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PREFACE

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ABSTRACT

This report summarizes the events of the Fourth POEM (Physical Oceanography of the Eastern Mediterranean) Scientific Workshop, held in Venice, Italy, at the Istituto Veneto di Scienze, Lettere ed Arti, from 27 August to 1 September, 1990. During this workshop, the scientific plan for the second phase of POEM (POEM-BC) was designed; it includes biological and chemical components. POEM-BC began in 1991 and comprises: (i) two general hydrographic surveys with chemical and biological studies; (ii) intensive field experiments focussing on process studies of the formation, dispersion and spreading of the LIW (Levantine Intermediate Water) in the Levantine Basin and of Deep Water in the Ionian Sea; (iii) a field experiment for biogeochemical fluxes studies. The field activity of POEM-BC is projected over a five year period.

RESUME

Le présent rapport récapitule les événements qui se sont déroulés au cours et à la suite du quatrième atelier scientifique POEM (Océanographie physique de la Méditerranée orientale) qui a eu lieu à Venise (Italie), à l'Istituto Veneto di Scienze, Lettere ed Arti, du 27 août au 1er septembre 1990. Le plan scientifique de la deuxième phase de POEM, qui comprend des composantes biologiques et chimiques (POEM-BC), a été mis au point lors de cet atelier. Les activités organisées au titre de POEM-BC, qui a démarré en 1991, sont les suivantes : (i) deux levés hydrographiques de caractère général accompagnés d'études chimiques et biologiques : (ii) des expériences in situ intensives axées sur l'étude des processus de formation, de dispersion et de propagation des LIW (eaux intermédiaires du bassin Levantin) dans le bassin Levantin et des eaux profondes dans la mer Ionienne ; (iii) une expérience in situ pour l'étude des flux biogéochimiques. La mise en oeuvre des opérations sur le terrain relevant de POEM-BC est envisagée pour une période de cinq ans.

RESUMEN ANALITICO

En este informe se expone en forma sucinta el desarrollo del cuarto Seminario científico POEM (Oceanografía Física del Mediterráneo Oriental), celebrado en el Istituto Veneto di Scienze, Lettere ed Arti, Venecia (Italia), del 27 de agosto al 1° de septiembre de 1990. En la reunión se trazó el plan científico de la segunda fase de POEM (POEM-BC), que abarca tanto componentes biológicos como químicos. La fase POEM-BC, iniciada en 1991, comprende: i) dos estudios hidrográficos generales con investigaciones químicas y biológicas; ii) experimentos intensivos sobre el terreno destinados a estudiar los procesos de formación, dispersión y difusión de la LIW (Agua levantina intermedia) en la cuenca levantina y de las aguas profundas en el mar Jónico; y iii) un experimento sobre el terreno para estudiar los flujos biogeoquímicos. Se prevé realizar las actividades sobre el terreno del POEM-BC durante un periodo de cinco años.

РЕЗЮМЕ

В настоящем докладе содержится краткое описание работы четвертого научного учебно-практического семинара ПОЕМ (Физическая океанография Восточного Средиземноморья), проведенного в Венецианском институте науки, литературы и искусства в Венеции, Италия, с 27 августа по 1 сентября 1990 г. В ходе этого учебно-практического семинара был разработан научный план для второй фазы ПОЕМ (ПОЕМ-БХ); он включает в себя биологические и химические компоненты. Программа ПОЕМ-БХ была начата в 1991 г. и в нее входят: (i) два общих гидрографических исследования с проведением химических и биологических исследований; (ii) интенсивные экспедиционные эксперименты с упором на изучение процессов формирования, рассеяния и распространения ЛПВ (Левантинских промежуточных вод) в Левантинском бассейне и глубоководных вод в Ионическом море; (iii) экспедиционный эксперимент по изучению биогеохимических потоков. Экспедиционные мероприятия ПОЕМ-БХ планируются на пятилетний период.

خلاصة

يتضمن هذا التقرير خلاصة لأنشطة حلقة العمل العلمية الرابعة لمشروع الأقيانوغرافيا الفيزيائية لشرق البحر المتوسط POEM التي عقدت في البندقية ، بايطاليا، من ٢٧ أغسطس الى ١ سبتمبر/أيلول ١٩٩٠، في معهد البندقية للعلوم والآداب والفنون . وأعدت في حلقة العمل المذكورة الخطة العلمية للمرحلة الثانية للمشروع (POEM-BC) التي تتضمن عناصر بيولوجية وكيميائية . وقد بدأت مرحلة POEM-BC في عام ١٩٩١ وهي تشمل : (١) استقصاءين هيدروغرافيين عامين مع دراسات كيميائية وبيولوجية؛ (٢) تجارب ميدانية مكثفة تتركز على دراسة عمليات تكون وتبعثر وانتشار المياه المشرقية الوسيطة في الحوض المشرقي والمياه العميقة في البحر الأيوني؛ (٣) تجربة ميدانية لدراسات التدفقات البيوكيميائية. ويتوقع أن يمتد النشاط الميداني لـ POEM-BC على فترة خمس سنوات .

摘　　要

本报告总结了一九九〇年八月二十七至九月一日在意大利威尼斯维尼托科学文学和艺术研究所举办的第四届东地中海物理海洋学（POEM）科学讲习班的活动。讲习班期间，制定了东地中海物理海洋学第二阶段（POEM- 生物学及化学）科学计划；该计划包括生物与化学内容。东地中海物理海洋学第二阶段（POEM- 生物学及化学）于1991年开始，包括：(i) 含有化学与生物研究的两项综合水文调查；(ii)集中进行有关利万特海盆利万特中层水（LIW ）和爱奥尼亚海的深层水之形成、扩散及流散过程研究的深入细致的现场试验。(iii) 关于生物地球化学流动研究的现场试验。东地中海物理海洋学第二阶段（POEM- 生物学及化学）的现场活动预计进行五年。

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FOREWORD AND ACKNOWLEDGEMENTS

The fourth POEM Workshop was held in Venice, Italy, from 27 August to 1 September 1990, hosted by the Istituto Veneto di Scienze, Lettere ed Arti. The main objective of the workshop was to design the scientific plan and related field work for the second phase of POEM (POEM–BC) which includes biological and chemical components. The workshop comprised four working groups, the summary documents of which constitute the main body of this report. A report of the meeting of the POEM Steering Committee, held on the final day of the workshop, is included in this volume.

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We would like to express our gratitude to Dr. Alessandro Franchini, Director of the Istituto Veneto di Scienze, Lettere ed Arti, for his hospitality. We also thank the Istituto per lo Studio della Dinamica delle Grandi Masse, CNR, Venice, for providing supporting facilities, and in particular its Director, Dr. Franco Dallaporta and the scientific/administrative secretary, Ms Jane Zanin, for providing excellent local arrangements and administrative assistance. UNESCO/IOC provided the necessary partial support for selected participants. The workshop appreciates the continuous support and participation of Dr. Gualter Soares, IOC.

Allan R. Robinson
Paola Malanotte-Rizzoli

POEM Co-chairpersons

WORKING GROUP I:	AIR-SEA INTERACTION	
		Brenner
	Chair:	Malanotte-Rizzoli
		Mustafa
		Nittis
		Theocharis
		Unluata

WORKING GROUP II:	WATER FORMATION	
		Artegiani
		Gacic
		Golnaraghi
		Lascaratos
		Manca
		Ozsoy
		Roether (first day only)
	Chair:	Robinson
		Spezie

WORKING GROUP III:	LOGISTICS, TECHNIQUES AND SURVEY DESIGN	
	Co-chair:	Hecht
		Leslie
	Co-chair:	Michelato
		Scarazzato
		Theocharis
		Unluata

WORKING GROUP IV:	BIOLOGY-CHEMISTRY	
	Co-chair:	Altabet
		Bregnant
		Franco
		Kress
		Marasovic
		McGillicuddy
		Rabitti
	Co-chair:	Salihoglu
		Siokou-Frangou
		Souvermezoglou
		Wood

REPORT OF WORKING GROUP I:
AIR-SEA INTERACTION

The Mediterranean Sea is known to be a concentration basin in which excessive evaporation plays a key role in controlling the inflow of Atlantic water and the formation of Levantine-Intermediate Water (LIW). In order to fully understand the complexities of the circulation of the eastern Mediterranean and in order to provide appropriate forcing functions (upper boundary conditions) for numerical models, air-sea fluxes must be specified. These fluxes include: wind stress (two components), short wave incoming radiation, longwave back-radiation, latent heat flux (evaporation), and sensible heat flux. At present, the most comprehensive flux fields available are the monthly mean climatological values computed by Paul May on a 1°x1° latitude-longitude grid. While these fluxes contain much useful information, they lack the details of synoptic (meteorological) variations which are believed to be important for episodic events such as LIW formation. It is also known that models which use monthly mean fluxes tend to underestimate the depth of the wind driven mixed layer.

In order to produce a more relevant set of surface fluxes for POEM, we must consider the availability of routine meteorological data. Ideally, we would like to use actual ship weather observations as a starting point. However, the work necessary to collect and process such type of data for the entire eastern Mediterranean is far beyond our capabilities. It is also doubtful whether the spatial and temporal resolution of ship observations and their quality would be sufficient for our purposes.

In our opinion, the best alternative is to obtain the most temporally complete set of data available. This consists of the daily synoptic analyses produced by various meteorological centers such as ECMWF or NMC.

For this purpose, Dr. Brenner has already obtained the twice-daily analyses (00 and 12 Greenwich Mean Time) for the entire Mediterranean region from ECMWF. These data cover the period 1980-1989 and include analyzed values of wind, temperature, relative humidity, and geopotential height on seven mandatory pressure levels (1000-100 mb) on a lat-long grid of 2 1/2° x 2 1/2°. A similar data set consisting of surface values was obtained from NMC by Nadia Pinardi. This latter set also includes SST analyses. It covers the period beginning in 1982. At this time, the ECMWF data appears more promising for generating a time series since it covers a longer period than the NMC data and since the ECMWF archives are continuously updated and made available upon request.

From these data Dr. Brenner will produce surface flux fields using standard bulk formulae. For the ECMWF an additional step of "post-processing" will be necessary in order to extrapolate/interpolate the mandatory pressure level values to surface (i.e., 10 m) values. The only other data missing is the cloud over fraction which is needed for the shortwave computations. For this we plan to use standard relative humidity to cloud amount conversions as used in Numerical Weather Prediction.

For salinity fluxes, precipitation fields are also necessary. Unfortunately, precipitation analyses are not routinely available and those that are available are notoriously inaccurate. Consequently for precipitation data we feel that climatological values will be the best alternative.

By the summer of 1991 Steve Brenner expects to have the flux fields (twice daily) available for the POEM-Phase I period. He will then make the flux dataset

available to the POEM community. Dr. Brenner plans to contact ECMWF and arrange to have the data set continuously updated as new analyses are added to their archive. SST values will be provided by IMGA based on their analyses of satellite images.

The main deficiency in our proposed surface flux fields is the relatively coarse spatial resolution of 2 1/2° x 2 1/2°. For the most general circulation studies simple interpolation of these fluxes onto the desired model grid should suffice. For mesoscale process studies (e.g., water mass formation experiments) an alternative method to produce surface fluxes with higher spatial resolution must be considered. For this we propose to develop an objective analysis scheme for the region of interest. The first guess for the OA will be provided by the corresponding ECMWF analyses (2 1/2° x 2 1/2° grid unless a 1° x 1° version can be obtained for specific dates by special prior arrangement).

The observations for the OA will consist of the shipboard measurements from the POEM ships participating in the experiment. Ideally this will require some type of precruise calibration of the shipboard weather sensors. Minimally, some type of quality check of the input data will be necessary.

Most of the software to produce the POEM-Phase I fluxes already exists. After this initial flux set is produced, the processing will be fairly routine and subsequent flux fields should be available with a lag time of only a few months (depending upon the lag time of archive updating at ECMWF). Dr. Brenner has committed himself to the flux analysis and distribution to the POEM community of analyzed fields for the POEM-Phase II period.

Remote Sensing

The IMGA group is developing a package for satellite data analysis for the POEM I-phase that includes the following fields:

a) SST;
b) Cloud coverage;
c) Objective analysis.

At present they have collected data for the years 1986-87 from the Lannion station, in the periods: 1986, August and September, 1987, July through October. The time resolution is of 10 days. They will contact both the University of Miami (Dr. Otis Brown), Lannion and the Italian Air Force to obtain data for 1985.

For the POEM-Phase II period, Dr. Guzzi, director of IMGA, plans to buy data from Lannion, possibly with the same time resolution. He will explore also the possibility to obtain data from the Italian Air Force. The data will be processed on a regular basis with the above described analysis starting from 1991. Dr. Guzzi expects to produce and distribute data (from the raw dataset to the processed one) to the POEM community. To do so, a common protocol must be defined for the data exchange between the POEM Institutes involved. Dr. Guzzi suggests to adopt the NCSA-HDF code that is of public domain and can be obtained by every interested scientist from the NCSA, University of Illinois facilities. The paragraph of the NCSA protocol relevant to the HDF code is quoted below:

> *"NCSA HDF, or Hierarchical Data Format, is a multi-object file format that facilitates the transfer of graphical and floating point data between various machines and operating systems, including the Cray, Sun, Alliant, Silicon Graphics, Macintosh, and IBM PC computers. HDF allows self-definition of data content and easy extensibility for future enhancements or compatibility with other standard formats; includes Fortran and C calling interfaces; utilities to prepare raw image or data files for use with other*

NCSA software; an interface for storing and retrieving compressed or uncompressed raster images with palettes; and an interface for storing and retrieving scientific datasets of up to seven dimensions together with information about the data, such as labels, units, formats, and scales for all dimensions."

Statement by Dr. Unluata on Remote Sensing Capabilities of the Institute of Marine Sciences, Middle East Technical University

The IMS-METU has acquired two new systems for processing remote sensing data. One of these systems is the Weathertrack equipment to receive directly from NOAA satellites infra-red and visible data in coarse-resolution APT (Automatic Picture Transmission) format. The system is useful to obtain on-site continuous data for up to four times a day to follow circulation features through surface temperature and to provide real time guidance to research vessels. The other system is the SEAPAK processing hardware/software to make detailed fine-resolution (HRPT - High Resolution Picture Transmission format) studies of AVHRR and the past Coastal Zone Color Scanner data. Both systems have been acquired recently and will be fully operational soon. The POEM community will be informed before the end of October 1990 on the potential use of these systems for POEM remote sensing studies.

Deep sea-shelf interactions

It was recognized that it is impossible to build a full scientific program and related experimental effort focussed upon deep sea-shelf interaction as this would require an effort of the same dimensions as the entire POEM programme. As an example, the Coastal Ocean Program was cited that is being developed in the United States with observational efforts devoted to the U.S. coastal shelves. The U.S. oceanographic community has been working at obtaining a consensus on the scientific research plan for two years already, but the actual beginning of the program is predicted for 1992 at the earliest.

The crucial importance of dynamic interactions between the deep sea and the coastal shelves of the Mediterranean was however recognized. Scientists from the POEM community are already planning theoretical work to attack different aspects of this broad scientific issue. A minimum experimental effort was recognized by the Working Group as feasible during the two general surveys planned for POEM-Phase II, to be carried out in October 1991 and March 1992. Thus the following recommendation was made:

> During the two interdisciplinary general surveys of the Eastern Mediterranean planned for POEM-Phase II, suitable transects of the hydrographic survey should be chosen by the participating scientist(s) of each vessel involved in the survey. Such transects should be extended with a few more stations to include the transition zone to the shelf. Specifically, the following extra stations were recommended:
>
> 5 stations on the slope between 700 m depth and the shelf break at 100m.
>
> One final station directly on the shelf.
>
> This minimum number of extra stations will allow to define and classify the variety of deep sea-shelf environments of the Eastern Mediterranean.

REPORT OF WORKING GROUP II: WATER FORMATION

I. Investigation of Levantine Intermediate Water Formation, Transformation and Dispersion

The Primary goals of this investigation will be to establish definitive answers to questions in regard to specific processes which lead to the formation of LIW, identification and quantification of the transport and dispersion of LIW, through the time of surveys. Previous phenomenological studies in the Levantine basin indicate that the anticyclonic features are the primary pools of LIW; however, the role of cyclonic and anticyclonic (AC) features in the formation and advection of LIW yet remain to be determined through the recommended experimental plans.

Region of Study

The purpose is to identify a region of cyclonic-anticyclonic interactions with the potential for LIW formation. The earlier studies indicate the region between island of Crete-Rhodes to Cyprus, limited by the Herodotus abyssal plain in the south contain several pairs of cyclonic/anticyclonic features with potential for our extended surveys. Specifically, (Rhodes-Cyclone-Anaximander AC), (Rhodes Cyclone-Antalya AC), and (Rhodes Gyre-Mersa Matruh AC) pairs are possible candidates for limited area, fine resolutions process studies. The advection and dispersion of the newly formed LIW could be studies based on a Lagrangian pattern following the jets and filaments interconnecting the features.

Experimental Program

The total time period is from mid-January to the beginning of May, 1993. This period is divided into 3 phases:

1. Preformation
2. Formation
3. Dispersion

Phase I: Preformation and Formation

January 1, 1993. Preliminary Survey to decide on final location. AXBT flights will cover a predetermined track which cuts across the important circulation features which have been identified in earlier POEM datasets, and also by remote sensing, to determine our final experimental design for the second phase.

Phase II: Preformation and Formation:

Jan. 15-March 15, 1993. This phase will concentrate on obtaining hydrographic fine resolution data in the predetermined domain by a series of surveys made by various ships replacing each other, for two week periods. During each survey 50-70 hydrographic stations, carefully located in the important features, will be occupied. The minimum suggested depth is 750 m, unless ship time is available to extend the measurements to 1000 m.

Phase III: Dispersion and Advection Experiments:

March 15-May 1, 1993. Multi-ship dispersion experiments following a Lagrangian pattern downstream of the formation events will attempt to describe the spreading and eventual fate of the newly formed LIW subject to advection by jets.

For this purpose hydrological stations will be occupied. 10-20 floats will be released at the end of Phase I and will be monitored during Phase II.

Meteorological Data:

Meteorological information necessary for studying the air-sea interactions responsible in the LIW formation will be collected from meteorological stations located along the nearest coastal sites as well as islands. Additional real time ship board measurements will contribute to the pool of meteorological data. If available, a monster buoy capable of resisting the severe winter condition will be deployed at a suitable open sea location during the total period of the experiment.

II. Deep Water Dispersion Studies and Direct Investigation of the Initial Phase of the Ionian Bottom Current

Objectives:

- to determine the existence of different deep water masses in the South Adriatic;
- estimation of the volume of the Adriatic water entering into the Ionian Sea;
- determination of pathways and dynamics of the DEEP Water along the western continental slope and bottom of the Northern Ionian.

Experimental design:

The experimental phase of this study has to cover the period of one year starting from the early winter, i.e., the preconditioning phase of the Deep Water formation.

To achieve the first objective it is suggested to do the following transversal CTD profiles: Gargano, Dubrovnik and Brindisi in January every other month starting 1994.

The fine CTD station network will be defined in the Otranto Strait and to the south of it to follow the dispersion of the Deep Adriatic Water in the Ionian Sea.

The second objective will be achieved by using Strait current measurements and aforementioned CTD data.

The third objective will be achieved by CTD measurements on profiles normal to the coast in the Northwestern Ionian (along the Italian coast). There will be one profile upstream of Taranto Bay and three downstream along the Calabrian continental slope. Another transect will be planned normal to the Greek coastline (Corfu transect) to determine the inflow of LIW into the Adriatic Sea as well as eventually the outflow of the dense deep water direct into the deep Ionian basin. Also the Cretan passage is desirable. The CTD profiles will be done every other month.

For the third objective it is also necessary to carry out direct current measurements both Eulerian (three moorings near the bottom on one of CTD transects) and Lagrangian measurements by 10 floats both upstream and downstream of the Taranto Bay. Full depth station with fine resolution and oxygen are required.

III. 'Straits' Report

From already existing RCM records in Cretan Straits an attempt will be made to estimate fluxes through them, in order to define the straits in which major exchange occurs.

In October 1991 and March 1992 mesoscale experiments will be conducted in the Cretan Arc straits. These experiments will both be CTD and RCM measurements, and they will allow us to better plan the 1994 DW experiments, as far as the contribution of the Aegean Sea is concerned.

Finally the Cretan Arc straits will be monitored with RCM (7 moorings of 3 RCMs) for a total duration of one year, during the DW experiment in 1994. This one-year experiment will help in understanding the contribution of the Aegean to the DW (if any), and at the same time it will help in understanding the role of the Cretan Sea to the AW-LIW circulation in the Levantine.

The Sicily Channel will be monitored for one year during 1994 with the series of RCM along one cross-section (probably 4 moorings of 3 RCMs). CTD casts will be performed in the Sicily Channel area every two to three months during the same period. A mesoscale grid will be implemented in the area close to the deepest part of the channel.

During the DW 1994 experiment 4 moorings of 3 RCM will be moored on Otranto Straits. A mesoscale grid just south of the Otranto Straits will be surveyed by CTD every 2-3 months during this one-year RCM experiment.

REPORT OF WORKING GROUP III: LOGISTICS, TECHNIQUES AND SURVEY DESIGN

Introduction

The working group on logistics, techniques and survey design has been asked to bring togther the needs of the other working groups and meld them into a unified scheme for POEM Phase II. The needs of the other working groups have been determined from their individual reports and a synthesis has been made here. As there is over a year before the first general survey cruise of POEM-II, there should be ample time to address and solve issues that may arise and conflicts that may appear.

Members

Members of the working group were as follows: Dr. Artur Hecht and Dr. Antonio Michelato (co-chairpersons), Mr. Wayne Leslie, Dr. Paolo Scarazzato, Dr. Alexander Theocharis and Dr. Umit Unluata.

Experimental Schedule

Current plans for POEM-II include four periods of field measurements. There are two general surveys scheduled for October 1991 and March 1992. There is a Levantine Intermediate Water formation experiment scheduled for the period January-March 1993 and a Deep Water formation experiment scheduled for 1994. A complete POEM-II time schedule and time line can be found in the report of the Steering Committee.

The general surveys will take place on the general 0.5 degree grid as before. As before, there will be regions of higher resolution; specified later in this report. The LIW formation experiment will focus on the Northwestern Levantine Basin. An AXBT flight will precede the shipboard experiments in order to predetermine the locations of important features. A repeating time series between cyclonic and anticyclonic features will be maintained to determine the occurrence of LIW formation. After such a formation event takes place, multiple ships will occupy the area in order to determine the dispersion of the LIW. Possibly a telemetered buoy will provide real-time weather and temperature vs. depth information. The Deep Water (DW) formation experiment will focus on the various strait regions: Otranto, Sicily, Cretan Arc and Cretan Passage. An important facet of the DW experiment will be long-term current meter moorings and the reoccupation of hydrographic stations on a bimonthly basis. The use of deep floats is also novel.

Physical Measurements

For the two general surveys, CTD station will be, in general, on a 0.5 degree grid in latitude and longitude. Specific station locations will be mapped at a later date. Exceptions to the general survey grid are: 1) the various straits (Otranto, Sicily, Cretan Arc); 2) Eastern side of the Cretan Basin; 3) Cilician Basin; 4) frontal regions to be specified at the time of the survey; and 5) selected shelf regions of interest. In these shelf regions, finest resolution should be done at the slope/shelf break. Stations at 100 m depth intervals (500 m, 400 m, 300 m, 200 m and 100 m) are considered adequate.

CTD stations will nominally be to 1200 m with the following exceptions: 1) intercalibration station (1500 m); 2) deep stations on a 3° longitude by 1° latitude grid (bottom); and 3) western Ionian stations determined necessary to follow the deep

currents (bottom). Stations will be occupied in a sequence which will facilitate the taking of intercalibration stations.

Bottle depths vary depending on the biological and chemical quantities desired. In order to collect sufficient water, it shall be necessary to make multiple casts at each station.

During the early phase of the LIW formation experiment (3rd week of January through mid-March of 1993), the focus will be on the northwestern Levantine Basin. A repeating time series of 50-100 1000 m stations will be occupied in sequence by different ships. The plan is to maintain as continuous a time series as weather permits. From mid-March through the end of April, multiple ships will simultaneously occupy a dispersion pattern. The specific nature of the stations has not yet been determined. Some 10-20 pop-up floats will be deployed.

The Deep Water formation experiment in 1994 will be concerned primarily with the strait regions. There will be current meters in the straits of Otranto, Sicily, Rhodes and Crete. There will be a hydrographic program which will include reoccupying stations on a bimonthly basis. A grid of stations will be located inside the mouth of the Adriatic, a section at the mouth, and three sections outside; along the western Ionian. These will all be high resolution, deep sections. Additional sections will be made in the Sicily Channel, the Cretan Arc and the Cretan Passage. Ten deep floats will also be deployed; a line of five off the "heel" of Italy and another line of five off the "ball of the foot" of Italy.

Biological and Meteorological Measurements

At each hydrographic station, each ship should observe and record the following quantities:

1. Time (Local or UTC, but clearly noted)
2. Location (degrees lat-long)
3. Air Temperature (degrees Celsius)
4. Humidity (Relative humidity, dew point or wet bulb)
5. Wind Speed (meters/second)
6. Wind direction (degrees from North)
7. Atmospheric Pressure (millibars)
8. Sea Surface Temperature (degrees Celsius)
9. Rainfall (centimeters) - if possible

Parameters 3-6 should be measured as close as is possible to the 10 m height as required by bulk flux formulae. Additional measurements which could be helpful but are not as crucial are total cloud cover (fraction) and net downward solar flux.

Intercalibration Requirements

1. Physical measurements will be intercalibrated as before. This is done through the use of observations over the depth range 900-1500 m at stations chosen in quiescent areas. There should be at least two intercalibration stations per joint research area. These stations should be occupied within a reasonable time period but do not need to be simultaneous. CTD sensors should be calibrated pre and post cruise.

2. Biological measurements will be intercalibrated in a manner as yet undetermined. However, there is a much greater time constraint on the measurement of biological variables than on physical variables. In order to intercalibrate measurements from 0-300 m, the measurements must be simultaneous. For the depth range 500-1200 m, the measurements must be made within 24 hours of each

other. If possible, ships should wait on station until simultaneous measurements can be made.

3. Meteorological instruments should be calibrated before cruises begin. Intership comparisons would be desirable. Minimally, instruments should be calibrated with the local meteorological service.

Required Equipment

Equipment necessary to make desired observations will have to be acquired. The logistics committee has no present recommendations on how the acquisition of this equipment is to take place. Some equipment will be acquired for the specific needs of individual institutions for research projects not involved with POEM. When possible that equipment should be made available for POEM related research.

I. Physics
   1. CTD
   2. Rosette
   3. 12 1.71 bottles
   4. 6 5.01 bottles
   5. Storage rack for bottles
   6. Reversing thermometers

II. Biology
   1. Transmissionmeter
   2. Fluorimeter

III. Miscellaneous
   1. Floats
   2. Meteorological/Oceanographic Buoy
   3. Current Meters
   4. Research Aircraft and AXBTs

REPORT OF WORKING GROUP IV: BIOLOGY-CHEMISTRY

As part of the POEM II planning workshop (Lerici, June 1990) a preliminary plan for biological and chemical studies during POEM II was developed. Though the biology-chemistry working group of the Venice meeting generally endorsed the scientific objectives and research issues, presented as part of that plan, the following report both extends and revises it. For example, it was felt, that greater emphasis on processes occurring in the deep water column was needed.

Our discussion focussed on the measurement program for the 1991 and 1992 basin-wide surveys with the list of recommended parameters nearly identical to the one found in the Lerici report. It was recognized that the trade-offs between scientific needs and limited at-sea and on-shore resources dictated a hierarchy of sampling schemes (Table 4): Those measurements deemed both essential and practical at every station on the regular sampling grid (0.50 grid; and at higher resolution in special regions and transects) are nutrients (PO_4^{-3}, NO_3^-, NO_2^-, SiO_4^-), continuous and discrete O_2, in-situ fluorescence, in-situ transmissometry, radiance (PAB) penetration during daylight, and discrete chlorophyll *a*. These measurements, are required to supply basic information regarding spatial variability in biological and chemical properties. Where higher resolution transects are made for physical parameters to better resolve sub-basin features, these measurements should also be made at each station along those transects if possible.

Measurements to be made at coarser resolution (2° grid, every 4th station) and in 'special' regions include chlorophyll *a* size fractionation, large phytoplankton species enumeration, and bacterial counts. It is recognized that the latter two are labor-intensive, but sample collection requires minimal effort and preservation is robust. The Working Group felt it was worthwhile to have a large number of samples taken from which a subset can be later chosen for analysis. Bacterial counts require more specialized equipment and expertise and technology transfer to each participating laboratory for this method will be pursued. Meso- and macro-zooplankton biomass determination and species identification will also be done at 2° resolution along special transects of the basin. These '2°' measurements while rather coarse will provide basic information regarding plankton ecology and biogeography in different regions of the basin.

POC, PON, and POP will be measured along special transects of important features (straits, cyclones, anti-cyclones, and jets) consisting of at least 6 stations for each ship. The reduced number of stations is mandated by the relatively large volumes of water required and long ship-board filtration times. These parameters provide basic information regarding the abundance and chemistry of biogenic particles and are essential for calibration of particle concentration estimates based on transmissometry. The latter will provide high resolution maps of particle distribution at resolution equal to that of the physical data. A similar strategy will be applied in using chlorophyll *a* data to calibrate the in-situ fluorometric data.

Vertical sampling resolution is guided by the need to resolve vertical features expected in each depth region (see Table 1). In-situ transmissometry, fluorometry, and O_2 (sensor on CTD if available) will be acquired continuously with depth on each CTD cast. Continuous irradiance profiles will be taken down to the 0.1% surface light level (100-200 m) on separate lowerings as close in time as possible as the CTD cast during daylight hours.

within the LIW. Since chlorophyll samples will be taken from six of the upper twelve depths, those should also be spaced to resolve the chlorophyll maximum based on the fluorescence profile. Chlorophyll size fractionation will be done at two depths one of which will be in the chlorophyll maximum and include 1, 3, 20 μm size cutoffs in addition to total. Samples for enumeration of the larger phytoplankton will be collected at the same depths as chlorophyll. At POM stations, POC, PON, POP samples will also be collected at 6 depths in the upper 300 m, preferably the same as those for chlorophyll, etc. Bacterial samples will be taken at 12 depths in the upper 600 m. Zooplankton tows will be made such that layers at 0-50, 50-100, 100-200, and 200-300 m are sampled discretely. However, depths can be adjusted based on hydrography. Separate zooplankton samples will be taken for separate biomass and species determination.

Detailed methodological writeups for all the measurements discussed above will be exchanged including a detailed analysis of accuracy and precision. Existing recent reports may be included. We recognize that intercomparison and intercalibration for all biological and chemical measurements is vital for the success of POEM II. We recommend, where applicable, the following 3 strategies for intercomparison and intercalibration.

1) Pre-cruise exchange of laboratory samples previously collected at sea.
2) At-sea intercalibration at designated stations, preferably simultaneously.
3) For easily preserved materials, post-cruise exchange of samples collected during the POEM II surveys.

Because of the critical importance of intercomparison and intercalibration we recommend that a special POEM II technical workshop take place to discuss protocols and current capabilities, regarding chemical and biological measurements carried out by each participating laboratory. Discussion of phytoplankton and zooplankton species enumeration and biomass determination should be specifically included.

It is recognized that a number of additional measurements would be useful in fulfilling the objectives listed in the Lerici report but at present cannot be prescribed for the POEM II Survey field program. However, this measurement should be included in 1995 process studies. Thes include atmospheric nutrient fluxes, particle flux measured by sediment traps, DOM, ^{14}C-primary production, HPLC pigment analysis, and microzooplankton and picophyte-plankton analysis.

Statistics and Data Reporting

Also critical to program objectives is reporting of data in uniform and consistent units with subsequent centralized data, storage accessible to all POEM II investigators,. Reported units, format, and level of processing should be discussed at the proposed technical workshop. With regard to data storage, Trieste has developed a data base system which is more or less compatible with other international data bases which we propose for the POEM Biology-Chemistry data base system. An important characteristic of this data storage system is its flexibility - that is, the ease with which the data can be subjected to different modes and levels of processing.

TABLE I: SAMPLES

Parameter	Grid	Volume Sample Required	Levels	Extra Wire-time Required
Nutrients, O_2	0.5°	1 L	12 0-300 m 12 300-CTD depth	
Chlorophyll (Chl.)	0.5°	100 mL	6 on fluorescence profile	
Chl. size fractionation	2°	2L	2	
Phytoplankton Larger species counts	2°	500 mL (some labs 1L)	6	
Bacteria	2°	25 mL	12 0-600 m	
POM	6 station/ship along special transects	10 mL	6	
Zooplankton	Along special transects		4: 0-50 m 50-100 m 100-200 m 200-300 m	1.5 h at day light
Fluorescence	0.5°	na	continuous	
Transmissometer	0.5°	na	continuous	
Light penetration (PAR)	0.5°		continuous	

TABLE II: EQUIPMENT

Parameter	At sea equipment	Manpower required
PO_4^{-3}, NO_3^-, NO_2^-, SiO_4^-, NH_4^+	Water sampler, Autoanalyzer or spectrophotometer, Deep freezer, preferably liq. N_2 or CO_2 (solid)	2
Chlorophyll	Water sampler, filter system, freezer, filters	1
Chl. size fractionation	Water sampler, filtering system, freezer	1
Phytoplankton	Water sampler	
Bacteria	Water sampler, refrigerator	1
POM	Water sampler, filtering system, filters	2
Zooplankton	Zooplankton net (Double closing net) 200 µm mesh size	2
Fluorescence (in situ)	In situ fluorometer (sensor on CTD or separate instrument)	
Transmissometer	Transmissometer (sensor on CTD)	
PAR	Lightmeter	1

APPENDIX I

FOURTH POEM SCIENTIFIC WORKSHOP

ISDGM - CNR, Venice, Italy, August 27-September 1, 1990

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APPENDIX II

REPORT OF THE POEM STEERING COMMITTEE

POEM Steering Committee Meeting
UNESCO Headquarters
Paris, France
3–4 January 1990

Steering Committee Participants:	Allan R. Robinson Paola Malanotte-Rizzoli, *Co-chairpersons* Artur Hecht Henri Lacombe (senior member) Antonio Michelato, *Executive Scientist* Alexander Theocharis Marsha Glass-Cormier, *Executive Secretary*
Executive Committee:	Gualter Soares, IOC
Observers:	Alexander Lascaratos U. of Athens, Greece Gunnar Kullenberg, IOC Secretariat K. Kitazawa, IOC Ocean Services Unit

AGENDA

POEM Steering Committee Meeting
UNESCO Headquarters
Paris, France
3–4 January 1990

I. National Reports

II. Scientific and Technical Coordination of the final phase of POEM I

Topics

1. Further Intercalibration Issues
2. Completeness of Data Sets
3. Auxillary Data (non-POEM gathered data as common inputs
   – unified topography and coastlines
   – surface wind stresses and heat fluxes
   – isotope data
4. Status of modelling and discussion of intercomparisons
5. Detailed Agenda for Venice Workshop/Colloquium
6. Current Meters
7. "Atlas"

III. Developments Toward a Scientific Program and Plan for POEM II

Topics

1. Identify Issues and required actions to insure drafting of Program and Plan document for Venice Workshop
2. Development of specific components of Biology and Chemistry of POEM II and its coordination with physical work
3. Specific issues of Biological and Chemical Intercalibration and interdisciplinary sampling considerations
4. Physical processes component – POEM II
5. Discussion of
   i. ASI
   ii. Coastal interaction components of POEM II
   iii. Adoption of scientific policy in these areas
6. Planning the development of adequate remote sensing component

National Reports

Recent scientific results were presented by:

A. Theocharis	—	Greece
A. Michelato	—	Italy
A. Hecht	—	Israel
U. Unluata	—	Turkey
A. Robinson	—	USA

Intercalibration Issues

Antonio Michelato reported on the Intercalibration Group's findings to date and actual state of the data files and action ideas to be taken for obtaining missing data sets. Solutions were presented to i) aid in processing POEM V data sets from Israel and ii) approach Cyprus on possibility of any available data.

Remote Sensing

The issue of remote sensing was discussed at the June 1989 Steering Committee Meeting in Cambridge and follow-up discussions took place. Action items and possible projects were suggested: application of 3 or 4 countries to the EEC for funding; run a cooperative remote sensing research project with whole of Mediterranean.

Current Meter Affair

OGS (A. Michelato) to contact K. Kitazawa at IOC for support in bringing technicians from POEM countries to OGS, Trieste, Italy to work on current meters and in their deployment.

Transitional Cruises

Discussion of shared and pooled data sets from POEM 1 and 3, and their distribution to scientists that received pooled data from POEM 2, 4 and 5. Discussion of formatting, accessibility, publication agreements and priority arrangements of unified commonly stored data took place.

Venice Workshop

Open discussion on the planning of the 4th Scientific POEM Workshop to be held in Venice, August 1990. The following working document was adopted by the Steering Committee.

A. Objectives

1. Synthesis of POEM I Science

   - Circulation and Physical Processes
   - Interdisciplinary aspects of results to date
   - Model intercomparisons and direction of research
   - Communicating work to national and international agencies and programs (to scientific infrastructure)

2. Draft Program and Plan Document for POEM II

   - Coordinated Interdisciplinary Surveys
   - Physical Processes Experiments on LIW
   - Biological and Chemical Processes Experiments
   - ASI and Coastal Interaction Components

B. Venue and Participants

- CNR-ISDGM, Venice, Italy
- 27 August — 1 September (as established at June 1, 1989 Steering Committee Meeting, Harvard)
- 50–60 Scientists in total: strong multi- and interdisciplinary attendance in balance with standard POEM participation

C. Workplan

- First (3) days: Symposium on Phase I POEM
- Second (3) days: Workshop on Phase II POEM and introduction of POEM II

Auxillary Data

In order for the POEM group to have the highest quality, available data a discussion took place to determine the best vehicle to obtain data outside the POEM community. A recommendation to set up a working group to identify data sets for standard unified topography, coastlines, surface wind stress and heat fluxes.

Status of Modelling and Discussion of Intercomparisons

Reports from Greece, Israel, Italy, Turkey and US (both Harvard and MIT) on recent developments in modelling and intercomparison were presented.

ASI and Coastal Intercation

Ongoing interest by physical scientists in POEM for meteorologists participation in POEM II was discussed. Possibility and vehicles for initiating such interest were aired.

Scientific Organizing Committee for the Lerici Meeting

The meeting will be approached from the physical understanding of a successful interface with biology and chemistry. The POEM Steering Committee members (6–8) plus an ad hoc committee of biologists and chemists will gather for one or two days to plan the development of the biological/chemical research component of the interdisciplinary ocean science program for POEM II.

Nomenclature

It was decided that the nomenclature for the common cruises carried out up to Summer 1987 must be changed as follows:

Year	Period	Name
1985	Oct-Nov	POEM01
1986	Mar-Apr	POEM02
	Oct-Nov	POEM03
1987	Mar-Apr	POEM04
	Oct-Nov	POEM05

As far as the regional or "not common" cruises are concerned, it was decided to use a capital letter to identify the country according to the following table

I	=	Italy
T	=	Turkey
G	=	Greece
S	=	Israel
C	=	Cyprus
U	=	USA
Y	=	Yugoslavia
D	=	Germany

followed by the sequential number of the cruise. So, for example, POEMI1 means the first regional cruise carried out by Italy.

Publication

It was decided that a publication in an international journal (i.e., Deep Sea Research) be considered as a vehicle primarily for published results of the Venice Workshop.

APPENDIX III

REPORT OF THE POEM STEERING COMMITTEE

POEM Steering Committee Meeting (Informal)
Istituto Veneto
Venice, Italy
August 31, 1990

Steering Committee Participants:	Allan R. Robinson Paola Malanotte-Rizzoli, *Co-chairpersons*
	Miroslav Gacic Artur Hecht Antonio Michelato, *Executive Scientist* Hassan Mustafa Alexander Theocharis Umit Ünlüata
	Marsha Glass-Cormier, *Executive Secretary*
Executive Committee:	Gualter Soares, IOC
Observer:	Selim Morcos

Planning *Deep Sea Research* Issue

Deep Sea Research editor John Milliman has been apprised of the interest in a dedicated volume of POEM I results and has responded positively. The guest editors would be the co-chairpersons, Allan R. Robinson and Paola Malanotte-Rizzoli. Contributed papers will go through the usual refereeing process. Substance and schedule for publication were discussed.

A table of contents was developed on the following:

1. A short paper on the total General Circulation (Robinson and Roether)
2. Surface Forcing Functions (Malanotte-Rizzoli)
3. Synthetical Papers (lead authors with appropriate co-authors of their choice)
   a. Synthesis of the Ionian General Circulation (Michelato *et al.*)
   b. Synthesis of Sea of Crete and Adjacent Ionian (Theocharis *et al.*)
   c. Synthesis of the Levantine Basin (Hecht, Ünlüata *et al.*)
   d. Adriatic and Otranto Straits (Gacic, Michelato *et al.*)
   e. Synthesis of Straits of Cretan Arc (Lascaratos *et al.*)
   f. Synthesis of the Straits of Sicily (Spezie *et al.*)

Timeline

A tentative timeline for the next stage of POEM was proposed

1990	August	Venice Workshop
	October	CIESM Perpignan, France
1991	May	Intercalibration Workshop Rovinj, Yugoslavia (suggestion only)
	August	IAPSO/IUGG Vienna, Austria (POEM Session)
		Steering Committee Meeting (to follow)
	October	Interdisciplinary Survey
1992	January	ASI Meeting (location to be announced)
	March	Intermediate Winter Survey
	August	Major Scientific Meeting (NATO-ASI or POEM Workshop)

Timeline *(continued)*

1993	January May	↕	Intermediate Water Field Work
1994			Deep Water Surveys
1995			Biogeochemical Experiments

Current Meter Affair

The proposed (as per Paris January Steering Committee Meeting) 1990 Workshop was postponed due to budget constraints at IOC. A tentative January 1991 date, to be finalized by A. Michelato, was presented for the Current Meter Workshop at OGS. As previously planned, a technician from each country would be sent to Trieste. A. Michelato would put forward a proposal to K. Kitazawa for IOC support and then confirm by letter to participants.

Special School

A special school to be held in Erice, Sicily was proposed for sometime in 1991 or 1992. A proposal would be submitted to NATO for an Advanced Studies Institute School.

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
8	The mangrove ecosystem: Human uses and management implications. Report of a UNESCO regional seminar held in Dacca, Bangladesh, December 1978. English only	1979
9	The mangrove ecosystem: scientific aspects and human impact. Report of the seminar organized by UNESCO at Cali, Colombia, 27 November-1 December 1978. Available in English and Spanish	1979
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
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
24	Coastal ecosystems of Latin America and the Caribbean. The objectives, priorities and activities of UNESCO's COMAR project for the Latin America and Caribbean region, Caracas, Venezuela, 15-19 November 1982. Available in English and Spanish	1983
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
28	Oceanographic modelling of the Kuwait Action Plan (KAP) Region. Report of symposium/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 coastal 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
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

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No.		Year
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
53	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. English only	1990
54	Relative sea-level change: a critical evaluation. UNESCO (COMAR) Working Group on Mean Sea-Level Rise and its Influence on the Coastal Zone	1990
55	Physical oceanography of the Eastern Mediterranean (POEM): The new phenomenology of the Eastern Mediterranean. POEM Scientific Workshop, Cambridge, Massachusetts, USA, 29 May-2 June 1989.	1991
56	Geological and geophysical investigations in the Mediterranean and Black Seas	1992

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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.	1982
	El Callao, Perú, 8-11 de septiembre de 1980.	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
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

CORRIGENDUM

(This page replaces page 13 of *UNESCO Reports in Marine Science No. 57*, wherein the first two lines were omitted.)

Specific sampling depths should be chosen at the time of the cast to resolve the depths of the near-surface nutricline, the O_2 minimum, and the nutrient maximum within the LIW. Since chlorophyll samples will be taken from six of the upper twelve depths, those should also be spaced to resolve the chlorophyll maximum based on the fluorescence profile. Chlorophyll size fractionation will be done at two depths one of which will be in the chlorophyll maximum and include 1, 3, 20 μm size cutoffs in addition to total. Samples for enumeration of the larger phytoplankton will be collected at the same depths as chlorophyll. At POM stations, POC, PON, POP samples will also be collected at 6 depths in the upper 300 m, preferably the same as those for chlorophyll, etc. Bacterial samples will be taken at 12 depths in the upper 600 m. Zooplankton tows will be made such that layers at 0-50, 50-100, 100-200, and 200-300 m are sampled discretely. However, depths can be adjusted based on hydrography. Separate zooplankton samples will be taken for separate biomass and species determination.

Detailed methodological writeups for all the measurements discussed above will be exchanged including a detailed analysis of accuracy and precision. Existing recent reports may be included. We recognize that intercomparison and intercalibration for all biological and chemical measurements is vital for the success of POEM II. We recommend, where applicable, the following 3 strategies for intercomparison and intercalibration.

1) Pre-cruise exchange of laboratory samples previously collected at sea.
2) At-sea intercalibration at designated stations, preferably simultaneously.
3) For easily preserved materials, post-cruise exchange of samples collected during the POEM II surveys.

Because of the critical importance of intercomparison and intercalibration we recommend that a special POEM II technical workshop take place to discuss protocols and current capabilities, regarding chemical and biological measurements carried out by each participating laboratory. Discussion of phytoplankton and zooplankton species enumeration and biomass determination should be specifically included.

It is recognized that a number of additional measurements would be useful in fulfilling the objectives listed in the Lerici report but at present cannot be prescribed for the POEM II Survey field program. However, this measurement should be included in 1995 process studies. These include atmospheric nutrient fluxes, particle flux measured by sediment traps, DOM, ^{14}C-primary production, HPLC pigment analysis, and microzooplankton and picophyte-plankton analysis.

Statistics and Data Reporting

Also critical to program objectives is reporting of data in uniform and consistent units with subsequent centralized data, storage accessible to all POEM II investigators,. Reported units, format, and level of processing should be discussed at the proposed technical workshop. With regard to data storage, Trieste has developed a data base system which is more or less compatible with other international data bases which we propose for the POEM Biology-Chemistry data base system. An important characteristic of this data storage system is its flexibility - that is, the ease with which the data can be subjected to different modes and levels of processing.