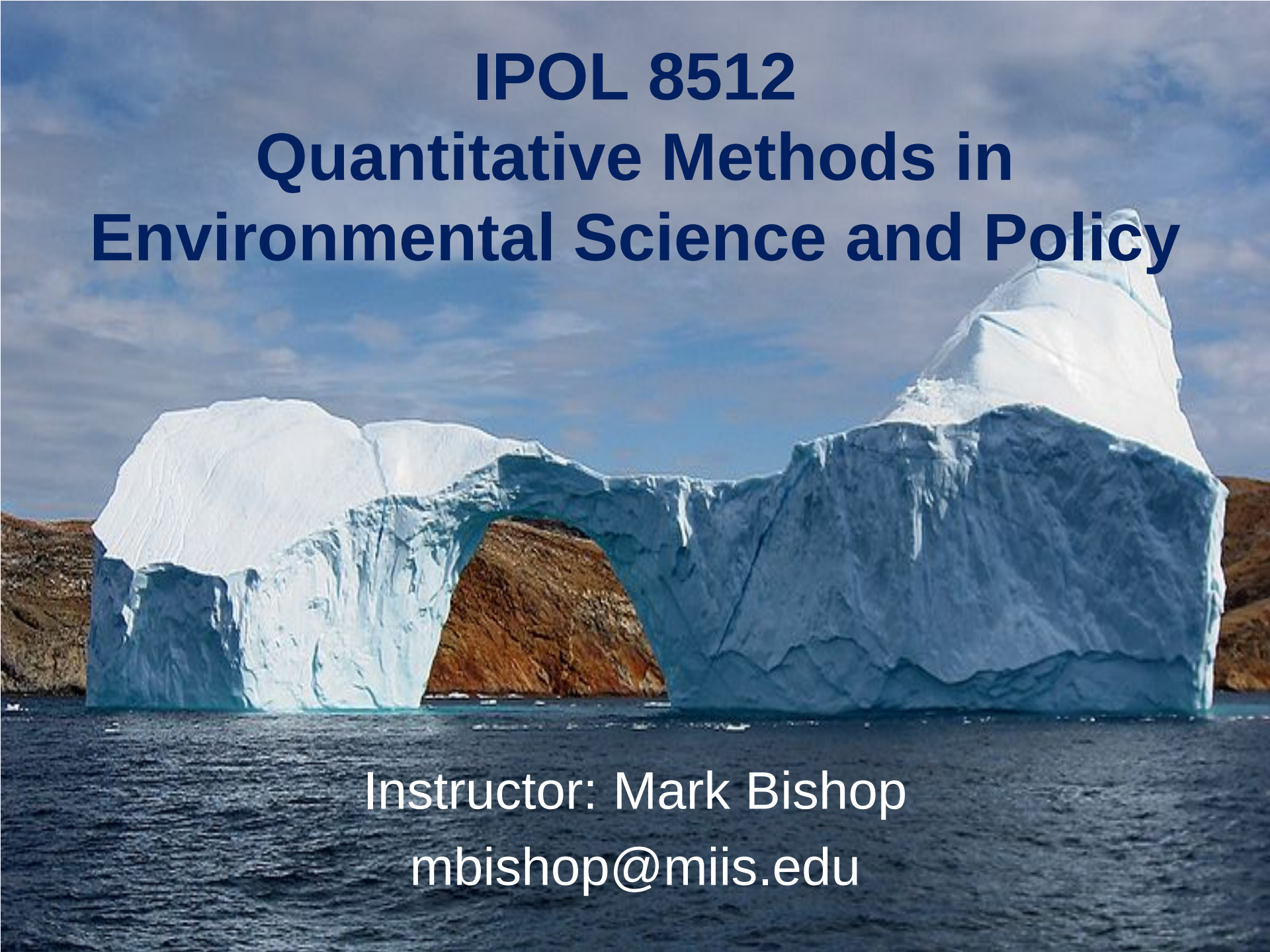
IPOL 8512
Quantitative Methods in Environmental Science and Policy



Instructor: Mark Bishop
mbishop@miis.edu

Course Description

- Introduces the use of ***quantitative methods*** in environmental analysis.
- Learn how to apply ***basic principles of natural science*** to a variety of globally important environmental problems.
- Topics covered include estimation techniques and stock-flow modeling; population and resource use; biogeochemical cycles; acid deposition; climate change; stratospheric ozone depletion; toxic pollution and public health; and radiation and radioactivity.
- Not only for aspiring environmental scientists and engineers, but also for those working in public policy, environmental law, ecological economics, international development, business, and journalism.

Information

- No prerequisites
  - Less math and science background = more time spent
- Class
  - 4 Credits
  - Tue-Thu 2:00-3:50 pm
  - Classroom: MRSE B104
- Instructor: Mark Bishop
  - mbishop@miis.edu or bishopmark@comcast.net
  - 831-241-8327
  - http://institutebishop.org/quant.htm
  - TA: Laura Henson
  - lhenson@miis.edu

Course Work

- Readings
- Homework
- Midterm exam and final exam

- See schedule

  http://institutebishop.org/quant_schedule.htm

Textbooks

- John Harte, ***Consider a Spherical Cow: A Course in Environmental Problem Solving***, University Science Books, 1988

  http://www.uscibooks.com/harte.htm
- Gilbert Masters and Wendell Ela, ***Introduction to Environmental Engineering and Science***, 3rd ed., Pearson Education, 2008
- John Harte et al., ***Toxics A to Z: A Guide to Everyday Pollution Hazards***, U.C. Press, 1991
- Daniel Botkin and Edward Keller, ***Environmental Science: Earth as a Living Planet***, 6th ed., John Wiley & Sons, 2007 *(optional)*
- Mark Bishop, ***An Introduction to Chemistry, Second Edition***, Chiral Publishing Company (optional)
  - textbook to loan for the duration of the course
  - textbook to keep after the course at http://preparatorychemistry.com/Bishop_Payment_MIIS.htm
  - Online versions of the text and study guide can be found at

    http://preparatorychemistry.com/Bishop_Chemistry_First.htm

Other Resources

- John Harte Spring 2009 Lectures

  http://itunes.apple.com/itunes-u/energy-resources-group-102/id461123544?mt=2
- *Cool the Earth: Save the Economy* by John Harte

  http://www.cooltheearth.us/download.php
- Student membership in the American Association for the Advancement of Science (AAAS), $75 includes a subscription to *Science*.

  http://www.aaas.org/membership/m_categories/
- Many more to come

Grades

- Problem Sets: 40%
- Midterm Exam: 25%
- Final Exam: 35%
- *Any student who attends all lectures, takes both exams, and hands in all problem sets having made a bona fide attempt to solve each problem, will receive a passing grade*.

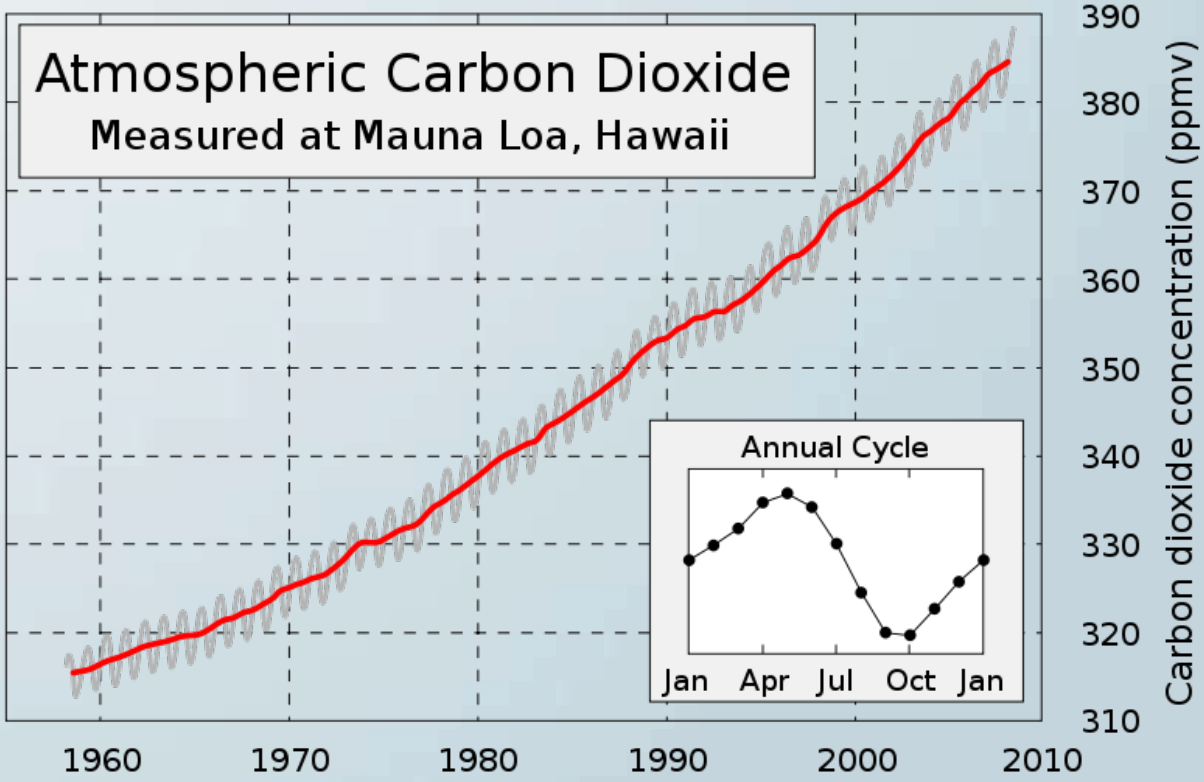
Human Dominated Ecosystems

Information from
Vitousek et al, Human Domination of Earth's Ecosystems,
Science Vol 277, 1997

- Land Transformation – 39-50% of vegetated surface
  - 10-15% of Earth's land surface agriculture or urban-industrial
  - 6-8% pastureland
  - Harvested forests
  - Primary driving force behind loss of biodiversity
- Oceans
  - 1995 – about 22% of recognized marine fisheries overexploited or already depleted
  - Human causes of destructive algae blooms

Human Dominated Ecosystems

- Biogeochemical Cycles
  - Carbon – CO_2 concentration increased from 315 ppm in 1957 to 392 ppm in 2011 – 30% increase from pre-industrial era



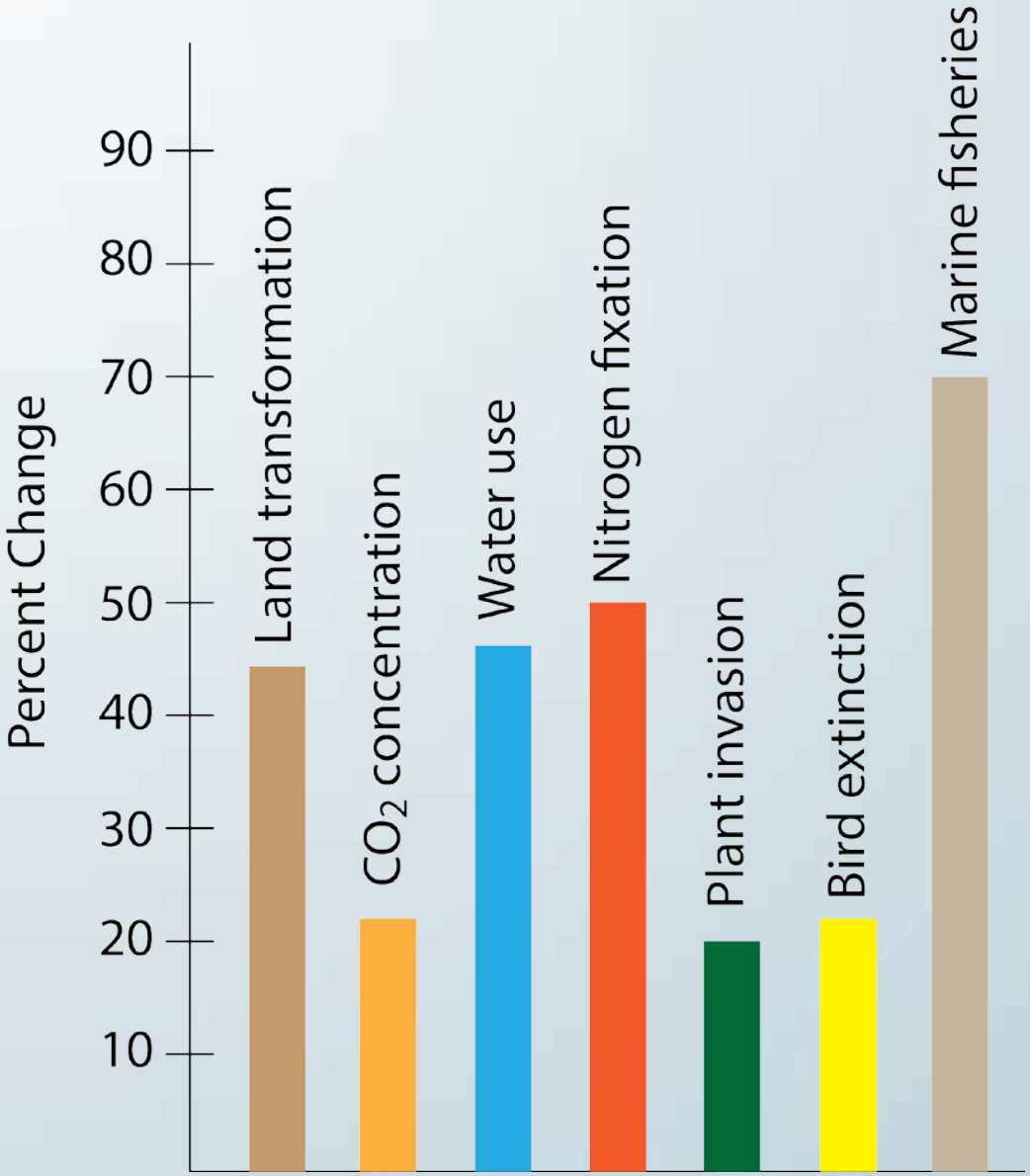
Human Dominated Ecosystems

- Biogeochemical Cycles
  - Water
    - U.S. only 2% of rivers run unimpeded
    - As much as 6% of Earth's runoff is evaporated due to human manipulations
    - About ¾ of Saudi Arabia's water from fossil water
  - Nitrogen fixation
    - Human activities (e.g. production of ammonia for fertilizers, conversion of nitrogen to nitrogen oxides in fossil fuel combustion, and others) add at least as much fixed nitrogen to terrestrial ecosystems as do all natural sources.

Human Dominated Ecosystems

- Biotic Changes
  - Rates of species extinctions 100-1000 times greater than before human dominance of the Earth.
  - As many as ¼ of bird species driven to extinction by human activities
  - 11% of remaining birds,18% of mammals, 5% of fish, 8% of plant species are threatened with extinction.
  - Rearrangement of Earth's biotic systems, mixing flora and faunas.

Some Measures of Human Impact



Vitousek et al, Human Domination of Earth's Ecosystems, Science Vol 277, 1997

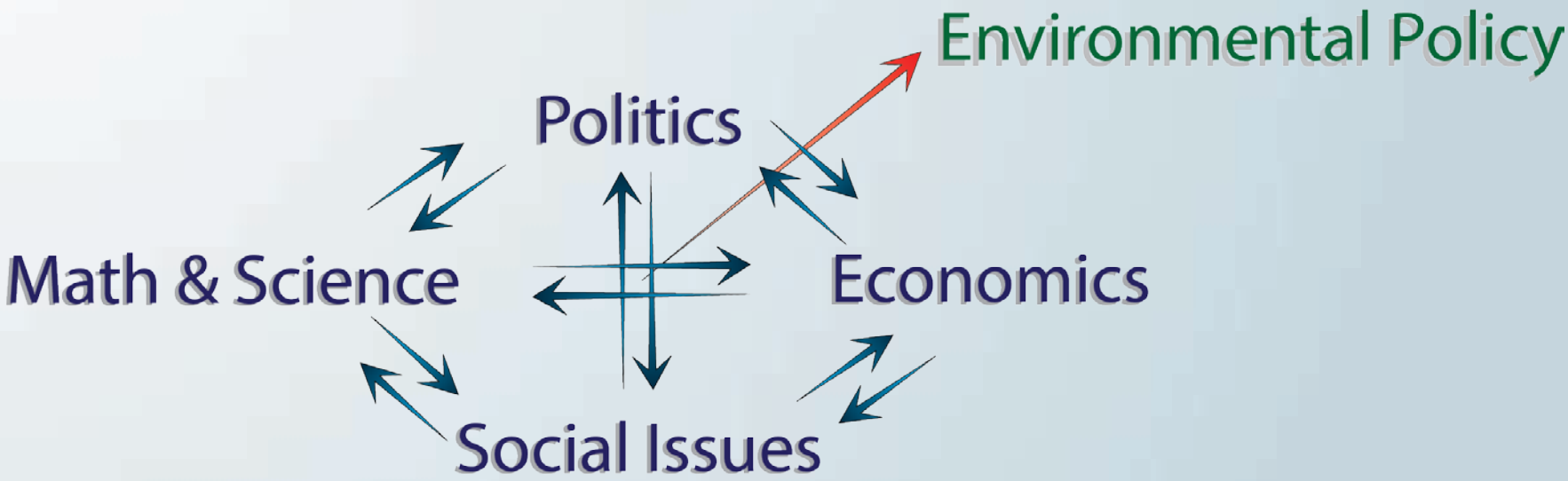
Factors Affecting Environmental Policy

One Factor More Important Than the Others?

Discussion Questions:

- Is it time to switch more of the research time and money spent on figuring out how to slow or reverse human-created environmental problems to figuring out how live with the troubles we've created?
- Which of the following **is** most important in shaping environmental policy; economics, social issues, politics, or math/science?
- Which **should be** most important in shaping environmental policy; economics, social issues, politics, or science?

It’s All Intertwined



- Math and science are important for intelligent environmental policy formation.
- This class is designed to give students a better foundation in the math and science related to environmental policy.