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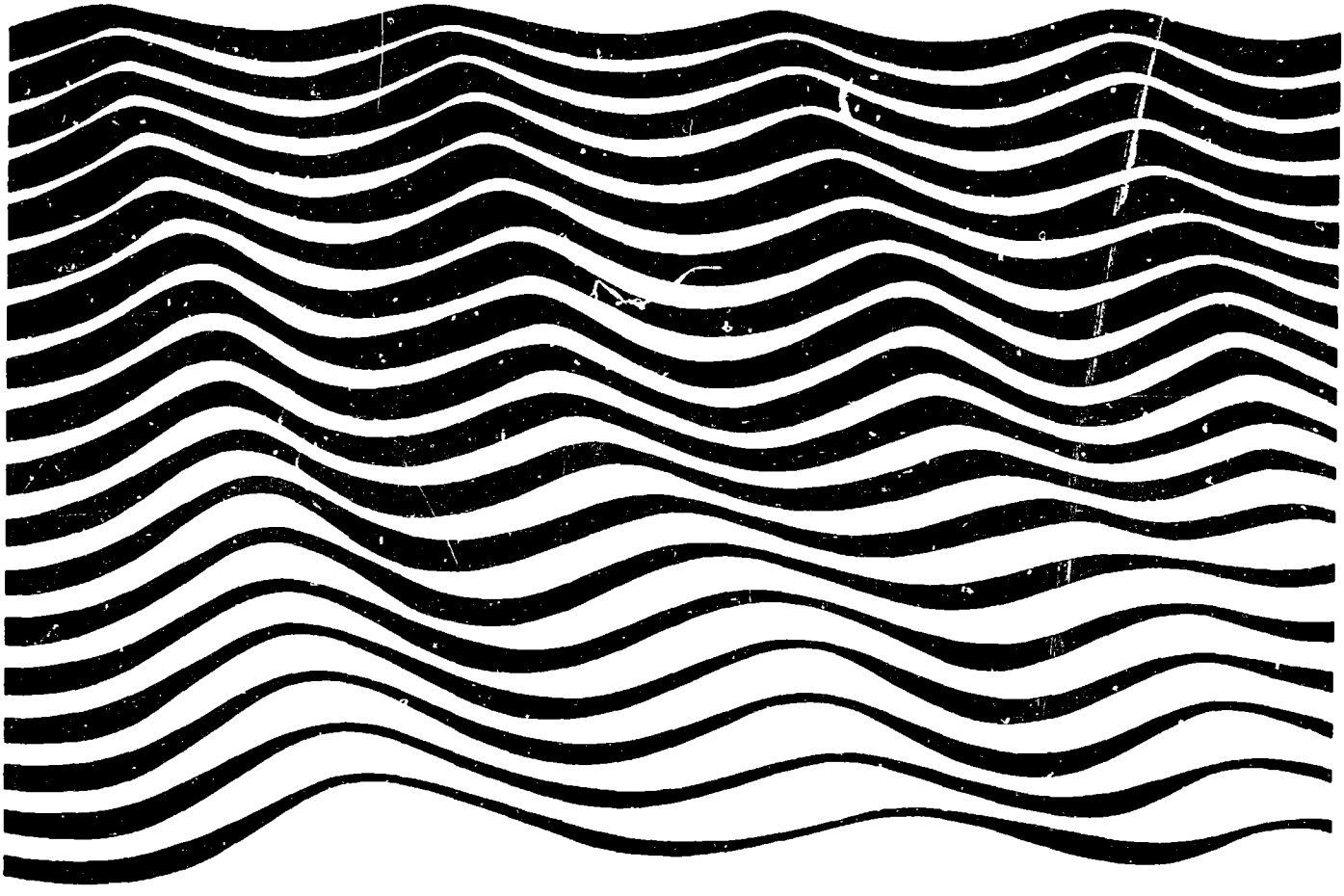
Physical oceanography of the Eastern Mediterranean (POEM): The intercalibrated POEM data set and the emerging picture of the circulation

POEM Scientific Workshop,
Trieste, Italy,
31 May - 4 June 1988



Unesco, 1990

UNESCO REPORTS IN MARINE SCIENCE

No.		Year
4	Syllabus for training marine technicians Report of an IOC/Unesco workshop held in Miami, Florida, 22-26 May 1978 Available in English, French, Russian and Spanish	1979
5	Marine science syllabus for secondary schools Report of an IOC workshop held at United World College of the Atlantic, United Kingdom, 5-9 June 1978 Available in Arabic, English, French, Russian and Spanish	1979
6	Organization of marine biological reference collections in the Mediterranean Arab countries Expert meeting held in Tunis, 20-23 September 1978 Available in Arabic, English and French	1979
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10	Development of marine science and technology in Africa Working Group of Experts sponsored by ECA and Unesco, Addis Ababa, 5-9 May 1980 Available in English and French	1980
14	Marine science and technology in Africa: present state and future development Synthesis of Unesco/ECA survey missions to African coastal states, 1980 Available in English and French	1981
15	Fishery science teaching at the university level Report of a Unesco/FAO workshop on university curricula in fishery science, Paris, May 1980 Available in Arabic, English, French, Russian and Spanish	1981
19	Mareas rojas en el Plancton del Pacífico Oriental Informe del Segundo Taller del Programa de Plancton del Pacífico Oriental, Instituto del Mar, Callao, Perú 19-20 de noviembre de 1981 Spanish only	1982
20	Quantitative analysis and simulation of Mediterranean coastal ecosystems: The Gulf of Naples, a case study Report of a workshop on ecosystem modelling Ischia, Naples, Italy, 28 March to 10 April 1981 Organized by the United Nations, Educational, Scientific and Cultural Organization (Unesco) and the Stazione Zoologica, Naples English only	1983
21	Comparing coral reef survey methods. A regional Unesco/UNEP workshop, Phuket Marine Biological Centre, Thailand, December 1982 English only	1983
22	Guidelines for marine biological reference collections Prepared in response to a recommendation by a meeting of experts from the Mediterranean Arab countries Available in English, French and Arabic	1983
23	Coral reefs, seagrass beds and mangroves: their interaction in the coastal zones of the Caribbean Report of a workshop held at West Indies Laboratory, St. Croix, U.S. Virgin Islands, May, 1982 English only	1983
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25	Ocean engineering teaching at the university level Recommended guidelines from the Unesco/IOC/ECOR workshop on advanced university curricula in ocean engineering and related fields, Paris, October 1982 Available in English, French, Spanish, Russian, Arabic and Chinese	1983
26	Global survey and analysis of post-graduate curricula in ocean engineering English only	1984
27	Productivity and processes in island marine ecosystems. Recommendations and scientific papers from the Unesco/IOC sessions on marine science co-operation in the Pacific, at the XVth Pacific Science Congress, Dunedin, New Zealand, February 1983 English only	1984
28	Oceanographic modelling of the Kuwait Action Plan (KAP) Region. Report of simposium/workshop; University of Petroleum and Minerals, Dhahran, Kingdom of Saudi Arabia 15-18 October 1983 English only	1984
29	Eutrophication in coastal marine areas and lagoons: a case study of 'Lac de Tunis' Report prepared by Dr M. Kelly and Dr M. Naguib English only	1984
30	Physical oceanography of the Eastern Mediterranean: an overview and research plan Report of a workshop held in Lerici, La Spezia (Italy), September 1983 English only	1984
31	MABAHISS/John Murray 50th anniversary: Marine science of the North West Indian Ocean and adjacent waters Report of a symposium on the occasion of the 50th anniversary of the MABAHISS/ John Murray Expedition (1933/34), University of Alexandria, Egypt, 3 to 7 September 1983 English only	1985
32	L'estuaire et la mangrove du Sine Saloum Résultats d'un Atelier régional Unesco-COMAR tenu à Dakar (Sénégal) du 28 février au 5 mars 1983 French only	1985
33	Coral taxonomy Results and recommendations of a regional Unesco (COMAR)/ UNEP Workshop with advanced training Phuket Marine Biological Centre Thailand, 10-26 February 1984 English only	1985
34	Bibliography on costal lagoons and salt marshes along the Southern Mediterranean coast (Algeria, Egypt, Libya, Morocco, Tunisia) Available in Arabic, English and French	1985
35	Physical oceanography of the Eastern Mediterranean (POEM): A Research Programme. Reports of the Organizing Committee Meeting, Paris, August 1984, and the Scientific Workshop, Lucerne, October 1984 English only	1985
36	Méthodologie d'étude des lagunes côtières. Résultats d'un atelier régional réuni à Abidjan du 6 au 11 mai 1985 French only	1986
37	Principles of Geological Mapping of Marine Sediments (with special reference to the African continental margin) Available in English and Russian	1986
38	Marine Sciences in CMEA countries Programme and results of co-operation Available in English and Russian	1986
39	Development of marine sciences in Arab Universities Meeting of Experts held at the Marine Science Station Aqaba, Jordan, 1-5 December 1985 Available in Arabic, English, French	1986
40	Human induced damage to coral reefs Results of a regional Unesco (COMAR) workshop with advanced training Diponegoro University, Jepara and National Institute of Oceanology Jakarta, Indonesia May 1985 English only	1986
41	Caribbean coastal marine productivity Results of a Planning Workshop at Discovery Bay Marine Laboratory, University of the West Indies Jamaica, November, 1985 English only	1986

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PREFACE

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ABSTRACT

This report presents the results of the Second Scientific POEM (Physical Oceanography of the Eastern Mediterranean) Workshop held in Trieste, Italy at the Osservatorio Geofisico Sperimentale (OGS), 31 May - 4 June, 1988. A collective data set was produced containing 23 data sets contributed from Germany, Greece, Israel, Italy, Turkey, the United States and Yugoslavia. Series of informal presentations were given with the discussion of the most recent analyses of POEM data sets: general hydrographic surveys and time series of current measurements in the Italian and Greek Straits. Considerable progress resulting from the modelling effort was evident in both the modelling of the general circulation and energetic mesoscale eddy field.

RESUME

Le présent rapport contient les résultats du deuxième atelier scientifique POEM (Océanographie physique de la Méditerranée orientale) qui a eu lieu du 31 mai au 4 juin 1988 à l'Osservatorio Geofisico Sperimentale (OGS) de Trieste (Italie). Cet atelier a permis de mettre au point un ensemble de données collectives comprenant 23 séries de données fournies par l'Allemagne, les Etats-Unis, la Grèce, Israël, l'Italie, la Turquie et la Yougoslavie. Les participants ont pu entendre diverses communications informelles à l'occasion de l'examen des analyses les plus récentes des ensembles de données POEM : travaux hydrographiques généraux et séries chronologiques de mesures des courants dans les détroits italiens et grecs. Des modèles de la circulation générale et du champ énergétique des tourbillons de moyenne échelle ont illustré de façon évidente les grands progrès accomplis dans le domaine de la modélisation.

RESUMEN

En este informe se exponen las conclusiones del segundo seminario científico sobre Oceanografía Física del Mediterráneo Oriental (POEM), celebrado en Trieste, Italia, en el Osservatorio Geofisico Sperimentale (OGS), los días 31 de mayo al 4 de junio de 1988. En el curso del mismo se expuso un conjunto refundido de datos, formado a partir de 23 subconjuntos de datos aportados por Alemania, los Estados Unidos, Grecia, Israel, Italia, Turquía y Yugoslavia. Se llevaron a cabo diversas presentaciones, de carácter no oficial, en el curso de las cuales se debatieron los análisis más recientes de conjuntos de datos sobre POEM: estudios prácticos de hidrografía de carácter general y series temporales de mediciones de las corrientes en los estrechos italianos y griegos, debates que pusieron de manifiesto los notables progresos alcanzados gracias a la elaboración de modelos matemáticos, tanto de la circulación general como del campo de turbulencias fuertes de mesoescala.

РЕЗЮМЕ

В настоящем докладе представлены результаты второго учебно-практического семинара ПОЕМ (Физическая океанография восточной части Средиземного моря), который проходил 31 мая - 4 июня 1988 г. в Триесте, Италия, в Экспериментальной геофизической обсерватории. Был подготовлен объединенный массив данных, содержащий 23 массива данных, которые были получены от Федеративной Республики Германии, Греции, Израиля, Италии, Турции, Соединенных Штатов и Югославии. Ряд ораторов выступил с неофициальными сообщениями, а также обсуждались самые последние анализы массивов данных ПОЕМ: общие гидрографические съемки и временные ряды измерений течений в проливах Италии и Греции. Наблюдается значительный прогресс в результате усилий по моделированию как в плане моделирования общей циркуляции, так и энергетических мезомасштабных вихревых полей.

ملخص

يعرض هذا التقرير نتائج حلقة العمل العلمية الثانية للأقيانوغرافيا الفيزيائية لشرقي البحر المتوسط ، التي انعقدت في تريبستا بايطاليا في مرصد التجارب الجيوفيزيائية ، من ٣١ مايو/أيار الى ٤ يونيو/حزيران ١٩٨٨ . وأعدت بيانات جامعة تتضمن ٢٣ مجموعة ، ساهمت في اعدادها كل من اسرائيل والمانيا وايطاليا وتركيا والولايات المتحدة الأمريكية ويوغوسلافيا واليونان . ونظمت سلسلة من العروض غير الرسمية بالاضافة الى مناقشات لأحدث التحاليل التي أجريت لمجموعات بيانات الاقيانوغرافيا الفيزيائية لشرقي البحر المتوسط ، وتناولت ما يلي : مسوح هيدروغرافية عامة ، وقياس حركة التيار في سلسلة من الفترات الزمنية في المضايق الايطالية اليونانية . وكان التقدم الهائل الذي أحرز نتيجة للجهود المبذولة في وضع النماذج جليا سواء فيما يتعلق بالنماذج التي وضعت لحركة تدفق التيارات بشكل عام أو بمجال الطاقة الخاصة بالحركة الدوامية المتوسطة .

摘　　要

本报告报道了１９８８年５月３１日－６月４日在意大利里雅斯特地球物理实验观测台（ OGS ）召开的第二次东地中海物理海洋学（ POEM ）科学讲习班的成果。报告刊出了一份集合数据集，其中包括德国、希腊、以色列、意大利、土耳其、美国和南斯拉夫贡献的２３套数据集。在有关东地中海物理海洋学数据集的最新分析的讨论部分，发表了一系列非正式论文：意大利和希腊海峡的一般水道测量和海流测量时间序列。从模拟结果来看，已在一般的环流模拟和活跃的中尺度涡流场模拟方面明显取得了相当大的进展。

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I. FOREWORD AND ACKNOWLEDGMENTS

The second POEM Workshop was held in Trieste, Italy, May 31–June 4, 1988 at the Osservatorio Geofisico Sperimentale (OGS), hosted by Dr. Antonio Michelato, Italian Coordinator and Executive Scientist of POEM.

The main objectives of the Workshop were:

1. To pool together the POEM hydrographic data sets into a common database with priority given to POEM V, II and IV as decided in the Steering Committee Meeting of Paris, January 1988.

2. To share the recent results of ongoing work, both in the analysis of POEM data and in the modelling component.

A series of informal presentations was given and general dicussion ensued, summarized in the collected abstracts. At the end of the Workshop, each POEM scientist who contributed POEM hydrographic details was given the tape with the pooled POEM database.

* * * * * * * * * * * * * * *

We would like to extend our gratitude and appreciation to the OGS, Trieste, Italy for their hospitality and excellent arrangements, and especially Dr. Antonio Michelato for his work in coordinating the Workshop. The facilities and support of the OGS staff were instrumental in accomplishing our most important objective — producing the data tapes from the pooled and collected data, an historical POEM achievement. UNESCO-IOC provided necessary partial support for selected participants. The Workshop especially appreciates Dr. Selim Morcos' contribution to POEM and welcomes the participation of Dr. Gualter Soares. And a special thanks to our young scientists who worked effortlessly throughout the week, both day and night, to produce this data tape, led tirelessly by Dr. Nadia Pinardi. The editing and production of this report were carried out by Ms. Marsha Glass Cormier, and we also thank Ms. Gail Tanner for assisting in production.

Allan R. Robinson

Paola Malanotte-Rizzoli

Co-Chairpersons, POEM
Cambridge, MA USA
May, 1989

II. AGENDA with Recommendations for Working Groups

AGENDA

Second POEM Scientific Workshop
OGS, Trieste, Italy — 31 May - 4 June 1988

Tuesday, 31 May

9:00 am — Opening Remarks
(Dr. R. Ramella, Director, OGS; Prof. A.R. Robinson, Harvard and Dr. S. Morcos, UNESCO)

PLENARY SESSION I (Chairman, A. Michelato)

9:30–10:00 am — A. Program Overview, including Report on Steering Committee Meeting in Paris (A. Robinson and P. Malanotte-Rizzoli)

10:00–11:45 am — B. Brief Overview of National Programs by Steering Committee Members (presented in alphabetical order by country)

- Cyprus (5 minutes)
- Egypt (5 minutes)
- Germany (10 minutes)
- Greece (10 minutes)

[Coffee Break — 15 minutes]

- Israel (10 minutes)
- Italy (10 minutes)
- Turkey (10 minutes)
- USA (Malanotte-Rizzoli) (10 minutes)
- USA (Robinson) (10 minutes)
- Yugoslavia (5 minutes)

11:45 am–12:15 pm — Report on the Modena Mapping Meeting

- Methodology (N. Pinardi)
- Maps (A. Hecht)
- Intercalibration and CTD's (A. Michelato)

12:15–12:30 pm — Aim and Scope of Workshop
(A. Robinson and P. Malanotte-Rizzoli)

12:30–1:00 pm — Computer Facilities at OGS (A. Crise)

[1:00–2:00 pm LUNCH]

2:00–5:30 pm Working Groups Meet

Wednesday, 1 June

9:00 am–1:00 pm Research Activities

[1:00–2:00 pm LUNCH]

2:00–5:30 pm WG 1 and 2 meet

Thursday, 2 June

9:00 am–1:00 pm Research Activities

[1:00–2:00 pm LUNCH]

2:00–3:00 pm WG 1 and 2 Meet
- Preparation of reports for subsequent session

PLENARY SESSION II (Co-Chairpersons: A.R. Robinson and P. Malanotte-Rizzoli)

3:00–3:45 pm A. WG 1 presentation of reports on progress and problems

3:45–5:30 pm B. WG 2 presentation of reports on progress and problems

Friday, 3 June

9:00 am–1:00 pm Research Activities

[1:00–2:00 pm LUNCH]

2:00–5:30 pm WG 1 Meets

Saturday, 4 June

PLENARY SESSION III (Co-Chairpersons: A.R. Robinson and P. Malanotte-Rizzoli)

9:00–9:30 am	A. Ionian Circulation (A. Artegiani)
9:30–10:45 am	B. Future Research Directions for Eastern Mediterranean (A. R. Robinson) Biological/Chemical Oceanography – Development and Applications to Bio-chemical and Environmental Problems (POEM Phase II) (A. R. Robinson) [Coffee Break 15 minutes]
11:00–11:30 am	C. Working Group Reports • Working Group 1 • Working Group 2
11:30–12:00 pm	D. Co-Chairpersons Business (A. R. Robinson and P. Malanotte-Rizzoli) • Summary • CIESM • Timeline

ADJOURN

WORKING GROUPS

There will be two Working Groups.

Working Group 1 (WG1): with subgoups	DATA ANALYSIS (a) Mediterranean (b) Adriatic (c) Aegean
Function:	Collective Data Analysis
Co-Chairpersons:	A. Michelato and N. Pinardi
Working Group 2 (WG2):	SCIENTIFIC ANALYSIS AND SYNTHESIS
Function:	(a) Summarize Research in Progress (b) Summarize Scientific Content of Modena Maps (c) Preliminary Data Inventory (d) One member of each institute to summarize substantive findings to date
Co-Chairpersons:	A.R. Robinson and P. Malanotte-Rizzoli

RESEARCH ACTIVITIES

Research activities will be comprised of the following:

1. Combination of individual data sets into a unified POEM data set
2. Intercalibration
3. Production of maps according to recommendations of the Modena Report, March 1988 (page 21, attachment 2)
4. The above three points applied to POEM-V, POEM-IV, and POEM-II

Detailed arrangements of research activities will be announced during the Working Group Meetings on Tuesday, 31 May.

III. OPENING REMARKS

Dr. Riccardo Ramella

It is with great pleasure that I, on behalf of the Osservatorio Geofisico Sperimentale, welcome you to the second POEM Scientific Workshop. I should first like to thank UNESCO and IOC for their continuous support to the POEM program in general, and to this workshop in particular. I also wish to thank the various national organizations whose sponsorship has been vital to the starting and successive development of the program.

The Osservatorio has been an active participant in the POEM program from the very start and thus is honoured to host this workshop, which represents a further step forward in the cooperation between the scientists involved in the study of the Eastern Mediterranean Sea.

In recent years we have become used to the idea that in some research fields, progress can best, and sometimes can only, be achieved by international collaboration. In fact the pooling of national resources is essential to undertake research that would be beyond the capacity of even a large country or to make progress faster than would be possible if only a single nation were involved.

Because of the nature of marine problems, such collaboration across national boundaries has been more common in oceanography than in any other research field. In this context, the POEM program is an excellent example of the results that can be achieved by the cooperative efforts of many nations. The integrated and coordinated participation of research vessels from different countries has made it possible to carry out five large-scale cruises in the Eastern Mediterranean Sea. The data set obtained is impressive in extent and quality and will surely be a milestone in the understanding of the physical and biochemical processes affecting these waters. The picture which is emerging displays a variety of hitherto unknown dynamic features and fluctuations in the general circulation both in time and space. Thus the need for the extensive use of modern measurement techniques and numerical modeling.

I hope that this workshop will provide a productive forum for discussion among the scientists of the region and that it will contribute to a better knowledge of the various mechanisms that drive the complex water movements in the Eastern Mediterranean Sea. I am therefore pleased to officially open the second POEM Scientific Workshop, with my best wishes for its success. Thank you and good luck!

Prof. Allan R. Robinson

It is a pleasure for me to thank the Director of the OGS for hosting this workshop. And it is a personal pleasure for me to greet my POEM colleagues and to anticipate another week

of stimulating interactions and hopefully of scientific progress in understanding the Eastern Mediterranean. I especially want to welcome new POEM scientists who are participating for the first time and also to welcome those ocean scientists who are joining us to observe and to discuss here subjects of interest. We are particularly glad that some younger scientists are joining us for the first time, and we hope they will benefit and contribute. I also thank Drs. Mario Ruivo and Dale Krause of the IOC and the UNESCO Division of Marine Sciences.

It is a special moment for me to remark that Dr. Selim Morcos of UNESCO, a scientist long interested in the Eastern Mediterranean who has been an architect and a tiller of POEM, will be retiring at the end of this year, and we hope he will remain interested and with us on the Steering Committee.

It is a very important moment in the POEM Scientific Program because we are ending Phase I of the Science and are beginning Phase II of the Science. In Phase I we have collected data, and we set up models. Now we are at the transition time where we have to pool the data, make a collective data set and carry out the cooperative and synthetic scientific analysis. The first step, major step, of Phase II is to be taken here in Trieste at this workshop. There are three goals of the workshop. The first is the absolutely essential one of creating an intercalibrated pooled collective data set. The second goal is to attempt a synthetical scientific statement about the Eastern Mediterranean as of now. The third goal is to initiate our planning for future Eastern Mediterranean science. Thus the substantive success of the Trieste Workshop is absolutely necessary for the success of the POEM Scientific Program.

The first POEM Workshop hosted in Turkey launched a successful Phase I of POEM scientific work. We hope that we will again achieve our goals here at Trieste. It is very fitting that Dr. Antonio Michelato host this workshop at the OGS because Dr. Michelato and his group have contributed substantially to POEM, to both critical technical issues and facilitating cooperative scientific investigations.

Dr. Selim Morcos

Dr. Ramella, Director General of OGS, ladies and gentlemen, my dear colleagues in the POEM community; it is with great pleasure that I speak to you today on behalf of UNESCO and the Intergovernmental Oceanographic Commission, the IOC. I take this opportunity to convey to you the greetings of the Director General of UNESCO, Dr. Federico Mayor, and his best wishes for a successful meeting to enhance the scientific cooperation in the Eastern Mediterranean.

As we all know, the Osservatorio Geofisico Sperimentale (OGS) of Trieste has been a participating institution in POEM since its beginnings. The efforts and assistance of OGS are well known to us; the efforts of its director, Dr. Riccardo Ramella and our friend, Dr. Antonio Michelato, are appreciated by all POEM scientists. I would like to take this

opportunity to express my sincere thanks to the OGS, its directors and staff, for hosting this workshop and providing all the necessary facilities for a successful meeting.

It is now almost two years since we met at the first POEM Scientific Workshop. It is for all of us a great pleasure to look back over these two years with a sense of accomplishment and fulfillment. Yes, you have achieved a great deal, much more than we anticipated.

In the first POEM workshop we attended in June, 1986, I stated that UNESCO and later, IOC, had adopted a favorable attitude toward the POEM program ever since the Round Table at the CIESM meeting in Cannes with discussions in December 1982. This was mainly based on the fact that the program came as a response to the genuine interest of the scientific community and was of potential benefit to the member states concerned, facts which we recognize highly. This appreciation and endorsement of the program by UNESCO and IOC has been expressed in terms of support to specific activities (eight meetings and four publications in three years). Then in a disguised form of warning and apprehension I said that the above activities were carried out with substantial resources from UNESCO and IOC, including the staff time and travel required to accomplish these activities. We look forward to a time when the POEM Program is strong enough to enter a new phase based mainly on the cooperative efforts of the scientific institutions involved, and on diversified financial resources — national, regional and international, as the case may be.

Two years ago POEM was therefore facing the problem of reduced resources both in staff time and in financial support. In spite of this, POEM performed remarkably well during the last two years.

- Two Steering Committee meetings took place in Palma de Majorica in October 1986 and in Paris in January 1988.

- POEM scientists participated in special POEM sessions within the framework of larger scientific meetings such as ICSEM in Palma de Majorica in October 1986, in the European Geophysical Soceity in Strasbourg in April 1987 and in Bologna in April 1988.

- A more specific and interesting activity was the meeting of the POEM Mapping Group in March 1988.

The greatest achievement of POEM during these last two years was the successful cooperative efforts among the participating institutions. Since the Erdemli POEM Workshop, three POEM cruises took place.

POEM III–86 Oct-Nov 1986

POEM IV–87 Mar-Apr 1987

POEM V–87 Aug-Sep 1987

More important is the progress made toward building a common data set and a community model. This is a remarkable record given the little support received from the international organizations for this purpose. This achievement is mainly based on national resources, and the commitment of the scientists and institutions involved.

Let me congratulate you in this achievement and tell you that your efforts deserve more recognition from the UN system, from the international and regional organizations and funding institutions. As you know, UNESCO and IOC are doing their best in supporting POEM, but your promising enterprise needs more financial resources to attain the objectives of POEM, particularly in

(i) training on certain aspects of oceanography and modeling

(ii) extending POEM activities to the southern Eastern Mediterranean where there is a great need to close the gap in data coverage

(iii) exchange of scientists and expertise, particularly during the coming phase of POEM, where a host of activities are planned for 1989 and 1990, including modeling studies based on the data obtained in the first phase of POEM.

Professors Allan R. Robinson and Paola Malanotte-Rizzoli will talk to you about our last Steering Committee meeting in Paris in January 1988, and on the future plans during the second phase of POEM. Now I recognize that we as scientists have concentrated our efforts on the scientific aspects of the program. We have not given much thought to the financial needs of POEM to adequately complete its first phase and to implement the ambitious plans of its second phase. POEM has built enough credibility to be an attractive regional program worthy of funding on a large scale. My advice is that no effort should be spared in the coming months to present a POEM program to certain organizations which have shown in the past an interest in supporting scientific efforts in the Mediterranean, particularly those requiring cooperation among European and Arab scientists and institutions.

Finally, I wish to express my best wishes for a successful meeting. These wishes are shared by my colleague Gualter Soares, from the IOC Secretariat, who is with us today, as well as my colleagues in Paris, particularly Dr. Dale Krause, the Director of the Division of Marine Sciences, and Dr. Mario Ruivo, the Secretary of the Intergovernmental Oceanographic Commission.

Thank you.

IV. PLENARY SESSION I

A. Program Overview including a Report on the Steering Committee Meeting in Paris, January 1988

Professors Allan R. Robinson and Paola Malanotte-Rizzoli
Co-Chairpersons, POEM

The origins of POEM were common scientific interests that led to scientific interaction — an interest in unknown regional science and the potential for the Eastern Mediterranean as a global process laboratory. POEM Phase I has been completed in the form of three major accomplishments: acquisition of data, setting up and calibration of models, and establishment of effective and serious cooperative scientific arrangements. The broader scientific overview of POEM is reflected in the following accomplishments:

i) Definitive general circulation surveys carried out with coarse mesoscale resolution, a basis for unbiased and definitive data set, and collective analysis of melded data;

ii) identification or discovery of an energetic mesoscale through "mid-ocean" eddies, coherent vortices, meandering Asia Minor currents, Rhodes Gyre oscillations, North African current extension of filaments and jets, and the important relationship of this mesoscale to water mass formation and transport;

iii) comprehensive basinwide transient tracer experiment that has been carried out.

POEM Phase II tasks start at the Trieste Workshop. A pooled intercalibrated collective data set must be established which began at the Modena mapping meeting. This scientific step must be used in synthetical scientific analysis of descriptive, kinematical, and dynamical processes. Finally and simultaneously, a cooperative modeling effort will develop and from it the construction of a community model.

The community model must be a 1990's or Multi-scale Model Hierarchy. Dynamical modeling must be associated with mesoscale processes, water mass formation and transport, and general circulation. The hierarchy can have a choice of explicit physics — primitive equation, quasigeostrophic, surface boundary layer, regional or basin scale, or a general circulation model with eddy resolving.

The Trieste Workshop must be a point of departure for air-sea interaction and the initiation of data assimilation. Future research directions must be addressed and planned at this stage of POEM. Movement towards an Eastern Mediterranean Ocean Descriptive Predictive System (ODPS) must be discussed. This will be a real time observational network for data assimilation in a dynamical model. Dynamical process studies of Air-Sea Interaction (ASI) must be initiated, a necessary step towards our next scientific program in the region. Biogeochemical processes and fluxes should be recognized as important for

not only scientific purposes but for the necessity of management and environmental quality control. A definitive study of deep water formation and thermohaline budgets should include Mediterranean-Adriatic interaction as well as the study of Levantine Intermediate Water (LIW) formations. The transport and fate of Levantine Intermediate Water formations through the Straits of Gibraltor should not be overlooked.

From the Trieste Workshop, a scientific overview statement will evolve into an article suitable for publication in *Nature*, authored by the POEM group. We will initiate future planning of post-POEM Eastern Mediterranean science.

The emergence of EPICS (Eastern Processes and Interdisciplinary Cooperative Studies — ODPS, ASI, Biogeochemical Fluxes, Thermohaline budgets, LIW formation and fate) is the natural response to POEM, our sonnet to the sea. Let this be the special name within our working scientific community for the new phase, POEM II.

For the benefit of those unable to attend the Steering Committee Meeting in January, a brief synopsis was presented. Presentation of the status of national research and review of field programs. Data Management and exchange was implemented by the POEM Mapping Group at CNR-IMGA in Modena, Italy in March 1988. A common methodology for mapping data was established. A Cruise nomenclature emerged. Modeling progress was reported and visits to Harvard in Spring 1989 were arranged for participating POEM institutes to work on the community model which will culminate in the Third Scientific POEM Workshop at Harvard. Program planning for the next two years with emphasis on concluding events for the final stages of POEM. A final and fourth scientific Workshop in Venice in 1990 will be the prelude to EPICS. The future directions of physical oceanographic implications of POEM and post-POEM in regards to chemical and biological interface.

The Trieste Workshop will produce the complete emerging picture of the Eastern Mediterranean, and the start of POEM Phase II.

B. Brief Overview of National Programs by Steering Committee Members

• CYPRUS

Cyprus has participated in three cruises with R/V TRITON, namely in the POEM-I-85 cruise of November 1985, the POEM-II-86 cruise of March-April 1986 and the POEM-V-87 cruise of September 1987.

The area covered was south and west of Cyprus by sampling ten stations each time. The data were acquired by a Sea-Bird Electronics CTD profiler, which was purchased especially for the POEM program. The sampling rate of the instrument is 24 Hz. The data were recorded on an UHER 6000 Report tape recorder and an IBM PC computer was purchased in July 1987 together with a 7475A Hewlett-Packard Plotter. The computer was not taken onboard.

Difficulties first arose in the communication of the deck unit and the computer, then in the communication of the computer and the plotter. The problems will be sorted out as soon as possible in order to proceed with the analysis of the data.

An N10 Bottle was fixed on top of the CTD profiler with two protected and one unprotected thermometers. Temperature recordings and water sampling were obtained from the lowest point each time.

Lina Athanassiadou

• EGYPT

Egypt concentrated on analysis of old data, historical rather than explore new data, due to problems with their ship. This work is reflected in their recent publications.

Ahmed El-Gindy

• GERMANY

A major survey cruise took place on the RV METEOR, POEM–V, August and September 1987. The following is the cruise report.

The primary purpose of the cruise was to carry out a detailed XBT, hydrographic and tracer survey of the Eastern Mediterranean in the context of the international program POEM. Additional work was concerned with marine chemical and pollutant studies, gravimetry and air chemistry. A smaller part of the work was extended also to the Western Mediterranean. Port dates:

Heraklion, Greece: August 16–18; August 31–September 1
Palermo, Italy: September 14–15
Enter Hamburg, FR Germany: September 24

The chief scientist: W. Roether, University of Bremen, Bremen, FR Germany.

The map in Figure 1 summarizes the hydrographic stations prior to entering Palermo, and that in Figure 2, the XBT drops. A total of 36 scientists participated in the cruise, from a total of seven nations (FR Germany, Italy, USA, Greece, Turkey, Bulgaria and Morocco).

The participating institutions are listed in Table I. Table II summarizes the types of work carried out on the cruise. The cruise track was designed to provide large-scale coverage of the entire Eastern Mediterranean, to allow execution of a hydrographic and tracer survey that would cover all the major water masses of the Eastern Mediterranean including the Cretan Sea and the Southern Aegean. This survey was to be complemented by more regional but higher-resolution hydrographic surveys carried out during the same period by ships from other nations, coordinated with the METEOR cruise within the POEM program. In the southern Levantine Basin, the survey was restricted due to lacking permission from Egyptian authorities.

The work proceeded largely as planned. It was even possible to extend the XBT work beyond the scheduled plan. Only the larger volume work had to be cancelled prior to Palermo because the samplers were lost due to breakage of the trawl wire. To ensure minimum contamination in the sampling trace organics and metals, as well as in freon measurement, much effort had to spent during the cruise.

The XBT data, which were processes in quasi-real time, showed intense mesoscale activity and indicated a wealth of structures in the near-surface flow. In the northern Levantine Basin, data density was such that objective dynamic interpolation mapping allowed reconstruction of the mesoscale field of the region. The hydrographic data (CTD + rosette) exhibited very smooth distributions in the deep water regime, but considerable scatter in the upper layers including the Intermediate Water. Both vertical and horizontal gradients in the deep water were very small, as were differences between the Ionian and Levantine Basin (i.e., between the western and eastern parts of the Eastern Mediterranean). The fact that a coherent set of high quality hydrographic data was collected will allow detailed study of the deep flow. The freon-12 data indicated very young water at great depth at the western slope of the Ionian basin, pointing to fast advection of newly formed deep water from the Adriatic. The water age increased towards the east and upwards to a maximum age layer near 1500 m depth. The Cretan Sea deep water was also found to be young, and rich in oxygen and nutrients, while its density was lower than that of the bottom water in the Levantine Basin. It appeared that deep outflow from the Cretan Sea was limited to 1200 m depth in the Levantine. Horizontal salinity trends within the Intermediate Water and the usual shallow salinity minimum were apparent in the data. The data obtained will be used in a detailed study of Eastern Mediterranean circulation,

mixing and water mass formation.

Highlights of the chemical work (Table II) included manifestation of quite low open ocean concentrations of crude oil residues and of tar ball material. There was some correlation of the latter with water current features as showing up in the XBT results. A correlation such as this is an example for the planned interaction between the POEM and the chemical parts of the cruise. The larger part of the chemical information to be gained will have to await further analysis and measurement in the home institutions. This holds likewise for the gravimetric and air chemistry programs.

The cooperation with the masters and crew of the ship and the technical performance of the ship were excellent, and the work was completed in good spirit, which was certainly helped by the good success of the scientific programs and by amiable weather.

Wolfgang Roether

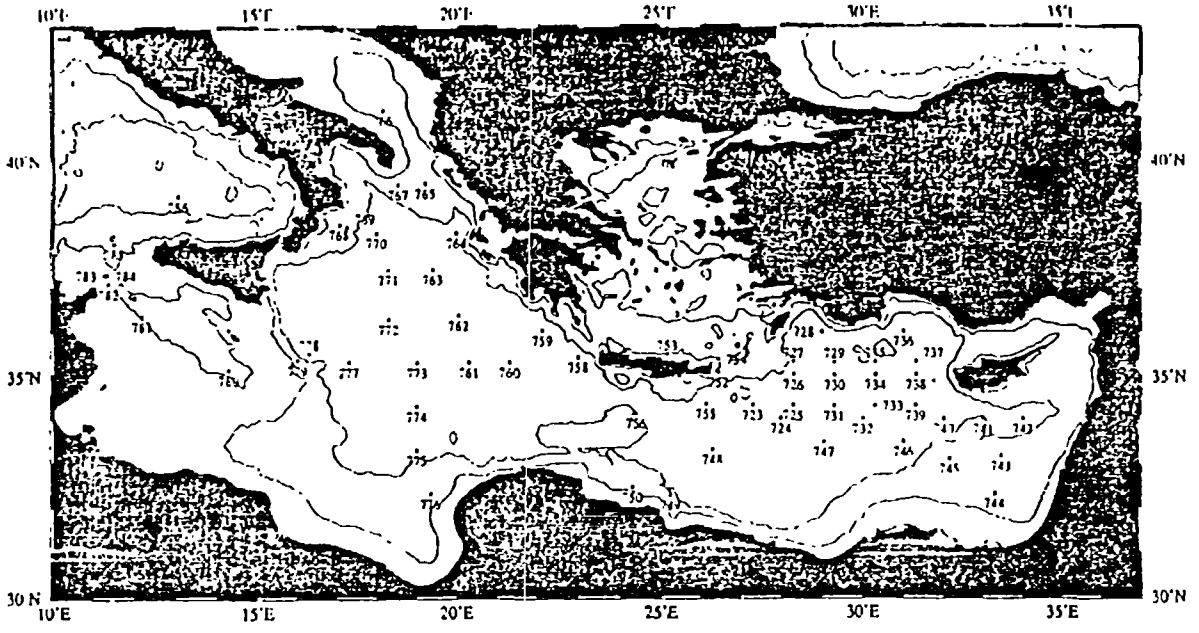

Fig. 1 Positions of hydrographic stations Heraklion-Palermo (Nos. 733–786), METEOR cruise 5/6, Aug.–Sept. 1987. There were three more hydrographic stations and seven neuston hauls after Palermo; because no CTD was available, part of the hydrographic work originally planned for the Western Mediterranean had to be cancelled.

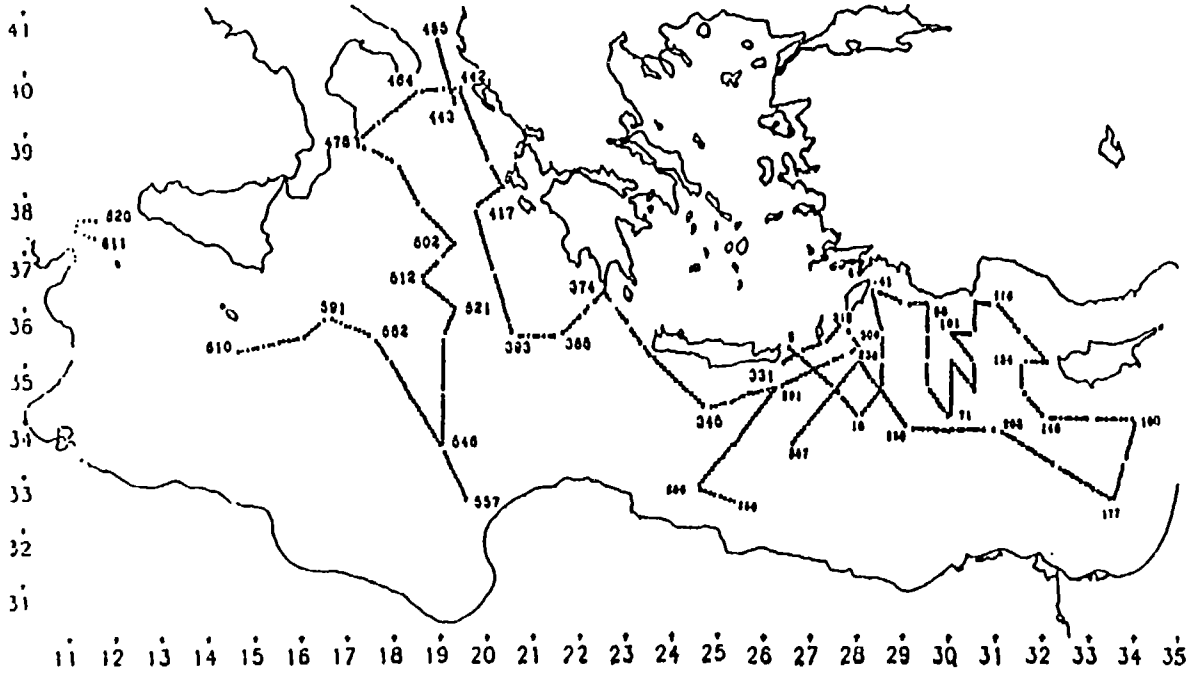

Fig. 2 Positions of XBT casts (Nos. 1–620). METEOR cruise 5/6.

Table 1. Participating Institutions, METEOR Cruise, 5/6

Alfred Wegener Institut für Polar- und Meeresforschung
Columbusstraße
2850 Bremerhaven / FR GERMANY

Geologisch-Paläontologisches Institut
Universität Hamburg
Bundesstraße 55
2000 Hamburg 1 / FR GERMANY

Harvard University
Division of Applied Sciences
29 Oxford St.
Cambridge, MA 02138 / USA

Institut für Geophysik
Universität Hamburg
Bundesstraße 55
2000 Hamburg 13 / FR GERMANY

IMGA-CNR
Via Emilia Est 770
Modena / ITALY

Universität Kiel
Abt. Meereschemie
Düsternbrooker Weg 20
2300 Kiel 1 / FR GERMANY

Institut für Umweltphysik der Universität Heidelberg
Im Neuenheimer Feld 366
6900 Heidelberg / FR GERMANY

Middle East Technical University
Institute of Marine Sciences
P.K. 28
Erdemli-Icel / TURKEY

Massachusetts Institute of Technology
Department of Earth, Atmospheric and Planetary Sciences
Cambridge, MA 02139 / USA

National Center for Marine Research
Athens / GREECE

Osservatorio Geofisico Sperimentale
P.O. Box 2011
34016 Trieste / ITALY

Sofia University
Fac. of Physics
Department of Meteorology
5 Anton Ivanov Blvd.
Sofia 1126 / BULGARIA

Technische Hochschule Darmstadt
Fachbereich 8
Hochschulstraße
6100 Darmstadt / FR GERMANY

Universität Bremen
Fachbereich 1
2800 Bremen 33 / FR GERMANY

Institut Scientifique de Peches Martimes
Casablanca / MOROCCO

Table 2. Field work during METEOR cruise 5/6

POEM: Hydrographic stations with CTD + 24 × 10 1 Rosette for measurement of salinity, oxygen, nutrients, chlorofluoremethanes (freons), tritium, and He-3. XBT casts, at 10 km distance, between hydrographic stations.

Organic trace substances: Extraction of organics from surface water and from subsurface water at selected stations (large volume sampling), as well as from material collected in neuston hauls; tar ball sampling.

Crude oil residues: Hexane extraction of surface water and sample preparation.

Dissolved organic carbon: Preservation of hydrocast water samples; large volume sampling at selected stations.

Trace metals: Sampling of surface water and sample preparation; some samples from hydrocasts.

Gravimetry: Continuous gravimetric recording long Eastern Med track with added work in the Western Med.

Air chemistry: Sampling for gaseous and particulate trace constituents of air and of rain in the Western Med and the North Atlantic.

- **GREECE**

The Greek activities within POEM were incorporated in the National Oceanographic Research Programme in the open sea, which includes field measurements, quality controls, processing and analysis of data, and modelling efforts.

During the first phase of POEM (1985–1987), when field work was the main activity of participating institutions of the Eastern Mediterranean, six large oceanographic cruises were conducted onboard R/V AEGAIO, carrying out surveys in the Aegean and Ionian Seas, as well as in the NW Levantine Basin (Rhodos gyre area). Greece covered quite a large area of the Eastern Mediterranean, contributing to a definitive and comprehensive physical data set.

For a better understanding of the circulation and water mass exchange between the Aegean and the rest of the Eastern Mediterranean, current measurements were performed

in the Straits of Cretan Arc during the period of the cruises.

Special attention was given to the quality of the collected data; (i) sensors of the CTD were calibrated before cruises; (ii) in the framework of POEM's *in situ* intercalibration procedure, a common deep station was taken by the R/Vs METEOR and AEGAIO in the Ionian in September 1987; (iii) participation in the Modena POEM Workshop, where CTD and XBT data sets were merged to form the POEM–V–87 General Circulation data set. The established intercalibration procedure showed that the data are satisfactory.

Data gathered were used in national cooperative research effort (NCMR Athens, Athens University, Thessaloniki Technical University).

To upgrade the study of thermal infrared images from Lannion Center, a Greek-Italian collaboration was proposed and will be established.

A cooperation between Greek universities and Yugoslavian and Italian centers was established.

Future activities planned:

(i) analysis and synthesis of the collected data (1985–1987), and

(ii) modelling, with concentration on formation and spreading process over open sea and shelf areas, upswellings over the Eastern Aegean, eddies, and circulation and exchange through the Straits of the Cretan Arc.

Proposed field activity: Intensive field program for monitoring the Straits of the Cretan Arc with sea-level, current and CTD measurements, to commence summer 1988.

Alexander Theocharis

- **ISRAEL**

- Continued coordination with Turkey–R/V BILIM, overlapping data.

- Objective analysis and intercalibration of data from pooled data with the Turkish data sets of POEM I and II.

- Sampling of chemical components has become an active part of surveys.

- XBT measurements have been taken south of Cyprus.

Artur Hecht

• ITALY

Starting with POEM–O, Winter 1985, five major surveys were completed covering all of the Adriatic, Otronto Straits, the Northern and Southern Ionian, and Straits of Sicily through to Winter 1987 POEM IV in coordination with R/V METEOR. Major Italian participation in POEM–V–87 was in the multi-national coordination and collaboration on the R/V METEOR, where full coverage of the Levantine Basin, Aegean, Southern Adriatic and Straits of Sicily took place.

Antonio Michelato

• TURKEY

Seven cruises on R/V BILIM were completed in October 1985, April 1986, June 1986, November 1986, February 1987, June 1987 and September 1987, in the Northern Levantine Basin. R/V BILIM data of April 1986 overlap with R/V SHIKMONA/Israeli data, June 1987 overlap with Greek data, and August 1987 data overlap with Italians and Israelis. Joint cruises with R/V SHIKMONA will take place throughout 1988 and 1989. Work on large scale general circulation and Asia Minor current will continue.

Ümit Ünlüata

• USA

The modelling effort carried out at MIT is focused upon the study of the general circulation of the Eastern Mediterranean with the scientific objective of determining which is the dominant driving force, if any, of the circulation: the wind stress field, the air-sea heat and evaporation fluxes, the forcing through the Straits of Sicily. A systematic approach has been adopted to explore each driving force in isolation from the others to fully understand their respective roles. In the series of experiments presented at the Trieste Workshop, the Straits of Sicily was kept closed and the focus was upon examining the effect of the local forcings provided by wind stress and heat fluxes upon the basin-scale currents. The model used is a hydrostatic shallow water, primitive equation model, with a free sea surface and linearized momentum equations. The model has active thermodynamics, and integrates advection/diffusion equations for temperature and salinity. The model is closed by the equation of state for density anomally recommended by UNESCO International standards. The model has the realistic Eastern Mediterranean bathymetry, coastlines and islands and was used in the three layer version, to simulate a surface layer of Atlantic water; an intermediate layer of Mediterranean LIW and a deep layer where the deep water mass is presumably found in the south Adriatic Sea are included in the model geometry. A series of numerical experiments was carried out spinning up the model a) with the climatological year of the wind stress field (monthly means linearly interpolated in time) in which temperature and salinity are supplied as boundary conditions to the surface

layer from the climatological seasonal means. The model then reconstructs prognostically the intermediate and deep fields of temperature and salinity b) with the climatological year of heat and evaporation total fields. (Monthly means linearly interpolated in time for incoming short wave and backscatter long wave radiation; latent and sensible heat; evaporation and precipitation.) The results obtained so far strongly suggest that the general circulation is mainly thermally driven in the Levantine basin while in the Ionian Sea, the wind stress curl has a stronger influence.

Paola Malanotte-Rizzoli

A Harvard and Modena/IMGA cooperative has been arranged; building towards a community model has been initiated. Mesoscale experimental research and analysis, data assimilation in the Harvard Open Ocean Model and applications to the Princeton GFDL model are in progress. Through a cooperative effort using over five years of data, in particular marine climate data region, existence of mid-ocean eddies were demonstrated. Again a joint US/Israel effort produced a detailed scientific study of the mesoscale revealed in this marine climate dataset. A most important result to date is mesoscale processes and water mass formation and transport processes are coupled problems.

US participation on the R/V METEOR completed a comprehensive mesoscale experiment. A unique multi-time and space scale circulation and mixing experiment from long deep time scales measured by transient tracers through a highly calibrated and uniformly measured hydrographic data matched uniformly sampled mesoscale eddy distribution over the entire domain.

Harvard Open Ocean Model has QG and PE option, with a surface boundary layer attached to the QG. Work with dynamics of the Rhodes Gyre is underway. All model development will be part of the basis of the community model.

Allan Robinson

• YUGOSLAVIA

Three cruises in the Southern Adriatic were completed. POEM-I complemented the Italian efforts. Interesting results were gained from intercalibration experiments. POEM III cruise encountered ship problems. Data from POEM IV produced resolution of a quasi-permanent feature in the Southern Adriatic: the permanent Southern Adriatic Gyre. A difference in sea level showed variations of inflow of Mediterranean water. Joint effort with the Greeks is showing response of sea level to atmospheric pressure force. Through future cooperation with the Italians, mesoscale experiment in the Southern Adriatic will hopefully resolve these kinds of features. Yugoslavian interest to initiate a sea level project as part of POEM, with the help of IOC and UNESCO, was stressed.

Miroslav Gacic

C. Report of the Modena Mapping Meeting

Dr. Nadia Pinardi
Dr. Artur Hecht
Dr. Antonio Michelato

The Modena Mapping Meeting took place at IMGA-CNR, Modena, Italy, March 7–18, 1988. A massive cooperative effort took place to pull together six collected XBT and CTD data sets from the POEM–V–87 General Circulation Cruise (August–October 1987). The combined data set was shared between the participating institutions I.M.G.A-CNR (Modena, Italy), O.G.S (Trieste, Italy), I.R.P.M-CNR (Ancona, Italy), Istituto Talassografico di Trieste-CNR (Italy), I.M.S-METU (Erdemli, Turkey), Harvard University (Cambridge, USA), NCMR (Athens, Greece) and IOLR (Haifa, Israel).

The goals were first to do a quality check of the data for instrument error and second to intercalibrate the different data sets with respect to the O.G.S bottle-calibrated CTD measurements. Vertical profiles of salinity, temperature and density were produced together with station location plots. The third objective was to analyze, by optional techniques, temperature, salinity and dynamic height data coming from the pooled data set. The results were a generally consistent picture emerged from the different CTD casts. The major goal was achieved by the use and sharing of a common data analysis procedure.

Objective analysis (OA) maps of 14° C and 15° C isotherms were displayed for different domains in the Eastern Mediterranean basin (Regions A, B, C, D) and for a large domain (Region L). Different OA parameters were used: the correlation decay length was varied between 40 and 67 km and the zero crossing distance varied between 60 and 100 km. Temperature and salinity maps at the depths of 20, 125, 250, 400 and 800 m were displayed for the Region L. Dynamic height referred to 450 and 800 m was computed and displayed at the levels of 50, 125, 250 and 400 m.

The POEM–V–87 data set was intercalibrated by comparing T and S values between 1000 and 1500 m for the common station locations. We supposed that the Trieste-METEOR data set (IT4) had the reference parameter values; all the data sets, except TK1 (Turkey), resulted within the bounds of acceptable errors. A depth constant correction to the salinity of -0.04 was applied to the Turkey data set.

D. Aim and Scope of the Trieste Workshop

Allan R. Robinson
Paola Malanotte-Rizzoli

The aim and scope of the Trieste Workshop is primarily the sharing and exchanging of data; producing a pooled and intercalibrated data set from the collected data; and to summarize and synthesize results and to analyze closely the POEM surveys of October-November 1985, March-April 1986 and August-September 1987. Just as important is the planning of future research through implications of POEM physical oceanography on biology, chemistry, environmental management, process studies, etc. From our cooperative efforts, a manuscript will be produced for publication in *Nature*. From the Trieste Workshop will come an emerging picture of the Mediterranean.

The community model is a multiscale model hierarchy, developed through mesoscale processes, water mass formation and transport, and general circulation. Dealing with varieties of forcing mechanisms, the hierarchy can choose from explicit physics - primitive equation, quasigeostrophic, surface boundary layer, or regional basin. Air-sea interaction and data assimilation must be initiated and developed.

V. PLENARY SESSION III

A. Future Research Directions for the Eastern Mediterranean

Professor Allan R. Robinson

The Trieste Workshop is used as a platform for the next steps. Movement is toward an Eastern Mediterranean Ocean Descriptive Predictive System (ODPS), an observational network for data assimilation in the dynamical model hierarchy. Further pursuit of dynamical process studies of air-sea interaction is a must for future progress and programs. Biogeochemical processes and fluxes will be an obvious necessity. A definitive study of deep water formation and thermohaline budegts, including Mediterranean-Adriatic interactions as well as the fate of the Levantine intermediate water, must be considered.

These directions lead us into Mediterranean EPICS - Eastern Processes and Interdisciplinary Cooperative Studies, the natural point of departure from POEM.

B. Co-Chairpersons Business

Professor Allan R. Robinson
Professor Paola Malanotte-Rizzoli

- A brief dicussion of the success of the Trieste Workshop.

- Goals were reached and the collective data tapes distributed. Agreement was reached as to the proprietary aspects of the collected data.

  For a period of three years from distribution, the data set is proprietary. The Co-Chairpersons will designate the official distribution date for each collective data set. For modelling studies and large scale synthetical studies, authorship will be first the names of the scientists who carried out the specific research, followed by an alphabetized list of those responsible for collecting the data. Collaborations are encouraged and should be worked out in the normal manner. During this three year period, studies in progress based on the collective data set should be brought to the attention of the Co-Chairpersons, who in turn will communicate the information to the Steering Committee. A major collectively authored paper is expected to be produced following the Venice Workshop, which is in two years and will be the final POEM Workshop. After three years, the data will be considered common database, and no rules have been established. After five years, it will be distributed to data centers.

- Following the CIESM session in Athens (October 1988), there will be no Round Table, but a small workshop for POEM scientists only will meet to discuss intercalibration problems.

- A reminder of future planned POEM activities was reviewed: following CIESM, modelling visits to Harvard, followed by the third POEM Scientific Workshop at Harvard, May 1989.

VI. ABSTRACTS OF WORKING GROUPS

A. Report of Working Group I: Data Analysis

Dr. Nadia Pinardi

Working Group I met in Trieste for four days with the aim of putting on a common format and physical device for the different data sets of POEM II and IV. Furthermore, missing Turkish, Greek and Italian Stations were added to the POEM V data set already collected at Modena during the Mapping Group Meeting. The first day included a discussion on the common format of the data. It was decided to translate the data in the OGS format since the POEM V data, initially distributed with the Modena format, had already been translated in the OGS standard format.

The data set contributing to the POEM II were from Greece, Italy, Turkey, Yugoslavia and Israel. The data sets contributing to POEM IV were from Greece, Italy, Turkey and Yugoslavia. The different data sets are listed in Table 1.

A brief quality check of the data was done by looking at single data sets T-S diagrams. The Italian contribution to POEM IV data set (IT34) had quality problems; profiles were unusually jagged and the salinity profiles shifted to high values. This data set occupies the Ionian region for March 87. A more detailed analysis of the data sets is expected to be done at OGS in the following months.

At the end of the meeting, a map showing the station locations for POEM II, POEM IV and the updated POEM V was presented to the plenary session and a tape from OGS was distributed to each participating country.

Table 1. Pooled Files

Name of data set	Comment
GR12	complete
GR14	complete
GR15	complete (new with respect to Modena)
IS12	incomplete (1 station)
IS15	incomplete (same as Modena)
IT12	complete
IT14	complete
IT15	complete (same as Modena)
IT25	complete (same as Modena)
IT24	complete
IT34	complete
IT35	complete
IT42	complete
IT45	complete (new with respect to Modena)
TK12	incomplete
TK14	incomplete
TK15	complete (new with respect to Modena)
US15	complete (same as Modena)
YU12	complete
YU14	complete
GE1	complete (not present at Modena)

Table Legend:

GR = Greece IS = Israel IT = Italy TK = Turkey
US = United States of America YU = Yugoslavia GE = Federal Republic of Germany

The first number following indicates the different national institutions (different only for Italy) and the second number indicates the POEM number (2 = POEM-II-86; 4 = POEM-IV-87; 5 = POEM-V-87).

B. Report of Working Group II: Scientific Analysis and Synthesis

Prof. Paola Malanotte-Rizzoli

Working Group II and Co-Chairpersons Allan R. Robinson and Paola Malanotte-Rizzoli focused upon the progress reports of POEM scientists on their ongoing work. A series of informal presentations was given with the discussion of the most recent analysis of POEM datasets: both the general hydrographic surveys and the time series of current measurements in the Italian and Greek Straits. The results of the modelling effort showed considerable progress both in the modelling of the general circulation and of the ubiquitous and energetic mesoscale eddy field. The abstracts of the given presentations are collected at the end of the report, and for some of the abstacts, full papers have also been provided.

UNESCO REPORTS IN MARINE SCIENCE

No.		Year
42	The application of digital remote sensing techniques in coral reef, oceanographic and estuarine studies. Report on a regional Unesco/COMAR/GBRMPA Workshop, Townsville, Australia, August 1985 English only	1986
43	Quaternary coastal geology of West Africa and South America. Papers prepared for the INQUA-ASEQUA Symposium in Dakar, April 1986 Available in English only	1987
44	Physical oceanography of the Eastern Mediterranean (POEM): Initial Results Unesco/IOC First POEM Scientific Workshop, Erdemli, Turkey, 16-20 June 1986 English only	1987
45	Marine science teaching and training at first degree (undergraduate) level. Recommended guidelines from a Unesco workshop on university curricula Paris, November 1986 Available in Arabic, Chinese, English, French, Russian and Spanish	1987
46	Comparison between Atlantic and Pacific tropical marine coastal ecosystems: community structure, ecological processes, and productivity. Results and scientific papers of a Unesco/COMAR workshop, University of the South Pacific, Suva, Fiji, 24-29 March 1986 English only	1987
47	Temperate coastal systems of Latin America. Report on meeting on COSALC Pilot Project No. VII, November 1986 Spanish only	1987
48	Coastal marine ecosystems of Africa. Objectives and strategy of the COMARAF Regional Project English only	1988
49	Eutrophication in the Mediterranean sea: receiving capacity and monitoring of long term effects. Report and proceedings of a Scientific Workshop, Bologna, Italy, 2 to 6 March 1987, Sponsored by, Unesco, FAO, UNEP, Regione Emilia Romagna and University of Bologna English only.	1988
50	Marine Geology of the West African shelf zone Available in English and Russian	1988
51	Physical oceanography of the Eastern Mediterranean (POEM): Programme for 1988 89 English only	1988
52	Year 2000 challenges for marine science training and education worldwide. Available in Arabic, Chinese, English, French, Russian and Spanish	1988

UNESCO REPORTS IN MARINE SCIENCE

Title of numbers which are out of stock

No.		Year
1	Marine ecosystem modelling in the Eastern Mediterranean Report of a Unesco workshop held in Alexandria, Egypt, December 1974 English only	1977
2	Marine ecosystem modelling in the Mediterranean Report of the Second Unesco Workshop on Marine Ecosystem Modelling English only	1977
3	Benthic ecology and sedimentation of the south Atlantic continental platform Report of the seminar organized by Unesco in Montevideo, Uruguay, 9-12 May 1978	1979
7	Coastal ecosystems of the Southern Mediterranean; lagoons, deltas and salt marshes. Report of a meeting of experts, Tunis, 25-27 September 1978	1979
11	Programa de Plancton para el Pacífico Oriental Informe final del Seminario-Taller realizado en el Instituto del Mar del Perú.	
12	Geologia y geoquimica del margen continental del Atlantico Sudoccidental Informe final del Taller de Trabajo organizado por la Unesco en Montevideo Uruguay, 2-4 de diciembre de 1980	1981
13	Seminario Latinoamericano sobre Enseñanza de la Oceanografía Informe final del Seminario organizado por la Unesco en São Paulo, Brasil, 17-20 de noviembre de 1978	1981
16	Marine and coastal processes in the Pacific: ecological aspects of coastal zone management Report of a Unesco seminar held at Motupore Island Research Centre, University of Papua New Guinea, 14-17 July 1980	1981
17	The coastal ecosystems of West Africa: coastal lagoons, estuaries and mangroves. A workshop report, Dakar, 11-15 June 1979	1981
18	Coral reef management in Asia and the Pacific: some research and training priorities. Report of a Unesco workshop held in Manila, Philippines, 21-22 May 1981 English only El Callao, Perú, 8-11 de septiembre de 1980	1982 1981