

ELM high-level metadata

General Information

Model Name(s)

Everglades Landscape Model (ELM): full regional application
Conservation Area Landscape Model (CALM): ELM application in WCA-2A
General Ecosystem Model (GEM): non-spatial, “unit” model (obsolete, not updated in Stella™ since version 0.5beta)

Current Version number: 2.1a

Version 2.1 -> 2.1a update: Aug 1, 2002
documentation update, public release
Version 2.0 -> 2.1 update: March 1, 2000
code/performance update

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Objectives

General: The ELM is a regional scale ecological model designed to predict the landscape response to different water management scenarios in south Florida, USA. The ELM simulates changes to the hydrology, soil & water nutrients, periphyton biomass & community type, and vegetation biomass & community type in the greater Everglades region.
ELMv2.1a: Hydrology and surface water quality (total phosphorus) Performance Measures for Greater Everglades region at 1.0 km² spatial grain

Simulation Environment

Language

ANSI C

Code project built around multiple modules within multiple source files

Solution method(s)

Spatially distributed; deterministic; continuous simulation; finite difference using Euler integration

Units

all metric, but translation into English units for some hydrologic output

GUI

no graphic interface; uses numerous Unix shell scripts

Platform(s)

OS for model development and application: Unix (Sun Solaris) or Linux

OS for input data pre-processing:

minimum required for application: Unix/Linux

preferred: Windows NT; (Macintosh can be used for all but ArcInfo GIS)

OS for automated model post-processing:

currently Macintosh OS 9/X (using AppleScript)

updating to Unix/Linux OR Windows NT (using Python and IDL)

Software applications**

Compiler: currently developed and applied using Sun Forte Developer 6 (code optimization, profiling, debugging); ELM code project can be built/executed w/o code or library changes under gcc v. 2.95 for Sun Solaris; other gcc versions under different Linux suites are being tested

Below applications are used to export text (or generic binary) files for input to model, and/or for post-processing; **these applications are not required to change parameters/input data and run simulation, but enhance useability of model

FileMaker Pro: (Windows/Macintosh) desktop database application used in 3 databases

GRASS (Open Source) GIS, migrating to ArcInfo: used for all spatial data storage etc

OpenOffice or MS Excel: used in some pre- and post-processing

IDL: used in spatial post-processing; however, any spatial evaluation software (e.g., most GIS) that can read generic binary data arrays can be used to view spatial output

Python: Open Source, object oriented (Window/Unix/Linux/Mac) scripting application for post-processing of text output files

Stella and Madonna: these (Windows/Macintosh) non-spatial, or unit-model, simulation environments are **not currently used/supported** by ELM project; may update future ELM documentation by updating the Stella unit model to reflect ELM code

Spatial domain

Vertical

3 dynamic vertical layers (saturated, unsaturated, surface storages)

Datum

vertical: 1929 NGVD

Horizontal

Datum

horizontal: 1927 NAD

Geographic domain (regional ELM)

UTM zone 17
 northing: 2953489
 southing: 2769489
 easting: 580711
 westing: 472711

Scalable

Grid size and spatial extent may be modified w/o source code changes
 Rescaled applications preferably within regional domain extent

Application: Regional, Greater Everglades

Implementation Name

ELM

Spatial extent

10,394 km²

Spatial grain

1 km² square grid cells

Description

Default CERP regional application domain.

Generally restricted to “natural” (non-urban/ag) wetland/upland regions, including all Water Conservation Areas, Holey Land, (most of) Rotenberger Tract, (most of) Big Cypress National Preserve, and (most of) Everglades National Park

Application: Subregional, WCA-2A

Implementation Name

CALM

Spatial extent

433 km²

Spatial grain

0.25 km² square grid cells

Description

Water Conservation Area 2-A

Temporal domain

Extent

Calibrate/validate

17 (soon 22) year period of record: 1979-1995 (-2000)

Application

31 (soon 36) year period of record: 1965-1995 (-2000)

Grain

Vertical solutions (ecology): 1 day time step

Horizontal solutions (water & constituent flux):

Overland flow: 2 hr @ 1 km² grid

Groundwater flow (& surface/ground integration): 2 hr @ 1 km² grid

Canal-cell-water control structure flow: 2 hr @ 1 km² grid

Documentation

General

web-based

Publications

peer reviewed ms: see Publications section of web site

reports: see Publications section of web site

Other peer review

SCT/RECOVER: pending

Model code

General

modular

ANSI C

unix/linux

available from web site

Vertical solutions

Global forcings

Hydrology

Periphyton/algae

Macrophytes

Standing dead detritus

Soil

Floc

P in water

Salt in water

Horizontal solutions

Water management

Surface & ground water flows

Fire

Habitat succession

Utilities

Budget & mass balance error analyses

Statistical (spatial and temporal) analyses

Input data

General

Databases, GIS apps

available from web site

Spatial maps

- IC Soil TP concentration
- Soil Bulk Density
- IC Soil Organic Bulk Density
- IC Vegetative habitats
- IC (Initial Condition) Surface Water Depth
- IC Unsaturated Water Depth
- IC Land surface elevation
- IC Multi-use Multiplier
- Aquifer hydraulic conductivity
- Phosphorus settling velocity (not used in normal ELM run)
- Basin/Indicator Regions
- Boundary Condition Identifiers
- Model domain identifier A (binary)
- Model domain identifier B (text)

Fixed parameters

- Driver (runtime) specifications
- Output (runtime) specifications
- Global ecological parms
- Habitat-specific ecological parms
- Water control structure attributes
- Canal/levee locations and attributes
- Meteorological station locations
- Basin/Indicator region flow definitions (only for basin-basin error-checking)

Time-varying forcings (inputs)

- Rainfall (daily spatial time series data)
- Meteorological – other (daily point data, interpolated during runtime)
- Water control structure flows (daily point data, all structures in domain)
- Water control structure TP concentrations (daily point data, domain boundary only)

Calibration data

General

Varying spatio-temporal grain, extent, and quality depending on variable

Hydrology

>40 stage monitoring locations with daily observations throughout region
relatively continuous records 1979-2000

Phosphorus: water column

>40 water quality monitoring locations with bi-weekly/monthly observations throughout region
heterogeneous temporal frequency depending on station, decade, and location

Phosphorus: soil

WCA-1: relatively fine-scale spatial sampling event in early 1991; update in 2002/03
WCA-2A: extremely limited spatial sampling in late 1970s; relatively fine-scale spatial sampling event in early 1991; relatively fine-scale spatial sampling event in 1997; update in 2002/03
WCA-3A&B: relatively fine-scale spatial sampling event in early 1991; update in 2002/03
Regional (WCAs, Holey/Rot, most of BCNP, most of ENP) : four (4) sparse spatial sampling events in 1995-96; update in 1998

Soil accretion

WCA-2A and WCA-3A: point location Cs137 sampling for long-term (1965-1990s)

Periphyton: biomass/biovolume, chemistry, community type

WCA-2A transects 1996-2000
WCA-1 transects 1996-2000
WCA-3A transects 1998-2000
Trexler spatial sampling
Taylor Slough transects
ENP flumes (199x-2000)
C-111 transects

Macrophytes: biomass, chemistry

WCA-2A transects 1996-2000
ENP flumes (199x-2000)
C-111 transects

Macrophytes: community type

WCA-1: Satellite classification 1990
WCA2A: photointerpretations, 1991, 1995
WCA3, ENP, BCNP: photointerpretations, 1995
Holey Land and Rotenberger Tract:
Other (e.g., WCA-2B, small subregions) FLUCSS 1995

Model performance

Sensitivity

Methods: multi- scale analysis (non-spatial, subregional, regional)

Results: See Publications section of web site

Calibration

Data sets

- Stage (point data)
- Surface water TP conc. (point data)
- Soil TP conc. (spatial maps)
- Soil accretion/elevation (spatial maps/point data)
- Habitats (spatial maps)

Results

- ELM v1.0: see Publications section of web site
- ELM v2.1: see Publications and Results sections of web site
- ELM v.2.x: pending 2000 update

Validation

Data sets: update to 2000 (from 1979-1995)

Results: pending data acquisition

Model application

General

Boundary conditions required from SFWMM (for applications, not for calibration etc.)

?Outputs from DMSTA?

?Future inputs to ATLSS?

Pre-processing

Water control structure flows

Stage (at domain boundaries)

Nutrient concentration in STA outflows

Nutrient concentration in non-STA source waters (if any)

Runtime

Regional ELM (10,394 cells): ~25 min/year (on Sun UltraSparc architecture, 200 Mhz)

Sub-regional ELM in WCA-2A (1,734 cells): ~10 min/year (on Sun UltraSparc architecture, 200 Mhz)

Post-processing

Point locations

Basin/Indicator region budgets

Basin/Indicator region summary variables

Spatial

Distribution of results

Web site posting