Monday 10 April 2006, 35th class meeting
(Miller Chapter 12, Red Sky Chapter 3, NG excerpts;
Miller Chapter 9 [water])

Environmental Biology (ECOL 206)
U. Arizona, spring 2006
Kevin Bonine, Ph.D.
Alice Boyle, Kristen Potter, Graduate TAs

1. TODAY: Global Climate Change, Water

2. Lecture schedule updates on your website
3. 206 Lab Website for handouts and assignments
   No lab this week

- next installment of Group Project:
  Oral Presentations (26 April-01 May), sign up in lab
- Thanks to guest speakers (Potter, Boyle, Mangin, etc.)!
- Exam III on Wednesday 19 April

Molly Alexandra Urbon-Bonine
Born
01 April 2006 at 7:03 am
8lbs, 0.7oz
20¼" long
Bad Grass

What could be a more serious threat to the Sonoran Desert than development?

By RENÉE DOWNING

Evolution Lecture Series

Tuesday, February 21
Biological Evolution: What It Is and What It Isn’t
Joanna Masel, Assistant Professor, Ecology and Evolutionary Biology

Tuesday, March 7
Cosmic Evolution: From Big Bang to Biology
Chris Impey, Distinguished Professor, Astronomy

Tuesday, March 21
Earth Evolution: The Formation of Our Planet
Joaquin Ruiz, Dean of the College of Science and Professor of Geosciences

Tuesday, March 28
Social Evolution: Cooperation and Conflict from Molecules to Society
Rick Michod, Professor, Ecology and Evolutionary Biology

Tuesday, April 11
Animal Evolution: Recycling Ancient Genes for New Uses
Lisa Nagy, Associate Professor, Molecular and Cellular Biology

Tuesday, April 18
Human Evolution: Tracing Our Origins with DNA
Michael Hammer, Research Scientist, Division of Biotechnology and Department of Ecology and Evolutionary Biology

Tuesday, April 25
Disease Evolution: The Example of HIV
Michael Worobey, Assistant Professor, Ecology and Evolutionary Biology
Climate Expert Says NASA Tried to Silence Him

Published: January 29, 2006

James E. Hansen, top NASA climate scientist, at the Goddard Institute in Upper Manhattan.
BE WORRIED. BE VERY WORRIED.

Climate change isn’t some vague future problem—it’s already damaging the planet at an alarming pace. It hasn’t just affected you, your kids and their kids as well.

EARTH AT THE TIPPING POINT
HOW IT THREATENS YOUR HEALTH
HOW CHINA & INDIA CAN HELP
SAVING THE WORLD—DR. BARRY STERN
THE CLIMATE CRUSADERS

Then

The South American Andes are crusted with glaciers, and the Upsala Glacier in Argentina is one of the grandest—or it was. In 1929, the ice sprawled before the photographer’s lens.

Now

The Upsala Glacier in 2004. The ice is retreating at least 180 ft. per year, and Andean guides now paint hash marks on mountain walls to show where the boundaries used to be.
Global Climate Change

1. Implications

2. Solutions
Global warming's sea-level rise would doom cities, 2 studies say

By Anne Hinard

FOR THE ARIZONA DAILY

Climate changes may rise oceans by more than 19 feet — and entire countries —

That's the finding of a University of Virginia study published in the Journal of Geophysical Research, which forecasts a sea-level rise of 1 to 2 meters by 2100, potentially causing widespread flooding and coastal collapse.

In one of the papers, built on a model that simulates climate data to determine solutions to climate change, the researchers projected that by 2100, the world's oceans would have risen by 0.5 to 1.5 meters, depending on the rate of greenhouse gas emissions.

That would mean a significant portion of the world's coastal cities, including those in the United States, would be at risk of erosion and flooding. The study also suggested that the rise could be even higher, up to 4 meters, if greenhouse gas emissions continue unabated.

"We've got a lot of work to do," said lead author of the study, Dr. John Callahan, a professor of environmental science at the University of Virginia. "We need to start making changes now to mitigate the impacts of climate change and reduce our dependence on fossil fuels."
Global Climate Change

GeoSigns, EcoSigns, Time Signs
National Geographic September 2004

We are changing our planet's climate and the evidence is to be found in the **geological, biological, and climatological** records available for study.

- Carbon Dioxide, Methane, Nitrous Oxide
- Deforestation, etc.
GeoSigns

Glaciers
(disappearing; water and electricity for humans)

Sea Level
(>100 million people live within 3’ mean sea level)
(1” sea level → 8’ beach loss)

Permafrost
(melting and causing subsidence; drunken forests)

Rate of Change

"Some of the ice we have here is already gone from the mountains."
A Courtline Bedroven
The outer section of the dome ice core (left) was cut in 1995. Mutt powder visible on ice indicates the freezing ice near right. Scientists are monitoring what effect the further disintegration of ice sheets--such as the Antarctic and Greenland glaciers--might have on earth's climate. Richard A. Defant
© 1999 National Geographic Society

8. Ozone Trends
The increase in chlorine in the atmosphere has an uncertain effect on earth's temperature. Both CO2 and temperature have risen sharply since 1960. Increase in CO2 data from Ice core samples.
Sea level rising

Coasts threatened
As ice melts and warmer seawater expands, the oceans will rise. How much depends largely on how much CO₂ and other greenhouse gases we continue to emit. This model projects rises of between a few inches and a few feet over the next century.

Weather turning wild?
Projected weather and climate changes

Storm warnings
Higher global temperatures could fuel extreme weather. At right are computer-model projections of the chance that various weather events will be more frequent in a warmer world.
GeoSigns

Hottest Years on Record
1. 1998
2. 2002
3. 2003
4. 2001
5. 1997

Albedo Feedback
(poles changing more rapidly [7-9 F]; 1 F globally)

North Atlantic Thermohaline Circulation
(transfers heat around planet, keeps Europe warm)
EcoSigns

Adelie Penguins, Polar Bears
(ice shelves for nesting and foraging on krill)
(thinner bears b/c feeding season shortened)

Timing of Migration, Reproduction (incl. TSD)

Shifting Ranges
(sky islands, invasives, decoupled food webs)

Anthropogenic Barriers
(restrict movements)

Coral Bleaching
(1998, 16% corals killed or bleached)
On the Rocks

Ecology
Nature changing its habits

Cycles out of sync

■ Off schedule
Flycatcher birds that migrate from Africa to the Netherlands to nest still arrive at the same time now as they did two decades ago. But because of warming, moth caterpillars on which nestlings feed emerge two weeks earlier than before. The birds’ peak hatching date has shifted too, but not enough. Nestlings now miss peak caterpillar hatching and may go hungry.

■ Plants shift
Warming in the mountains of southern Switzerland (thus fewer days of frost) has forced some plants upslope and allowed exotic plant species to invade.
**TimeSigns**

Stalagmites, Coral Rings  
(evidence of cave flooding; annual variability)

Tree Rings  
(sophisticated recorders of environmental fluctuations)

Ice Cores  
(data going back >100,000 years)  
(ice cores as conservation tools?)

Sediment Cores  
(mud, pollen)

Pack Rat Middens  
(hoarders, urinaters, climate fluctuation)