Environmental Modeling

U.S. EPA’s Office of Research and Development

Provide science and technology to support EPA’s mission of protecting human health and the environment.

Science to Support EPA’s Mission

EPA Mission

Protect Human Health and the Environment

Program Offices
(Air, Water, Waste, Chemicals)
- Policies
- Regulations
- Congressional mandates

Regional Offices
Primary Interface with States

Office of Research and Development

Scientific Foundation

National Decisions

Implementation

• Policies
• Regulations
• Congressional mandates

Congressional mandates

Policies

Regulations
EPA Goals 2014-2018

- Addressing Climate Change and Improving Air Quality
- Protecting America’s Waters
- Ensuring the Safety of Chemicals and Preventing Pollution
- Cleaning Up Communities and Advancing Sustainable Development
- Enforcing Laws, Ensuring Compliance

Research Programs

- Air, Climate & Energy
- Safe and Sustainable Water Resources
- Chemical Safety for Sustainability
- Sustainable and Healthy Communities
- Human Health Risk Assessment
- Homeland Security
Community Multi-Scale Air Quality Model (CMAQ)

Multiple processes control air pollutant concentrations that vary by hour, location, day and pollutant.
Green Infrastructure Modeling Toolkit
epa.gov/water-research/green-infrastructure-modeling-toolkit

HAWQS
Hydrologic and Water Quality System – A National Watershed and Water Quality Assessment Tool

News Releases from Region 06

EPA awards $3.9M to University of Texas for Water Infrastructure Modeling Research Center

11/02/2016
Watershed Tools

National Aquatic Resource Survey (NARS) Data

StreamCat Characterization

Model-based condition (everywhere)
Water Quality Models

Climate
- Meterological data
- Hydrodynamic model
  - Water residence times,
    circulation patterns,
    temperature, salinity

Point source loading
- Land use
- Nutrient loads
  - Water Quality model
    - daily N, P, DO, chl a

Benthic invertebrate models
- Seagrass model
- Fish models
- Ecosystem model
Water Quality Benefits Platform

Water Quality Data
Baseline conditions and policy impacts

Linking WQ to Benefits
Expressing water quality in economically meaningful terms

Population
Spatial distribution and demographic data

Aggregation
Combining valuation model and population data to estimate total benefits

Valuation
Hedonics
Recreation Demand
Stated Preference
Population Models for Chemical Risk Assessment

Dynamic Energy Budget (DEB)

Markov Chain Nest Productivity Model (MCNest)

HexSimPLE Rapid Response Models

Application (pesticides)

Running the Model

Pesticide Impact Scenarios
Modernizing Existing EPA Pesticide Models

- **Map Reduce**
  
  Count # times conc > threshold (0.1 µg/L)
  
  \[ L = [0, 0, 0.1, 0.24, 0.35, 0.2, 0.12, 0.04, 0, \] 
  
  \[
  \text{map}(\lambda x: \text{True if } x > 0.1 \text{ else False}, L) \\
  \text{reduce}(\lambda x, y: x + y, \text{Map}) \text{ Reduce} = 4
  \]

- **Parallelization**

- **Cloud optimization to meet computing needs**
Chemical Tools

Interspecies Correlation Estimation (Web-ICE) V3.3 – release June 2016

Estimates the acute toxicity of a chemical to a taxa from the known toxicity to a surrogate species

SeqAPASS: Sequence alignment to predict across-species susceptibility
Ecosystem Services

- Formalize and standardize a list of beneficiaries
- Provides an architecture to house metrics and indicators

https://www.epa.gov/eco-research/final-ecosystem-goods-and-services-classification-system
Decision Support for Communities

Structured Decision Making (SDM)

Understand context
Define Objectives and Measures
Develop Options
Evaluate Consequences, Uncertainties, and Tradeoffs
Take actions, Monitor, Adapt

A formalization of common sense for decision problems that are too complex for informal use of common sense
Model Frameworks

- Infrastructure for integrated modeling workflows
- Standards for interoperability (automated data exchange)
- Utilities for uncertainty analysis, data acquisition, information synthesis, data visualization, etc.
Thank you, Questions?

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