To Dr Kolb 12/7/04

UWUCC Appr 11/30/04
Senate Info 2/1/05

04-35

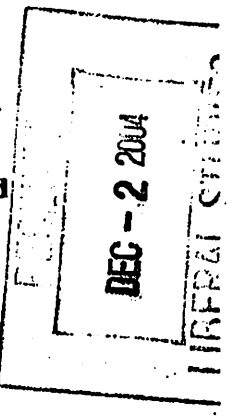
Undergraduate Distance Education Review Form

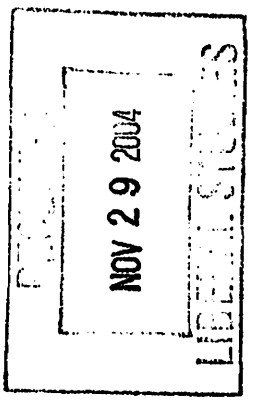
(Required for all courses taught by distance education for more than one-third of teaching contact hours)

Existing and Special Topics Course

Course: GEOS 103 – Oceans and Atmospheres

Instructor of Record: Hovan **phone:** 7-7662 **e-mail:** hovan@iup.edu





Step One: Department or its Curriculum Committee

The committee has reviewed the proposal to offer the above course using distance education technology, and responds to the CBA criteria as follows:

1.	Will an instructor who is qualified in the distance education delivery method as well as the discipline teach the course?	✓ Yes	___ No
2.	Will the technology serve as a suitable substitute for the traditional classroom?	✓ Yes	___ No
3.	Are there suitable opportunities for interaction between the instructor and student?	✓ Yes	___ No
4.	a. Will there be suitable methods used to evaluate student achievement?	✓ Yes	___ No
	b. Have reasonable efforts been made to insure the integrity of evaluation methods (academic honesty)	✓ Yes	___ No

5. Recommendation:

✓ Positive (The objectives of the course can be met via distance education.)

___ Negative

Darlene Richardson 11-23-04
signature of department designee date

If positive recommendation, immediately forward copies of this form and attached materials to the Provost and the Liberal Studies Office for consideration by the University-Wide Undergraduate Curriculum Committee. Dual-level courses also require review by Graduate Committee for graduate-level offering. Send information copies to 1) the college curriculum committee, 2) dean of the college, and 3) Dean of the School of Continuing Education.

Step Two: UNIVERSITY-WIDE UNDERGRADUATE CURRICULUM COMMITTEE

X Positive recommendation

___ Negative recommendation

Gail S. SecRist 12/2/04
signature of committee chair date

Forward this form to the Provost within 24 calendar days after review by committee.

Step Three: Provost

✓ Approved as distance education course

___ Rejected as distance education course

[signature] 12/14/04
signature of Provost date

Step Four:

Forward materials to Dean of the School of Continuing Education.

Indiana University of Pennsylvania

Geoscience Department
Indiana University of Pennsylvania
114 Walsh Hall
Indiana, Pennsylvania 15705-1087

(724) 357-2379 telephone
(724) 357-6208 fax

Date: November 17, 2004

From: Steve Hovan

Re: Distance Education approval for existing course (GEOS103 – Oceans and Atmospheres)

Attached are the following items associated with my proposal to GEOS103 as a Distance Education section this summer:

- Undergraduate Distance Education Review Form
- Copy of Syllabus of Record for existing course GEOS103 – Oceans and Atmospheres
- Copy of on-line Syllabus for Distance Education sections of GEOS103 – Oceans and Atmospheres
- Example modules for on-line course:
    1. Seafloor Bathymetry
    2. Air-sea Connections – El Nino and Southern Oscillation Events

In addition, I would like to address the criteria established in the CBA regarding Distance Education qualifications:

1. Is the instructor qualified in the distance education delivery method as well as the content?

    I am very well qualified to teach the content of this course. My doctoral thesis was in the field of Oceanography and directly dealt with the interactions between atmospheric and oceanic systems. Furthermore, I have considerable in-class experience teaching this course having taught more than a dozen sections of this course in the past few years. Regarding technological expertise, I currently utilize web-based instruction in my on-campus version of the course and have been trained in the use of WebCT by our IDC.

2. Will the technology serve as a suitable substitute for the traditional classroom?

    Certainly. Many on-line resources are available to enhance the instruction of topics related to the oceans and the atmosphere. In fact, this course may be better suited for instruction via distance education as students will be able to explore and discover aspects of oceanography that are often difficult to represent in the physical classroom (i.e. mid-ocean ridge vent communities and large scale, real-time data acquisition regarding weather phenomena.

3. Are there suitable opportunities for interaction between the instructor and the student?

    I will offer this course via WebCT and students will be required to submit discussion responses to bulletin boards and chatrooms. I will monitor these discussions directly. In addition, students will have direct email access to ask me questions "off line".

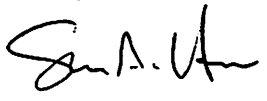
4. a. Are there suitable methods to evaluate student achievement?

Students will be evaluated based on required discussion responses to questions posed in each module. In addition, self-assessment quizzes, sectional quizzes (essay) and a final exam (essay) will be used to gauge student achievement.

b. Have reasonable efforts been made to insure the integrity of evaluation methods?
All sectional quizzes and exams will be designed to assess student understanding from their response to essay thought questions. These questions will be formulated in such a way that no "correct" response is required; instead the thought process and ability to synthesis conceptual information will be evaluated.

Please feel free to contact me if you have any questions or I can help clarify any confusion you might have about this proposed course.

Sincerely,



Steve Hovan
Geoscience Dept
(x77662)

Oceans and Atmospheres GEOS 103

ON-LINE SECTION - Summer Term 2005
(3 credit hours)

Text: Essentials of Oceanography, 7'th edition
Author: Thurman
also available on reserve at our library

Course website:
Add course WebCT URL when available

Instructor:
Dr. Steve Hovan
office: 206 Walsh
phone: 357-7662
email: hovan@iup.edu

CATALOG DESCRIPTION

The Earth's oceans and atmosphere play a crucial role in determining the pace and extent of changes occurring to our global environment. Examines the composition and character of these components and their interaction with other major components of the Earth system.
Prerequisites: no prerequisites (no geoscience majors/minors)

COURSE GOALS:

This course is designed to examine a selected number of major topics related to the Earth and the global environment and is targeted toward non-science majors. The course is will cover two important components of the Earth's environment - the ocean and the atmosphere. The goal of this course is not to provide you with a complete overview of each of these disciplines, but rather to give you a basic understanding and necessary background to examine several important issues facing our species today and in the future. When finished with this course, my hope is that you will leave with a better understanding of the scientific method, how oceanographers work to address regional and global problems and to critically assess the scientific methods used to make policy decisions that affect our lives outside of the classroom.

COURSE OBJECTIVES:

1. Students will learn about the composition of the ocean environment and how physical, chemical, geological, and biological changes interact to cause important changes this important component of the Earth's system.
2. Students will learn what causes and controls weather phenomena and how these changes influence and are influenced by human interaction.
3. Students will learn how the atmospheres and oceans interact to create the present-day pattern of global climates and the possibility for further changes in the future.

READINGS:

Our textbook covers most of the topics we will cover during class. The textbook is written at an introductory level with interesting features about current topics in oceanography. In addition to the required textbook readings, several reference websites are provided and you will need the information provided by them for this course. Our exams will have questions related to both textbook and web-based material.

CLASS ASSIGNMENTS

Open-book quizzes and essay tests will be sent to all students at your IUP email address. If you choose to submit an open-book quiz or exam, your completed work must be emailed back to me by the time and date given on the syllabus. Late assignments will not be accepted without a validated medical emergency. Also, please be aware that if you have your IUP email forwarded to another address, such as yahoo or hotmail, I will NOT be notified if the email message bounces. It is your responsibility to make sure that you have received your email assignments. If you have not received an assignment by a day after the date on the syllabus, be sure to contact me by email. If I do not get an assignment back from you on time, I will simply assume that you chose not to do it.

GRADES:

Grades for this course will be determined based on the percentage of 250 points awarded as follows:

Discussion of topic "Analysis Questions"	50 points
Top two scores of three 50 pt quizzes	100 points
Final Exam	100 points

All quizzes and exams are open-book, open-note essays that emphasize critical thinking rather than memorization.

ACADEMIC INTEGRITY:

In an online course where direct supervision by a faculty instructor is not possible, there exists a great potential for students to inadvertently or deliberately violate the academic integrity policies of IUP. In this class, you are expected to always answer quiz and exam questions in your own original words, without extensive reference to the work of others. Please be aware that copying entire sentences straight from a text-book or internet web site is considered plagiarism and will be severely penalized in your grade. In addition, working closely with a fellow student on any quiz or exam so that your submitted work bears great similarity in content and organization will be considered cheating and will be severely penalized in your grade. Depending on the nature of the infraction, the instructor may submit a referral form to the university documenting the violation of academic integrity or require alternative work in place of the initial assignment.

Anticipated Schedule of Lectures

PART I My goal in this class is to bring relevance to a number of significant issues facing our society that involve the oceans and atmosphere. In order to do this, we learn some of the necessary " background" about what these spheres are like, how they formed and why they are important. In this section we will discuss topics related to birth and evolution of the earth.

MODULES

Importance of Oceans to Life on Earth
Origins of Earth, Ocean, and Atmosphere
Plate Tectonics

SECTIONAL QUIZ #1 DATE: Quiz#1Date

PART II During this portion of class we examine the bottom of the seafloor and the sediments covering it. Often we think of this as simply "mud" but it's much more exciting than that! We'll focus on what types of sediments are found in the sea and how they can help us learn to better understand global climate changes.

MODULES:

Seawater Properties
The Seafloor – Coastlines to the Abyss
Oceanic Sediments – More than just muddy bottoms

SECTIONAL QUIZ#2 DATE: Quiz#2Date

PART III Now we'll turn our attention to the ocean water. What causes currents? How does they affect global climate? How does the atmosphere interact with the ocean to distribute heat throughout the world? We'll look at the global pattern of atmospheric winds, and oceanic circulation, then take a closer look at an example of how these two systems interact to produce major weather phenomena called "El Nino" events and Hurricanes.

MODULES:

Global atmospheric circulation / ocean currents
El Niño - connecting the atmosphere, oceans, and weather of the world
Hurricanes and their lasting influence on the coasts

SECTIONAL QUIZ #3 DATE: Quiz#3Date

PART IV In the final phase of this class we will continue to look at oceanic and atmospheric interactions... but this time a it concerns the "greenhouse effect". We'll try to understand the economic, political, and societal impact these resources may have today and in the future. Whether you are a scientist, teacher, athlete, artist, or just some joe off the street, these are issues that you will have to deal with eventually... either directly or indirectly (i.e. through your tax dollars). Finally, we'll also take a brief look at the marine ecosystem and what potential it offers toward food production on earth.

MODULES

The Greenhouse Effect and the role of the oceans
Food from the Sea

Managing Global Resources

FINAL EXAM DATE: FINAL EXAM DATE

Note: Final Exam is cumulative and will integrate material from the entire course

1. **Syllabi of Record**

GS 103 Oceans and Atmospheres

I. Catalog Description:

GS 103 Oceans and Atmospheres — 3 credits, 3 lecture hours

Prerequisites: No Geoscience Majors/Minors — (3c-0l-3sh)

The Earth's oceans and atmosphere play a crucial role in determining the pace and extent of changes occurring to our global environment. This course will examine the composition and character of these components and their interaction with other major components of the Earth system.

II. Course Objectives:

1. Students will learn about the composition of the ocean environment and how physical, chemical, geological, and biological changes interact to cause important changes this important component of the Earth's system.
2. Students will learn what causes and controls weather phenomena and how these changes influence and are influenced by human interaction.
3. Students will learn how the atmospheres and oceans interact to create the present-day pattern of global climates and the possibility for further changes in the future.

III. Course Outline:

A. Origin of the Earth, Oceans, and Atmosphere (6 hours)
   1. The blue planet
      - Making the Earth
      - Making the Moon
      - The origins of water
   2. The early Earth
      - Geological evolution of the planet
      - Mantle and crust origin
      - Plate tectonics

B. Marine provinces and sedimentation (6 hours)
   1. Seafloor topography
      - Shelves and slopes
      - Trenches and ridges

Seamounts and banks
2. Coastal and pelagic sediments
Processes of marine sedimentation
Distribution of marine sediments
Marine sedimentation, past and present

C. Seawater properties and ocean chemistry (4 hours)
1. Ocean composition
The major salts
What else is in there?
2. Ocean properties
Sound and light
Salinity and pressure

D. Air and sea interactions (4 hours)
1. Fluids in motion
Atmospheric circulation
Waves
2. Ocean circulation
Surface circulation and currents
Thermohaline (deep) currents

E. Life in the oceans (6 hours)
1. Primary productivity
Photosynthesis
The base of the food chain
2. Marine food resources
Availability of nutrients
Upwelling zones
3. Marine communities
Coral reefs: the oceans' rain forests
A whole new world: hydrothermal vent communities

F. The Earth's gaseous envelope (4 hours)
1. What's up there?
Atmospheric structure
Atmospheric composition
2. Energy makes the world go around
Solar energy
Energy from the earth

G. Weather and major weather phenomena (6 hours)
1. The daily forecast
Mid-latitude storms
The jet stream
2. Weather as a destructive force
Severe thunderstorms
Tornados and hail
3. Rain, clouds and fog

H. Climate and climatic changes (6)
1. Climate distribution
Koppen classification
Zonal climate distribution
2. Local climate variation
Urban climates
Microclimates
3. Human influences on climate
Carbon dioxide and the greenhouse effect
Ozone destruction and pollution

IV. Evaluation Methods

The final grade for this course will be determined as follows:

85% Tests. Four tests, consisting of multiple choice, true-false and matching questions, worth 100 points each. Tests will be computer-graded and adjusted to a mean of 75% so that 90-100%=A; 80-89%=B; 70-79%=C; 60-69%=D; below 60%=F. The same scale will be used for the final point score.

15% Non-text book review. A four to five page book review of the non-text reading is due the last day of class. Worth 75 points.

V. Required textbooks, supplemental books and readings:

Textbook: Thurman, INTRODUCTION TO OCEANOGRAPHY (6th ed). New York:

Non-text: May vary with instructor, but will include choices such as:
Michael Crichton SPHERE
John Barnes MOTHER OF STORMS
WHAT LIGHT THROUGH YONDER
WINDOW BREAKS
SECRETS OF THE SEAS

VI. Special resource requirements: None

VII. Bibliography

Ahrens, C.D., 1994, METEOROLOGY TODAY: AN INTRODUCTION TO WEATHER, CLIMATE AND THE ENVIRONMENT (5th Ed.) New York: West Publishing 591 p.

Anthes, R.A., 1992, METEOROLOGY (6th Ed.). Columbus: Merrill Publishing, 218 p.

Lutgens, F.K. and Tarbuck, E.J., 1995, THE ATMOSPHERE (6th Ed.). Englewood Cliffs NJ: Prentice Hall, 461 p.

Gross, M.G., 1990, OCEANOGRAPHY (6th Ed). Columbus: Merrill Publishing, 190 p.

Ingmanson, D.E. and Wallace, W.J., 1993, OCEANOGRAPHY: AN INTRODUCTION (5th Ed.). New York: Wadsworth Publishers, 493 p.

Lutgens, F.K. and Tarbuck, E.J., 1995, THE ATMOSPHERE (6th Ed.). Englewood Cliffs NJ: Prentice Hall, 461 p.

Pickard, G.L. and Emery, W.J., 1990, DESCRIPTIVE PHYSICAL OCEANOGRAPHY: AN INTRODUCTION (5th Ed.) New York: Pergamon Press, 320 p.

Skinner, B.J. and Porter, S.C., 1995, THE BLUE PLANET: AN INTRODUCTION TO EARTH SYSTEMS SCIENCE. New York: John Wiley & Sons, 493 p.

Suckling, P.W. and Doyon, R.R., 1991, STUDIES IN WEATHER AND CLIMATE (3rd Ed.). Raleigh: Contemporary Publishing Co., 202 p.

Air-Sea Connections – El Niño and Southern Oscillation Events

Outline

I. Plate Tectonic Theory...summary

A. Earth's surface can be divided into several rigid lithospheric plates

B. Plates (crust + upper mantle) "ride" on top of asthenosphere

C. Driving Force - mantle convection cells created by heat released from radioactive decay in earth's interior

D. Most tectonic activity (earthquakes, volcanoes, mts., etc.) occurs at the edges of plates

II. Plate Boundaries (where the action is) (see figure: boundaries.gif, size=56kb and movie: plates_mov, size=353kb)

A. Divergent - where plates move apart

- new material added to lithosphere (mostly mid ocean ridges)
- volcanoes... oceanic crust (basalt)
- rate of spreading: 2-10 cm/yr
- examples: MidAtlantic Ridge, Red Sea/East African Rift

B. Convergent - where plates come together

- lithosphere material "recycled" back into mantle
- trenches, earthquakes, volcanoes
- Three types:
  1. ocean-ocean (eg. Japan, Aleutians)
  2. ocean-continent (eg. Andes)
  3. continent-continent (eg. Himalayas, Appalachians, Alps)

C. Conservative (transform) - plates slide past eachother

- no material added or removed from lithosphere ("conservative")
- earthquakes
- Examples: transform faults along mid ocean ridges, San Andreas

III. Intraplate volcanism (hey, what about Hawaii?)

- hot spots and mantle plumes (figure: hawaii_cartoon.jpg), size=92kb
- give direction and rate of plate movement
- examples: Hawaii, Yellowstone

IV. History and Future tectonics

- see figure: Pangea_assemble.jpg, size=31kb
- figure: Pangea_breakup.jpg, size=29kb
- movie: Pangea_breakup.mov, size=263kb

V. Important geological information that is explained by Plate Tectonic Theory

- Mid-Ocean Ridge system (see figure: seafloor_bathy.jpg, size=62kb)
- Earth's magnetic field reversals (magfield.jpg, size=60kb and magstripes.gif, size=16kb)
- polar wandering (movement of continents) (APW.jpg, size=60kb)
- interior layers of Earth (earth_layer.jpg, size=44kb)
- earthquake seismic zones (eq_globaldist.jpg, size=96kb)

Explore and Discover

In our textbook, read Chapter 2, and the following websites:

Introduction to El Niño
http://ess.geology.ufl.edu/usra_esse/El_Nino.html

U.S. Climate Data Center El Nino description
http://www.cdc.noaa.gov/ENSO/enso.description.html

International Research Institute for Climate Prediction
http://iri.columbia.edu/climate/ENSO/index.html

El Niño Guide
http://ww2010.atmos.uiuc.edu/(Gh)/guides/mtr/eln/home.rxml

NOAA/PMEL/TAO - What is an El Niño (ENSO)?
http://www.pmel.noaa.gov/tao/elnino/el-nino-story.html

El Niño Primer
http://nsipp.gsfc.nasa.gov/enso/primer/englishwelcome.html

University of Illinois El Niño Guide:
http://ww2010.atmos.uiuc.edu/(Gh)/guides/mtr/eln/home.rxml

U.S. Climate Data Statistics – El Nino vs 100 year average
http://www.cpc.ncep.noaa.gov/products/predictions/threats2/enso/elnino/index.html

Assess

Analysis #1: Discovery and Description

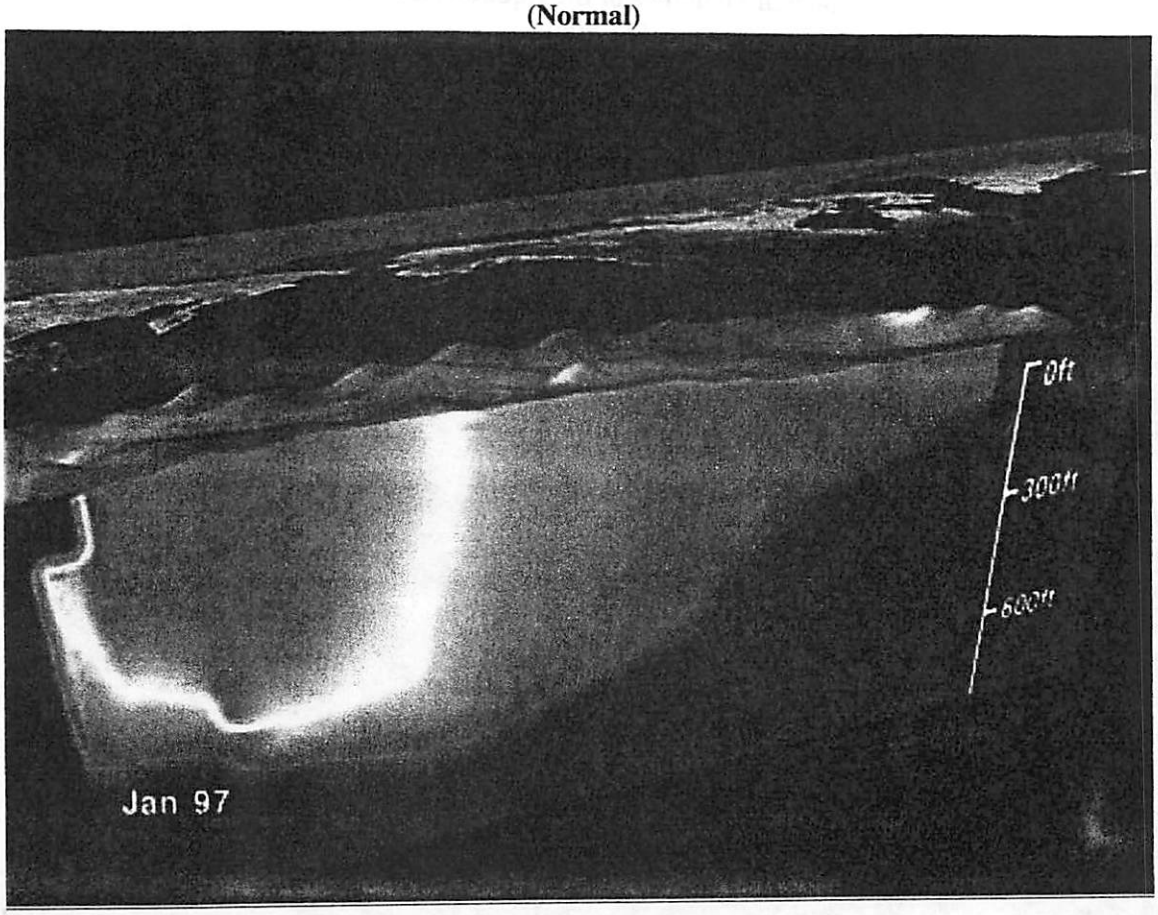
What does the TOPEX/POSEIDEN satellite measure? Describe how these measurements relate to El Niño? What are the units? What are the uncertainties? What other methods are used to monitor conditions associated with El Nino? What do these measurements suggest about the possibility of an El Niño occuring this year?

Analysis #2: Winds and Water

El Nino is a phenomina that occurs mainly in the tropical Pacific Ocean as the oceans respond to changes in the strength of the Tradewinds. Below is a sketch of the "normal"(i.e. non-El Niño) temperature conditions in a cross-sectional cutaway diagram across the equatorial region of the Pacific Ocean. Describe how the normal conditions of tradewinds and ocean currents create the thermal profile observed.

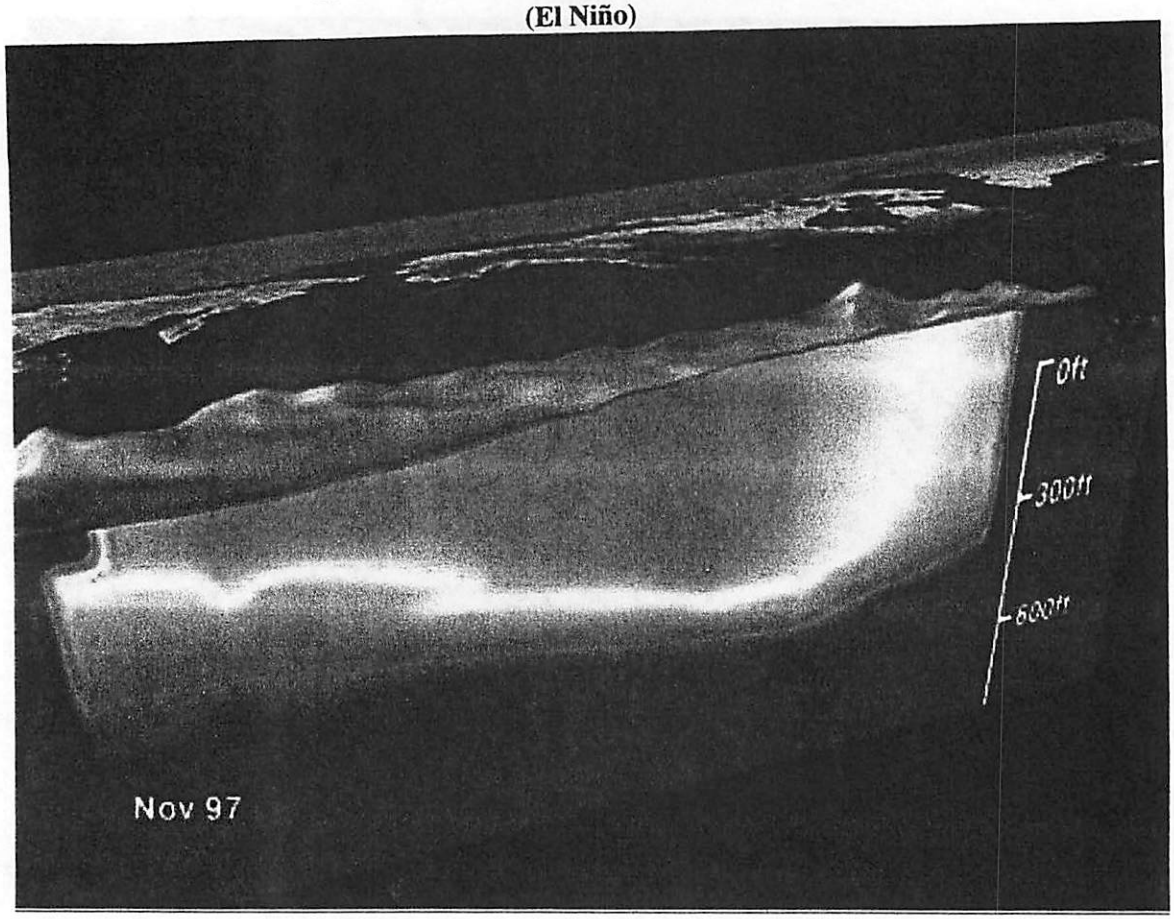
http://www.pmel.noaa.gov/tao/elnino/nino_profiles.html

Thermal Structure of the Equatorial Pacific
(Normal)



Below is the typical temperature profile during an El Niño Event. Describe how it differs from the one shown above.

Thermal Structure of the Equatorial Pacific
(El Niño)



Analysis #3: Different things to different people

El Niño events have a wide range of impacts and far-reaching influence. Not only do they directly impact the equatorial temperature and climate, but also they often have a "ripple effect" throughout the world. These teleconnections can often have devastating consequences on regional economies and, more importantly, populations. In the following chart, identify the impact El Nino events might have on each region or population listed:

Population/Industry	Impacts	Explanation of Impact	Possible Economic Consequences
Peruvian Fishing Industry			
Indonesian Hardwood Forestry			
Tourism along the Great Barrier Reef of Australia			

Sport Fishing in California			
Diseases in the Gulf Coast of the U.S.			
Coffee Industry along the Columbian Mt slopes			
Galapogos Coral Reef Studies			
Ski slopes in Colorado and Wyoming			

Examine the information related to the long-term trends of El Nino events in Pennsylvania at

http://www.cpc.ncep.noaa.gov/products/predictions/threats2/enso/elnino/index.html

What are the typical temperature and precipitation responses of El Nino in the area near western Pennsylvania (or your hometown). What are the uncertainties in these data? Identify three local industries that could be affected by El Nino events. How might each industry be able to prepare for El Nino if we could predict them a year in advance?

From the Coastlines to the Abyss – The Seafloor

Outline

I. Continental Margins - (see figure: seafloor_bathy.jpg, size=62kb)

- compositionally same as the rest of the "continents" (granite rocks), but currently covered by oceans

A. Atlantic (passive) type (see figure: passive_margin.jpg, size=37kb)

1. shelf: 100-200 m depth (thus, exposed during lower SL during glacial periods) up to 1000's km wide, but ave 80-100 km
2. slope: marks the boundary between cont- oc crust
3. rise: piles of seds transported off shelf (deep sea fans)

B. Pacific (active) type - (lots of volcanoes & E.Q.'s)

1. narrower shelf and steeper slope
2. trench

C. Submarine Canyons: common feature to both margins

1. narrow, v-shaped erosional valleys
2. created by river erosion (when sealevel was lower) or by turbidity currents (see fig: turbidity_currents.jpg, size=40kb, movies: sealevel.mov, size=139kb and iceage_NA.mov, size=191kb)

II. Ocean Basins - (see figure: seafloor_bathy.jpg, size=62kb)

- rock type is basalt (see figure: Atlantic_xsect.jpg, size=64kb)

A. Abyssal Region

1. Atlantic: lots of sediments -- very flat = abyssal plains
2. Pacific: less sediments -- "rougher" = abyssal hills (also has more islands & seamounts)

B. Mid-Ocean Ridge system

(nearly continuous volcanic mtn chain - appx 60,000 km long!)

1. Atlantic: mid Atlantic ridge (MAR)
steeper, more rugged topography, narrower ridge
2. Pacific: east Pacific rise (EPR)
less rugged and broader than MAR
3. features: volcanism, shallow earthquakes, hydrothermal vents

Explore and Discover

In our textbook, read Chapter 03 and the following websites:

NOVA: Into the Abyss:
http://www.pbs.org/wgbh/nova/abyss/mission/

MBARI Marine Ops: Tiburon
http://www.mbari.org/dmo/vessels/tiburon.html

NOAA Ocean Explorer
http://oceanexplorer.noaa.gov

Autonomous Underwater Vehicles of University of Tokyo

http://manta.iis.u-tokyo.ac.jp/research/kaiyou/kaiyou-e.html

Scientific American: Panoramas of the Sea Floor
http://instaar.colorado.edu/geophysics/members/lincoln/0697pratson.html

Ocean Drilling Program Science Operator
http://www-odp.tamu.edu/index.html

Seamounts: Window on Ocean Biodiversity
http://www.npaci.edu/online/v5.15/seamounts.html

NOAA Ocean Explorer: Davidson Seamount
http://oceanexplorer.noaa.gov/explorations/02davidson/davidson.html

SeamountsOnline
http://seamounts.sdsc.edu/main.html

Dive and Discover: Expeditions to the Sea Floor
http://www.divediscover.whoi.edu/

NeMO Explorer
http://www.pmel.noaa.gov/vents/nemo/explorer.html

Vents Program Home Page
http://www.pmel.noaa.gov/vents/

Hydrothermal Plume Studies
http://www.pmel.noaa.gov/vents/PlumeStudies/PlumeStudiesIntro.html

NOAA's Sounds in the Sea web site and read their mission plan:
http://oceanexplorer.noaa.gov/explorations/sound01/background/plan/plan.html

Assess

Analysis #1: Exploration Technology

For each of the following, identify the type of oceanographic tool (submersible, ROV, satellite, etc), describe its basic features and discuss its role in advancing our understanding of geological processes on the sea floor.

Research Tool	Type	Basic Features	Scientific Advances
Meteor			
Trieste			

ODP			
Challenger Expedition			
Alvin			
Kaiko			
Deep Flight			
Topex/Poseidon			
Tiburon			

Analysis #2: Hydrothermal Vents

Join several expeditions to explore the Mid-Ocean Ridge system in Alvin:

http://www.divediscover.whoi.edu/

From your voyages, answer the questions from on-line quizzes found at:

http://www.divediscover.whoi.edu/infomods/vents/index.html

http://www.divediscover.whoi.edu/infomods/vent_biology/index.html

Post discussion responses to these questions:
How has the discovery of hydrothermal vents served to unite the fields of geological, chemical, physical, and biological oceanography? Discuss the ways that each one of these "subdisciplines" of oceanography contributes to our understanding of hydrothermal vents.

Analysis #3:

Exploration of the deep oceans is sometimes referred to as the discovery of "inner space". Compare our exploration of inner space with that of deep outer space. How are the tools used for each similar and how are they different? In what ways is the exploration of the oceans more difficult than the exploration of deep space?