1-2015

NRSM 532.01: Forest Ecosystem Analysis

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SYSTEMS ECOLOGY MODEL LOGIC (NRSM 532, BIOS 534)

Spring 2015

Professor: Steven Running
Teaching Asistant: Matt Jones x6706
SC 428, Phone: 243-6311
Text: Forest Ecosystems: Analysis at Multiple Scales (2007), by R.H.Waring and S.W.Running.

DATE	SESSION	CH	TOPIC
1/27	1	1	Ecosystem modeling principles
1/29	2	1	Space/time scaling principles
2/3	3	2	Climatology 1
2/5	4	3	Spatial Climatology
2/10	5	7	Energy budgets
2/12	6	7	Comparing Ecosystem Models
2/19	7	-	CLASS MODEL SUMMARIES
2/24	8	2	Water Cycle
2/26	9	3	Carbon Cycle 1
3/3	10	3	Carbon Cycle 2
3/5	11	4	Nutrient Cycles 1
3/10	12	4	Nutrient Cycles 2
3/12	13	5	Succession models – stand development
3/17	14	5	Forest carbon credit models
3/19	15	6	Biotic Disturbances
3/24	16	6	Abiotic Disturbances
3/26	17	7	Regional scaling logic
3/31	Spring Break		
4/1	Spring Break		
4/7	18		CLASS MODEL ANALYSES 1
4/9	19		CLASS MODEL ANALYSES 2
4/14	20	7	Remote sensing principles
4/16	21	7	Landcover change
4/21	22	8	Regional biogeochemistry
4/23	23	8	Vegetation – atmosphere models (GCM Land)
4/28	24	10	Fluxtower validation
4/30	25	9	Global carbon cycle
5/5	26	10	Climate Change projections
5/7	27	-	Assessment models
5/12	28		FINAL PROJECTS
5/16	29		FINAL PROJECTS

LEARNING GOALS AND OUTCOME

Computer modeling is possibly the most common means of studying ecological systems, because one can never measure all relevant functions of a complex system. The learning outcome I desire is for each student to achieve an ability to analyze any new ecosystem model they might encounter for stated purpose, key assumptions, structural organization and logic, critical limitations and limits of applicability. Secondly I want each student to be able to evaluate

whether their own research would be enhanced by modeling their ecosystem and where they might find a candidate model to start from.

NRSM 532 CLASS PROJECTS

CLASSWORK RESPONSIBILITIES (this is what your grade is based on)

1] DISCUSSION during class

2] First Model Summary Exercise.
I will help each of you choose an ecosystem model relevant to your own studies, and guide you to where the model is published. You will prepare a brief summary of the model using the ppt template I provide to give in class on Feb 19. We will then, as a class, evaluate each of these models for their conceptual basis, appropriate uses, key assumptions, input requirements etc.

3] Detailed model analysis.
Next, I want each of you to choose a *different* model from your first, and do a more detailed analysis. I want you to choose a well-documented and widely-used ecosystem model and evaluate it carefully. Summarize the stated objective and purpose of the model, key assumptions, the domain of interest in time and space, necessary inputs, model structure, connections, flowchart, the most important outputs, testing and validation and finally examples of uses that have been published. I expect this report to be 5-10 pages long, with appropriate graphics showing the model, validation, references, science done with the model etc.
DUE: 7 April

4] Final project. To develop your own skills in systems analysis, I want each student to try a first conceptual layout of an ecosystem analysis problem of your choice, with objectives, assumptions, domain, logical flowchart, key cause-effect linkages and references. This class project will be the basis for our "final", as each student will present their project to the class verbally, and in written form to me.
Remember from lecture 1 the general purposes of systems modeling:
- **to analyze the entire system holistically**
- **to understand connections and causality**
- **to organize field data**
- **to prioritize future data collection**
- **to generalize beyond the study site**
- **investigate manipulations and perturbations**
- **predict future system behavior**
And seven steps to model development we looked at:
 1. **Define the question**
 2. **Bound the question – model objective**
 3. **Develop a conceptual model**
 4. **Determine the equations that define the process**
 5. **Computer implementation and parameterization**
 6. **Model testing and implementation**
 7. **Make conclusions**

DUE: Finals week (May 12-16) for class presentations, and a written report.

Examples of Systems Ecology MODELS for NRSM 532/BIOS 534

Each of these models has a history of journal publications, validation, testing, open source code and documentation.

Stand Level models
Biome-BGC – multi scale ecosystem biogeochemical cycles
http://www.ntsg.umt.edu/project/biome-bgc
FIRE BGC – a version of Biome-BGC that incorporates fire disturbance and successional processes
FVS-BGC and TREE-BGC – forest inventory driven hybrid models

Century and DAYCENT – a grassland biogeochemical cycling model
http://www.nrel.colostate.edu/projects/century/

ED – a forest model of stand demographics
http://www.oeb.harvard.edu/faculty/moorcroft/data_sets/ed_2.1/

TEM – a terrestrial ecosystem model of biogeochemical dynamics
http://ecosystems.mbl.edu/tem/

DLEM – dynamic land ecosystem model
https://fp.auburn.edu/sfws/esra/models/models_dlem.htm

StandCarb – forest carbon budget
http://andrewsforest.oregonstate.edu/pubs/webdocs/models/standcarb2/intro.htm

Watershed - Regional level models
RHESSYS – a regional scale hydro-ecological simulation that routes streamflow
http://fiesta.bren.ucsb.edu/~rhessys/

VIC – a hydrologic and water management model
http://www.hydro.washington.edu/Lettenmaier/Models/VIC/

HEC-RAS – watershed management model

MOD 17 – satellite data driven calculation of terrestrial plant production
http://www.ntsg.umt.edu/project/mod17

3PGS – a simple satellite driven physiologically based model of forest growth

Ecopath and Ecosim – aquatic ecosystem and fish management model
http://ecopath.org/

CERES Wheat - Wheat crop growth and yield model
http://nowlin.css.msu.edu/wheat_book/

Global models
NCAR CLM – a land biophysical process model that works in a GCM
https://www2.cesm.ucar.edu/working-groups/lmwg

IBIS – Integrated Biosphere Simulator in a GCM
http://www.sage.wisc.edu/download/IBIS/ibis.html

Orchidee – a DGVM http://labex.ipsl.fr/orchidee/

LPJ – a dynamic global biome and vegetation model
http://www.nateko.lu.se/lpj-guess/education/

MC1 and MAPSS – ecosystem biogeography model from Oregon State

Ecosystem service – socioeconomic models
Invest – an ecosystem services model for water, carbon, and biodiversity
http://www.naturalcapitalproject.org/models/models.html

2052 – a global socio-economic model http://www.2052.info/

MAGICC – a global integrated assessment model
http://www.cgd.ucar.edu/cas/wigley/magicc/

IGSM - MIT IGSM Integrated Global Assessment Model
http://globalchange.mit.edu/research/IGSM

DICE – Dynamic Integrated Model of Climate and Economics, Nordhaus
http://www.econ.yale.edu/~nordhaus/homepage/dicemodels.htm

IMAGE Global integrated assessment model
http://themasites.pbl.nl/tridion/en/themasites/image/

FUND Climate Framework for Uncertainty, Negotiation and Distribution (FUND) is a so-called integrated assessment model of climate change.
http://www.fund-model.org/

PAGE

EPIC – agricultural crop model

There are many, many others, feel free to suggest one you are interested in.