Shelf Hypoxia and the U.S. IOOS Coastal Modeling Testbed

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U.S. IOOS Coastal Ocean Modeling Testbed

IOOS Testbed Project

- 5 teams, 64 scientists/analysts
- SURA is overall lead
- One year project (May 2010-11)
  - NCE to Dec 2011
- Multi-sector engagement
  - federal, academia, industry
- Goals:
  - Less about models than process
    - Enable modeling and analysis
  - Stable infrastructure focus
    - testing environment
    - tools
    - standard observations
    - ***transition to operations (R2O)***

Coastal Inundation Gulf & Atlantic Coast
Rick Leuttich, UNC-CH

Shelf Hypoxia Gulf of Mexico
John Harding, NGI

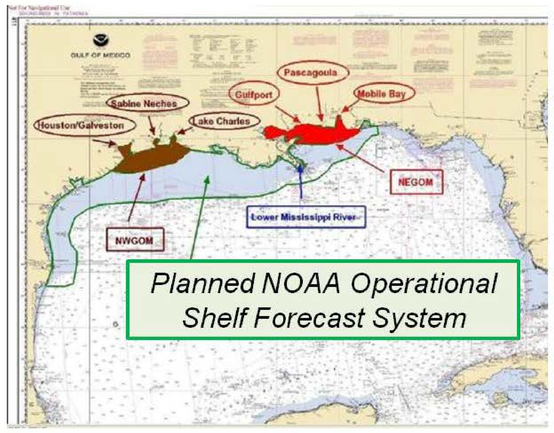
Estuarine Hypoxia Chesapeake Bay
Carl Friedrichs, VIMS

Cyber Infrastructure
Eoin Howlett, ASA

Testbed Advisory Evaluation Group
Rich Signell, USGS

Shelf Hypoxia Testbed Approach

- Collaboration
  - R2R
  - R2O (Transition)
- Data
  - In Situ
  - Forecast System
- Models
  - Development
  - Evaluation



Motivation

Why Gulf of Mexico Shelf Hypoxia?

- Multi-Agency (federal & State) Mississippi River/Gulf of Mexico Watershed Nutrient Task Force action step: "Continue to reduce uncertainty about the relationship between nitrogen and phosphorus loads and the formation, extent, duration, and severity of the hypoxic zone, to best monitor progress toward, and inform adaptive management of the Coastal Zone." (http://www.epa.gov/msbasin/actionitems.htm)
- A near real-time synoptic scale hypoxia forecast capability will allow the capture of the true temporal variability of formation, extent, duration and severity of the Gulf of Mexico Dead Zone.

Roles of PIs

- John Harding, NGI
  - Shelf Hypoxia Modeling Team
- Rob Hetland, TAMU
  - Sub project 1: Assess hydrodynamic skill (nested vs. unnested hindcasts)
- Katja Fennel, Dalhousie
  - Sub-project 2a: Assess hypoxia skill (unnested vs. nested hindcasts);
  - Sub-project 2b: Assess hypoxia skill (different hypoxia approaches)
- Jerry Wiggert, USM
  - Sub-project 3: Evaluate and Transition NAVOCEANO AMSEAS; Enable transition of developmental NGI/NCDDC OceanNOMADS

Shelf Hypoxia Initial Focus (1-2 yr)

Challenge the CI Team to Enhance Academic/Operational Collaboration & Transition

- Evaluate *regional* model boundary conditions on current *coastal* hypoxia modeling in the northern GoM
- Compare NOAA and EPA Approaches to Gulf hypoxia
- Transition related *regional* circulation component of this initial system as a baseline operational capability
- Enable transition of NGI/NCDDC Developmental OceanNOMADS (FY11 NODC External Milestone)

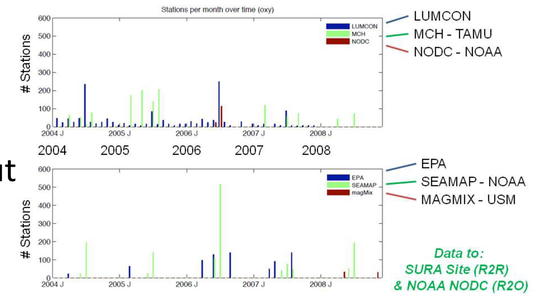
Project Partners

- Martinho Marta Almeida, TAMU
- Frank Bub, NAVOCEANO *
- Scott Cross, NOAA NCDDC *
- Pat Fitzpatrick, MSU
- Courtney Harris, VIMS
- Matt Howard, GCOOS
- Jiatang Hu, Dalhousie
- Dong Shan Ko, NRL
- Arnaud Laurent, Dalhousie
- John Lehrter, EPA NHEERL *
- Alan Lewitus, NOAA CSCOR *
- Bruce Lipphardt, U Delaware
- Chris Mooers, Portland State
- Steve Morey, FSU
- Rich Patchen, NOAA CSDL *
- Eugene Wei, NOAA CSDL*
- Jiangtao Xu, NOAA CSDL

Collaboration & Data

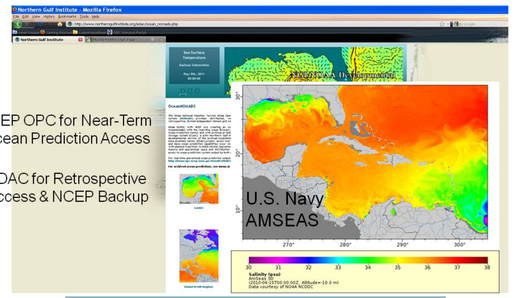
- 4-Year, Multi-Source, Quality Controlled Hypoxia Data to **Testbed** & **NOAA NODC**
- Retrospective **Navy** Ocean Prediction Output Now Available on **NGI** Developmental and **NOAA NODC NCDDC** Production Servers

Hypoxia Data: Compile, Edit & Store



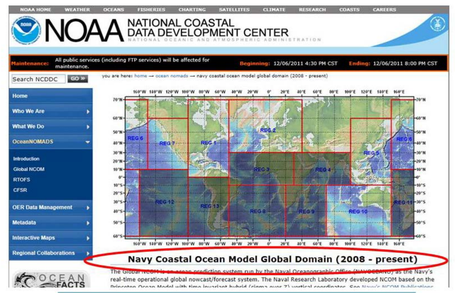
Data to: SURA Site (R2R) & NOAA NODC (R2O)

Access to Gulf Forecasts
NGI/NCDDC EDAC/OceanNOMADS



http://www.northerngulfinstitute.org/edac/ocean_nomads.php

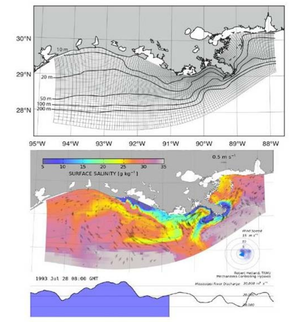
NCDDC OceanNOMADS Production Site – R2O



http://www.ncddc.noaa.gov/ocean-nomads

Collaboration & Models

Nesting Impact on Physical Properties ***(Testbed, NOAA CSDL, NRL)***



Fennel/ ROMS Model Grid, Bathymetry & Sample Salinity Snapshot for 28 Jul 93

What is impact of not having offshore forcing?

ROMS Salinity Skill Scores (Nested in Gulf Models):

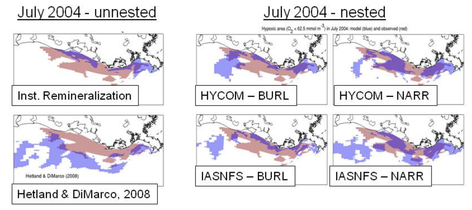
HYCOM	0.54
IASNFS (NCOM)	0.56
IASNFS 6h	0.55
NGOM (POM)	0.51
NGOM 3h	0.52
CLIM (unnested)	0.38

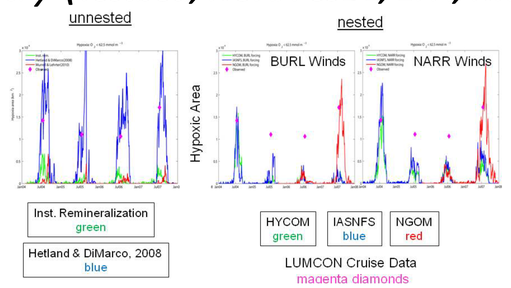
AMSEAS Surrogate

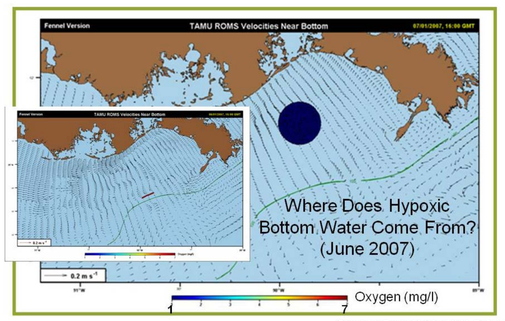
ill score = 1-sum(obs. - model)^2 / sum(obs.-climatology)^2
y data from MCH program profiles for 2004-8, from surface to 50 m)

Nesting Impact on Biogeochemistry ***(Testbed, NOAA CSDL, EPA, NRL)***

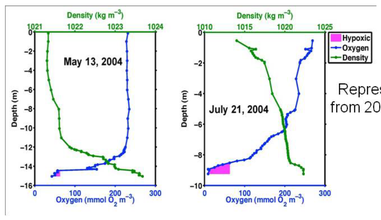
Impact of Nesting on Hypoxic Area less obvious







Courtesy Bruce Lipphardt, U. Delawa

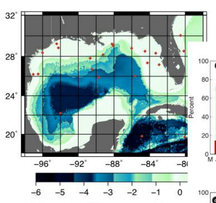


Representative O_2 profiles from 2004 LUMCON Cruises

Indefinite impact of nesting likely due to biogeochemistry being more important than horizontal boundaries in this present generation of biogeochemical models

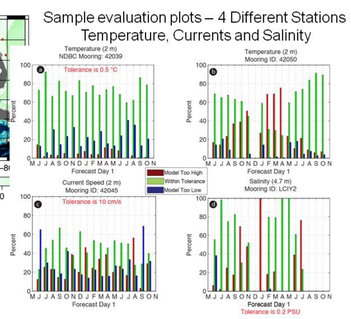
Biogeochemical models need attention on vertical resolution of bottom boundary layer, treatment of vertical diffusion & sediment interface biogeochemistry

AMSEAS Operational Evaluation ***(Testbed, NAVO, NOAA CSDL)***



Mooring Sites used in AMSEAS evaluations (from NOAA NDBC)

Sample evaluation plots – 4 Different Stations Temperature, Currents and Salinity



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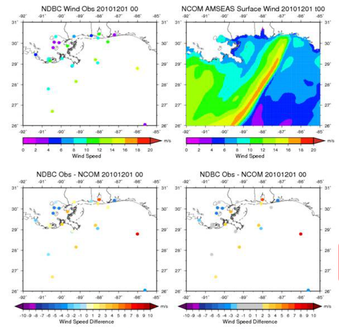

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AMSEAS COAMPS Wind Comparisons (speed: m/s)

Images courtesy Pat Fitzpatrick & Yee Lau (MSU)

Technical Report @ http://testbed.sura.org/