

Applications of the Atlantis Model in the Gulf of Mexico

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The logo for the University of South Florida (USF), featuring the letters "USF" in a gold serif font on a dark green rectangular background.

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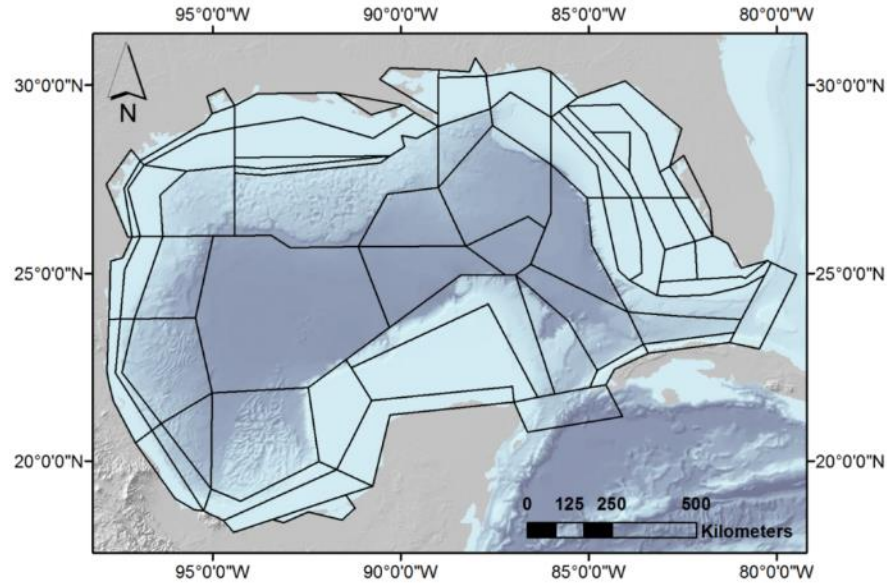
April 29, 2014. NOAA Southeast Regional Office Brownbag

Overview

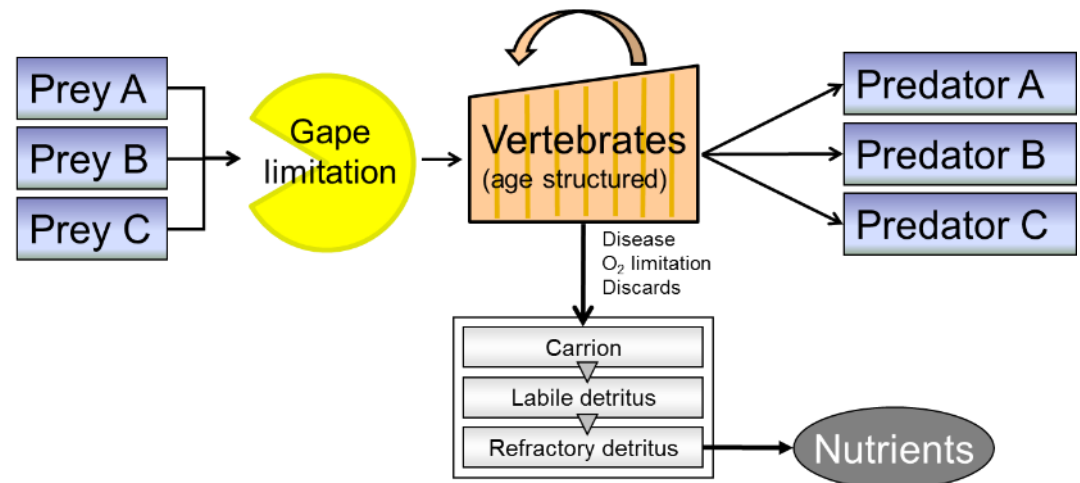
- Atlantis model
- GOM implementation
 - Diet
 - Biomass
 - Other data
- Application 1: DWHOS
- Application 2: IEA
- Application 3: Hypoxia

Atlantis

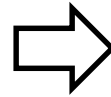
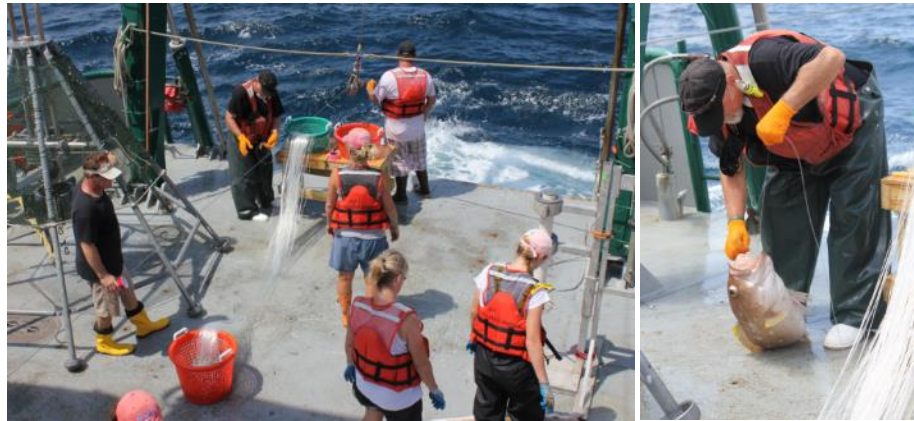
- Bacteria to apex predators (“end-to-end”)
- Irregular polygons
- Fully age structured
- Larval transport
- Space limitation
- Biogenic & physical habitat
- Nutrient and waste cycling
- Detailed fisheries accounting



GOM polygons



Food web analysis



Gut content analysis

C-IMAGE longline surveys

- 136 stomachs analyzed in lab
- 19 under-sampled species (bycatch/deep)

Other data

235 spp.



FishBase

15 spp.



SeaLifeBase

905 spp.

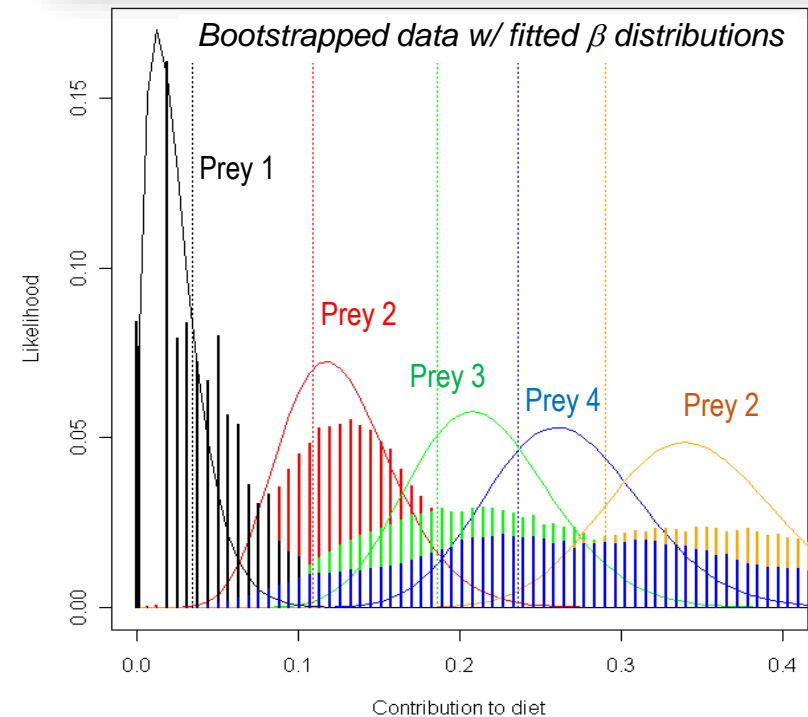
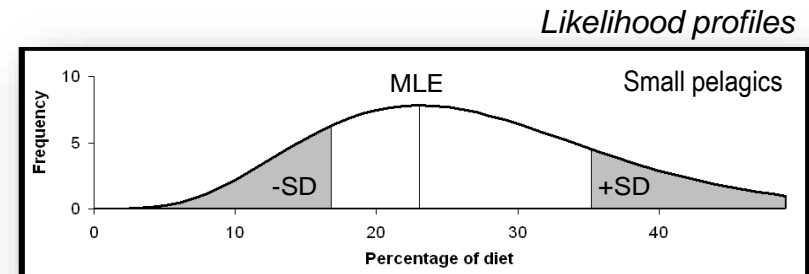
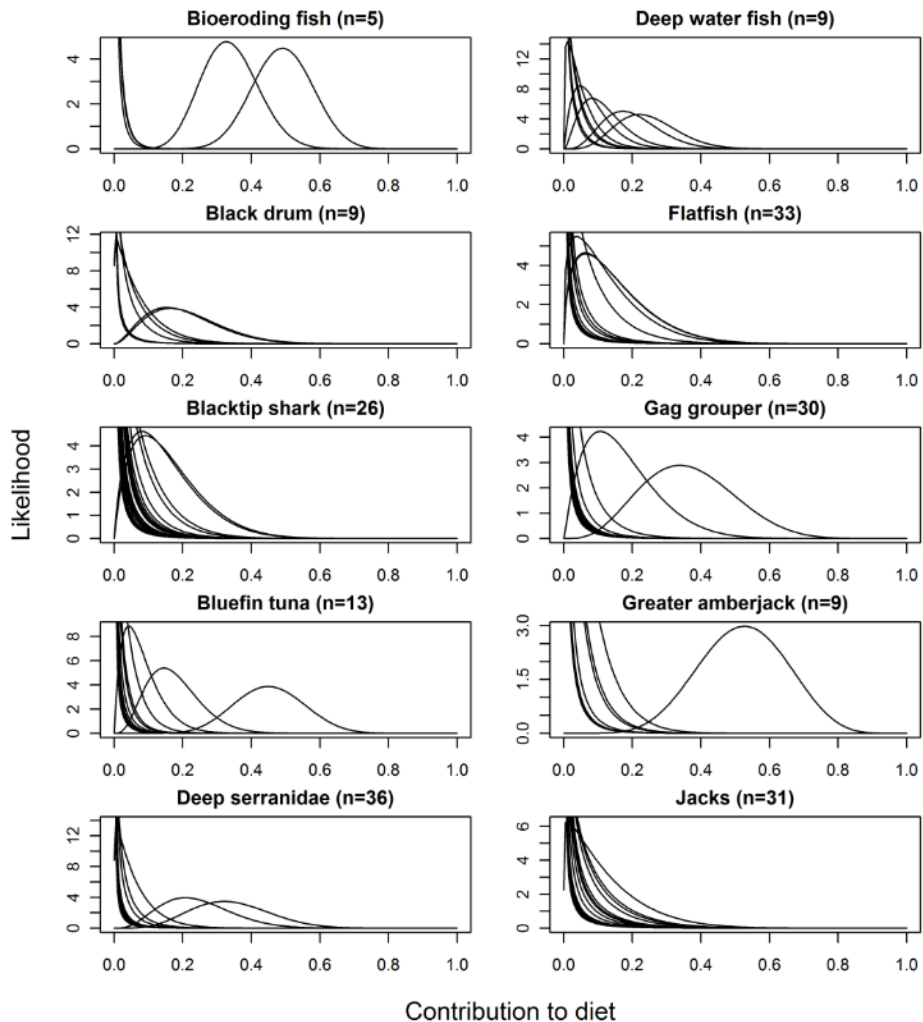


FWRI Diet database
(B. McMichaels)

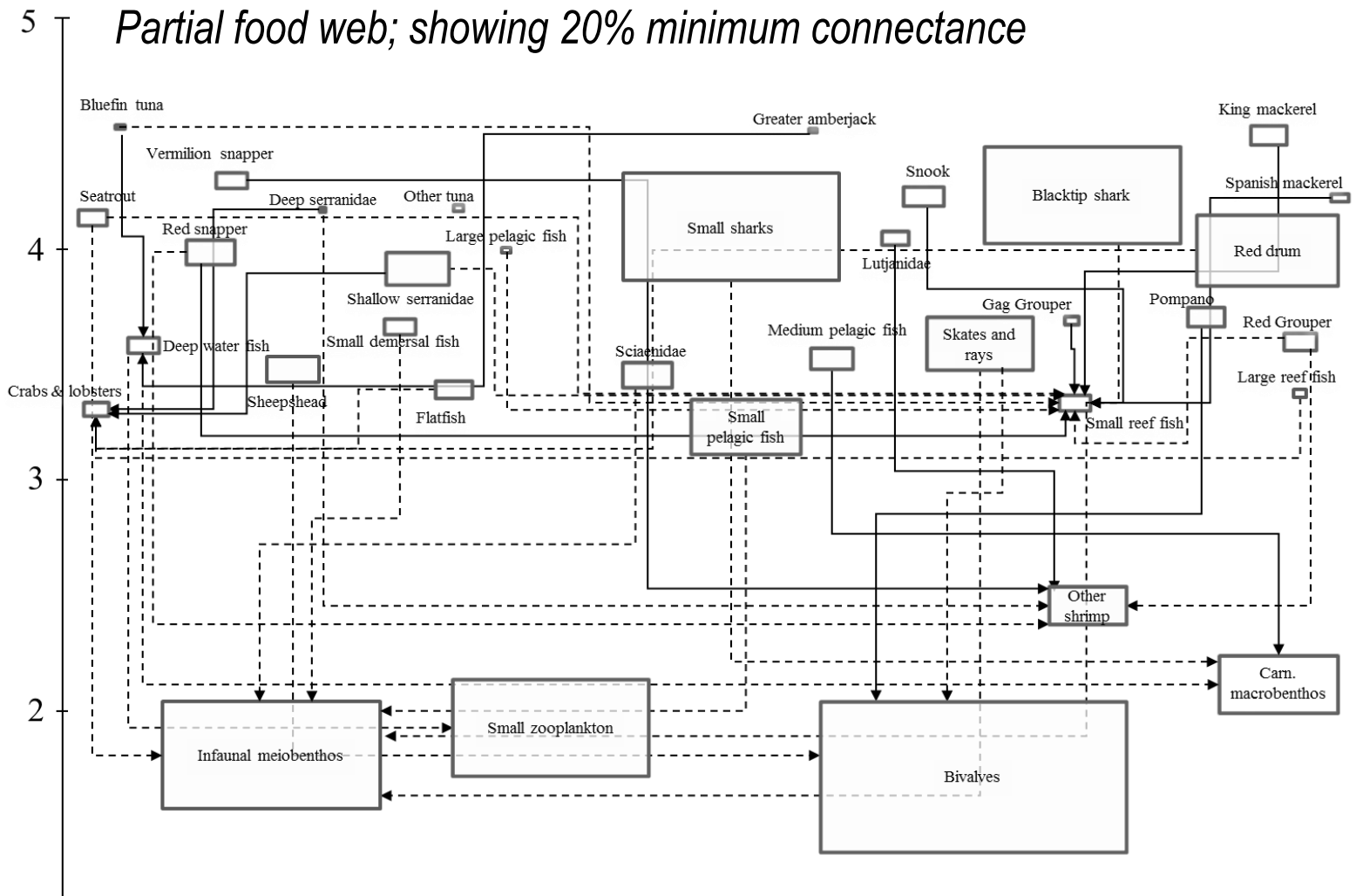


Morphometrics for gape-limited feeding

Methodological paper 1: Diet



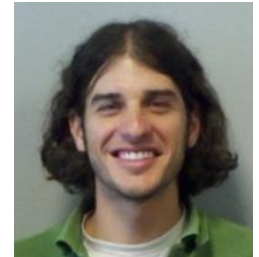
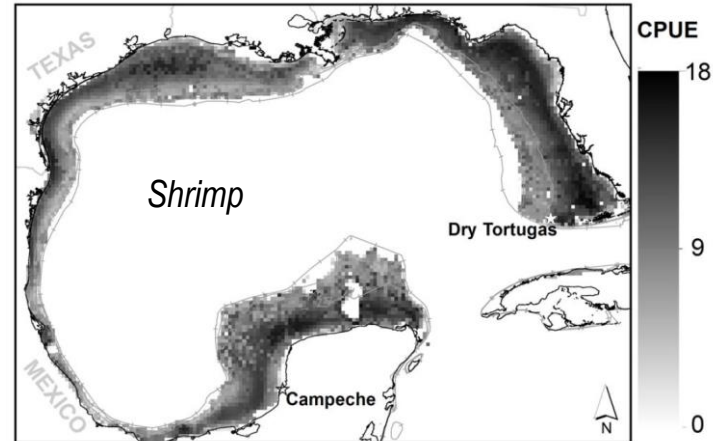
Gulf of Mexico food web



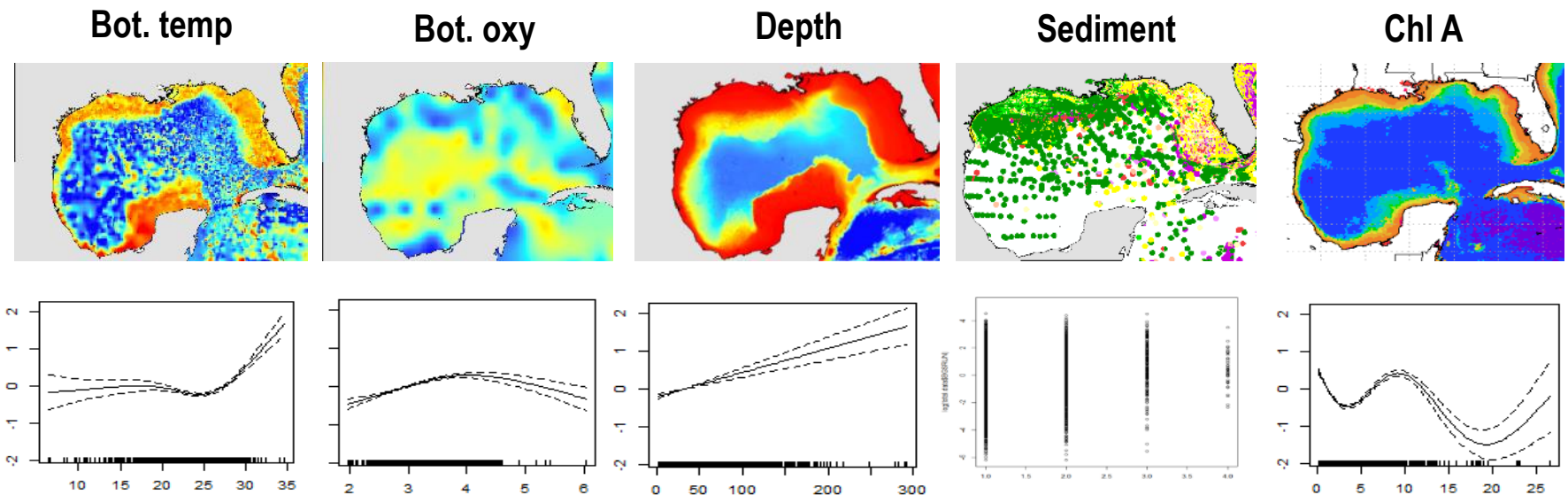
Michelle Masi, USF

Methodological paper 2: Biomass

- GAM predicts relative biomass distribution based on environmental predictors
- 2/3 data for model training, 1/3 for validation
- Neg. binomial w/ log link
- 1/12th degree resolution



Mike Drexler, USF



Methodological paper 3: Larval dispersal

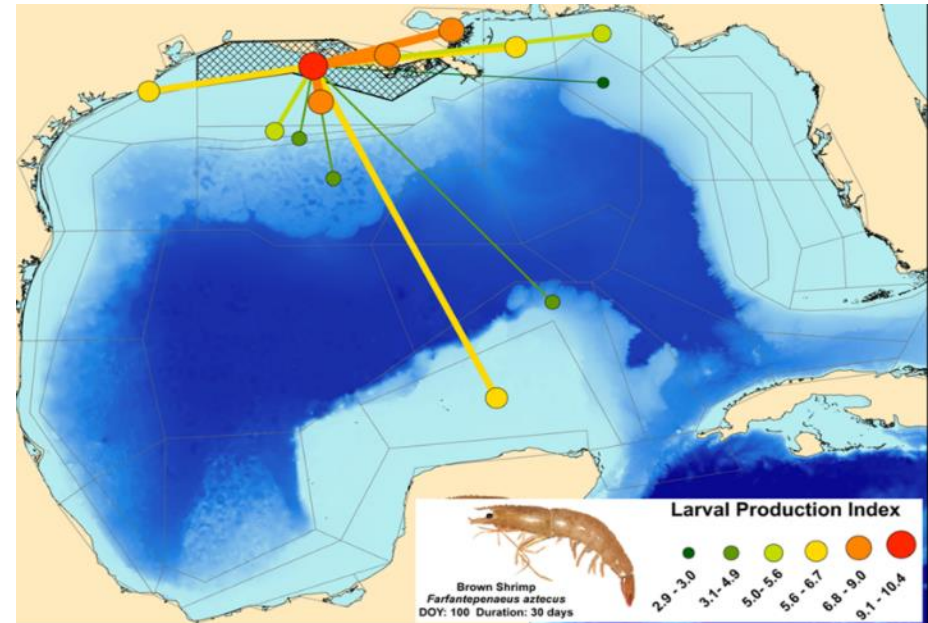
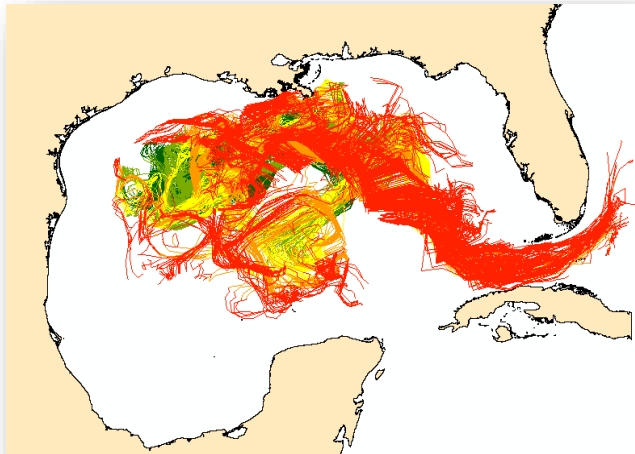
- Lagrangian passive drift model of larval transport
- Individual based model
- Driven by GoM HYCOM NCODA (Chassignet et al. 2007)
- Egg density calculated based on spawner biomass (from generalized additive model, Drexler and Ainsworth 2011)
- Source/destination matrix imported to Atlantis
- **Provides connectivity** for 46 spp.



Mike Drexler, USF

Provides connectivity

Red grouper larvae



Application 1: Oil impacts

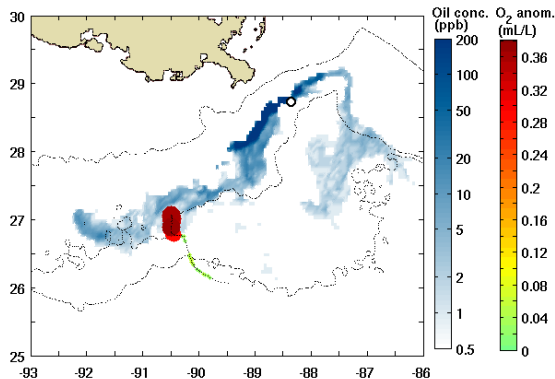


Lindsey Dornberger, USF

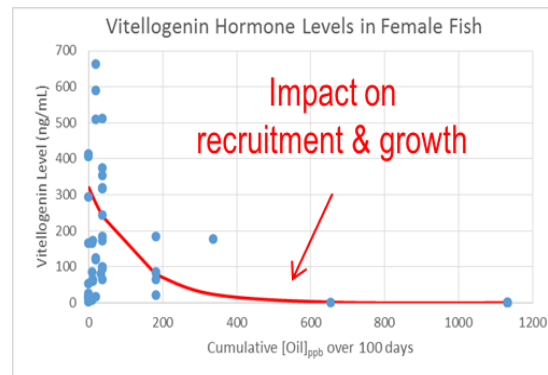
Oil impacts module for Atlantis

- Developed Nov 2013 for C-IMAGE
- Allows spatial forcing function for mortality, growth and recruitment
- Useful for oil, HABs and other spatial stressors

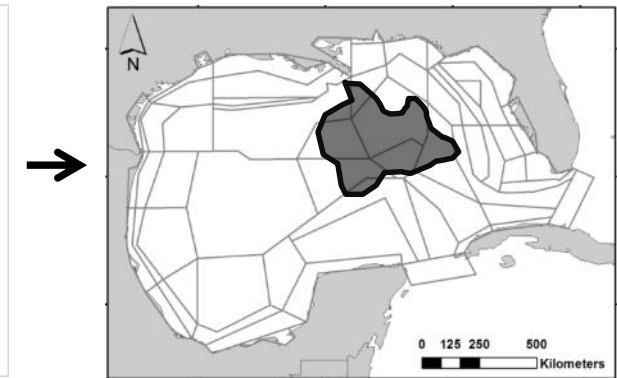
Oil concentrations from far field modeling (Clair Paris, UM)



Functional response from toxicology studies



Spatial impacts in Atlantis

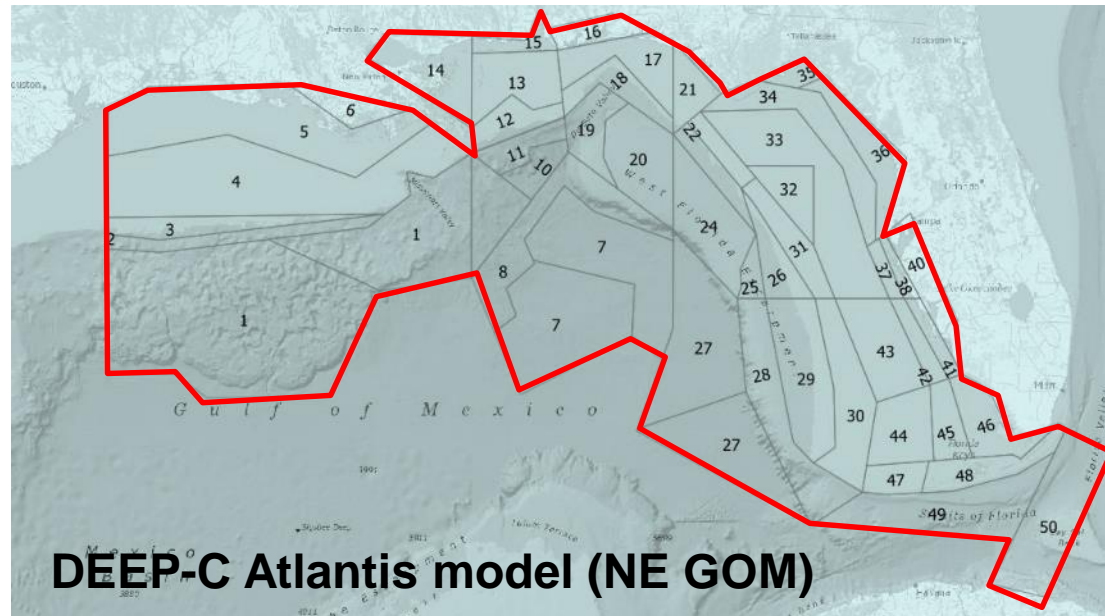
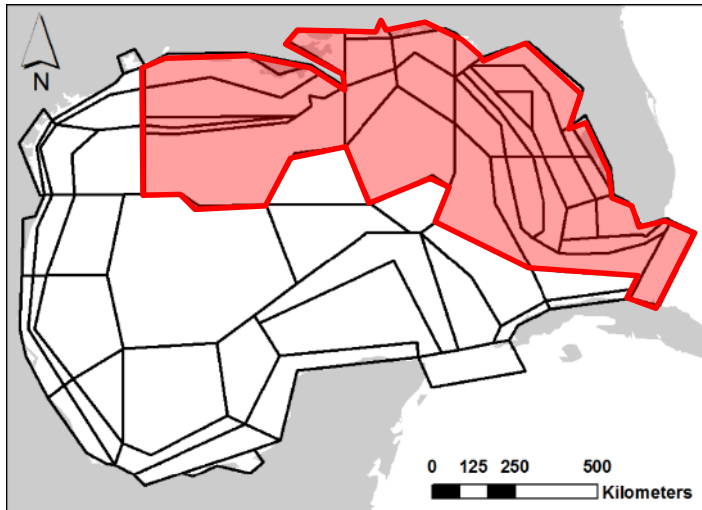


CIMAGE Renewal

- Campeche Bay model for IXTOC comparison
- MOSSFA (marine snow) for DWHOS – includes hypoxia

NE Gulf Atlantis model

C-IMAGE / IEA



DEEP-C Atlantis model (NE GOM)



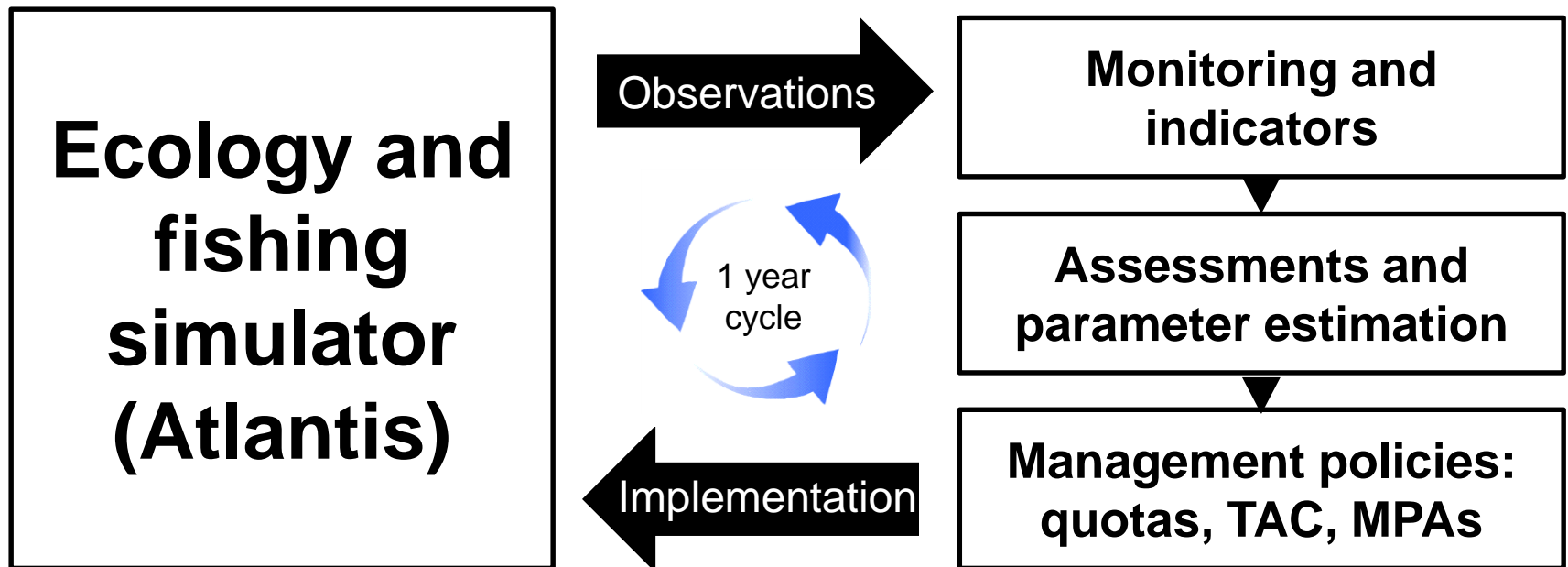
Felicia Coleman
Stephen Gosnell

- Deep-C is funding Lindsey Dornberger to act as a liaison with CIMAGE
- Same oil forcing functions will be used in both models
- Similar data and structure
- Eventually, we may be able to feed boundary conditions into Deep-C model
- Focus: Mercury bioaccumulation

Application 2: IEA

Role of Atlantis in Integrated Ecosystem Assessment

- Evaluation of indicators
- Management Strategy Evaluation (MSE)



- Ongoing Sea Grant project testing harvest control rules in the GOM under climate change

Application 3: Hypoxia

Relevant processes explicitly modeled in Atlantis

- Point-source terrigenous nutrient loading (e.g., Mississippi R.)
- Bottom-up trophic dynamics (e.g., plankton blooms)
- Bacterial growth and respiration
- DO depletion in water column and sediment
- Oxygen requirements by species
- Hydrodynamics from ROMS limited to short time series

Outputs

- Ecological indicators
(biomass, numbers, age structure biodiversity, species ratios, condition factor)
- Biophysical indicators (DO, DON, Chl A)
- Fisheries economics
- Seasonal/daily outputs available



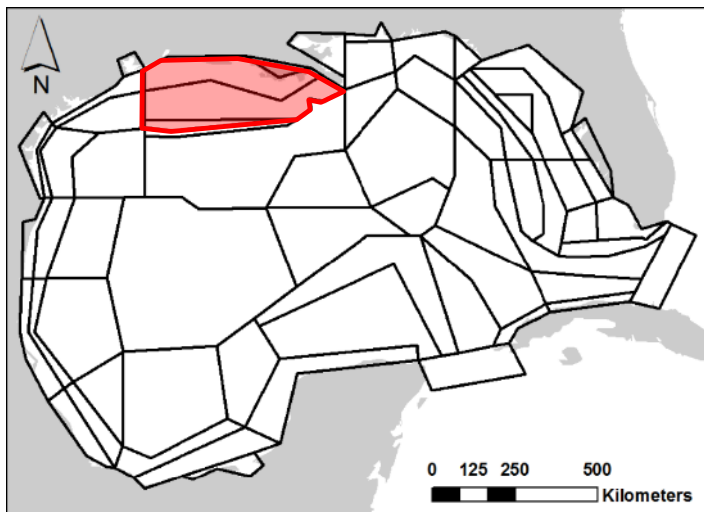
dec.ny.gov



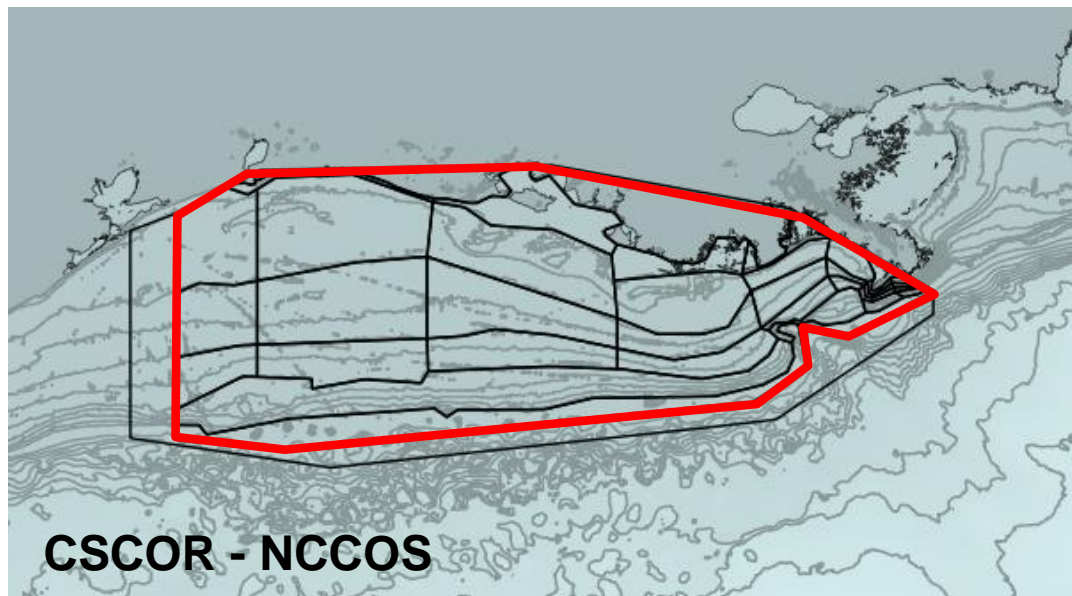
Nat geo

A nested suite of models

C-IMAGE / IEA



Doran Mason
Andrea Vander Woude



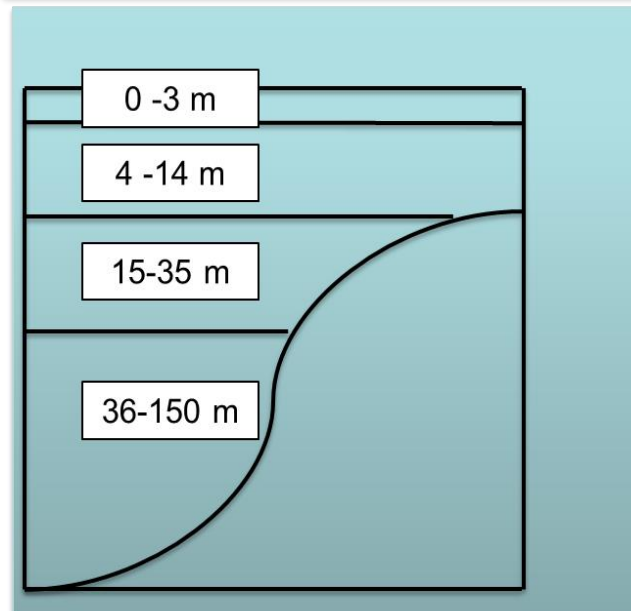
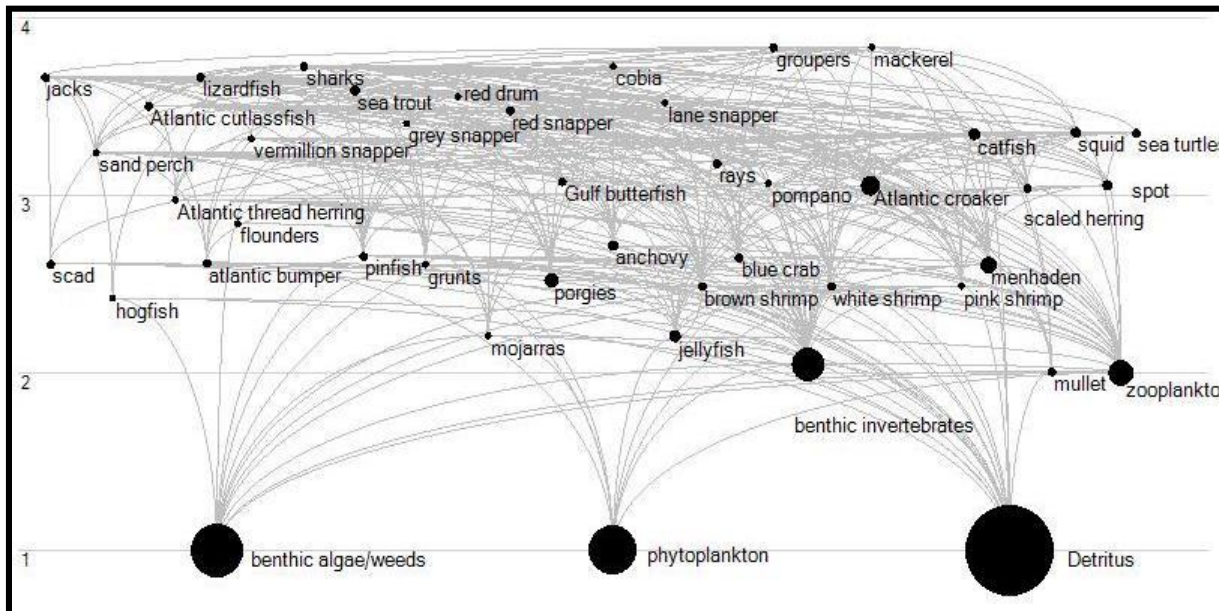
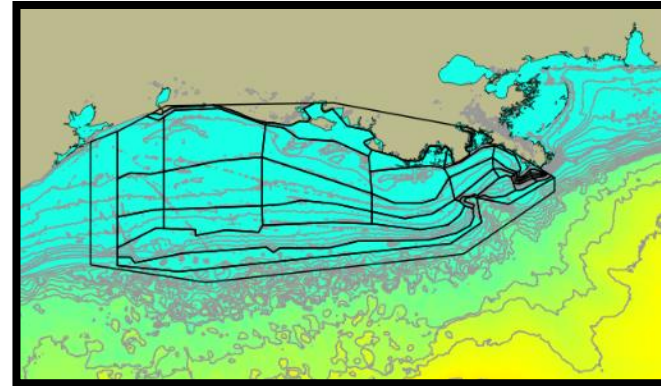
CSCOR - NCCOS

- Doran Mason (GLERL) and post-doc Andrea Van Der Woude developing a TX-MS-LA shelf model to look at hypoxia effects (Dead zone)
- Center for Sponsored Coastal Ocean Research (NCCOS) sponsored research for reducing size of the hypoxic zone by the Gulf of Mexico/Mississippi River Watershed Nutrient Task Force.

NCCOS Model status

Model specs

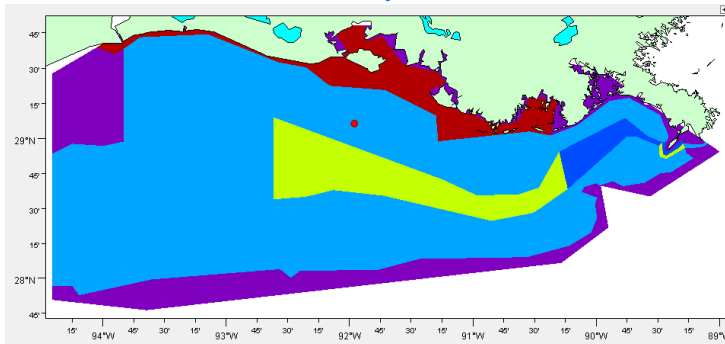
- 4 water column depth layers plus sediment
- ~30 polygons
- 45 functional groups
- Diet, biomass, movement described
- Still tuning (stable to 180 days)



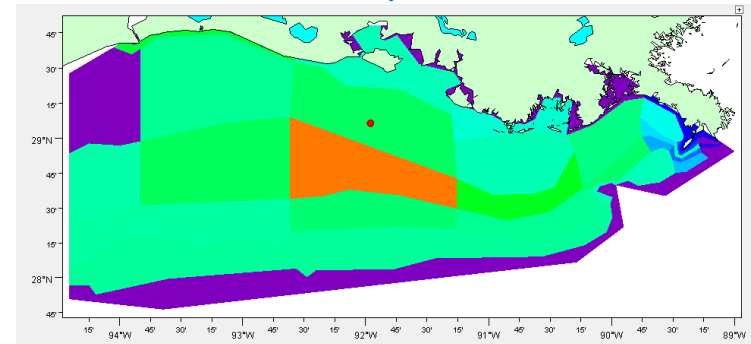
NCCOS Model status

- Input river values for Dissolved Organic Nitrogen, Ammonia and Silicate from the Atchafalaya and the Mississippi River to force hypoxic conditions
- Incorporated the hydrodynamics from Rob Hetland and this was interpolated by the Atlantis developers to each grid cell and each layer

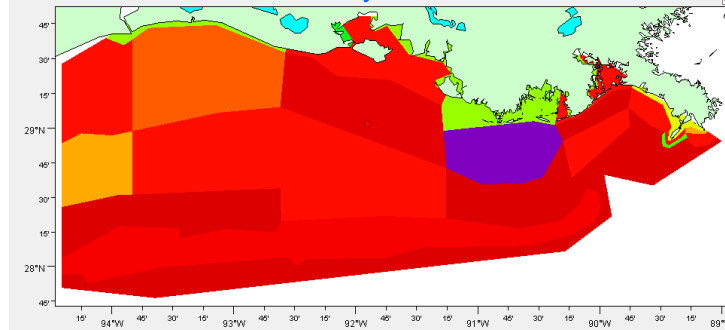
DON concentration Day 1



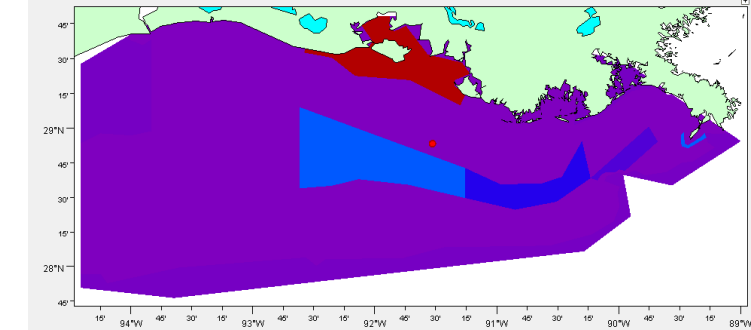
DON concentration Day 178



DO concentration Day 1



DO concentration Day 178



Collaborators

University of South Florida (Ainsworth, Murawski)
SEFSC-NOAA (Schirripa, Kelble, Zimmerman)
NWFSC-NOAA (Levin, Kaplan)
University of Miami (RSMAS) (Die, Babcock)
Florida State University (Coleman, Gosnell)
FWRI (Mahmoudi, Chagaris)
CSIRO (Fulton)
NCDDC (Beard, Parsons, Carleton)
& many others

