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NAVAL OCEAN ANALYSIS AND PREDICTION (NOAP) - AN INTEGRATED EDUCATION AND RESEARCH PROGRAM AT THE NAVAL POSTGRADUATE SCHOOL

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An integrated education and research program, **Naval Ocean Analysis and Prediction (NOAP)**, has been recently established at the Naval Postgraduate School's (NPS) Oceanography Department with support from the Naval Oceanographic Office (NAVO), the Office of Naval Research (ONR) and Naval Postgraduate School (NPS). With its blend of education, research and service, this addition to NPS' meteorology and oceanography (METOC) curricula further prepares students to assume operational jobs and provides a link between research and development and the Navy's operational communities (Chu, 1995).

1 Three Components

This program consists of three major components: education, research, and service. Each component, directly related to the Navy's METOC missions, has several feedback loops among student officers, NPS faculty and staff, and the Navy's METOC units and scientific institutions.

For the **educational component**, a series of new courses have been developed in a very different way from the traditional approach. We adopt the **open-door** format (Fig. 1). The course materials were mostly from the Navy's METOC units and the scientific institutions. As soon as a course was developed, sets of course notes were sent out for review. Comments and suggestions have been received from various institutions. Technical staff members from the METOC units and scientists from the ocean modeling and prediction community were invited to offer guest lectures, and student officers were organized to tour the METOC units. A guest lecture given by Mr. Clancy from Fleet Naval Meteorology and Oceanography Center (FNMOC) was very well received by the student officers. Students thought a tour to FNMOC worthwhile. Thus, the NOAP educational component provides the student officers with the most advanced knowledge of the Navy's METOC systems. During the course work, students learn the basic physics, model assumptions, model development and formulation, and most importantly, understand the success and weakness of each METOC system, and future improvements. A set of laboratories were developed from simplifying various METOC models (Fig. 2). Through the lab assignments student officers have hand-on experiences with these METOC models.

For the **research component**, the projects were also originated from the Navy's establishments, and were pursued by joint effort among the NPS students, faculty and staff, and scientists at the Navy's METOC units and scientific institutions (Fig. 3). Current research projects include Littoral Zone Prediction Systems, South China Sea Prediction System, Master Oceanographic Observational Data Set (MOODS) Analysis, and Environmental Effects on Joint Warfare Analysis. Several student officers have obtained their M.S. degree through this program: LT Nate Edmons (1996), LT. Charles Fralick (1994), LCDR Eric Gottshall (1997), LCDR Akira Kuninaka (1997), LCDR Wei-Szu Li (1992), LT Ching-Chung Li (1994), LT Gonzalo Montenegro (1993), LCDR Hsing-Chia Tseng (1995), and LCDR Susan Wells (1994). Most theses were completed under my guidance and Dr. Michael Carron and Mr. Steven Haeger at NAVO, and were presented at international and national conferences. With good quality most theses were published in refereed journals, such as the *Journal of Geophysical Research - Oceans.*

For the **service component**, I have been involved in various Navy's METOC services, as an example, I was selected as a co-chair of the Commander, Naval Meteorology and Oceanography Command (NMOC) Independent Modeling Review Panel (CIMREP), a position which also allows me to obtain current knowledge for teaching and to investigate opportunities for Navy-

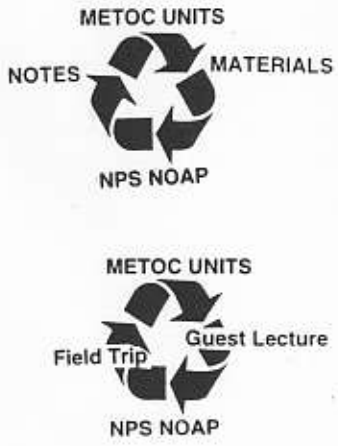

Figure 1 – Open door format of the NOAP education.

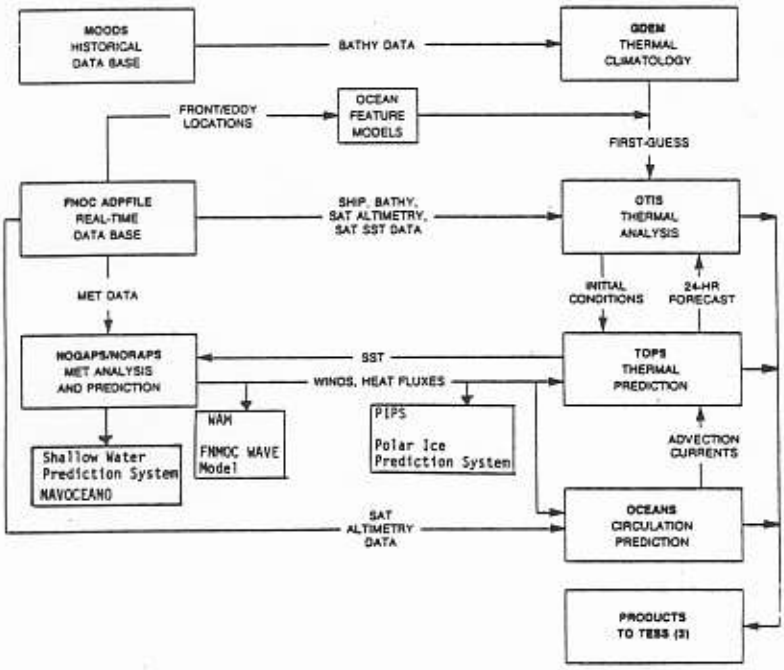

Figure 2 – Various METOC models taught in the NOAP course.

relevant research.

2 Feedback Among the Three Components

The three NOAP components interact, help, and strengthen each other (Fig. 4). Through NOAP education, student officers obtained the most advanced knowledge about METOC modeling and simulations, including basic physics, formulation, successes, weaknesses and a clear idea for improvement. This lays a solid foundation for the NOAP research. New results from NOAP research are immediately included into the NOAP courses. This keeps the NOAP education current. The NOAP educational and research activities further prepare student, faculty and staff for better services to the Navy's operations.

3 NOAP And Naval METOC Operations

NOAP is an important element of the Navy's METOC training pipeline (Fig.5). The Basic Oceanography Accession Training (BOAT) school furnishes junior officers with a fundamental understanding of meteorology and oceanography as well as the structure of NMOC. Attendance at the Naval Postgraduate School later provides systematic graduate level education in meteorology and physical oceanography. Participants in the NOAP course receive a global view of the Navy's METOC systems and a clear idea for future improvements. By gaining advanced knowledge about the METOC systems and then working on the Navy's challenges under the guidance of NPS faculty and scientists at operational METOC activities, NOAP participants are better prepared for an operational tour. With this solid background, officers entering the Joint METOC Tactical Applications Course (JMTAC) offered by the Naval Oceanographic Office's Atlantic and Pacific Components are well on their way to becoming outstanding METOC officers.

4 NOAP And Scientific Community

The Navy sponsors a broad spectrum of METOC activities ranging from basic research to operational work. The NOAP program links student officers with the scientific community. Through the NOAP's education, METOC officers become very familiar with the most advanced knowledge about METOC modeling research and development and understand the successes, problems, and difficulties of the METOC systems. In the

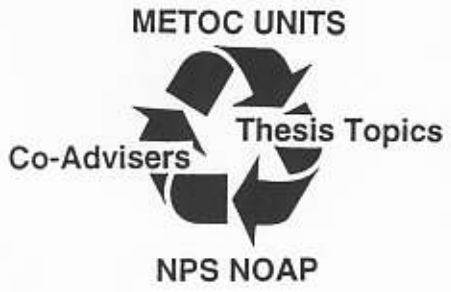

Figure 3 – Open door format of the NOAP research.

Figure 4 – Feedback loops among NOAP education, research, and service.

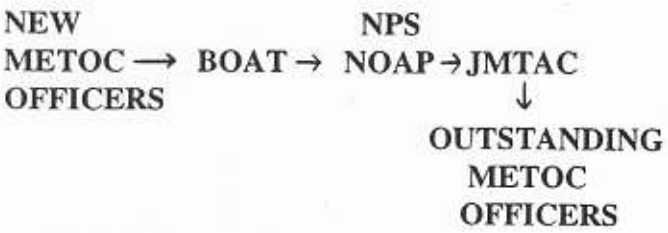

Figure 5 – The Naval METOC training pipeline.

future, these officers will be more supportive for the scientific community (Fig. 6). Such a feedback process benefits not only the Navy's METOC education but also the scientific community.

5 Conclusions

(1) This integrated education/research program ties the METOC education with the Naval operations and blends the basic research with the Navy's operational work.

(2) Through its three-pronged approach (education, research, and service), NOAP enhances education for the Navy's METOC officers while benefiting the meteorology and oceanography communities in which they will one day serve.

References

Chu, P.C., 1995: Naval ocean analysis and prediction program at NPS. *Naval Meteorology and Oceanography Command News*, **8**, 5-6.

Edmons, Nate, "South China Sea ocean circulations simulated by a primitive equation model," MS in Physical Oceanography, September 1996. Part of the thesis was presented at the International Ocean Modeling Workshop, Princeton University, 3-5 June 1996 (invited paper).

Fralick, C., "Yellow Sea thermal structure," MS Thesis in Physical Oceanography, NPS, September 1994, Part of the thesis was presented at the 27th International Liege Colloquium on Ocean Hydrodynamics, Liege, Belgium, 7-11 May 1995. This thesis was published in the Journal of Geophysical Research, 1997.

Gottshall, E., "Environmental Effects on Naval warfare simulations," MS in Physical Oceanography, December 1997. Part of the thesis was presented at the 64th Military Operations Research Society Symposium on Environmental Effects on Naval Warfare Simulations, Kansas AFB, 17-19 June 1996.

Kuninaka, A., "Yellow Sea/East China Sea thermohaline structure", MS Thesis in Physical Oceanography, December 1997.

Li, C.-C., "A numerical simulation of seasonal circulation in the South China Sea," MS Thesis in Physical Oceanography, March 1994. Part of the thesis was presented at the Second International Conference on Air-Sea Interaction and Meteorology and Oceanography of the Coastal Zone, Lisbon, Portugal, 1994.

Li, W.-S., "Using the C-vector method to derive the three dimensional circulation pattern near the east Greenland polar front," MS Thesis in Physical Oceanography, NPS, December 1992. Part of the thesis was presented at the American Meteorological Society Third Conference on Polar Meteorology and Oceanography, Portland, 29 September-2 October 1992.

Montenegron, G., "Three dimensional vorticity field in the California current system," MS Thesis in Physical Oceanography, NPS, March 1993.

Tseng, H.-C., "South China Sea warm-core and cold-core eddies detected from the Navy's Master Oceanographic Observation Data Set (MOODS) ," MS Thesis in Physical Oceanography, NPS, September 1995. Part of the thesis was presented at the International South China Sea Monsoon Experiment Scientific Workshop (invited paper), Beijing, China, 5-7 June 1995. This thesis was published in the Journal of Geophysical Research, 1997.

Wells, Susan K., "Temporal and spatial decorrelation scales of the Yellow Sea thermal fields," MS Thesis in Physical Oceanography, NPS, September 1994. Part of the thesis was presented at the 27th International Liege Colloquium on Ocean Hydrodynamics, Liege, Belgium, 7-11 May 1995. This thesis was published in the Journal of Geophysical Research, 1997.

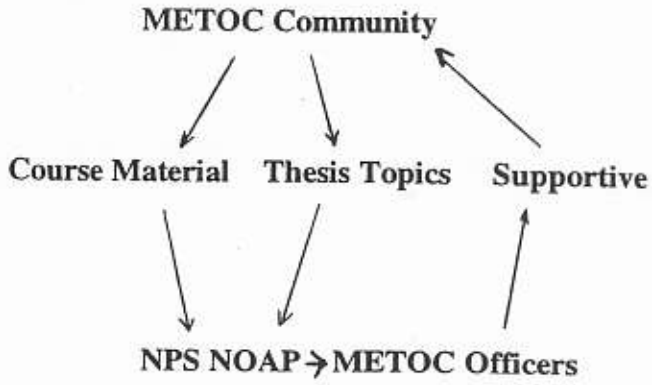

Figure 6 – Feedback loops between NOAP and the scientific communities.