Environmental change in the big-data era

Environ 89S; spring 2022
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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
- 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 of readings from science and the media
  - Data analysis in R
  - Debate current issues, bringing in the science
- 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 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

<table>
<thead>
<tr>
<th>Date</th>
<th>Topics</th>
<th>Tools</th>
<th>due</th>
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<tbody>
<tr>
<td>Jan  6</td>
<td>1. Overview</td>
<td>background concepts and R</td>
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<tr>
<td>Jan 11</td>
<td>2. CO2 emissions and global warming</td>
<td>Discussion, R tutorial</td>
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<tr>
<td>Jan 13</td>
<td>3. Mauna Loa data</td>
<td>Working group analysis</td>
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<tr>
<td>Jan 18</td>
<td>3. Mauna Loa data</td>
<td>Working group analysis</td>
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<tr>
<td>Jan 20</td>
<td>4. Extreme events</td>
<td>Code and interpretation</td>
<td>#3</td>
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<td>Jan 25</td>
<td>5. Drought, flood, fire, hurricanes</td>
<td>Discussion, extreme events report</td>
<td>#4</td>
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<td>Jan 27</td>
<td>6. Who’s fault? NY city vs big oil</td>
<td>Debate preparation</td>
<td>#5</td>
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<tr>
<td>Feb  1</td>
<td>7. Climate change science</td>
<td>1:00 pm: register</td>
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<td>Feb  3</td>
<td>8. Debates</td>
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<td>Feb  8</td>
<td>9. Discussion: scientific evidence</td>
<td>BBS data</td>
<td>#7</td>
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<td>Feb 10</td>
<td>10. eBird evidence</td>
<td>EBird data</td>
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<td>Feb 15</td>
<td>11. BBS data</td>
<td>Hurricane impacts, trends over time</td>
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<td>Feb 22</td>
<td>12. Which species in decline?</td>
<td>BBS data, GLMs, interactions</td>
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<td>Feb 24</td>
<td>13. Breeding-bird data</td>
<td>Synthesis discussion</td>
<td>#9-11</td>
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<td>Mar  1</td>
<td>14. Endangered species act background</td>
<td>Prepare position statements</td>
<td>#12</td>
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<td>Mar  3</td>
<td>15. Debate</td>
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<td>Mar 10</td>
<td>16. Fisheries on the brink</td>
<td>ESA rebuttals</td>
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<td>Mar 22</td>
<td>17. Seasonal trends</td>
<td>Exploratory data analysis</td>
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<td>Mar 24</td>
<td>17. Seasonal trends</td>
<td>Paragraphs on Fisheries response</td>
<td>#15</td>
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<tr>
<td>Mar 29</td>
<td>17. Seasonal trends</td>
<td>Paragraphs on Fisheries response</td>
<td>#16</td>
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<td>Mar 31</td>
<td>18. Debate</td>
<td>Interactions, Debate preparation</td>
<td>#17</td>
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<td>Apr  5</td>
<td>19. Prepare final presentation</td>
<td>Working group rebuttals</td>
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<td>Apr  7</td>
<td>20. Final presentations</td>
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<td>Apr 12</td>
<td>20. Final presentations</td>
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<td>Apr 19</td>
<td>20. Synthetic discussion</td>
<td>Final papers due, Course evals</td>
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