PNNL-13408

Example of an Aquatic Ecological Assessment, Based on a User-defined Water Concentration Module and WEAP

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Prepared for the
U.S. Army Research and Development Center
Waterways Experiment Station
U.S. Army Corps of Engineers
3909 Halls Ferry Road

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Example Case 3 – Aquatic Eco Assessment

Known surface water (SW) Concentrations û WEAP

This example demonstrates access to the Framework for Risk Analysis in Multimedia Environmental Systems (FRAMES) at a specified location and other functionality of the Wildlife Ecological Assessment Program (WEAP).

Introduction

The U.S. Army Research and Development Center, Waterways Experiment Station (WES), U.S. Corps of Engineers develops tools to help analysts assess the impacts of anthropogenic activities in the environment. As such, WES is developing the Army Risk Assessment Modeling System (ARAMS) to provide the Army with the capability to perform human and ecologically based risk/hazard assessments associated with past-practice and current activities at military installations. The intent of the system is to provide a platform from which a variety of assessments can be performed, using screening-level tools, science-support tools, site-specific databases, physicochemical databases, visualization, and Conceptual Site Model (CSM) guidance. The system is envisioned to help a risk analyst visualize an assessment from source, through multiple environmental media (e.g., groundwater, surface water, air, and land), to sensitive receptors of concern (e.g., humans and wildlife). Concurrently, WES is also sponsoring the development of the science-support-based Land-Based Management System (LMS), which has many of the same goals as ARAMS, yet is taking a more detailed approach to each of the components of an integrated system. The linkage of ARAMS and LMS is an ultimate goal of WES, such that utilization of the components in each system can be used by the other system to support assessment activities.

To help use current and existing state-of-the-art multimedia tools and to gain an appreciation for current technological advances, the Pacific Northwest National Laboratory (PNNL) is supporting WES and ARAMS by modifying and updating the Framework for Risk Analysis in Multimedia Environmental Systems (FRAMES) for inclusion as a component in ARAMS. FRAMES is a Windows-based software platform that provides an interactive user interface and, more importantly, specifications to allow a variety of DOS and Windows-based environmental codes to be integrated within a single framework. As new components in ARAMS and FRAMES, PNNL and WES have developed the Wildlife Ecological Assessment Program (WEAP) and Environmental Residue-Effects Database (ERED), respectively.

WEAP is a software package that summarizes ecological health impacts to wildlife from exposures to chemical contaminants. WEAP is a statistical package that 1) correlates duration of exposure to contaminant levels to help determine the impacts of the exposure to organisms and 2) bridges the gap between simulated chemical transport and fate modeling and ecological-risk assessment data that are available from laboratory studies. The WEAP statistical analysis accommodates different organisms as they relate to different contaminants, resulting in a flexible and versatile tool. ERED is an ecological toxicity database, containing ecological benchmark data by chemical and lifeform species.

This document provides an illustrative example associated with the linkage and application of the WEAP ecological model and ERED database within FRAMES. This illustrative example uses "measured" time-varying surface water concentrations with WEAP to determine the ecological impact on aquatic life. These measured values are entered into the FRAMES system. This case calculates the percentage of time that an aquatic species is exposed to 1) acceptable impacts, 2) unacceptable impacts

with less than 50% mortality, and 3) unacceptable impacts with equal to or greater than 50% mortality. The output also summarizes the probability of equaling or exceeding a concentration, based on exposure duration.

Description and Rationale

This case will use "measured" time-varying surface water concentrations with WEAP to determine the ecological impact on aquatic life. These measured values will be entered into the FRAMES system using the User Defined Exposure Point File Module. This case will calculate the percentage of time that an aquatic species is exposed to acceptable or unacceptable with less than 50% mortality, and equal to or greater than 50% mortality impacts.

Input Data

Open the Multimedia Framework (fui.exe). Select New from the File menu. Enter a file name and select Open. Enter a site name at the prompt and click Ok. To start building a case, double click on the Contaminant icon, left click on the icon located on the main screen, hold down the mouse button drag the icon to the desired location. Repeat this operation to place the following icons into the workspace:

1 "Contaminants"
1 "Eco Benchmarks"
1 "Surface Water"
1 "Eco Effects"

Connect the Contaminant icon and Surface Water icons together by holding down SHIFT, clicking on the Contaminant Icon, dragging the cursor to the Surface Water icon, and releasing the mouse button (Note: To remove this line, repeat the steps used to connect it. To remove an icon from the screen, right click, and a menu will appear with different options. Click "Delete," and the icon will be taken out).

In the same fashion, connect the following pairs of icons:

Contaminants	**û**	*Surface Water*
Contaminants	**û**	*Eco Benchmarks*
Contaminants	**û**	*Eco Effects*
Surface Water	**û**	*Eco Effects*
Eco Benchmarks	**û**	*Eco Effects*

FRAMES should now look something like Figure 1.

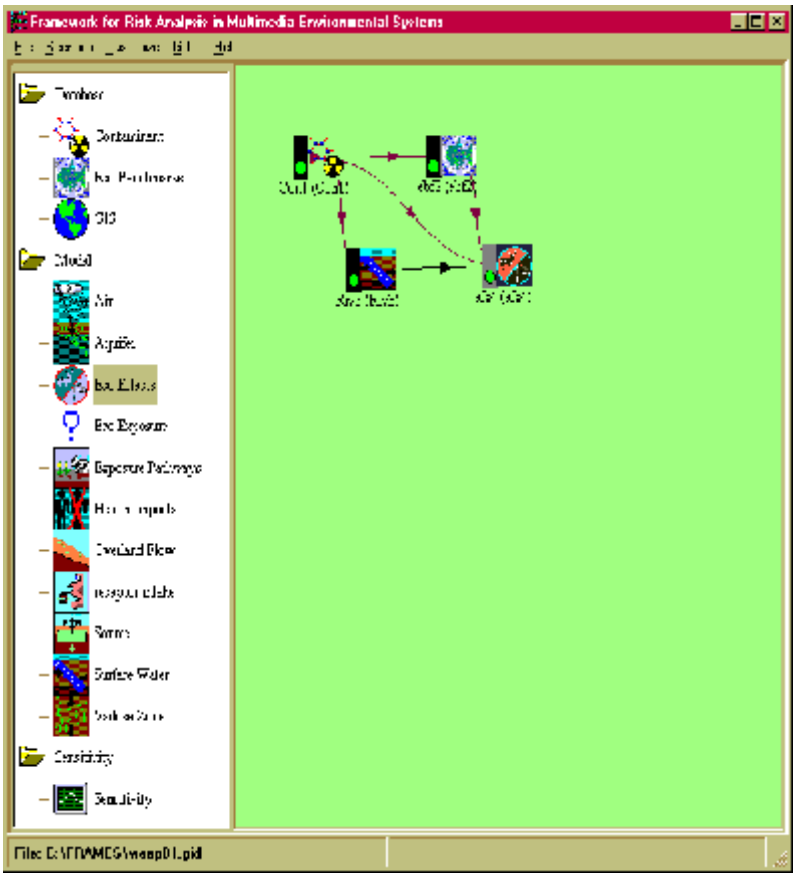

Figure 1. Multimedia Framework Screen

Contaminant Database Module

Right click the Contaminant icon and choose General Info. When the General Info screen opens, enter "Contaminants" in the Label text box and select "FRAMES Default Chemical Database Selection" in the "Select from applicable models" text box. Click OK at the bottom of the screen to return to the work area. The signal light attached to the contaminant icon will change from black into red. Right click on the contaminant icon in the main screen and choose "User Input" on the menu that appears. The Contaminant Selection screen will open. Select "All Contaminants" from the "Possible Contaminants" dropdown box. The contaminant used in this case is Flouranthene (see Figure 2). Scroll to select the contaminants from the contaminants list or use the Find option to search for them. Click "OK" to return to the work screen. The Contaminant icon's status light will change from red to green.

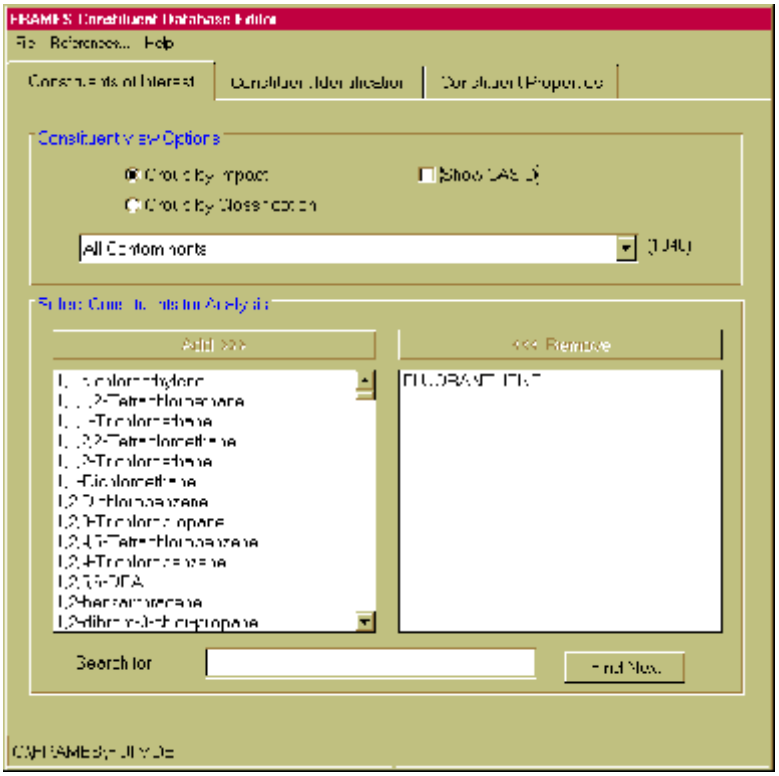

Figure 2. Contaminant Selection Screen

Following is a listing of all data input required by the remaining modules used in this case. *Names of module icons* are in bold Italics. *Menu items* (displayed by right clicking on the icon) are shown below and indented to the right of the icon names. *Explanations* of data required by each menu item are indented further to the right.

Surface Water

General Info

A window titled “Object General Information” will appear. In “Select from Applicable Models,” choose “FRAMES Known Surface Water Concentration/Flux” and click “Ok.” The traffic light next to the Surface Water icon should turn red.

User Input

A window titled “FRAMES Known Surface water Concentration/Flux Module” will appear. Enter the following data into the spreadsheet at the bottom of the window:

Time (Day)	Concentration (Mg/L)
0	0
.00786256898	100
.01674729633	5
.98708063917	90
.99494920815	60
.99888349264	85
.00281777713	30
.01068634611	75
.98202984732	10
9.9898984163	15
.99776698528	5
95.00170126977	95
100.00563555426	20

Click "File Save and Exit."

Run Model

The model will run in the background. The traffic light next to the Surface Water icon should turn green.

View/Print Module Output

A second menu will appear, select the "WCF Text View." The view should output a screen like Figure 3.

Eco Benchmarks

General Info

A window titled "Object General Information" will appear. In "Select from Applicable Models," choose "PNL ERED Database" and click "Ok." The traffic light next to the Eco Benchmarks icon should turn red.

Run Model

A window will appear prompting you for a user name and password. Enter a valid username and password and click "OK." ERED data will proceed to be loaded from the database.

A window titled "Data Editor" will appear. Click "Life form Aliases" in the data tree at left. A list of life forms will appear to the right. Check (by clicking in the check box) "Asterias rubens" and "Brachionus calyciflorus." Click "File Save Changes and Exit." The icon next to the Eco Benchmarks icon should turn green.

Eco Effects

General Info

A window titled "Object General Information" will appear. In "Select from Applicable Models," choose "Wildlife Ecological Assessment Program" and click "Ok." The traffic light next to the Eco Effects icon should turn red.

User Input

A window titled “Wildlife Ecological Assessment Program” will appear. In the data tree on the left, click “Starfish.” A panel labeled “Starfish info for Life form dependant data” will appear at right. Enter this data in the spreadsheet inside the panel:

Time	Location
day	Pick Location
50	Location1 (Riv3)
100.01	None

Click “Rotifer” and repeat the process using this set of data:

Time	Location
day	Pick Location
0	None
50	Location1 (Riv3)
100.01	None

Double click “Starfish.” An item called “FLOURANTHENE” will appear in the data tree. Click it and fill in this data on the right:

Acute exposure duration – ACUTETIME

4.02	Day

Chronic Limit– CCC

22	Mg/L

Description of effect

ED 50

Duration	Concentration
Day	Mg/L
0	66
29.99	55
100.01	44

Double click “Rotifer.” An item called “FLOURANTHENE” will appear in the data tree. Click it and fill in this data on the right:

Acute time of exposure – ACUTETIME

4.02	Day

Description of effect

ED 50

Criterion Continuous Concentration value – CCC

10	Mg/L

Duration	Concentration
0	95
4.02	95
20.02	50
60.01	30
100.01	30

Click "File ➪ Save and Exit." The traffic light next to the Eco Effects icon should turn yellow.

Run Model

The model will run in the background. The traffic light next to the Eco Effects icon should turn green.

View/Print Module Output

A second menu will appear, select the "EXF Text View." The view should output a screen like Figure 3.

Expected Results

Viewer outputs should look like the three viewers of Figure 3.

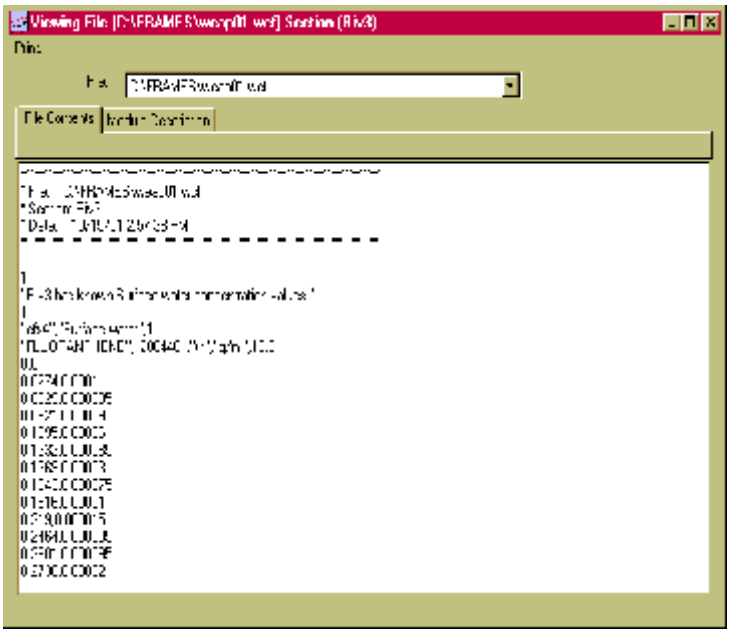

Figure 3a. Viewer for Surface Water

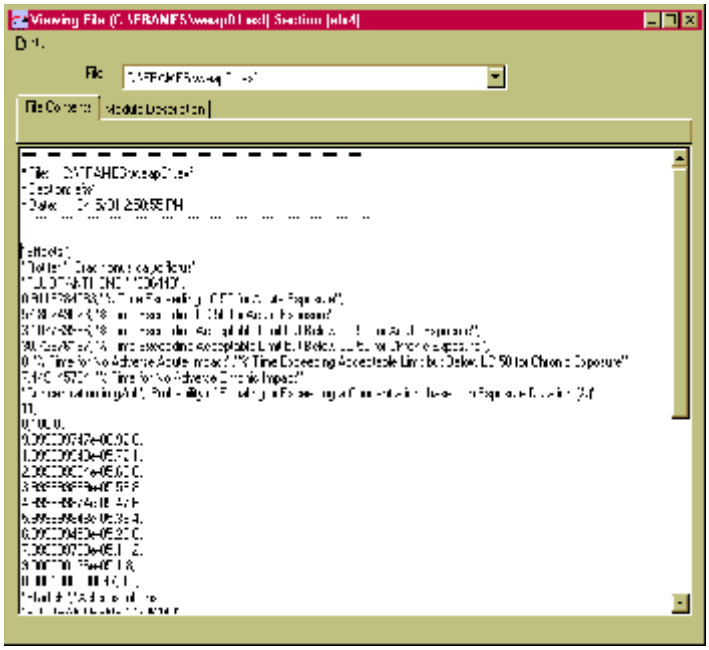

Figure 3b. Viewer for Eco Effects

Testing Results

Testing Results were identical to Expected Results.