Environmental Analysis Methods 1 – Fall 2016

Head Instructor: Amgad Elgowainy

Schedule: Mondays and Wednesdays 10:30-11:50 am

Instructors:

- Introduction: Charles Macal
- Pathway Analysis (PA): David LePoire
- Lifecycle analysis (LCA): Amgad Elgowainy
- Climate and Policy- Megan Clifford

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Student Hours: TBD

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Course website: course reading material will be posted online 2 weeks before lessons start.

Course Description: The course objective is to introduce and familiarize the students with the analytical approaches and methods of environmental analysis and assessment used to support decision-making and the development of policies and regulations at local, regional, national, and global scales. Beginning with the introduction of the "environment" as a complex system, an overview of the linkages among the various approaches for environmental analysis and assessment, and the discussion of climate change science as a complex system within the science-policy context, the course will then provide an introduction to pathway analysis of contaminant releases to the environment, and finally to lifecycle analysis as a method to assess energy, material inputs and environmental releases, and their impacts associated with all stages of a product/process's life.

Course Requirements: The course has two requirements: participation, and the development of an individual project that spans through the three main focus areas of the course.

- Participation- Attendance and participation to all classes is required
- Project assignment - Each student will develop an individual project for the duration of the course.

Exams: There will be a midterm exam where students will present progress on their individual project, and a final exam in the form of a formal presentation of project results.

Course Materials: There are a number of environmental science text books that discuss the various problems addressed in the classes but no single text book will cover all these issues. Reading and studying materials are provided in the table below. Further reading materials will be identified as classroom material is developed.

Grades: Final exam: 70%, Midterm exam: 30%. To appeal a grade, provide reasoning in writing via email to Instructor, within one week of classes since grading. Instructor will decide if to regrade the entire exam.

Date	Content	Instructor	Reading/Studying Materials
Lesson 1 9/26	Introduction to course content and rationale, course structure and content relationship, why knowledge of methods is important. Environmental science as a complex system science *Presentation of project topics*	Macal	Sterman, J. D. 2001. **System Dynamics Modeling: Tools for Learning in a Complex World,** *California Management Review* 43(4):8-25 Sterman, J.D. (2011) **Communicating Climate Change Risks in a Skeptical World**. *Climatic Change*. DOI 10.1007/s10584-011-0189-3.
Lesson 2 9/28	Introduction to complex systems, systems principles Causal modeling and system dynamics Background on climate change	Macal	**The Climate Change Controversy** https://gpwayne.wordpress.com/ **Nations approve historic global climate accord,** Nature, Jeff Tollefson & Kenneth R. Weiss, 12 December 2015 http://www.nature.com/news/nations-approve-historic-global-climate-accord-1.19021 **John Sterman on the Paris climate accord WGBH TV**: http://wgbhnews.org/post/will-cop21-climate-deal-save-world
Lesson 3 10/3	Climate Change-- Systems Modeling Application *Students select their project*	Macal	Ford, Andrew (2010) **Modeling the Environment**, 2nd ed. Island Press. Goosse H., P.Y. Barriat, W. Lefebvre, M.F. Loutre and V. Zunz, (2008-2010). **Introduction to climate dynamics and climate modeling.** Online textbook available at http://www.climate.be/textbook.
Lesson 4 10/5	Climate change – People and Policy	Clifford Macal	
Lesson 5 10/10	Introduction to environmental transport pathways, groundwater, surface water, air, etc. Examples from radiological assessment.	LePoire	Fate and Transport Models:
Lesson 6 10/12	Application of specific models in an integrated software package- RESRAD.	LePoire	Software: RESRAD (onsite)
Lesson 7 10/17	Identifying scientific and regulatory uncertainties. Understanding role of	LePoire	Probabilistic Risk Analysis for a High-Level Radioactive Waste Repository

	conservative assumptions and sensitivity analysis.		Balancing Realism and Conservatism
Lesson 8 10/19	Specific Cases: Rocky Flats, Yucca Mtn, Risk Debate	LePoire	Radioactive contamination from the Rocky Flats Plant Yucca Mountain nuclear waste repository Radiation Hormesis:
Lesson 9 10/24	Other contaminants; Mercury, PCBs, Lead.	LePoire	Case Study: Clair Patterson Global Mercury Assessment Fate and Transport Modeling of Sediment Contaminants
Lesson 10 10/26	Other uses: mitigation analysis, Bayesian sampling for compliance. Emergency decision support tool.	LePoire	Emergency Decisions Bayesian
Lesson 11 10/31	Environmental pathways issues, and trends. Progress reports from student projects	LePoire	Threading the Environmental Needle
Lesson 12 11/2 MIDTERM	*In class project proposal presentation and discussion*	*All instructors*	
Lesson 13 11/7	Introduction to Lifecycle analysis (LCA) of energy systems and relevance to environmental sustainability and policy making	Elgowainy	https://greet.es.anl.gov/publication-c2g-2016-report
Lesson 14 11/9	LCA scope, methodology, calculations, and models	Elgowainy	https://greet.es.anl.gov/publication-c4z3r4c2 (pages 1-19)
Lesson 15 11/14	Introduction to the GREET® model	Elgowainy	https://greet.es.anl.gov/publication-c4z3r4c2
Lesson 16 11/16	Hands-on training of GREET® tool	Elgowainy	https://greet.es.anl.gov/index.php?content=greetdotnet
Lesson 17 11/21	LCA applied to transportation energy systems: petroleum and fossil-based fuels	Elgowainy	-Elgowainy, et al. (2014) "Energy Efficiency and Greenhouse Gas Emissions Intensity of Petroleum Products at US Refineries,"

			Environmental Science and Technology, doi: 10.1021/es5010347. -Forman, et al. (2014) "US Refinery Efficiency: Impacts Analysis and Implications for Fuel Carbon Policy Implementation," *Environmental Science and Technology,* doi: 10.1021/es501035a.
Lesson 18 11/23	LCA applied to transportation energy systems: biofuels and electric vehicles	Elgowainy	https://greet.es.anl.gov/publication-xkdaqgyk
Lesson 19 11/28	Critical issues impacting LCA outcome for various energy systems	Elgowainy	Wang, M., et al., Methods of dealing with co-products of biofuels in life-cycle analysis and consequent results within the U.S. context. Energy Policy (2010), doi:10.1016/j.enpol.2010.03.052
Lesson 20 *11/30*	Recap of LCA and questions on final project	Elgowainy	
FINALS 12/5	*Final project presentation (group I)*	*All Instructors*	
FINALS 12/7	*Final project presentation (group II)*	*All Instructors*	