Global Change 1: Introductions

**Professors**
- David Allan, School of Natural Resources and Environment; dallan@umich.edu
- George Klig, Department of Ecology and Evolutionary Biology, Course Coordinator; gklig@umich.edu
- Ben van der Pluijm, Department of Geological Sciences, Program in the Environment, Program Director for Academic Minor in Global Change; vdpluijm@umich.edu
- Chris Poulsen, Department of Geological Sciences, poulsen@umich.edu

**GSI team**
- Sarah Barbrow, Biology; sbarbrow@umich.edu
- Dan Horton, Geology; danhorton@umich.edu
- Maoi Jones-Yellen, SNRE; maoi@umich.edu
- Menan Jangu, Anthro/SNRE; mjangu@umich.edu

**Support**
- Haley Cureton; globalchange@umich.edu

**Global Change 1: Introductions**

Interdisciplinary, Team-taught
Natural and Social Science Curriculum

“To become better equipped to contribute to the important debates concerning global environmental change, resource management and societal adaptation strategies.”

Science and understanding changes, we have to keep up!
GC1 - Course Objectives

Understand Earth as an "integrated system":

• **Change and evolution** (stars, solar systems, atmosphere, soils and life evolve from precursors)
• Underlying **physical and natural processes**, how they work and how they are integrated
• **Variability and uncertainty** (climate has always varied, prediction is difficult in complex systems)
• **Human alteration** of Earth’s physical and biological systems (rates are key)

Course Management: U-M’s Ctools

https://ctools.umich.edu/

Lectures
Lectures, cont.

Lecture Notes and PowerPoint files

1. Your own class notes. Be here, so you learn more and won’t be surprised.

2. Supporting notes on-line (but they do not replace lectures).

3. PowerPoint slides through CTools and LectureTools (updated prior to lectures)

Information Environment (LectureTools)

Bring your wireless-enabled laptop to class for lecture notes, web access, and real-time searches

Details on Friday …
Labs: Discussions and Analysis

- Before lab, read articles
- In class, discuss questions and activities related to the articles to explore our role in global change.

System Dynamics Modeling (Stella)

Population Example:
\[ \text{BIRTHS} = (\text{BIRTH RATE}) \times (\text{POPULATION}) \]

- Stocks are variables of interest
- Flows change stocks. Flows go into or out of stocks
- Converters change relationships between stocks and flows
- Connectors allow information to be passed between variables

Next Week's Lab Reading

Before coming to lab, read:

The Challenges We Face - A History of our Future
2003 State of the World
p. 3-13

“We have only one or perhaps two generations in which to reinvent ourselves.”
Group Term Project

The term project is a group research activity that will be presented in a PowerPoint class presentation and posted as a website.

Students organize into teams of 3 to develop a plan and implement the project related to the course material.

Suggestions for project topics and sample projects are offered, but the choice will be left to each team with guidance from your lab instructor.

Grades

The class uses a point system for determining final grades:
- Midterms (2): 100 points each
- Final: 150 points
- Lab/Discussion: 13 points each (hand-in by next lab)
- Lecture Homework: 5 points each (hand-in by next lab)
- Term Project: 100 points total
- Surveys/Assessments: 1 point each (excluding UM’s E&E)

Optional, non-graded self-tests for lectures available as a link on the CTools site.

The total points are normalized on a scale from 0-100, using a straight scale for letter grades. The grades are:
- 0-59 = E
- 60-62, 63-65, 66-69 = D-, D, D+
- 70-72, 73-75, 76-79 = C-, C, C+
- 80-82, 83-85, 86-89 = B-, B, B+
- 90-92, 93-95, 96 and up = A-, A, A+

George Kling
Department of Ecology & Evolutionary Biology
1041 Natural Sciences Bldg
Office hours, F 3-4
gwk@umich.edu

Teaching:
- Global Change (Bio 110)
- Ecosystem Ecology (EEB 476)
- Limnology (study of lakes; EEB 483)

Research:
- Aquatic Ecosystems
- Impacts of Climate Change
- Biogeochemistry
  - Arctic, Africa, Michigan
Recent climate change and variability...

![Graph showing N.H. Temperature (°C) over the years from 1000 to 2000.]

Mann et al. (1999) GRL 26:759-762

...provides perspective on where we are headed

This is your future...

![Graph showing Global Temperature (°C) and N.H. Temperature (°C) projections to 2100.]

My Themes

- Global change on our planet can only be understood by combining "abiotic" and "biotic" components - must look at the whole Ecosystem

- A combination of facts and scientific concepts can help us understand even the most complicated problems

- Science is NOT hard, and everyone can and MUST learn enough to make rational decisions about our world's future
Possible Projects

- The "missing sink" - Where did all the CO₂ go?
- Microbes rule, Humans drool
- Does the rainforest really matter?
- The day the Earth turned brown and blue - The limits to food production
- Who's doing who? Climate skeptics and the use and misuse of Science facts
- Who needs more ice? Melting the Earth's glaciers (a.k.a. "Water World 2050", starring B. van der Pluijm as K. Costner...)
- WWF Climate 2008 "rage in the cage" - People vs. Nature
- Abrupt climate change - can El Nino's run wild?
- Whatcha gonna do when the rain don't come - Shifts in the Global water cycle

Me -- Chris Poulsen

- Associate Professor in Dept. of Geological Sciences and Dept. of Atmospheric, Oceanic and Space Sciences
- Paleo/climatologist
- Ancient ice ages
- Times of extreme warmth
- Climate impacts – water resource
- South American climate and tectonics
- GS114 - Global Warming
- GS116 - Introductory Geology in the Field
- GS151 - Ice Ages Past and Present
- AOSS221 - Earth System Dynamics
- AOSS410 - Earth System Modeling

Our Place in Space

- How did 'IT' all start?
- What are the origins of our solar system and planet Earth?
Evolution of a Habitable Earth

• Why is Earth the only habitable planet in our solar system?
• What were the steps in making a habitable Earth?

Our Solid Earth: Plate Tectonics

• What is the age of the Earth, and how do we know?
• Plate what?

Our Fluid Earth: Ice, Atmosphere & Ocean

• From fiery hell to icy rock. What controls Earth’s climate?
• Why do the winds blow?
• Global warming? How, why, and so what?
We wish to know:

• Where we are going
• Why we should care
• How the pieces fit together

• And, maybe… Who is this guy?

Evolution and Ecology Roadmap

http://tolweb.org/tree/phylogeny.html

David Allan
daflan@umich.edu

My Courses
Environ 110 Earth and Ecosystems (fall)
Environ 111 Human Impacts (winter)
Environ 520 Fluvial Ecosystems (fall)

My Research
Watersheds, Land Use, and River Ecosystems
Environmental Flows
River Restoration

My Interests
Travel
Camping
Reading

My themes

• Human-induced changes to the planet need to be understood within the context of natural processes and evolutionary change

• Not just climate change: global deforestation and desertification, over-harvested resources, global homogenization of species, altered mineral cycles

• Life diversity and life processes are at risk
Efforts to Reconcile God and Nature

Charles Darwin
1809 - 1882

Threats to Biodiversity

Human actions now threaten species and ecosystems to an extent rarely seen in earth history.

- Over-harvest
- Habitat destruction
- Climate change
- Exotic species

Why should we care about biodiversity?

- The wonder of nature
- Ecosystem goods and services
  - Clean water, productive soils, the recycling of nutrients, food and fiber, recreation, spiritual renewal
- The accelerating rate of species loss
- Emerging diseases

http://www.divegallery.com/Leafy_Sea_Dragon.htm
Research: Structural Geology
field areas: the northern Appalachians, the USA continental interior, North and South America’s Grenville, northern Spain’s Cantabria, East African Rift, US-Canadian Rockies, San Andreas (CA) and Alpine (NZ) faults.
topic areas: brittle and ductile faults, deep crustal architecture, fault gouge and pseudotachylyte, intraplate stresses, microstructures and textures, magnetic anisotropy, X-ray goniometry, paleomagnetism, geochronology, physical oceanography

Teaching
Interdisciplinary undergraduate teaching: Global Change, Environmental Geology, concentrator and graduate-level specialty classes, IT-supported classroom education (GeoPocket), IT-supported field-based education (GeoPad).

World Map of Hazards
http://www.munichre.com/

Global Change Curriculum and Minor
http://www.globalchange.umich.edu/
The GC2 Wheel of Lectures (Winter Semester)

How to read this slide:
Clockwise from the “midnight” position:

1) First three basic Conceptual & Chronological Units preparing us to think about broad issues of past, present and future

2) The heart of the course is four theme-driven modules on relatively recent past and present issues: colonization, energy, climate, and conservation

3) We conclude with a future-oriented series of lectures on global trends, including health

Introduction to Global Change

Interdisciplinary, Natural and Social Science Curriculum examining Dimensions of Global Change

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Wrapping up

- Global Change encompasses all the ways that our planet has been changing since its formation ~4.5 billion years ago to today, and looking toward the future.
- Humans are affecting Earth and its life support systems at an unprecedented rate, which poses new challenges to humankind and our planet.
- Decisions and good policy require good science.

... that is why you are in Global Change!