

**Guide to the Records of the Mid-
Ocean Dynamics Experiment, 1970-1976
AC.0042**

Finding aid prepared by Deborah Shea

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617.253.5690
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Summary Information

Repository	Massachusetts Institute of Technology. Institute Archives and Special Collections
Creator	Mid-ocean Dynamics Experiment-One. Scientific Council
Creator	Mid-ocean Dynamics Experiment
Title	Mid-Ocean Dynamics Experiment records
Date [inclusive]	1970-1976
Extent	4.5 cubic feet in 3 record cartons, 2 manuscript boxes, 1 large flat box, and 6 storage tubes
Location	Materials are stored off-site. Advance notice is required for use.
Language	English
Abstract	The Mid-Ocean Dynamics Experiment (MODE-I), carried out between March and July of 1973, was a collection of twelve experimental and theoretical scientific projects performed simultaneously. Using different instruments to measure the same phenomena from dissimilar views, the project explored the role of mesoscale eddy motions in the dynamics of general oceanic circulation. The collection primarily consists of correspondence, notes, meeting minutes, proposals, strategy statements, and reports from the working files of various project members.

Citation

Mid-Ocean Dynamics Experiment records, AC 42, box X. Massachusetts Institute of Technology Institute Archives and Special Collections, Cambridge, Massachusetts.

Historical note

The Mid-Ocean Dynamics Experiment (MODE) was one of the first large-scale and extensively instrumented field experiments carried out by physical oceanographers. Conducted in two phases between November 1971 and July 1973, the experiment explored the role of mesoscale eddy motions in the dynamics of general oceanic circulation. Henry Stommel of MIT and Woods Hole Oceanographic Institution (WHOI) was a driving force behind the plans for the experiment. It was during British oceanographers John Swallow and James Crease's R/V *Aries* expedition in 1959-1960 that evidence for the existence of energetic, rotating water columns or eddies was obtained. For their experiment, free drifting floats, since known as Swallow floats, were ballasted at 2000 and 4000 meter depths in the northwestern Atlantic Ocean and tracked in an attempt to measure slow drift in deep water. Plans for a mid-ocean dynamics experiment were solidified during a summer panel meeting at WHOI on July 20-24, 1970. Thirteen academic and oceanographic institutions and an international team of oceanographers from the United States, Great Britain, Sweden, and West Germany would later agree to participate in the experiment.

MODE was as much an exercise in organization as it was a scientific experiment. Collective responsibility and authority for the experiment resided in the twenty-one-member MODE Scientific Council, formed in mid-1971. Its membership consisted of the principal investigators from each of the experimental projects and representatives from the MODE Theoretical Panel. In addition, a six-member Executive Committee, two co-chairmen, Allan R. Robinson of Harvard University and Henry Stommel, and an executive officer, Dennis Moore of Nova University, monitored the overall operation of the experiment. Standing committees were created out of a need for cooperation and collective guidance among investigators. The National Science Foundation's Office for the Decade of International Ocean Exploration was the principal source of funding for the Mid-Ocean Dynamics Experiment. Other sources included the Office of Naval Research, the National Oceanographic and Atmospheric Administration, and the British National Environmental Research Council.

The intensive MODE-I field program, carried out between March and July 1973, was the culmination of a sixteen-month theoretical and observational field study known as both MODE-0 and PREMODE. The MODE-I program was a collection of twelve individual experimental and theoretical scientific projects performed simultaneously, each a substantial experiment in its own right. The field program for MODE-I was concentrated in a 600-square-kilometer test site that extended from 28 N 69 40'W, an area in the mid-ocean between Bermuda and Florida.

The duration of MODE-I was limited by the endurance of the equipment. Six ships, two aircraft, and a variety of new, sophisticated instruments, neutrally buoyant floats, "free fall" velocity profilers, and air-dropped current probes, were utilized for the experiment. The design of the experiment relied on an objective mapping scheme previously developed by meteorologists, and applied to oceanography for this experiment.

A coordinated communications network was necessary to organize the movements of the six-ship MODE fleet, personnel, and instrumentation. Undersea cables were extended from a communications center set up at the Bermuda Biological Station to land lines in the US, making phone communications between

ships and participating institutions possible. Termination points were at WHOI, MIT, and Harvard, Yale, and Johns Hopkins Universities.

Information critical to the ongoing evolution of the field program, hydrostatic data, float positions, instrumentation launches and recoveries, was relayed daily to the "Hot-Line Center" and disseminated in weekly *MODE Hot Line Bulletins* and biweekly *Mode Hot Line News* publications.

MODE-I generated a massive amount of data. An important component of the experiment was the use of different instruments to measure the same phenomena from dissimilar views. In this way a greater understanding of instrument accuracy could be determined and ultimately synthesized into a description of an eddy. To provide a forum for theoretical and dynamical discussions of the eddy problem and general oceanic circulation, to disseminate synthetic analysis of MODE-1, and to develop a draft for a synoptic atlas, scientists followed MODE-I with a two-month "Summer Institute" at the University of Rhode Island in July and August of 1974. Discussions with the ten-member USSR delegation at the Summer Institute led to plans for a joint US and USSR experiment, to be called POLYMODE. The goal was to investigate the eddy field not only on the main thermocline, but also in the deep ocean and upper mixed layer.

Two films, "Storms in the Deep Sea" and "The Turbulent Ocean," both made by Centre Films, Inc. of Hollywood, California, document the Mid-Ocean Dynamics Experiment. The latter film was made for television and aired on the Public Broadcasting System in June of 1974. A third film, the "Recovery of a MODE Mooring," by Adam Gifford and Buoy Group Film, was developed for a presentation to one of the funding agencies, the Office of Naval Research.

Scope and Contents of the Collection

The records of the Mid-Ocean Dynamics Experiment (MODE), 1970-1976, document the development, organization, progress, and results of a large-scale, intensive and logistically complicated oceanography program. Robert Heinmiller, a research associate at Woods Hole Oceanographic Institution (WHOI) and later coordinator of the succeeding POLYMODE project, collected the MODE records from the working files of Nick P. Fofonoff of WHOI, Executive Officer Dennis Moore, Curt Collins of the National Science Foundation, and Carl Wunsch of MIT.

Information pertaining to the development and organization of MODE can be found in files labeled "Background information" (box 1, folders 1,2). Henry Stommel's correspondence from 1969 to 1974 is particularly valuable (box 2, folder 92; box 3, folders 1,2). His correspondents included an international roster of scientists, many of whom were involved in MODE. His correspondence with Warren S. Wooster, president of the Scientific Committee on Oceanic Research (SCOR), led to the creation of a SCOR working group which examined the merits of such an experiment (also see box 2, folder 47, SCOR correspondence). More information about the development of MODE can be found in the minutes of the MODE-I Scientific Council (box 3, folders 22-29) and in the action items, agendas, and minutes of the Executive Committee (box 3, folders 30-33).

The Mid-Ocean Dynamics Experiment occurred in two phases, a sixteen-month pilot program called MODE-0 or PREMODE, and MODE-1, an intensive four-month field program. Information regarding the PREMODE program can be found in *A Plan for U.S. Participation in the Mid-Ocean Dynamical Experimentation*: volume I, January 1971, *The Experiment 1971-1973* and [volume II], March 1971, *Research Proposal Submitted to the NSF/IDOE by WHOI* (box 1, folders 22, 23). A list of PREMODE projects with a brief description and assigned number can be found in box 1, folder 33 along with reviewer questions and comments from the National Science Foundation's Office for the Decade of International Ocean Exploration (NSF/IDOE), the principal funding agency.

Additional information about PREMODE (and the later MODE-1) can be found in several subseries in the administrative records, proposals (box 1, folders 43-123; box 2, folders 1,2), reports (box 2, folders 6-46), and staff records (box 2, folders 48-92; box 3 folders 1-16). The proposals and staff records have been arranged alphabetically by principal investigator. The staff files contain correspondence and papers authored by principal investigators. Included in the reports subseries are progress reports dating from 1970 to 1973 with information about equipment testing and field observations, and a draft of a *MODE-0 Atlas* (1973) which contains papers, data, and summaries by various investigators (box 2, folder 42). Presentations of the results of MODE-0 experiments were given by investigators at the Scientific Council meeting of January 18-19, 1973, as was a review of the overall data analysis program (box 5, cassette tapes).

More information regarding proposals funded by the NSF/IDOE and the overall administration of the MODE program can be found in the NSF/IDOE correspondence file (box 1, folder 30). The bulk of the NSF/IDOE correspondence was authored by Worth D. Nowlin, Jr. of Texas A&M University, who was acting deputy head of, and later consultant to, the NSF/IDOE.

Final strategy statements for the MODE-I field program were presented for discussion by principal investigators at the October 1972 Scientific Council meeting, and an overall plan for implementation of the field program was formulated (box 1, folder 24). The plan was revised as *MODE-I: The Program and The Plan* in March 1973 (box 1, folder 26). More information regarding the field program can be found in notes and correspondence of the various standing committees: Density Committee; Ship Needs and Scheduling Committee; and the Theoretical Panel (box 3, folders 34-45), as well as the *MODE-I Operations Handbook*, February 1973 (box 3, folder 58). A sampling of raw data, information regarding the tracking of specific temperature isotherms from March 11-June 3, 1973 and ships' data summary sheets, is available in box 3, folders 46-49 of Series 3. Information about the ships used during the field experiment, including personnel lists, schedule revisions, and summaries of operations can be found in box 3, folders 59-66. Also, summaries of ships' progress, and work proposed and carried out, can be found in the weekly *Mode Hot Line Bulletins* and biweekly *MODE Hot Line News* (box 3, folders 69,70; box 4, folders 1-7). The latter has a cumulative index by subject and author, and a list of articles in each issue is provided in box 4, folder 8.

Much of the raw data from the experiment was incorporated into the *Atlas of the Mid-Ocean Dynamics Experiment*, 1977, along with each investigator's analysis of his method for data acquisition and handling. The publication documents MODE-1 and some of the succeeding post-MODE experiments, such as the tracking of some "SOFAR" floats beyond the five-month MODE-1 timetable. The *MODE Atlas* is arranged by project with data given on common base charts when possible, to facilitate comparison.

Arrangement note

The collection is organized into the following series: Series 1. Administrative Records; Series 2. Scientific Council and Standing Committee Minutes and Correspondence; Series 3. Field Experiment Data, Reports, and Administrative Material; Series 4. Publications and Related Materials.

Administrative Information

Publication Information

Massachusetts Institute of Technology. Institute Archives and Special Collections 1986

Revision Description

2009

Access note

The collection is open for research. Access to MIT records is governed by Institute record policy.

Intellectual Property Rights

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Related Materials

Related Archival Materials note

Collection on the POLYMODE Program, AC 321

Massachusetts Institute of Technology, Institute Archives and Special Collections

Controlled Access Headings

Corporate Name(s)

- Massachusetts Institute of Technology. Dept. of Earth and Planetary Sciences
- Mid-ocean Dynamics Experiment-One. Scientific Council
- Mid-ocean Dynamics Experiment
- MODE
- Woods Hole Oceanographic Institution

Personal Name(s)

- Baker, D. James
- Bradshaw, Alvin
- Collins, Curtis A.
- Cox, Charles S.
- Davis, R. (Russ E.)
- Fofonoff, Nicholas Paul, 1929-
- Hansen, Donald V.
- Hasselman, Klaus, 1931-
- Heinmiller, Robert H.
- Katz, Eli
- Moore, Dennis W.
- Robinson, Allan R.
- Schleicher, Karl
- Stommel, Henry M., 1920-
- Voorhis, Arthur
- Wunsch, Carl

Subject(s)

- International cooperation.
- Oceanography--Atlantic Ocean--Charts, diagrams, etc.
- Oceanography--International cooperation.
- Oceanography--Research--Atlantic Ocean.
- Oceanography.

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Atlas of the Mid-Ocean Dynamics Experiment: MODE-I, edited by the MODE-I Atlas Group. Cambridge: Massachusetts Institute of Technology, 1977.

Collins, Curtis A., and Robert H. Heinmiller. "The POLYMODE Program." *Ocean Development and International Law* 20: 391-408.

MODE-I Scientific Council. "MODE-I, the Program and the Plan: An Overview of the Program and Detailed Description of the Field Experiment", 1973 (unpublished)

Administrative Records

Collection Inventory

Series 1. Administrative Records

	Box	Folder
Correspondence, associated research projects 1971-1973	1	3
Correspondence, MODE publications 1975, 1977 to 1978	1	5
Correspondence 1972-1974	1	4
Correspondence, <i>Atlas of the Mid-Ocean Dynamics Experiment (MODE-I)</i> , Valery Lee, co-editor 1976-1978	1	6
Department of the Navy, Office of Naval Research, correspondence, comments on PREMODE proposals 1971-1973	1	7
Financial correspondence, projects and funding sources 1971-1973	1	8
Hot-Line Center, Bermuda Biological Station. MODE logo undated	1	9
Hot-Line Center, Bermuda Biological Station. correspondence, procedures, distribution list 1971-1973	1	10
Hot-Line Center, Bermuda Biological Station. "MODE-I Communications Manual" 1973 March	1	11
Report on Management Information System, data guidelines, symbol codes for MODE diagrams 1971	1	12

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Carl Wunsch's notes on the preliminary meeting on engineering aspects of the MODE program 1970 March 30	1	13
Program, "A meeting for discussion 'Ocean Currents and their Dynamics" 1970 November 19 to November 20	1	14
Review of MODE-I, notes, report, list of proposals and principal investigators 1971 June	1	15
Agenda and announcement, Numerical Models of Ocean Circulation Symposium 1972 October 17to October 20	1	16
Minutes, POLYMODE discussion meeting at Woods Hole Oceanographic Institution 1973 July 11	1	17
Program, workshop on the role of the ocean in predicting climates 1973 September to October	1	18
Draft of speech by William Schmitz, MODE-I presentation, Novosibirsk, USSR, 1973 September 15-16	1	19
Abstract and program, American Geophysical Union Annual Meeting 1974 April 8-12	1	20
<i>Ocean Science News</i> , description of PREMODE projects, instrumentation needs 1970 October 23	1	21
A Plan for U.S. Participation in Mid-Ocean Dynamical Experimentation: Volume I, <i>The Experiment 1971-1973</i> 1971 January 15	1	22
A Plan for U.S. Participation in Mid-Ocean Dynamical Experimentation: Volume 2, <i>Research Proposal Submitted NSF/DOE by Woods Hole Oceanographic Institution for Participation in the Preliminary Mid-Ocean Dynamics Experiment</i> 1971 March	1	23

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<i>MODE-I: The Plan for the Field Experiment</i> 1972 October	1	24
MODE-I, "Final Strategy Statements" 1972 October 12	1	25
<i>MODE-I: The Program and the Plan</i> 1973 March	1	26
National Academy of Engineering Marine Board, "MODE-I, An Engineering Case Study of the Moored Systems," by Edward Kolb approximately 1973	1	27
National Institute of Oceanography (Wormley, England), contributions to PREMODE and MODE-I 1971-1973	1	28
National Oceanic and Atmospheric Administration, correspondence 1971-1973	1	29
National Science Foundation, Office for International Decade of Ocean Exploration (NSF/IDOE), correspondence and diary notes 1970-1974	1	30
NSF/IDOE, correspondence, budget and fiscal reports 1971-1975	1	31
Joint NSF/IDOE and Office of Naval Research (ONR) meeting re: PREMODE 1971 March 4	1	32
NSF/IDOE, proposed grants for PREMODE, project descriptions, budget, comments, questions 1971 March - August	1	33
NSF/IDOE, summary of projects, <i>International Decade of Ocean Exploration</i> 1971 October	1	34
NSF/IDOE review of MODE project, correspondence, transcription of tape of meeting 1972 October 31	1	35

Subseries 1A. Proposals

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Joint NSF/IDOE and ONR review of MODE, agenda, correspondence 1973 November 27	1	37
Joint NSF/IDOE and ONR review of MODE, memorandum 1974 October	1	38
NSF/IDOE, "Evaluation of the International Decade of Ocean Exploration, a National Science Foundation Research Program," Harbridge House, Inc., and J.D. Costlow, D.R. Kester, F.P. Manheim, and D.S. Polis 1976 October	1	39
Directory of MODE participants, news distribution lists 1973-1974	1	40
Foreign participation in MODE, by country, correspondence, 1971-1973 1971-1973	1	41
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Subseries 1A. Proposals

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D. James Baker, principal investigator, Harvard University: "Deep-Sea Pressure Measurements in the PREMODE Experiment," submitted to NSF/IDOE 1971 December	1	44

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Francis P. Bretherton, principal investigator, Johns Hopkins University: "Towards a MODE-I Synthesis," NSF/IDOE 1973 July	1	51
Charles S. Cox, principal investigator, Scripps Institute of Oceanography: Electric and Magnetic Measurments on Bermuda and Magnetic Measurements on the Bahamas in Support of MODE-I, NSF/IDOE 1972 January	1	52

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Charles S. Cox, principal investigator, Scripps Institute of Oceanography, with Robert L. Parker: "Preparation for Sargasso Sea Studies of Electric Field," NSF/IDOE 1971 March	1	54
Charles S. Cox, principal investigator, Scripps Institute of Oceanography, with Robert L. Parker and Victor Vacquier: "Electromagnetic Studies of the Ocean Lithosphere and of the Ocean Water Currents at the MODE-I Site," NSF/IDOE 1971 July	1	55
Russ E. Davis, Walter H. Munk, co-investigators, Scripps Institute of Oceanography, with Myrl C. Hendershott: "MODE Array Design as an Inverse Problem," NSF/IDOE; with correspondence, review 1972 July	1	57
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Russ E. Davis, Myrl C. Hendershott and Greg Holloway, co-investigators: "Dynamics of Large Scale Ocean Eddies, Verification of Eddy Dynamics from Incomplete Data and Mean Flow Interaction," MODE-I Theoretical Panel 1974 April	1	59
Nick P. Fofonoff, principal investigator, WHOI: "A Proposal for Participation by the Moored Array Group at WHOI," [ONR] 1970 August	1	60

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Klaus F. Hasselman, principal investigator, WHOI: "Investigation of Interactions between Short Internal Gravity Waves and Large Scale Motions in the Ocean," additional mathematical details, correspondence, NSF/IDOE 1971 May	1	69
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Walter H. Munk and Frank E. Snodgrass, co-investigators, Institute of Geophysics and Planetary Physics, La Jolla, California: "Fluctuations in the Abyssal Pressure and Temperature Field," correspondence, NSF/IDOE 1970 December	1	78
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Asim Yildiz, principal investigator, Ocean Dynamics Group, University of New Hampshire: "An Informal Proposal on Vortex Generation and Vortex Dynamics," correspondence, MODE-I Theoretical Panel 1974 April	1	80
Theodore E. Pochapsky, principal investigator Columbia University: "Measurements of Deep Ocean Current Profiles," reviewer comments, NSF/IDOE 1971 March	1	81
William S. Richardson, principal investigator, Nova University: Proposal for exploratory velocity measurements as part of the PREMODE experiment, correspondence, NSF/IDOE 1970 August	1	82
William S. Richardson, principal investigator, Nova University: "Oceanic Current Measurements from Aircraft as part of the PREMODE Experiment," NSF/IDOE 1971	1	83
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Peter Rhines, principal investigator, University of Cambridge, England: "A Proposal for Theoretical and Practical Study of a Turbulent, Quasi-Geostrophic Ocean Interior," correspondence, NSF/IDOE 1971 July	1	85
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Peter Rhines, principal investigator, WHOI: "Theory and Computer Experiments on Oceanic Eddies and Waves, and Analysis of Field Observations," correspondence, NSF/IDOE 1973 April	1	87

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Allan R. Robinson, principal investigator, Harvard University: Proposal for continued support of the Harvard Project and general expenses of the Theoretical Panel, NSF/IDOE approximately 1973	1	92
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C. Rooth, W. Duing, principal investigators, University of Miami: 1970 Quasi-Lagrangian Observations in the Layer of Maximum Static Stability," PREMODE 1970	1	94
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