Environmental change in the big-data era

Environ 89S; spring 2023
James S Clark, Nicholas School of the Environment, Department of Statistical Science
Lauren Jenkins, TA

89S courses are seminars. This semester we confront the science behind the changes happening now and where they are leading us. This course combines key topics in climate change, biodiversity, and big data, examining scientific issues, their importance for the public at large, and how well we understand them. 89S courses focus on student discussions. In this case, discussions consider a combination of scientific literature, contemporary media, and analysis of data. Our first meeting provides logistics for the class and introduces the software package R.

Course objectives
- Articulate climate and biodiversity change happening now
- Evaluate how information on environmental change is generated and interpreted
- Learn and apply the language R to basic modeling problems
- Analyze and critique the evidence

Students will have learned skills to
- Recognize basic types of data and methods used to analyze them
- Gain a first exposure to concepts in modeling and computation
- Incorporate analyses into discussion and debate

Format
- Class activities:
  - Overview lecture material from vignettes
  - Discussion/debate of readings from science and the media
  - Data analysis in R
- Three vignettes:
  - Rising CO2, climate change, and who pays?
  - Declining biodiversity: climate, agriculture, and other stressors
  - Fisheries declines

Cross-cutting themes
Data sources
- Monitoring networks
- Citizen science

Inferring cause, predicting change
- Foundations: classical statistics, probabilistic (Bayesian) modeling, machine learning
- Quantifying relationships, prediction: trends, sensitivity, interactions, hidden variables
- Big data: special challenges

Assignments

- Questions based on readings and data applications are included with each vignette. Answers will be posted to Sakai by each student prior to meetings. Group coordinators will summarize for the full class.

Grading

- 30% Participation in discussions: *including as coordinator and in debates*
- 45% Group and individual assignments: *mostly short answer*
- 25% Final presentation and report: *includes your reviews of colleague presentations*

Schedule

		Topics	Tools	due
jan	11	1. Overview	background concepts and R	
	18	2. CO2 emissions and global warming	Discussion, R tutorial	
	23	3. Mauna Loa data	Working group analysis	
	26	4. Extreme weather	Working group analysis	
	30	5. Extreme events	Discussion, background research	#3
feb	1	6. Debate preparation	Discussion, extreme events report	#4
	6	7. Debate	Debate	#5
	8	8. Biodiversity Intro	Megafauna	
	13	9. Megafauna continued		#6
	15	10. Birds-eye view on the biodiversity crisis	Breeding bird survey	#7
	20	11. Discussion: scientific evidence	BBS data	#8
	22	12. BBS data: trends	Ebird data	
	27	13. Endangered species act	Debate prep	
mar	1	14. ESA debate	Debate	
	6	15. Fisheries on the brink	Background research	#9-11
	8	16. Data exploration	Background research	#12
	20	17. Fisheries trends	Prepare final presentation	
	22	18. Overfishing North Carolina	Exploratory data analysis	#13, 14
	27	19. Fisheries debate prep	NC Marine fisheries in court	
	29	20. Fisheries debate	Final presentation outline due	
apr	3	21. Population growth		#15
	5	22. Population growth discussion	Background for Vanuatu	#16
	10	23. Vanuatu's request for the Internl Court	Debate Prep	#17
	12	24. Vanuatu debate	Draft final presentations	
	17	25. International court of Justice	Final outline	
	19	Prepare final presentation	Working groups	#18
	24	Final presentations		
	26	Final presentations	Final papers due, Course evals	