ICEMM Workgroup 3: Forecasting of Ecosystem Functions and Services

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Overview

• Hypoxia, Excess Nutrients, and Harmful Algal Blooms chapter of Integrated Hydro-terrestrial Modeling (IHTM) report (Harvey et al)

• Toward FAIR, Integrated, environmental modeling (Ken Bagstad)

• Federal updates (all)
Hypoxia
Nutrient Loading
and
Harmful Algal Blooms
Key Challenges

• Hydrodynamic modeling for coastal hypoxia
  • Challenging, time-consuming, steep learning curve

• Simulating effects of BMPs and other management actions

• Understanding algal toxin production/release
  • From cell rupture/death or not?

• Macroalgae - Modeling production, accumulation

• Data availability versus information need

Photograph of a lake shoreline during a cyanobacterial bloom (top) and map of a bloom distribution in Western Lake Erie (credit: NOAA Great Lakes Environmental Research Laboratory, https://www.noaa.gov/what-is-harmful-algal-bloom)
Desired Outcomes

• Near term
  • Integrate near-term forecasts of meteorological and biological conditions with human activities for operational adaptability in hydrologic control, agriculture, waste management, to inform dynamic decision making

• Long term
  • Future model projections improve management planning and direct actions by stakeholders that mitigate the occurrence and harmful effects of hypoxia and HABs

Chapter: J. Harvey et al. Hypoxia, Excess Nutrients, and Harmful Algal Blooms chapter of Integrated Hydro-terrestrial Modeling (IHTM) report
Toward FAIR, integrated environmental modeling

Ken Bagstad, Ferdinando Villa, Stefano Balbi
Standard data & modeling flow

• First time running an environmental model:
  - Download & preprocess input data
  - Parameterize & run models
  - Calibration, validation, sensitivity analysis
  - Policy analysis; disseminate results to stakeholders & scientific community
  - Archive data and models using metadata standards

• Second, third, fourth time:
  - Download & preprocess input data
  - Parameterize & run models
  - Policy analysis; disseminate results to stakeholders & scientific community
  - Archive data and models using metadata standards

Same process!
Open data & models state of the art: important advances but not good enough

• “Analysis ready data”
• Model/algorithm libraries
Does environmental modeling always need to be painstakingly slow?

**Status quo**

Data repository

**Linked, web-based collaborative modeling**

Semantic Web

Expert contributing knowledge

Expert contributing data & models
Infrastructure for FAIR, AI-supported scientific modeling

Box 2 | The FAIR Guiding Principles

1. Semantics
2. Open, linkable data
3. Open, linkable models
4. Software infrastructure

https://www.go-fair.org/fair-principles/
http://www.integratedmodelling.org
Achieving interoperability

1. *Share data on the web* – enabling it to be automatically ingested by models
   - Models are *global* (run anywhere) yet *highly customizable*

2. *Share models on the web*, and specify when & where to use each model
   - Models are *global* (run anywhere) yet *highly customizable*

3. Open-source software for stakeholders (modeling & visualization) & modelers (to contribute data & models)

4. Fast & transparent (show all data sources & calculations)
   - Enables *co-generation/analysis* of accounts with stakeholders

http://aries.integratedmodelling.org/?p=1458
A global knowledge network for ecosystem service data & models

• “Global yet customizable” models
• Working with Interamerican Development Bank to customize for Western Hemisphere
• Can do the same elsewhere


Martínez-López et al. 2019
Federal Updates

• *Hypoxia, Excess Nutrients, and Harmful Algal Blooms* chapter of Integrated Hydro-terrestrial Modeling (IHTM) report (Harvey et al)
  • Hypoxia Task Force, HABHRCA are examples of collaboration

• EPA Integration of Final Ecosystem Goods and Services (FEGS) with National Ecosystem Services Classification System (NESC)


• Others?