

# **PEER REVIEW OF THE EVERGLADES LANDSCAPE MODEL (ELM)**

## **WORKSHOP 1**

### **Summary of Public Workshop for Expert Review Panel Questions and Initial Comments on the ELM Documentation**

**August 1-2, 2006  
West Palm Beach, Florida**



**Prepared by:  
Victor J. Bierman, Jr., Ph.D.  
Wendy M. Larson  
Limno-Tech/HydroQual, LLC**

**August 25, 2006**



## TABLE OF CONTENTS

<b>1. PREFACE.....</b>	<b>1</b>
<b>2. INTRODUCTION.....</b>	<b>2</b>
<b>3. BACKGROUND PRESENTATIONS .....</b>	<b>4</b>
<b>4. SUMMARY OF TECHNICAL ISSUES AND QUESTIONS.....</b>	<b>6</b>
<b>5. ADDITIONAL INFORMATION REQUESTED BY PANELISTS .....</b>	<b>8</b>
<b>6. DRAFT REVIEW REPORT OUTLINE .....</b>	<b>9</b>
<b>7. STAKEHOLDER QUESTIONS AND COMMENTS.....</b>	<b>10</b>
<b>8. REFERENCES.....</b>	<b>11</b>

## **1. PREFACE**

This document is a synthesized summary of the proceedings of a public workshop for Expert Review Panel questions and initial comments on the Everglades Landscape Model (ELM), Version 2.5. The workshop was held on August 1-2, 2006 in West Palm Beach, Florida. It was conducted as part of the ongoing independent peer review of the ELM, initiated on July 10, 2006 with the public release of ELM v2.5 documentation on the South Florida Water Management District (SFWMD) web site dedicated to the ELM (<http://my.sfwmd.gov/elm>). Information on the process and the science of the peer review, including the full [schedule](#) is provided under the "[Peer Review](#)" tab of the ELM web site.

The August 1-2 workshop was the first of two public workshops dedicated to the ELM Peer Review process. The second workshop will be held on December 6 and 7, 2006 at SFWMD Headquarters. There will be two teleconferences between the first and second workshops. The agenda for the [August 29](#) teleconference is available on the ELM webpage, and includes details for joining the call. The agendas for the September 22 teleconference and the December 6-7 workshop will be posted before these events on the ELM peer review webpage.

This summary was prepared by Dr. Victor J. Bierman, Jr. and Wendy M. Larson of Limno-Tech/HydroQual, LLC. Dr. Bierman is the scientific facilitator for the ELM peer review process. In that capacity, his primary responsibility is to support the review panel so that they can best meet the goals of the peer review, and to facilitate clear and open communications among the Panelists and Model Developers. The SFWMD project manager, Dr. H. Carl Fitz, was responsible for workshop logistics and for audio/video recording of all workshop sessions. These recordings contain the complete details from the workshop and copies can be provided on request by Dr. Fitz.

## 2. INTRODUCTION

The ELM is a regional-scale, integrated ecological assessment tool designed to understand and predict the landscape response to different water management scenarios in south Florida. In simulating changes to habitat distributions, the ELM dynamically integrates hydrology, water quality, soils, periphyton, and vegetation in the Everglades region. The model has been developed through a multi-disciplinary, collaborative effort among a wide variety of scientists and engineers, under the direction of the SFWMD.

The overall Goal of the ELM peer review is to “*Judge the quality and credibility of the science of the ELM, particularly in its applicability to decision-making for Everglades management*”, finding critical defects and suggesting remedies for any such problems. Panelists were selected based on professional credentials in integrated modeling, or combinations of landscape, water quality and hydrologic modeling, in addition to experience in peer review of modeling efforts. More detail on the qualifications and responsibilities of the peer review panelists is provided on the ELM peer review webpage.

The independent experts who are serving on the Peer Review Panel are:

Dr. William J. Mitsch, Panel Chair  
Distinguished Professor of Natural Resources and Environmental Science  
The Ohio State University

Dr. Lawrence E. Band  
Voit Gilmore Distinguished Professor  
University of North Carolina at Chapel Hill

Dr. Carl F. Cerco  
Research Hydrologist  
U.S. Army Engineer Research and Development Center

The Scientific Facilitator is Dr. Victor J. Bierman, Jr. of Limno-Tech/HydroQual, LLC.

Before the Workshop, Panelists were provided with relevant introductory information, including the [Documentation of the Everglades Landscape Model: ELM version 2.5](#) (Fitz and Trimble, 2006a and 2006b), which is available for download on the ELM webpage.

The morning of Day 1 of the workshop was dedicated to background presentations by District staff about ELM development and capabilities, and the 2002 interagency review of the ELM by the Model Refinement Team of the Restoration Coordination and Verification (RECOVER) Program. The remainder of the workshop was set aside for topics as desired by the Panelists, and development of an outline and assignments for the Peer Review Report. The workshop agenda, which describes the format for the workshop follows.

## **Peer Review of the Everglades Landscape Model (ELM) Agenda for Workshop I**

**Topic:** Public Workshop for expert Review Panel questions and initial comments on the ELM documentation.

**Location:** Facilities of the “Community Foundation for Palm Beach & Martin Counties”, 700 South Dixie Highway, West Palm Beach, FL 33401.  
Phone: (561) 659-6800

**Date:** August 1-2, 2006: Tuesday 9:00 am – 5:00 pm; Wednesday 9:00 am – 1:00 pm.

**ELM information:** Model documentation and current Peer Review Schedule & Agenda found at: <http://my.sfwmd.gov/elm>

### **August 1**

9:00 – 12:00 am: Introductions, overview, management questions; ELM objectives, application niche and conceptual framework

1:00 – 5:00 pm: ELM applications, linkages to data and updates since 2002 interagency review

### **August 2**

9:00 am – 1:00 pm: Continued deliberations among Expert Panel members; working session for Panelists to plan for Draft Report on ELM documentation

**Contact:** The Scientific Facilitator of the Peer Review of ELM is:

Dr. Victor J. Bierman, Jr.  
Limno-Tech/HydroQual, LLC  
Phone: 336-274-2688  
email: vbierman@limno.com

### 3. BACKGROUND PRESENTATIONS

Background information on the ELM and the ELM peer review process was provided in nine presentations by Limno-Tech/HydroQual and SFWMD staff. Brief summaries of the presentations are provided below; for more detail the reader is referred to the ELM peer review webpage where all the presentations are available for download.

#### Overview: Peer Review of the Everglades Landscape Model

Dr. Victor Bierman, Jr., Scientific Facilitator of the ELM Peer Review introduced the Panelists, Limno-Tech/HydroQual staff, and SFWMD staff. He provided a brief introduction to the ELM, and highlighted the ELM review goals and objectives. The review goal is to judge the quality and credibility of the science of the ELM, particularly in its applicability to decision-making for Everglades management. Dr. Bierman emphasized that the model application niche is at the heart of the peer review process.

#### Restoration Coordination and Verification (RECOVER) Program

Kim Chuirazzi, Environmental Scientist (RECOVER Division, CERP Planning Department, SFWMD) and Andy Gottlieb (Everglades Partners Joint Venture, USACE) first explained the missions of the RECOVER program (evaluation, assessment, and planning and integration). The four regional sub-teams were described; the Greater Everglades Sub-Team will be one of the principal users of the model. Activities of the Evaluation Team were explained, with a focus on the development of hydrologic, ecological, and water quality performance measures. These measures serve as quantitative indicators of conditions in natural and human systems. Currently water quality proxies (e.g., STA bypass flow) are being applied by the Evaluation Team, but the presenters described how the ELM could be applied to Greater Everglades Performance Measures to help predict the relative performance of project alternative scenarios. The role of adaptive management in the process was also discussed.

#### ELM Modeling Strategy for CERP Projects

Dewey Worth, Director of CERP project management, discussed the Comprehensive Everglades Restoration Plan (CERP) and the modeling strategy to address projects needs. He explained that there are two basic needs to be addressed in model application: 1) development of an array of alternatives; and 2) benefit comparisons among alternatives. He discussed water quality considerations with respect to the Everglades Restoration Accelerated Projects (Acceler8).

#### Long-Term Plan Goals and Everglades ‘Data Universe’

Jamie Serino, Director of the Everglades Division (Watershed Management Department, SFWMD) explained the Division’s primary research programs, the types of data measured, and how models may be used in Everglades research and accelerated recovery efforts. One research program, the Everglades Long-Term Plan, is focused on achieving compliance with the water quality criteria, including EPA’s phosphorus criterion. Options for accelerating recovery of phosphorus impacted areas were described. Vegetation mapping and “living laboratory” studies were described, and a list of principal types of

measured data was provided. The potential use of ELM in research projects was discussed.

### **Modeling at SFWMD**

An overview of the roles, responsibilities, and activities of the Hydrologic and Environmental Systems Modeling (HESM) Department was provided by Jayantha ('Obey') Obeysekera, Ph.D., P.E., Director. He described the capabilities of the SFWMM or 2x2 Model, which has served for 25 years, and the need for and development of the next generation Regional Simulation Model (RSM). The schedule is based on replacing 2x2 with RSM by 2008. There is some overlap between the RSM and ELM (e.g., both models simulate hydrology). In the future, the RSM and ELM may be part of one model framework.

### **2002 Interagency Review of Everglades Landscape Model**

A summary of the 2002 review of previous versions of the ELM by the interagency Model Refinement Team (MRT) was presented by Ken Tarboton, Past Tri-Chair of CERP RECOVER Model Refinement Team (MRT); Director of Model Development & Implementation Division (HESM Department SFWMD). Dr. Tarboton explained that the MRT was unable to come to consensus on the several issues, including appropriate use of the model and recommendations. There has been much model development since the 2002 review.

### **CERP RECOVER MRT Comments: Responsiveness of ELM v2.5**

Dr. Carl Fitz, Project Manager and Lead Environmental Scientist, Model Application Support Unit (HESM Department, SFWMD) provided a detailed matrix of the MRT reviewers' comments on the ELM v2.1a, with follow up action via ELM v2.5. He indicated that the matrix was prepared before recent comments were received from the Department of Interior. Dr. Fitz linked specific DOI comments to areas in the model documentation where he believed the DOI comments were reasonably well-addressed.

### **Integrated Ecological Assessment Using the ELM**

Dr. Carl Fitz, Project Manager and Lead Environmental Scientist, Model Application Support Unit (HESM Department, SFWMD) presented a detailed description of the goals and objectives of the ELM, examples of how it can be applied, and descriptions of how well it works. He compared model results to hydrology water quality, and ecology data. Dr. Fitz also addressed the question: "Will the model be applied?" in the context of the documentation and peer review process.

### **Model Structure of the Everglades Landscape Model**

Dr. Carl Fitz, Project Manager and Lead Environmental Scientist, Model Application Support Unit (ESM Department, SFWMD) presented details on the conceptual model, source code, and model algorithms. There were many questions from the Panelists during Dr. Fitz's presentations related to various aspects of the model, including bias of model predictions.

#### **4. SUMMARY OF TECHNICAL ISSUES AND QUESTIONS**

During and following the background presentations on Day 1, Panelists had an opportunity to ask questions and discuss issues with SFWMD staff. The outcome of these discussions was a strawman list of issues and questions identified by the Panelists, as shown below. The Panelists agreed that these issues and questions should be addressed in the Peer Review report. All questions posed by Panelists outside of the workshops will be posted along with model developers' responses on the ELM peer review web site.

1. Compatibility between model and available data
  - a. Numbers of state variables
  - b. Levels of process resolution
2. Structure & Function of Habitats
3. Consistency among model time scales
  - a. Time step for numerical solution method
  - b. Temporal resolution for external forcing functions
    - i. Meteorological
    - ii. Physical transport
    - iii. Mass loadings
    - iv. Extreme events/climate change
  - c. Temporal resolution for model outputs
4. What combinations of temporal and spatial resolution should be used for comparisons between computed and observed values?
  - a. Events
  - b. Seasonal
  - c. Annual
  - d. Decadal
5. Weight-of-evidence approach to reality-check model
  - a. Model state variables
  - b. "Approved" performance measures
  - c. Spatial and temporal gradients
  - d. Flow and mass balance components
  - e. Auxiliary variables
    - i. Cesium-137
    - ii. Chloride
    - iii. Carbon?
    - iv. Biomass (e.g., satellite imagery)
      - Use of above-ground photosynthetic biomass?
    - v. Other ecological variables
  - f. Perturbation analyses



6. Influence of boundary fluxes/initial conditions versus internal processes.
  - a. Atmospheric loading
  - b. Canals
  - c. Overland flows
  - d. Sediment-water exchanges
  - e. Water column
  - f. Sediment
  - g. Biomass
7. Influence of advective/dispersive transport versus chemical/biological processes
  - a. Long-term average
  - b. Influence of events
8. System response times
  - a. Washout time in response to zero external mass loadings
  - b. Load-up time in response to zero initial conditions
  - c. Response times to perturbations in external forcing functions
9. Capabilities and limitations of ELM Version 2.5
  - a. Can it be one of the tools used to address management questions?
  - b. Can it be used to address P load-response relationships?
  - c. Can it be used to design STAs?
  - d. Is it better than Best Professional Judgment?
10. Context of ELM and relationship to Everglades restoration
  - a. Provides systems approach
  - b. Identification of data gaps
  - c. Relationships among multiple models (e.g., ELM, RSM)
  - d. Implications of limited resources

## **5. ADDITIONAL INFORMATION REQUESTED BY PANELISTS**

To address some of the issues listed in Section 4, Panelists requested that they be provided with: 1) simulation results under a variety of hypothetical “perturbations” of different phosphorus (P) loads and initial conditions; and 2) spatial summaries of P surface water quality performance characteristics in relation to distance from structure/canal inflow points/vectors.

In response to item No. 1, the model developers will conduct the following five runs:

### **HISTORICAL INITIAL CONDITIONS (Same as the 1981-2000 calibration run)**

1. Double all external P loads.
2. Halve all external P loads.
3. Zero all external P loads.

### **HISTORICAL EXTERNAL LOADS (Same as the 1981-2000 calibration run)**

4. Zero (or near-zero) initial conditions for P concentrations in water, sediment and biota.
5. Doubled (eutrophic) initial conditions for P concentrations in water, sediment and biota.

All five of these runs will be for 20 years (1981-2000) and post-processed results will be provided that compare model responses among the simulations, using many of the same summaries as in Chapter 6, Model Performance, ELM 2.5 Documentation Report. Unprocessed model outputs will also be made available. Results from these five runs will be directly comparable to the "base run" in the ELM 2.5 Documentation Report.

In response to item No. 2, Dr. Bierman will coordinate with the Panelists and model developers to define the spatial summaries in more detail and identify the ELM post-processing tasks that will be necessary to provide the requested additional information.

## **6. DRAFT REVIEW REPORT OUTLINE**

During the workshop, Panelists prepared the following draft outline for the Peer Review Report. The authors for each section are indicated in parentheses. Panelists will prepare a final outline by August 29, and complete the draft report by September 28, 2006. All materials will be posted on the ELM peer review webpage.

### **EXECUTIVE SUMMARY (Mitsch)**

Introduction

Conclusions

Recommendations

### **REPORT BODY**

#### **Model Summary**

Goals, Niche, etc. (Mitsch)

Model Conceptual Framework (Band)

Previous Reviews/Replies of Modellers (Cerco)

Current Model Improvements (Cerco)

#### **Discussion**

Compatibility of Data and Model (Band)

Habitat Choices (Mitsch)

Model Time and Space scales (Cerco)

Reality Check--Calibration/Verification/Validation (Band)

Boundary Conditions/Initial Conditions (Band)

System Response Times/ Perturbation Analysis (Cerco)

Context of ELM and Relationship to Everglades Restoration (Mitsch)

Documentation (Cerco)

Capabilities/Applications/Limitations of ELM 2.5 (Mitsch, Cerco, Band)

## **7. STAKEHOLDER QUESTIONS AND COMMENTS**

Oral comments and questions from stakeholders focused on the goals and objectives of the peer review, contents of the review report, and specific aspects ELM. These comments are summarized below:

- It is important that the Panel provide input on the suitability and applicability of ELM for CERP/RECOVER purposes, including the ability of the model to characterize differences between scenarios. As an example, positive model bias across marsh areas of the interior indicates model under-prediction. Panelists' perspective on the applicability of the model for marsh simulations as it relates to scenario comparisons for management decisions would be very helpful.
- New data for 39 marsh stations are available and consideration should be given to using these data to validate the model. This exercise may help better understand spatial gradients and perhaps help explain the observed increases in Lake Okeechobee phosphorus concentrations over recent years.
- From an end user perspective, clarification from the Panel is needed about the two performance measure descriptions and the proper context for illustrating differences. For example, are the differences that occur over the course of a year justified with the model, or are they more adequately displayed over a 20-year timeframe? If the temporal scale is inappropriate, then what is the appropriate scale?
- Be sure that questions listed in the scope of work are addressed in the review report. Make sure that specific conclusions related to the questions that need answers are not lost in the report recommendations - keep them separate.
- For any model there are "perfect parts" and "not so perfect" parts. The Panel should provide insight into the "not so perfect" parts so that end users understand where they can and can not go with the model.
- The timeline for the review is important, but it is more important to make sure the final product is correct than to meet deadlines. If necessary, consider extending the timeline.
- A stakeholder asked if different phosphorus settling rates are used for different habitat types. Dr. Fitz responded that the particulate settling rate does not vary between habitat types, but there are many other factors affecting phosphorus concentrations. For example, biota types and distribution are a causal factor in spatial attenuation.

[Written comments received from Stakeholders](#) with responses from model developers are posted on the ELM peer review webpage. Additional comments from Stakeholders related to the peer review should be directed to the Scientific Facilitator of the Peer Review (Dr. Victor J. Bierman, Jr. of Limno-Tech/HydroQual, LLC., [vbierman@limno.com](mailto:vbierman@limno.com)). All comments and responses will be posted on the ELM peer review webpage.

## 8. REFERENCES

- H. Carl Fitz and B. Trimble. 2006a. Documentation of the Everglades Landscape Model: ELM v2.5. *Overview Version of Full Report*. Hydrologic & Environmental Systems Modeling Department, South Florida Water Management District. July 10.
- H. Carl Fitz and B. Trimble. 2006b. Documentation of the Everglades Landscape Model: ELM v2.5. Hydrologic & Environmental Systems Modeling Department, South Florida Water Management District. July 10.