PRELIMINARY ASSESSMENT DATABASE OF ECOLOGICAL RISKS FROM CONTAMINANTS IN STORM WATER RUNOFF

Boyce, E. D., T. C. Siewicki, K.H. Phillips, P. B. Key, and M. H. Fulton

National Oceanic and Atmospheric Administration, National Ocean Service,
Center for Coastal Environmental Health and Biomolecular Research, 219 Fort Johnson Road, Charleston, SC 29412

Abstract

NOAA has implemented the Coastal Storms Program that is improving information, forecasts, tools, and training for protection of coastal communities. Although national in scope, it is being tested as a pilot program in Florida's St. Johns River watershed, the Pacific Northwest's Lower Columbia River watershed, and the Southern California Bight. One part of this initiative is the development of forecast models for ecological effects from storms. The effects that major storm events have on the movement of pesticides, polycyclic aromatic hydrocarbons (PAH), and metals into nearby waterways are poorly understood. A landuse-based risk assessment approach was used to identify the contaminants in each of the pilot areas that pose a risk to natural resources. A goal of this project is to minimize these risks by proposing mitigation strategies. So far, approximately 480 pesticides, 19 PAHs, and 17 metal compounds have been identified for agricultural, residential and commercial applications; rooftop and roadway runoff; and other non-point sources within the St Johns and Lower Columbia River watersheds. Detailed data relevant to application amounts and locations, known toxicity thresholds, and chemical characteristics that affect each pesticide's transport and fate were collected and compiled into an online searchable database (http://www.chbr.noaa.gov/easi). The ecological risks were ranked according to this information and three contaminants were identified for each area as posing significant hazards and potentially occurring at high levels after heavy rains. Detailed toxicology, as well as ground and surface water modeling were conducted to estimate risk to resident biota. These tools are provided to help identify species and locations at risk, plan resource assessment after major storms and, ultimately reduce effects of poor storm water quality on aquatic resources.

Methods

- Determine land uses and land cover for the watershed of the pilot study
  - Collect data from federal, state, and local agencies
  - Compile data into a GIS using ArcGIS 9.1 (See Figure 3)

- Determine what contaminants could potentially enter the study watershed based upon the land cover classification
  - Use reported agricultural pesticide use when available
  - For unreported use of pesticides, PAHs, metals determine potential use by what is allowed for use according to the EPA and contaminant label
  - Include contaminants typically found in road runoff

- Collect information about each contaminant from scientific literature
  - Compile chemical structure, toxicity, and fate information
  - Calculate the rate and area of contaminant application based on the land use and label information
  - Use local traffic counts to estimate PAH contribution from roadway runoff

- Rank the contaminants according to risk
  - Rank each contaminant according to usage rate, solubility, half-life, and LC50s. Give each an overall rank according to those factors.
  - Gather a panel of experts to review the rankings and other empirical data to narrow down the list to three chemicals of particular concern

- Predict potential risk to the environment by using computer models
  - Choose an representative area of the watershed to model
  - Run the Pesticide Root Zone Model (PRZM) and Exposure Analysis Modeling System (EXAMS) to simulate the fate and transport of the three contaminants of concern through the root zone and surface water of the watershed

- Make the collected information publicly available
  - Risk assessment information gathered for each contaminant put into a searchable database on the project website www.chbr.noaa.gov/easi.
  - Modeling results presented to local stakeholders and published in scientific literature.
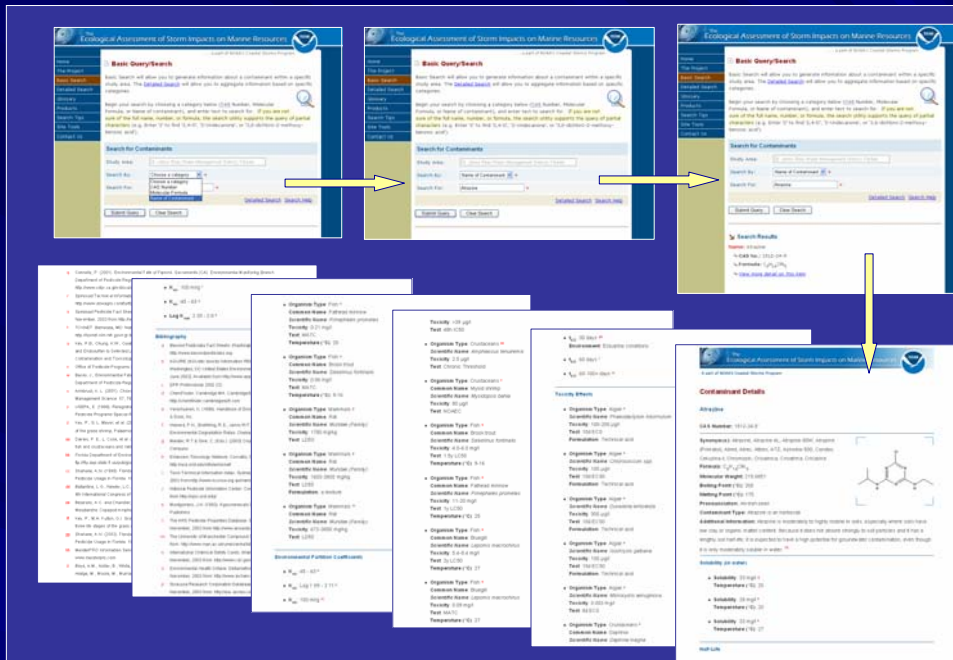

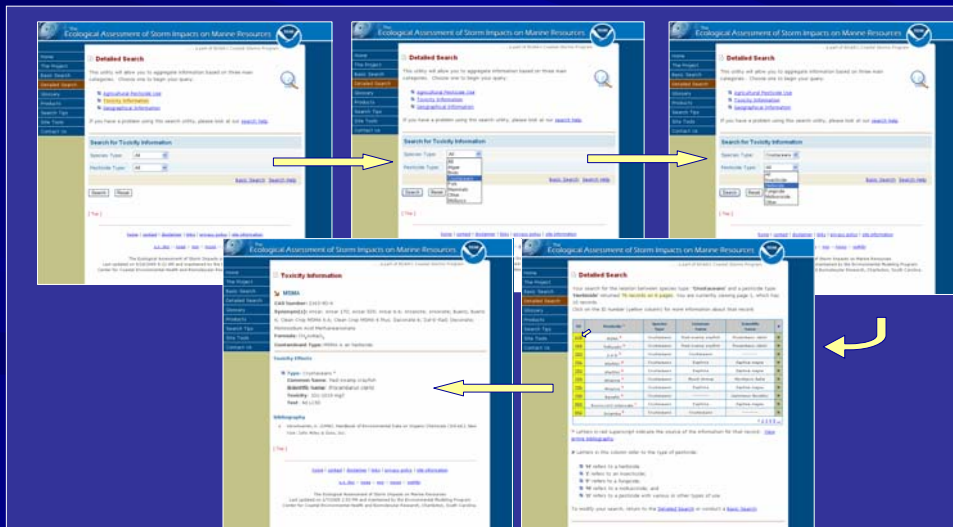**Figure 1:** Creating a printer-friendly fact sheet for a contaminant using the **Basic Search** function

Figure 2: Finding specific toxicity information according to species and contaminant type using the **Detailed Search** Function
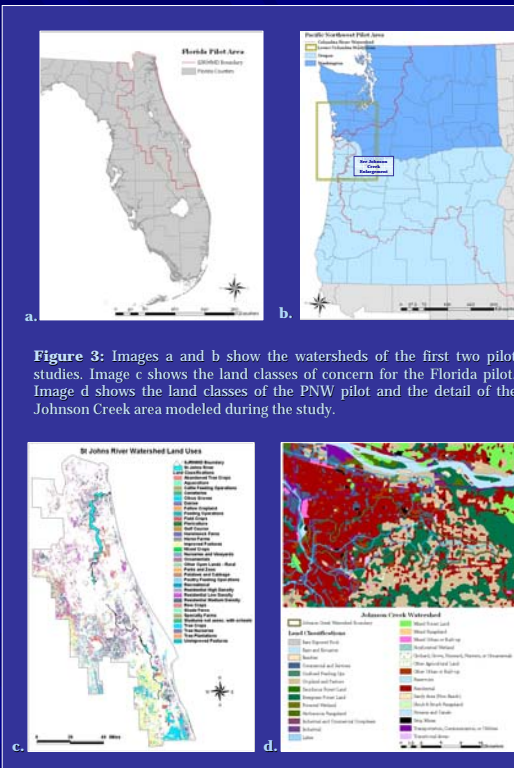

Figure 3: Images a and b show the watersheds of the first two pilot studies. Image c shows the land classes of concern for the Florida pilot. Image d shows the land classes of the PNW pilot and the detail of the Johnson Creek area modeled during the study.

Database Features

- Includes 516 contaminants
  - 480 Pesticides
  - 19 PAHs
  - 17 Metal Formulations
- Toxicity information on 169 species
  - Lethal concentrations and doses (LC50, LD50, etc.)
  - Effective concentrations (EC50, NOEC, etc.)
- Chemistry information available for each contaminant
  - Molecular weight
  - Structure
  - Solubility
- Fate information available for each contaminant
  - Partition coefficients (Koc and Kow)
  - Half-life in soils
- Variety of Search Methods (See Figures 1 and 2)
  - By chemical name, CAS number, or formula
  - By contaminant and species type
  - By crop and county (Florida pilot area only)

www.chbr.noaa.gov/easi