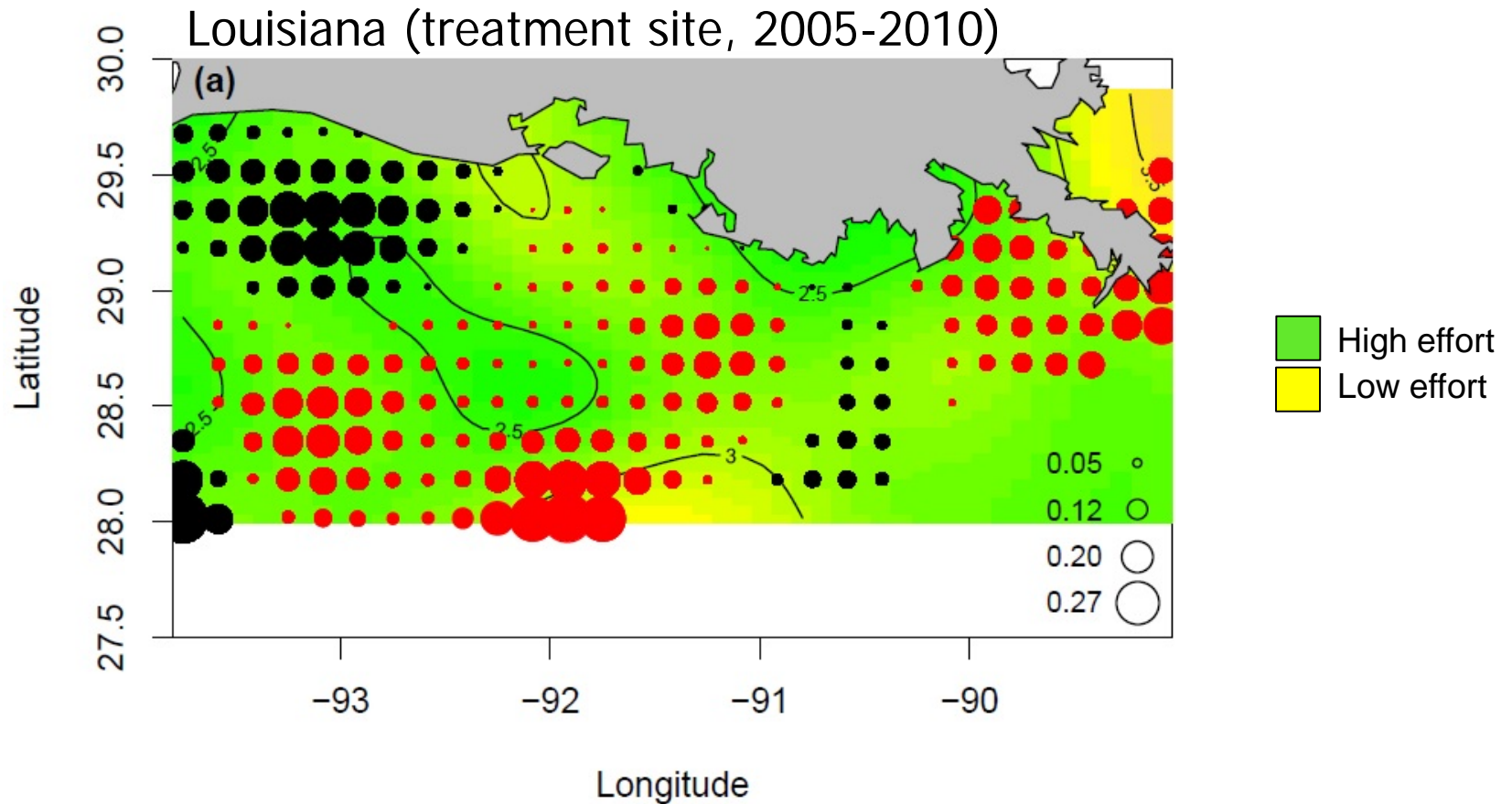
Approach:

- Relate spatially and temporally dynamic fishery responses (catch, effort) to spatially varying environmental conditions
- Account for nonlinearities and correlated effects
- Map the hypoxia effect in space (provide spatially explicit information on fishery response to process-based model)

Source of spatial data on fisheries:

- Electronic logbook data of individual shrimp tows (2005-present)
- Penaeid shrimp logbook data (1960-present)
- Menhaden logbook data (1983-present)

Example: Hypoxia Effects on Spatial Distn of Shrimp Fishery



○ Slope of Effort: DO relationship

Black: When avg DO is low, effort increases

Red: When avg DO is low, effort decreases

Ecological Indicators of Upper Trophic Level Fish Community

Ecological Indicators

- Biodiversity
- Community abundance and biomass
- Pelagic:demersal ratio
- Average size of demersal fishes

Data

- SEAMAP bi-annual bottom trawl surveys
- Initial predictors: hypoxia severity, fishing pressure
- Potential additional predictors: wetland loss, river flow/nutrient loading

Approach

- Change point analysis: nonlinear time series approach to identify trends and critical thresholds

Outreach Elements

- Annual webinar workshops and meetings at scientific conferences/workshops
- Research blog (beginning in year 2)
- Coordination with fisheries management/stakeholders

Specific Applications

- Incorporate results into NMFS stock assessment process:
 - Presentations at Data Workshops and for Gulf Fisheries Mgmt Council
 - Langseth et al. (2016) Initial management strategy evaluation incorporating hypoxia effects on Gulf menhaden
- Incorporate results into Gulf Integrated Ecosystem Assessment:
 - Future updates of the Gulf Ecosystem Status Report (currently due in mid 2017)
- Mississippi River/ Gulf of Mexico Hypoxia Task Force:
 - Hypoxia forecasting and extent assessment
 - Evaluation of different monitoring approaches
- Intra-seasonal hypoxia forecasts:
 - Provide to NMFS (e.g., shrimp forecast), sport and commercial fisheries

Questions?

