Multimedia Learning Materials for Marine Applications

Sherwood R. Wang
Patrick Parrish
Patrick Dills
UCAR/COMET® Boulder, CO
Thomas Lee
Naval Research Laboratory Monterey, CA

Abstract- **This presentation provides an overview of multimedia learning materials produced by the COMET® Program for civilian and military operational meteorologists, university students, and others interested in marine science. There are several project teams developing learning materials on different aspects of marine science. The NPOESS Integrated Program Office sponsors a team dedicated to highlighting current and future polar-orbiting satellite capabilities. Currently, the team is developing a series on microwave remote sensing that emphasizes applications over oceans, including near-surface ocean wind speed and direction, sea-surface temperature, total precipitable water, and precipitation estimation. Other COMET teams, sponsored by the National Weather Service, are developing modules several topics in marine meteorology. All of the modules integrate carefully designed, scientifically accurate animations and models addressing crucial scientific concepts related to module objectives. The presentation will include an overview of the COMET Program and the NPOESS/IPO efforts, along with examples from several modules from the NPOESS and marine meteorology series.**

I. INTRODUCTION

For over 15 years, the Cooperative Program for Meteorological Education and Training (COMET®) has been providing leading-edge multimedia-based education and training materials on weather forecasting and related topics to the operational meteorological community, universities, and international users. Recently, the program has expanded its scope to include other topic areas such as hydrology and marine applications. This paper describes the COMET Program and provides several module examples that address topics in or related to marine science.

The COMET Program's mission is to serve as a premier resource that supports, enhances, and stimulates the communication and application of scientific knowledge of the atmospheric and related sciences for the operational and educational communities. We currently offer over 40 modules and 1400 hours of online instruction.

As a part of the University Corporation for Atmospheric Research (UCAR), the COMET program receives support from the National Science Foundation for facilities and some administrative activities. Sponsoring agencies provide most of the support for module and residence course development. These include:

- NOAA
  - National Weather Service (NWS)
  - National Environnemental Satellite Data Information Service (NESDIS)
- U.S. Department of Defense
  - Air Force Weather Agency (AFWA)
  - Naval Meteorology and Oceanography Command (NMOC)
- Environment Canada—Meteorological Service of Canada
- Australian Government, Bureau of Meteorology
- Integrated Program Office (IPO)—National Polar-orbiting Environmental Satellite System (NPOESS)

Together, these organizations provide direction and support for multimedia and classroom-based educational activities produced by the COMET program.

II. NPOESS/IPO MODULES

The COMET program has several project areas that deal with various aspects of marine science. The IPO, which manages the NPOESS program, has supported development efforts in the area of polar-orbiting remote sensing. Polar-orbiting satellites cover the earth once every 12 hours, including the otherwise data-sparse oceans. Recent work has included many illustrations of remote sensing applications that relate to marine science. In our online module entitled *Advances in Microwave Remote Sensing: Ocean Wind Speed and Direction*, there are explanations of how the near-surface ocean wind field can be characterized by changes in ocean-surface microwave emmisivity. (See Figure 1.) Other remote-sensing ocean products include sea-surface temperature, altimeter-derived ocean heat potential product, ocean color, and sea ice amount and concentration and are covered in other COMET modules sponsored by the IPO.

Tropical cyclone analysis is another area where remote sensing provides crucial information on the characteristics of storms before they are within range of land-based sensors. The *Microwave Analysis of Tropical Cyclones* module includes information on how microwave sensors detect and characterize tropical cyclone features. The module also provides guidelines for interpreting microwave images.

1-4244-0115-1/06/$20.00 ©2006 IEEE

Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE	2. REPORT TYPE	3. DATES COVERED
01 SEP 2006	**N/A**	**-**

4. TITLE AND SUBTITLE	5a. CONTRACT NUMBER
Multimedia Learning Materials for Marine Applications	5b. GRANT NUMBER
	5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)	5d. PROJECT NUMBER
	5e. TASK NUMBER
	5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **Naval Research Laboratory Monterey, CA**	8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR/MONITOR'S ACRONYM(S)
	11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release, distribution unlimited

13. SUPPLEMENTARY NOTES
See also ADM002006. Proceedings of the MTS/IEEE OCEANS 2006 Boston Conference and Exhibition Held in Boston, Massachusetts on September 15-21, 2006, The original document contains color images.

14. ABSTRACT

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			
unclassified	**unclassified**	**unclassified**	**UU**	**4**	

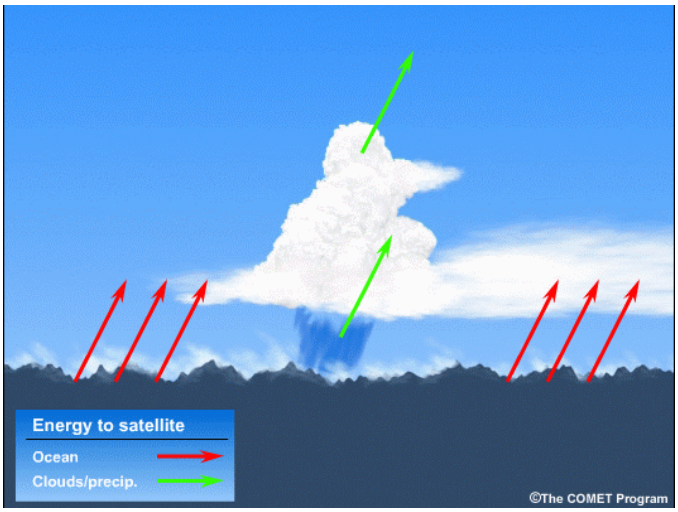

Figure 1. Microwave energy increases as the ocean surface roughens

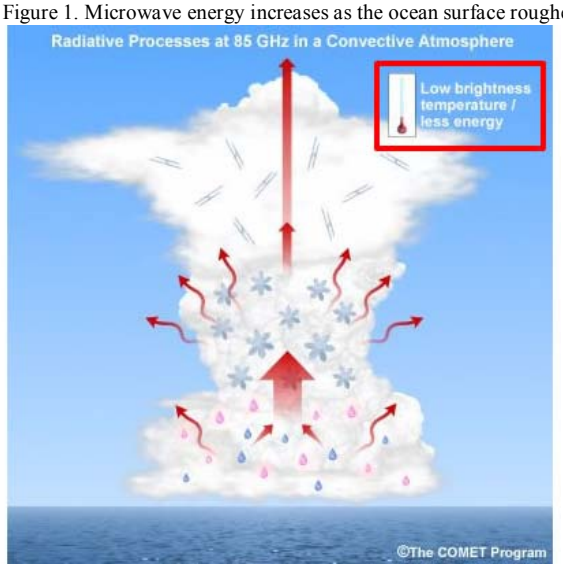

Figure 2. Microwave energy at 85 GHz through a cloud

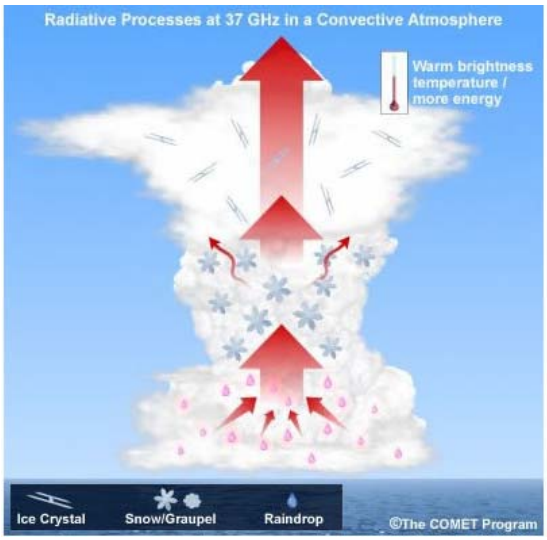

Figure 3. Microwave energy at 37 GHz through a cloud

Figures two and three compare emitted energy from a hypothetical storm cloud and 37 and 85 GHz.. Figures four and five microwave imagery at these two frequencies.

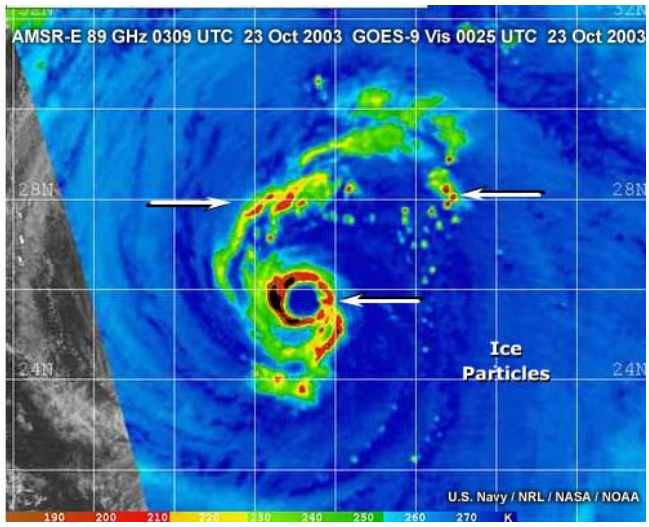

Figure 4. 85 GHz image showing cold cloud tops composed of ice particles

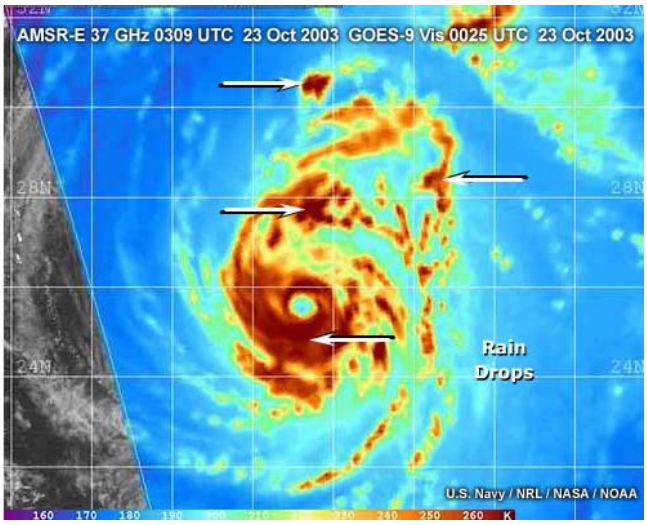

Figure 5. 37 GHz image showing rain drops within clouds

III COMET Marine Science Activities

The COMET Program has a marine science series currently in production that includes several conceptual animations to explain fundamental concepts in this area. The *Wave Types and Characteristics* module discusses the following attributes of waves found in large bodies of water.

- Wave types (based on generation sources)
- Physical characteristics
- Mathematical expressions that define physical traits
- Statistical traits (i.e., wave spectrum and height)
- Swell propagation, dispersion, and decay

Figure 6 shows an example explaining the basic terms used in describing waves. This module provides an introduction to wave behavior and explains several key concepts needed to pursue other topics in this area.

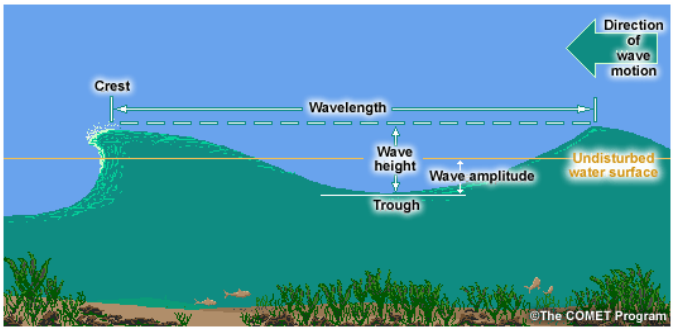

Figure 6. Illustration of wave nomenclature

The *Wave Life Cycle I: Generation* module discusses the process of wind-wave generation and the factors that limit wave growth. The module covers wind fetch, including dynamic fetch associated with storms, special wind events, and observation systems. Figure 7 shows an example showing wave growth within a fetch area.

Wave Life Cycle II: Propagation and Dispersion continues the discussion of seas and swell, showing how both large-scale and local factors influence wave behavior. Figure 8 shows how wave energy can become more focused farther from the fetch.

Figure 7. Animation showing wave growth within a fetch

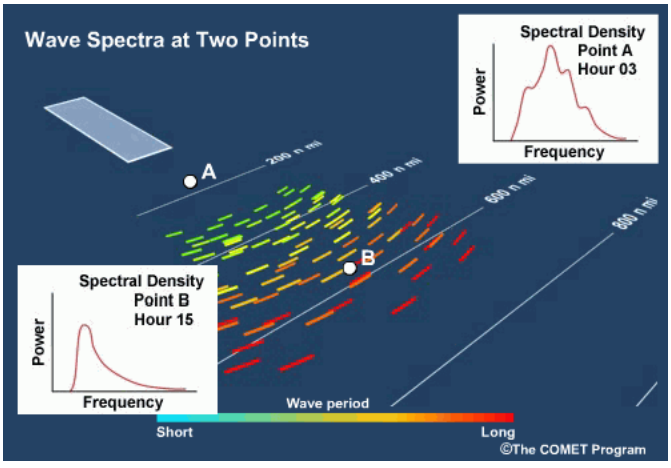

Figure 8. Animation showing how wave energy can change with distance

The marine series module, *Rip Currents: Near Shore Fundamentals,* provides information on the formation of rip currents using a series of interactive conceptual animations that allow the user to vary parameters in the nearshore environment and see the resulting changes in how and where rip currents form. Figure 9 shows a scene from this interactive animation.

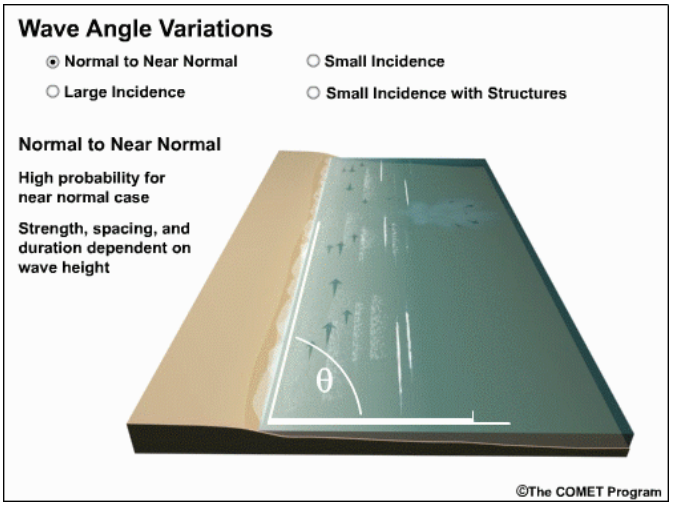

Figure 9. Rip current formation

Another module, *Shallow Water Waves*, continues the discussion about the nearshore environment by describing waves how break as they approach shore, including shoaling, refraction and wave damping. Wave-current interactions and coastal effects on wave behavior is also discussed. Figure 10 illustrates wave shoaling.

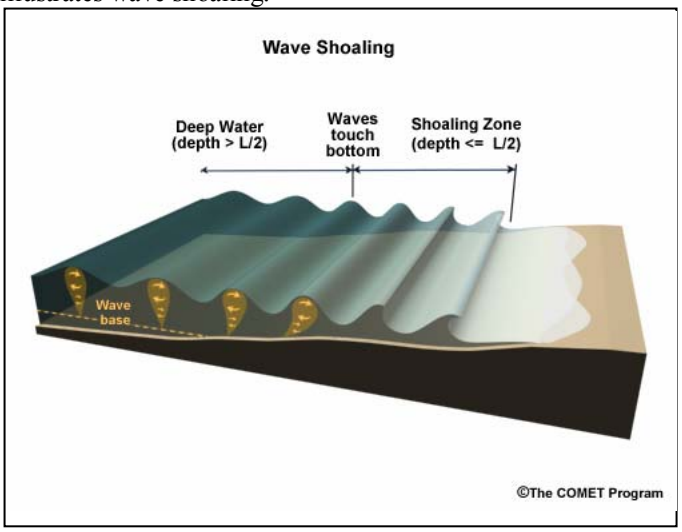

Figure 10. Illustrating wave shoaling

IV. Conclusion

In conclusion, the COMET Program provides a wide variety of education and training materials that relate to marine science. The IPO sponsors a team that focuses on polar-orbiting remote sensing that includes several marine science

applications. Other teams work specifically on marine science topics. The extensive use of animations, visualizations, and instructional illustrations help make the material easier to comprehend and apply.

V. REFERENCES

[1] All modules can be accessed at http://www.meted.ucar.edu