

AIR-OCEAN SCIENCES CURRICULA AT THE
NAVAL POSTGRADUATE SCHOOL - MONTEREY, CALIFORNIA

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Abstract

Air-Ocean Sciences Programs at the Naval Postgraduate School (NAVPGSCOL), Monterey, CA, are designed to provide graduates with a thorough understanding of either air-ocean, atmospheric, oceanographic, or hydrographic sciences and to develop the technical expertise necessary to apply the knowledge of these sciences in support of all aspects of military operations. Currently, Air-Ocean Curricula are open to U.S. officers of all uniformed services, allied officers and civilian employees of the U.S. federal government. Curricula include: #373 Air-Ocean Science; #374 Air-Ocean Tactical Environmental Support; #441 Hydrographic Sciences; #440 Oceanography; and #372 Meteorology. NAVPGSCOL provides a unique opportunity to study the environment in total; the atmosphere, the oceans and their interaction.

1. Introduction¹

On 09 June 1909, the Postgraduate Department of the U.S. Naval Academy was established at Annapolis, Maryland. Closed during World War I, this department resumed classes in 1919 and grew in size in subsequent years to the point at which it became designated the U.S. Naval Postgraduate School (NAVPGSCOL). In 1927, a General Line Course was established to acquaint junior naval line officers with modern Naval developments and to broaden their professional knowledge of future command at sea. The school's activities broadened dramatically during World War II both in student enrollment and in program development and expansion to meet the evolving needs of the Navy. Between 1945 and 1948, the Congress established the school as a separate activity with its own Superintendent and the authority to award bachelor's, master's and doctor's degrees. In December 1951, the former Del Monte Hotel was acquired and Monterey, California became the new home of NAVPGSCOL. Enlarged facilities enabled

the School to continue growth in both curricular programs and student enrollment. In 1956, the Navy Management School was formed as a component of NAVPGSCOL to provide graduate education in the theory and application of administrative science. In 1958, the General Line School was renamed the General Line and Naval Science School, and a Bachelor of Science curriculum was offered to selected officers who had not completed undergraduate education. Additional requirements for baccalaureate courses resulted in a Bachelor of Arts curriculum in 1961. A major internal reorganization in 1962 merged the Management, Engineering and General Line Schools, making NAVPGSCOL in effect, a naval university, unified in policies, procedures and objectives. In 1973, NAVPGSCOL, the Naval War College, and the U.S. Naval Academy were made components of the Naval Education and Training Command. NAVPGSCOL currently occupies a multimillion dollar campus and graduates an average of 800 students a year comprised of officers of all five U.S. services and approximately 25 allied services. Since 1975, civilian employees of the U.S. federal government have also been enrolled.

The NAVPGSCOL Superintendent is a rear admiral of the Navy line. Principal assistants include: the Provost/Academic Dean who is the senior member of the civilian faculty; and two Navy line captains, the Director of Programs, and the Director of Military Operations and Logistics. Academic programs and direct supporting functions are operated and administered through a unique organization composed of Curricular Offices and Academic Departments. The Curricular Offices are staffed by naval officers and academic associates whose primary functions are threefold: academic counseling and military supervision of students; curriculum development and management to insure attainment of professional and academic objectives; and liaison with curricular sponsor representatives. Students are grouped in the following curricular program areas:

¹Naval Postgraduate School Catalog, 1981-82, p. 5-9, Monterey, California 93940.

Administrative Science
Aeronautical Engineering
Air-Ocean Sciences
Command, Control and Communications (C3)
Computer Technology
Electronics and Communications
National Security Affairs/Intelligence
Naval Engineering
Operations Research/Systems Analysis
Weapons Engineering/ASW

The teaching functions of the classroom and laboratory plus thesis supervision are accomplished by faculty from eleven academic departments and three interdisciplinary groups. Over 80% of the teaching staff are civilians of varying professional rank; the remainder are military officers.

Administrative Sciences
Aeronautics
Computer Science
Electrical Engineering
Mathematics
Mechanical Engineering
Meteorology
National Security Affairs
Oceanography
Operations Research
Physics and Chemistry

ASW Group
Command, Control and Communications
(C3) Group
Electronic Warfare Group

The NAVPGSCOL is accredited by the Accrediting Commission for Senior Colleges and Universities of the Western Association of Schools and Colleges. Specific engineering curricula have been accredited by the Accrediting Board for Engineering and Technology.

2. Air-Ocean Sciences Curricula

Five curricula are included under the general category Air-Ocean Sciences:

- #373 - Air-Ocean Science
- #374 - Air-Ocean Tactical Environmental Support
- #441 - Hydrographic Sciences
- #440 - Oceanography
- #372 - Meteorology

Qualifications for admission common to all curricula include a baccalaureate degree or the equivalent with above average grades in mathematics and the physical sciences. For admission to the #373 - Air-Ocean Science Curriculum, the undergraduate degree should be in meteorology, oceanography or the equivalent. Completion of mathematics through differential and integral calculus and one year of college physics is considered minimal preparation. A year of college chemistry is also required for all curricula with the exception of #372 - Meteorology. Specific program details are included in the sections following [See also Figure 1.]

#373 - Air-Ocean Science

While this curriculum is open to officers of the other U.S. military services, allied officers and qualified civilian employees of the U.S. federal government, its availability to U.S. Naval officers is limited to those of the Restricted Line (Special Duty - Geophysics). Successful program completion leads to the award of the degree Master of Science in Meteorology and Oceanography. Naval officers are also awarded the XX47P subspecialty billet code upon successful program completion.

This program's objective is to provide qualified personnel a thorough understanding of the air-sea environment and to develop the technical expertise to provide and utilize meteorological and oceanographic data and knowledge in support of all aspects of military operations. This education enhances performance in all duties throughout a career including operational billets, technical management assignments and policy-making positions. Students develop sound graduate level technical ability based on general engineering and scientific principles, build a new appreciation for continuing education, acquire diverse professional knowledge, develop analytical ability for practical problem solving, broaden their capacity for original thought and discover a new personal confidence that leads to productive achievement throughout their careers.

The Air-Ocean Science Curriculum is interdisciplinary in nature and encompasses those areas of meteorology, oceanography, and hydrographic sciences which are directly related to environmental support of military operations. Classroom instruction is supplemented by laboratory exercises both ashore and afloat. The Research Vessel ACANIA is sponsored by the Oceanographer of the Navy for class laboratory experience as well as for individual research efforts. Guest lectures, seminars and field trips serve to round out the curriculum. Close proximity of the Fleet Numerical Oceanography Center and the Naval Environmental Prediction Research Facility are most conducive to effective liaison on operationally significant problems and germane research. A master's thesis is required. Upon completion of this program, a student is qualified to independently serve as a meteorological and oceanographic forecaster in support of military operations.

Matriculation may occur any quarter with preferred entry in the fall and spring. A typical program for a well-qualified student is eight quarters (two years).

#374 - Air-Ocean Tactical Environmental Support

This curriculum is open to all Naval officer communities (surface, sub-surface and aviation), officers of other U.S. services, allied officers and qualified civilian employees of the U.S. federal government. Successful program completion leads to the award of the degree Master of Science in Meteorology and Oceanography. Naval officers

are also awarded the XX49P subspecialty billet code upon successful program completion.

The program's principal objective is to provide students with a thorough understanding of the air-sea environment and operations analysis principles to forecast atmospheric, oceanic and acoustic conditions which affect operations, tactics and strategy in all areas of Naval warfare (air, surface, and sub-surface). Primary emphasis is placed on the understanding of the impact of the environment (atmosphere, ocean and their interface) on weapons systems, sensors, platforms, and communication systems (including electromagnetic, optical and acoustic propagation). The program recognizes the importance of interactions between the atmosphere and the oceans, and deals with the relationships at the air-sea interface. A master's thesis is required.

Interdisciplinary in content, this curriculum provides a firm foundation in meteorology and oceanography. Though similar in content to the #373 - Air-Ocean Science curriculum, this curriculum provides a sequence of courses in operations research and physics germane to stated program objectives.

Matriculation may occur any quarter; preferred entry is in the fall or spring. The program is eight quarters (two years) in length.

#441 - Hydrographic Sciences

This program is open to officers of the National Oceanic and Atmospheric Administration, Coast Guard, Corps of Engineers, allied officers and qualified civilian employees of the U.S. federal government. Successful program completion leads to the award of the degree Master of Science in Hydrographic Sciences.

This program's objective is to provide students with a sound understanding of oceanography and hydrography. Hydrography (a subdiscipline of mapping, charting and geodesy (MC&G)) is the science of the measurement, description and charting of the sea floor with special reference to navigation and marine operations. This interdisciplinary program integrates the scientific principles of oceanography with the practical engineering procedures of hydrography. Students achieve the technical expertise to provide and utilize hydrographic data in support of all aspects of hydrographic operations. This education enhances performance in duties associated with operational billets, technical management assignments and policy-making positions.

This curriculum recognizes the importance of precise positioning systems, error budget analysis, accuracy requirements, data collection methods and data reduction techniques as applied to the planning, conduct and evaluation of hydrographic, magnetic and gravity surveys. Graduates are prepared to make optimum use of the ocean environment in the course of their duties and to conduct and evaluate research in oceanography and hydrography,

both basic and applied. Classroom instruction is supplemented by laboratory exercises both ashore and afloat. The Research Vessel ACANIA is available for class laboratory experience as well as for individual research efforts. Additionally, the National Oceanic and Atmospheric Administration provides laboratory time aboard working hydrographic survey ships. Each student is required to complete a master's thesis, the subject of which often addresses a problem of scientific interest and practical value to the student's sponsoring agency.

Typical program length is eight quarters (two years). Preferred matriculation is in the fall.

#440 - Oceanography

This program is open to officers of other U.S. military services, allied officers and qualified civilian employees of the U.S. federal government. Successful program completion leads to the award of the degree Master of Science in Oceanography.

The Oceanography Curriculum's objective is to provide students with sound understanding of the science of oceanography and to develop the technical expertise to provide and utilize oceanographic and acoustical data in support of all aspects of military operations. Particular emphasis is placed on the understanding of oceanic effects on the solution of the undersea warfare problem. This education enhances performance in all duties throughout a military career including operational billets, technical management assignments and policy-making positions. A master's thesis is required.

The focus in this program is on modern Physical Oceanography. Topic areas which are addressed include: dynamical oceanography and meteorology; physical oceanography and marine meteorology; acoustic and non-acoustic anti-submarine warfare principles; shallow water and nearshore oceanography of extended jurisdiction zones; all scales of oceanic variability; methods of ocean prediction; regional oceanography and meteorology including polar, tropical, and other areas; air-sea interaction; oceanic data systems; methods of optimum track ship routing, search and rescue modeling, spectral wave modeling, tidal level and current modeling, and storm surge modeling; influence of physical oceanic phenomena on marine resources and their management; and, interaction of ships with waves.

Matriculation may occur any quarter; preferred entry is in the fall. The program is typically eight quarters (two years) in length but may be adjusted depending on individual student's qualifications. A Ph.D. program is also available.

This program is open to officers of other U.S. military services, allied officers and qualified civilian employees of the U.S. federal government. Successful program completion leads to the award of the degree Master of Science in Meteorology.

Naval Postgraduate School, 1981; Naval Postgraduate School Catalog. Monterey, California, 228 pp.

Atmospheric conditions that prevail throughout the world are frequently important, even critical, to the planning and execution of military and civil operations. The objective of the Meteorology curriculum is to provide students with a sound understanding of the science of meteorology and to develop the necessary expertise to provide and utilize meteorological data in support of all aspects of weather-dependent operations. Interdisciplinary in content, this program encompasses those areas of meteorology which are directly related to the environmental support of operations. Course sequences in synoptic and dynamic meteorology as well as numerical prediction are included. The importance of the air-sea interface is also recognized and addressed directly. Classroom instruction is supplemented by laboratory exercises, computer solutions to various problems and guest lectures and seminars. A master's thesis is required. Upon completion of the program, the student is qualified to serve independently as a meteorological forecaster.

Matriculation may occur any quarter with preferred entry in the fall. Typical program length is six to seven quarters (1-1/2 to 1-3/4 years). A Ph.D. program is also available.

3. Summary

The following is taken from a July 1981 message addressing graduate education from the Chief of Naval Operations: "We must counsel our junior officers regarding the opportunities resulting from attendance at Naval Postgraduate School. Advanced education is professionally and intellectually broadening, will enhance career prospects, and is a definite promotion plus. The Naval Postgraduate School is the surest way our promising officers can meet their graduate education goals. All Naval Postgraduate School programs support a Navy subspecialty . . ." Liaison with the principal program sponsor, the Oceanographer of the Navy (CNO-OP-952), and periodic curricula reviews assure that Navy educational requirements are, and will continue to be, satisfied in NAVPGSCOL Air-Ocean Sciences Curricula.

Additional program details are available from:

Air-Ocean Sciences Curricular Officer
Code 35
Naval Postgraduate School
Monterey, CA 93940
408-646-2044 -- AUTOVON 878-2044

Required courses are
indicated by "X".

FIGURE 1.
Curricula/Course Matrix

	<u>373</u>	<u>374</u>	<u>441</u>	<u>440</u>	<u>372</u>
<u>BASIC/PREREQUISITE</u> (Class hours-Laboratory hours)					
Multivariable Calculus/Laboratory (5-2)			X		
Linear Algebra and Vector Analysis (4-0)	X	X	X	X	X
Differential Equations (4-0)	X	X	X	X	X
Computer Science/FORTRAN Programming	X	X	X	X	X
Atmospheric Thermodynamics (3-1)	X	X		X	X
Oceanic Thermodynamics (3-1)	X	X	X	X	
Partial Differential Equations and Integral Transforms (4-0)	X	X		X	X
Numerical Analysis (3-2)	X			X	X
Statistics for Science and Engineering (4-0)	X			X	X
Marine Meteorology (4-1)			X		
<u>DYNAMICS</u>					
Air-Ocean Fluid Dynamics (4-0)	X	X		X	X
Dynamic Meteorology (4-0)	X	X		X	X
Dynamical Oceanography (4-0)	X	X		X	
Air-Sea Interaction (4-0)	X	X		X	X
Numerical Air and Ocean Modeling (4-3)	X			X	X
Gravity Wave Theory (4-0)			X		
Tides (4-0)			X	X	
Nearshore and Wave Processes (3-1)			X	X	
Shallow Water Oceanography (3-2)				X	
Advanced Air-Sea Interaction (3-0)				X	
<u>ANALYSIS</u>					
Meteorological Analysis (4-3)	X	X		X	X
Ocean Circulation Analysis (4-2)	X	X		X	
Analysis of Air-Ocean Time Series (3-2)	X	X		X	X
Tropospheric and Stratospheric Analysis (4-0)	X	X			X
Tropospheric and Stratospheric Analysis Laboratory (0-7)	X				X
Tropical Meteorology (3-4)	X	X			X
Synoptic Oceanography (3-2)	X			X	
Polar Meteorology/Oceanography (3-1)				X	
Oceanic and Atmospheric Observational Systems (2-2)				X	
Mesoscale Meteorology (3-0)					X
<u>PHYSICAL</u>					
Remote Sensing of the Atmosphere and Ocean (4-2)	X	X		X	X
Atmospheric Factors in Electromagnetic and Optical Propagation (4-0)	X	X			X
Physics of Sound in the Ocean (4-2)	X	X		X	
Ocean Influences in Underwater Acoustics (4-0)	X	X		X	
Physical Processes in the Lower and Upper Atmosphere (3-0)	X	X			X
Sound in the Ocean (3-0)			X		
<u>FORECAST/APPLICATIONS</u>					
Wave and Surf Forecasting (2-2)	X	X		X	
Acoustic Forecasting (2-2)	X	X			
Prognostic Charts and Forecasting Weather Elements/ Laboratory (3-3)	X	X			X

	<u>373</u>	<u>374</u>	<u>441</u>	<u>440</u>	<u>372</u>
<u>TACTICAL ENVIRONMENTAL SUPPORT</u> (Class hours-Laboratory hours)					
Introduction to Applied Probability for Systems Technology (4-1)		X			
Decision and Data Analysis (4-0)		X			
Search, Detection and Localization Models (4-0)		X			
Introduction to Combat Models and Weapons Effectiveness (4-1)		X			
Simulation and War Gaming (3-1)		X			
Weapons Systems and Weapons Effects (4-0)		X			
 <u>HYDROGRAPHIC SCIENCES</u>					
Marine Geophysics (3-0)			X		
Mapping, Charting and Geodesy (4-2)	X		X		
Hydrographic and Geodetic Survey (4-2)	X		X		
Electronic Survey and Navigation (4-0)			X		
Hydrographic Survey Planning (1-3)			X		
Hydrographic Survey Field Experience (3-8)			X		
Geodetic Survey Field Experience (1-4)			X		
Advanced Hydrography (3-0)			X		
Geometric and Astronomic Geodesy (4-0)			X		
Gravimetric and Satellite Geodesy (4-0)			X		
Photogrammetry and Remote Sensing (3-2)			X		
 <u>OTHER</u>					
Biogeochemical Processes in the Ocean (4-3)			X		
Computing Devices and Systems (4-0)			X		
Ocean Maritime and Tort Law (4-0)			X		
Thesis Research	X	X	X	X	X
Air-Ocean Science Seminars	X	X	X	X	X
*Track Option [course work in an area of student and/or sponsor interest]					
Number of available course slots in a typical program	4	2	4	3	4

*Track Option Courses

Meteorology

Mesoscale Meteorology (3-0)
Advanced Numerical Weather Prediction (3-0)
Advanced Tropical Meteorology (3-0)
Advanced Geophysical Fluid Dynamics I and II (3-0)
Cloud Physics (3-0)

Oceanography

Nearshore and Wave Processes (3-1)
Biogeochemical Processes in the Ocean (4-3)
Shallow Water Oceanography (3-2)
Small Scale Oceanic Processes (2-2)
Advanced Synoptic Oceanography (4-0)
Advanced Biological Oceanography as Applied to Naval Operations (2-3)
Advanced Chemical Oceanography as Applied to Naval Operations (2-3)

Shared (Meteorology/Oceanography)

Polar Meteorology/Oceanography (3-1)
Topics in Satellite Remote Sensing (3-0)
Advanced Air-Sea Interaction (3-0)
General Circulation of the Atmosphere and Oceans (3-0)
Oceanic and Atmospheric Observational Systems (2-2)

Hydrographic Sciences

Hydrographic Survey Planning (1-3)
Photogrammetry and Remote Sensing (3-2)
Marine Geophysics (3-0)
Geometric and Astronomic Geodesy (4-0)
Gravimetric and Satellite Geodesy (4-0)
Tides (4-0)

Note. Additional Track Options are available in: Tactical Environmental Support; Computer Science; Statistics; etc.