P2.1 TWO NEW UNDERGRADUATE EARTH SCIENCE WEB MODULES IN AIR-SEA INTERACTIONS

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1. INTRODUCTION

Efforts to increase student learning and incorporate technology in the classroom have led to the development of many interactive internet activities for earth science instruction. These activities make use of the burgeoning earth science resources available online and through other outlets. Digital libraries for earth system sciences have become clearinghouses for many online resources (Ginger and Marlino 2002). We have developed two interdisciplinary web-based modules that make use of online resources and that were intended to increase student understanding of materials that traditionally were delivered through lectures and/or cookbook labs.

The senior authors were encouraged to develop active learning Internet activities through the NASA -JPL "Ocean Envoys" program (http://www.coexploration.org/oceanenvoys). This on-going program unites teachers with NASA scientists over the Internet and also offers several online workshops and resources for educators. Teachers may pose questions directly to scientists or to fellow colleagues located throughout the United States. Instructors may also share instructional lessons and activities with each other. In 2002, we received a modest grant from California State University, Los Angeles to develop Internet activities focusing on air-sea interactions. The proposed activities would be available for teachers, including those affiliated with the Ocean Envoys program.

2. AIR-SEA INTERACTION MODULE

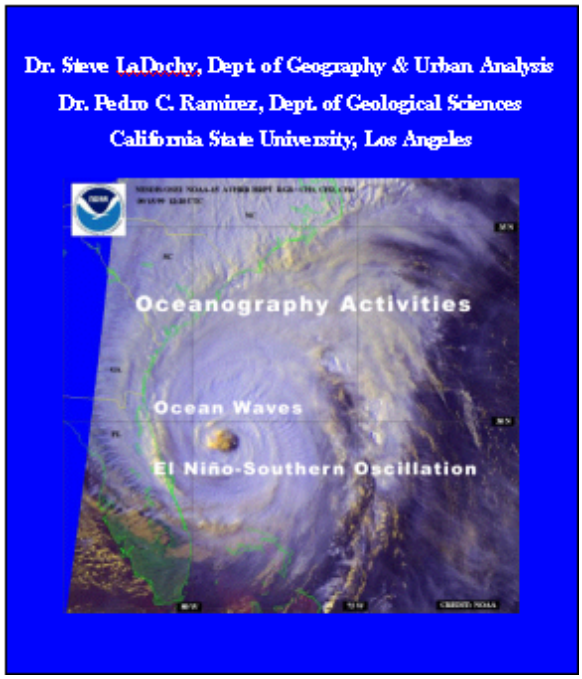

Figure 1. Homepage for two Air-Sea Interaction modules.

In spring and summer 2002, students in general education undergraduate courses in Earth Science and Oceanography were introduced to two on-line learning activities using course WebCT homepages. Both modules incorporate satellite images, illustrations and animations assembled mainly from NASA and NOAA Internet websites and educational CDs. These Internet modules complement and re-enforce classroom lectures, readings, and discussions on important topics in oceanography such as the complex air-sea interactions associated with El Niño/ Southern Oscillation (ENSO).

The modules developed are: "*Ocean Waves*" and "*El Niño-Southern Oscillation*." The first activity examines the anatomy of waves and wind-wave relationships. Included in this module is an exercise on tsunamis, the great

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Figure 2. Homepage for the *Ocean Waves* module.

waves of our oceans. The second module focuses on explaining El Niño, La Niña and the Southern Oscillation, followed by an analysis of the development of strong El Niño and La Niña events during 1997-1999. The El Niño-Southern Oscillation module uses the interrelationships between winds, ocean temperatures and weather patterns to show the global impacts of ENSO. In both modules, students learn interactively by answering questions related to the visual information presented and by receiving feedback.

Students access the homepage for the activities from the course WebCT Internet address, using individual student ids and passwords. The homepage provides links to both modules (Figure 1). Sections centered on *Wave Anatomy*, *Global Waves*, *Local Waves*, and *Tsunami* comprise the *Ocean Waves* module (Figure 2). The *Wave Anatomy* section informs students about wave structure, and the one on *Global Waves*, uses NASA animations to examine the global distribution of wave heights and wind speeds and how these elements are measured from space (Figure 2). The segment on *Local Waves* shows southern California wind-wave relationships through animations using recent data compiled by the Navy. The *Tsunami* section of the *Ocean Waves* module introduces the triggering mechanism for the potentially destructive waves, as well as where these waves are likely to occur and how fast they travel using a case study. An animated simulation of a tsunami hitting the west coast is used to test students' understanding of wave dynamics (Figure 3).

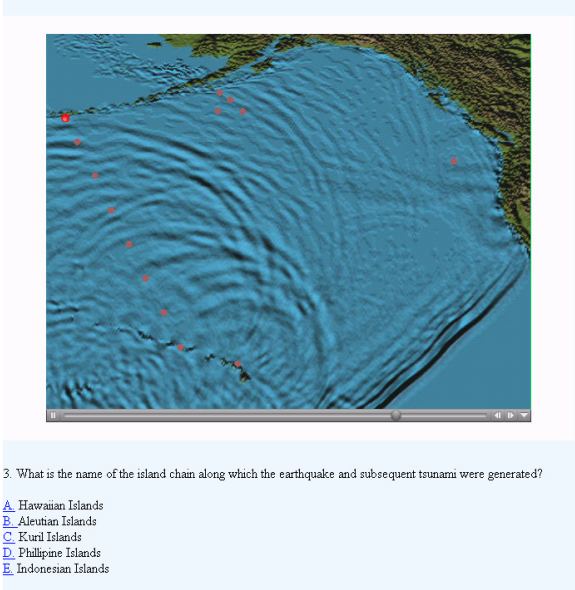

Figure 3. Tsunami Simulation and sample question (source: NOAA).

For the "*El Niño/Southern Oscillation*" module (figure 4), students learn the basics of the air-sea interactions associated with El Niño and La Niña, and respond to questions modified from an exercise developed by AMS Project Atmosphere. Students then investigate the origin of the Southern Oscillation Index (SOI) and answer questions related to recent SOI measurements. Global and regional impacts of ENSO on weather are presented using information posted on Florida State's Atmospheric Sciences web page (http://www.coaps.fsu.edu/lib/booklet) and at Golden Gate Weather's page (http://ggweather.com/calenso.html).

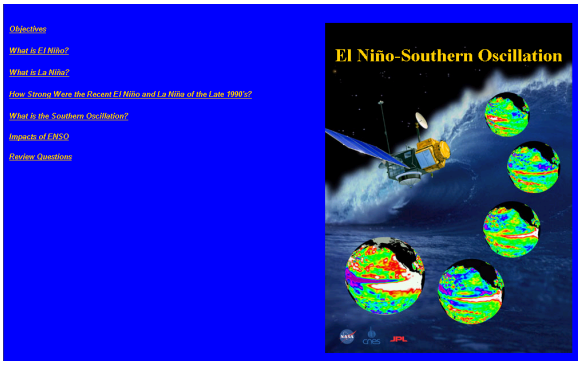

Figure 4. Homepage for the El Niño-Southern Oscillation module.

3. ASSESSMENT OF MODULE

The authors used a survey to help assess the value of the activities (Figure 5). The summer 2002 Earth Science class of about 40 students completed the exercises and provided feedback. Although some students were frustrated with the slow uploading of animations, the majority felt that they were more knowledgeable on the

Review Questions

1. Which region of the world has the highest waves?
   a. Equatorial
   b. Subtropical
   c. Mid-latitude
   d. Subpolar

2. The highest part of a wave is the _____.
   a. wavelength
   b. trough
   c. crest
   d. curl

3. The greatest frequency of tsunamis occurs in the _____ Ocean?
   a. Atlantic
   b. Indian
   c. Pacific
   d. Southern

4. During the El Niño phase of ENSO the _____ equatorial Pacific is warmer than normal.
   a. western
   b. central and eastern
   c. central and western
   d. northern

5. During the 1997-1998 El Niño event, ENSO was _____.
   a. positive
   b. negative
   c. neutral
   d. warm

6. During the La Niña phase of ENSO, Southern California weather is _____.
   a. unusually dry
   b. unusually wet
   c. near normal
   d. extremely stormy

7. A storm in the South Pacific can cause large waves on the Southern California beaches.
   a. True
   b. False

8. After doing this exercise I feel I know more about air-sea interactions.
   a. Strongly agree
   b. Somewhat agree
   c. Somewhat disagree
   d. Strongly disagree

9. Online activities are useful in learning Earth Science concepts.
   a. Strongly agree
   b. Somewhat agree
   c. Somewhat disagree
   d. Strongly disagree

10. What did you like most about the activity?

11. What did you like least about the activity?

Figure 5. Review questions were used as a method for assessing student learning.

topics after running the modules and that online activities are useful for earth science instruction.

4. FUTURE PLANS

Future plans call for the refinement of the modules developed through both the addition of updated materials, as they become available, and the modification of questions attached to the activities. The activities will be administered to future general education courses in earth science and oceanography. Additionally, we plan to distribute the activities to earth science instructors at our university and at other academic institutions. Dissemination of modules will also occur at professional conferences. The compilation of instructor and student assessment data will form the basis for refinement of the activities.

5. SUMMARY

Two modules focused on air-sea interactions have been developed. One module examines the structure and distribution of waves and the causes of tsunamis. The second module centers on the oceanographic and meteorological changes related to the onset of El Niño and La Niña events. Preliminary assessment data indicate that student perceptions of the usefulness of the modules for earth science instruction are favorable.

To receive a copy of the *Air-Sea Interactions* CD-ROM, please send an e-mail to: sladoch@calstatela.edu

6. ACKNOWLEDGEMENTS

The authors wish to thank CSULA for supporting this project with an Innovative Instructions grant. Thanks also go to JPL, NASA, for providing classroom sets of ocean science materials to our students.

7. REFERENCES

Ginger, K. and M. Marlino, 2002: Digital libraries in the classroom: Using the Digital Library for Earth System Education (DLESE) to support learning. *11th Symposium on Education* of the 82nd Annual Meeting of the American Meteorological Society (AMS), Orlando, FL (January 13-17).