Community Earth Ecosystem Modeling for NGoM

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OBJECTIVES

1. Provide a common suite of interconnected numerical models to be used in predicting the path and fate of oil products and oil-contaminated sediment.

2. Produce hydrodynamic, transport, and water quality drivers for selected ecosystem effect modeling.
Numerical models offer understanding and management of ecosystem effects from oil contamination, e.g.

• Integrating knowledge into a testable, holistic framework (synthesis)

• Predicting future ecosystem effects. (stochastic results from an ensemble of forcing processes)
Earth Ecosystem Models integrate the complex human, natural, chemical, and physical interactions of ecosystems as they respond to human and natural system perturbations.

Northern Gulf Institute

Earth System Models are a class of models that integrate components and processes beyond the physical, dynamical systems present in climate models, with the intention of accurately representing the complex human, natural, chemical, and physical interactions that contribute and respond to climate.

The NGI Conceptual Earth Ecosystem Model: Level 1

Conceptual model is the product of the NGI Ecosystem Team and MSU H₃O Group
Weather & Climate

Hydrology

Estuarine, Coastal & Gulf Oceanography

OGDB*

Water Quality**

Food Web

Assemblages

Individual Species

Response & Remediation

Recreation

Infrastructure

Fishing

Social & Economic

* OGDB = oil, gas, dispersant, & by-products
** Biogeochemistry of the water column and benthos

Physical

Biotic

Human
Weather & Climate

Hydrology

Estuarine, Coastal & Gulf Oceanography

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** Biogeochemistry of the water column and benthos
Informatics

Informatics is applying “... advanced information technology to science and engineering problems ... to enable scientific discovery, and ... creatively integrate research and education for the benefit of technical specialists and the general population.”

Weather & Climate

Hydrology

Estuarine, Coastal & Gulf Oceanography

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** Biogeochemistry of the water column and benthos

Physical

Biotic

Human
Hydrology Level 3

- From Weather
  - Temperature, Wind Speed & Humidity
  - Precipitation Intensity, Duration, & Spatial Coverage

- Terrain and Land Cover
- Land Use & Management Methods
- Runoff of Water, Sediment, Nutrients, & Other
- Evapotranspiration to Atmosphere
- Flow to and from Groundwater

For land & water surfaces – from the watershed to the sea
Weather & Climate Level 3

Short Term Climate
- ENSO, NAO

Estuarine, Coastal, Basin Oceanography
- Temperature (t), Waves (t)

Hydrology
- Runoff & Groundwater (t)

4-D Atmospheric Pressure

4-D Winds

4-D Temperature

4-D Moisture (Clouds, Precipitation, Humidity)
Weather
- sfc. momentum flux,
- sfc. heat flux,
- sfc. moisture flux
- sfc. pressure (t)

Estuary, Coastal, Basin
3D Geometry
- Shape, topography,
- bathymetry

Astronomical Tides
- Sea Level (t),
- 4-D Currents

Hydrology
- Runoff & Groundwater (t)
For waterbodies – streams, rivers, lakes, reservoirs, estuaries and coastal waters – from the land to the sea

** Biogeochemistry of the water column and benthos
OGDB Transport Level 3

* OGDB = oil, gas, dispersant, & by-products

Transport by advection & diffusion & transformation:
Biological – i.e. biodegradation
Chemical – i.e. oxidation
Physical – i.e. sorption

Source: Mark Bricka, MSU
Ecosystem Level 3 & 4

Food Web
Assemblages
Individual Species

Comprehensive Aquatic Systems Model (CASM)

Light

Dissolved and Particulate Carbon

Phytoplankton
Zooplankton
Planktivorous Fish
Decomposers
Benthic Invertebrates
Benthic Insects
Benthic Piscivorous Fish
Benthic Omnivorous Fish
Emergents

Macrophytes
Periphyton

Temperature
Depth
Velocity
Salinity
TIS
POC, DOC
Dissolved O₂

Light

Nutrients
DIN
DIP
Si

Toxicity data
Chemical concentrations

Slide created by Steve Bartell E2 Environmental Engineers
Informatics Level 3

- Data: Observed, Modeled, Extracted
- Database
- Data Standards & Metadata
- Software Standards
- Presentation, Web & Cyberinfrastructure
- Presentation & Analysis Tools & Standards
- Analyses & Interpretation
- Data Mining & Inference Engine
For more information

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