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OCEANOGRAPHIC PROGRAMMES DURING THE FIRST GARP GLOBAL EXPERIMENT (FGGE)

Note by the Secretariat

This information document is based upon the 3rd Draft of the IOC Oceanographic Programme related to GARP (IOC/INF-281 Rev. 2) and Interim Reports of relevant Panels of SCOR Working Group 47 (Oceanographic Programmes during FGGE)

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OCEANOGRAPHIC PROGRAMMES DURING THE FGGE

PURPOSE OF DOCUMENT

In its planning for the First GARP Global Experiment (FGGE), the ICSU/WMO Joint Organizing Committee for GARP has looked to the oceanographic community for the development of an oceanographic programme during the FGGE that would contribute not only to the FGGE objectives, but to the principal objectives of oceanographic research which will benefit from FGGE data. Therefore, the purpose of this document is to specify the concept that SCOR WG 47 is following in developing oceanographic programmes which are expected to provide basic data for modelling studies of coupled ocean-atmosphere phenomena. First priority is given to obtaining data and research results related to the first GARP objective*), and secondly to the second GARP objective*).

Basic Concepts

The atmosphere reacts to the ocean principally through the transfer of heat across the air-sea interface, and to a lesser extent to transfer of water and momentum from the surface. In general, changes in the sea surface temperature regions begin to be effective after a week or two. These sea surface changes are, in turn, influenced by atmospheric forcing of the sea surface, and of changes within the ocean mixed layer as deep as several hundred meters. For still longer time scales, such as interannual variability, processes as deep as 1000 meters are involved.

The FGGE offers a number of opportunities to oceanographers interested in developing oceanographic and coupled ocean-atmosphere models. The main

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* The Global Atmospheric Research Programme (GARP) is a programme for studying those physical processes in the troposphere and stratosphere that are essential for an understanding of:

- The transient behaviour of the atmosphere as manifested in the large-scale fluctuations which control changes of the weather; this would lead to increasing the accuracy of forecasting over periods from one day to several weeks (called first GARP objective);
- The factors that determine the statistical properties of the general circulation of the atmosphere which would lead to better understanding of the physical basis of climate (called second GARP objective).

attraction of FGGE to the modeller is the availability of atmospheric input in regions of the ocean which are normally not so well covered, in particular the equatorial regions, the Indian Ocean, and the southern oceans.

Although the prediction of sea surface temperature has been identified as the most important initial input that the oceanographer can provide to the atmospheric modeller, from the overall viewpoint of developing coupled ocean-atmosphere models to understand long term climatic variation, all aspects of ocean modelling which determine the response of the overall system on any time scale must be regarded as potentially important. However, within the time limitation of FGGE, the most relevant oceanographic experiments will concern the oceanic surface circulation and the upper layer of the ocean which exhibit significant response on atmospheric forcing (in different space and time scales). Tables I and II show examples of the close relationship between studies in the ocean and the atmosphere.

TABLE I

EXAMPLES OF OCEAN COMPONENT RELATIONSHIP TO GARP SUBPROGRAMMES

GARP SUBPROGRAMMES	EXAMPLES OF OCEAN COMPONENT
Tropical	Sea surface temperature anomalies of even less than 1.0°C have significant influence on the atmospheric general circulation
Numerical Experimentation	Coupled ocean-atmosphere models
Climate Dynamics	Ocean Heat transport
Monsoon	Sea surface temperature anomalies of even less than 1.0°C have significant influence on monsoon circulation and are strongly correlated to precipitation over the subcontinent
Polar	Ice and current drift
Radiation	Back radiation is a function of the sea surface temperature
Air-Surface Interaction	Energy flux between ocean and atmosphere boundary layer

TABLE II

EXAMPLES OF SHORT TERM CLIMATE EXTREMES NEEDING OCEANIC STUDY

EXAMPLES OF SHORT TERM CLIMATIC EXTREME	OCEANIC STUDY NEEDED
1. South Asian summer monsoon	• Studies of the anomalous sea surface temperature over the Arabian Sea which may have a significant effect upon the evaporation rate over the sea, the cross-equatorial flow over the sea, and the precipitation rate over the Indian subcontinent.
2. Drought	• Studies of persistent anamalies in ocean surface temperatures which may be related to drought by way of the anomalous atmospheric circulation forced by the anomalous oceanic heating.
3. Synoptic scale sea-surface temperature anomalies	• Observational and theoretical studies aimed at elucidating the sources of the anomalies • Studies aimed at identifying the effects of the anomalies (e.g., "El Niño")
4. Sea-ice variations	• Observational testing of hypotheses and parameterization schemes, both concerning the influences governing the formation and extent of sea ice and concerning the influence of sea ice on the atmosphere and ocean.

The IOC programmes of IODE, IGOSS, IDOE, Co-operative Investigations, and TEMA and SCOR Working Groups 34, 36, 38, 43, 47, 49 and 55 have certain elements which are related to FGGE (see Tables III and IV). Those aspects which are supportive of FGGE include (i) internationally agreed upon procedures for the collection, exchange, and archiving of oceanographic data needed for boundary conditions and variables in General Circulation Models; (ii) research projects which provide increased understanding of air-sea interaction processes on many scales; (iii) investigative programmes that include ocean observational facilities which can be used to improve the meteorological observing systems over ocean areas; (iv) training, educational, and assistance programmes that can increase participation by developing countries; and (v) parallel high priority interests in the equatorial, Indian, and southern ocean areas during 1977-1980. It is also important to point out that FGGE will be most supportive of the IOC and SCOR ocean programmes by providing an unprecedented data set for studying the many ocean processes linked to atmospheric forcing and feedback. The Ocean assumes a major role in the GARP second objective. In this respect, it is obvious that the IOC programmes of IODE, IGOSS, IDOE and the Co-operative Investigations would provide considerable support. Likewise, major support is to be provided by SCOR Working Groups 34, 36, 38, 40, 43, 47, 49 and 55. In fact, it is almost certain that IOC and SCOR will have the major responsibility for fulfilling the ocean aspects of the GARP second objective. In this respect, objectives have been identified which include (i) understanding and parameterizing subgrid scale processes which determine the circulations of the ocean; (ii) constructing a hierarchy of models for studying climate dynamics on various time scales; (iii) assembling suitable data sets for testing climate models; and (iv) identifying the properties of deep ocean sediments which contain climatological evidence of very long-time scales.

It should be pointed out that the successful attainment of these objectives may be realized only if all the component parts of IOC and SCOR are sufficiently coordinated so as to ensure a balance of priorities with the expected commensurate resources, and participating nations of the world. Further, it is highly desirable to have a major increase in activity related to education, training, assistance and technology transfer so that the badly needed participation by developing countries can be realized.

TABLE III

CONTRIBUTING RELATIONSHIPS BETWEEN EXISTING IDOE PROJECTS
AND THE SCIENTIFIC OBJECTIVES OF THE GARP SECOND OBJECTIVE*

SCIENTIFIC OBJECTIVES OF GARP II	CONTRIBUTING IDOE PROJECTS
Understand and parameterize sub-grid scale processes which determine the circulation of the ocean	° MODE; POLYMODE; NORPAX; CUEA; JASIN
Construct a hierarchy of models for studying climate dynamics on various time scales	° GEOSECS; POLYMODE; NORPAX; ISOS; CLIMAP; CUEA; JASIN
Assemble a comprehensive data set for testing climate models	° NORPAX; ISOS; CLIMAP; CUEA
Identify the properties of deep ocean sediments which contain climatological evidence of very long-term scales	° GEOSECS; CLIMAP; Plate Tectonics and Metallogenesis

* The supportive contributions from the living resource element of IODE has been included because it might more logically fit within the biomass aspect of climate rather than the ocean aspect.

TABLE IV

RELATION OF SCOR WORKING GROUPS TO THE

OCEAN SCIENTIFIC OBJECTIVES TO GARP II

SCIENTIFIC OBJECTIVES OF GARP II	RELEVANT SCOR WORKING GROUPS
Understand and parameterize sub-grid scale processes which determine the circulation of the ocean	Working Group Numbers: 34; 36; 38; 43; 47 and 55
Construct a hierarchy of models for studying climate dynamics on various time scales	Working Group Numbers: 34; 36; 38; 47, 49 and 55
Assemble a comprehensive data set for testing climate models	Working Group Numbers: 43 and 47
Identify the properties of deep ocean sediments which contain climatological evidence of very long-time scales	Working Group Number: 40

Development of Oceanographic Planning since 1974

SCOR WG 47 has been developing, in collaboration with IOC and WMO, the elements of an oceanographic programme during FGGE. Following wide ranging enquiries in 1975, WG 47 determined that from the oceanographic point of view it would be advantageous to concentrate on the equatorial regions and the northern parts of the Indian Ocean. Fortunately the meteorologists had, separately, determined that these same areas were the most important from their point of view although additionally they plan some concentration in the polar regions. The oceanographic and meteorological plans will therefore be mutually supportive. Because of logistics and other reasons it was considered advisable for the field programmes of the three equatorial oceans to be planned separately and therefore three separate planning panels were developed. The SCOR Working Group itself has concentrated on the planning of field work and observational programmes and has not itself assumed responsibility for the development of numerical modelling which is more directly the concern of other Working Groups of SCOR, such as WG 49 on Mathematical Modelling on Oceanic Processes and WG 34 on Internal Dynamics of the Ocean, with which WG 47 has established close collaboration and whose views are being taken into account in the planning of the programme.

Because the time and space scales on which it is feasible for oceanographers to work are different from those of meteorologists, it is not practicable to consider the development of an oceanographic programme in terms of a relatively dense network of observing stations or points throughout the equatorial region. Meteorologists have their atmospheric models on a global scale and the various observing systems of FGGE are designed to provide as dense as possible a network of observations. Oceanographers, on the other hand, cannot yet contemplate comparable programmes and therefore the oceanographic plans for FGGE must be developed largely on a problem, or process, oriented base.

The programmes being developed are based on the results of a series of meetings and on specific proposals for investigations from different regions. A number of pilot studies have been completed, or are still in progress, and

further discussions between theoretical and observational scientists are needed to determine, based on the results of pilot studies and on further examination of the theoretical base lines, more precisely the areas and kinds of studies that are likely to be most profitable.

Below are given outlines of the probable contributions to the oceanographic programmes in the three equatorial ocean regions, as known at the beginning of 1977. Plans are still developing and following some important meetings which are scheduled during 1977 further contributions to the observational programmes will be identified and it is expected that an updated status report will be produced by WG 47 in late 1977. As will be seen, the developing network of oceanographic investigations will provide a more extensive series of measurements in the equatorial regions than has hitherto been possible, particularly during the SOPs, which will contribute further to the development of verification of ocean wide models and coupled ocean-atmosphere models. Fig. 1 indicates the areas in which, at the end of 1976, scientists have indicated interest in conducting research. The proposal by the USSR for evenly spaced (five degree longitude) meridional cross sections is unlikely to be achieved because of the lack of available research ships but by combining measurements from a wide variety of observational methods and of a limited number of meridional sections, it is confidentally expected that a more complete coverage of the equatorial regions will be achieved than is currently shown in Fig. 1.

It is expected that, in addition to the research vessels whose primary mission is oceanographic studies and which is indicated in the following section in more detail, use will be made of many of the FGGE tropical wind observing ships (TWOS) which have primarily a meteorological research mission. Plans are being made also to instrument islands and coastal stations with tide gauges and possibly temperature sensors and the use of satellite measurements for the study of equatorial and coastal upwelling is being undertaken.

Meteorological data will also be available from several FGGE observing systems, e.g., the World Weather Watch Network, aircraft dropsondes and meteorological satellites.

Outline of Known Plans at the beginning of 1977

Atlantic Ocean

Scientific Background: Preliminary results from GATE have revealed a number of fascinating phenomena: energetic oscillations of the equatorial currents, vertically propagating equatorially trapped waves, incipient mid-ocean eddies. The objectives of GATE, namely the determination of the spatial and temporal scales of the variability of the tropical oceanic circulation, have successfully been realized. We are thus in a position to pose the next set of questions, and to design an experiment to answer these questions. For example what are the energetics of the westward propagating 16-days oscillations of the equatorial currents? How do these oscillations effect the Brazilian coastal currents? What is the nature of the variability of the tropical ocean outside the latitude band 2°N to 2°S?

GATE concentrated on the central and western tropical Atlantic and paid little attention to the Gulf of Guinea. This is a very important region, however, because of the strong seasonal upwelling that occurs there. It is intriguing that the upwelling is not correlated with the intensity of the winds parallel to the coast. The modification of coastally trapped Kelvin waves, and equatorially trapped waves, because of the proximity of the near zonal coast to the equator, may affect the upwelling. An experiment in the eastern equatorial Atlantic will be of great value.

The First GARP Global Experiment (FGGE), which will have two Special Observing Periods (SOP) in January-February and May-June 1979, presents a unique opportunity for an oceanographic experiment, in the tropical Atlantic, to study the above phenomena. The design of such an experiment must await completion of the analysis of the GATE data, and of the historical data act which will give information about seasonal and interannual variability.

At present 22 ships have been identified to work in the tropical Atlantic 5 from the USSR, 5 from USA, 4 from France, 3 from Brazil and 1 each from Nigeria, Italy, United Kingdom, Germany (Federal Republic of) and the German Democratic Republic. Most of the ships have already been definitely identified and now there are a number of meetings to discuss and co-ordinate the possible extent of the work (see section on further development of the oceanographic programmes). The following lists is specific oceanographic objectives is tentative and will be more detailed in the SCOR WG 47 report from the Atlantic panel (Miami, 11 March 1977).

Scientists of the Federal Republic of Germany will undertake an experiment on horizontal and vertical mixing processes in the equatorial undercurrent using one research ship and three current metre moorings.

The Institute of Marine Research of the German Democratic Republic Academy of Sciences hopes to be able to contribute one research ship particularly during the second Special Observing Period in a mid-ocean position at the Equator.

USA expects to concentrate on the western equatorial region using research vessels and moorings in collaboration with vessels from Brazil. The USA plans a current metre array in the western part of the north equatorial counter current to study variability on an almost annual time scale and north south heat temperature.

The USSR expects to have five ships making simultaneous meridonial sections 500 kilometres apart between 20°N and 10°S.

A joint USA/French programme will maintain an array of instrumental moorings near the Equator in the Gulf of Guinea. A US research vessel will study the variability of the equatorial current system and its relationship to atmospheric forcing in the vicinity of 40°W using moorings cyclosondes and hydrographic stations. France expects to use two ships and an aircraft and instrumented moorings to study the biology of the equatorial upwelling in the Gulf of Guinea.

Pacific Ocean

Scientific Background: The plans being developed for the Pacific Ocean will take advantage of the unique opportunity to study the relationship between ocean circulation and the wind stress and heat flux fields. It will concentrate on defining the large scale response of the ocean circulation to atmospheric forcing and will include a number of important smaller scale problems which bear directly on the coupling between ocean and atmosphere. Components of the Pacific Programme will include: dynamics of upwelling and mixing at the Equator, Fluctuations in the Western Pacific, Eastern boundary fluctuations and Island monitoring. The objectives of the Pacific Panel are to identify those few key areas where these processes might most effectively studied with the resources available.

Japanese scientists are interested in undercurrent and trapped wave studies at the equator. There are plans to work near 140°E for about 40 days on a cruise which will also do meteorological work (tentative dates May/June 1979). In the vicinity of 170°E a French vessel would like to work making regularly repeated N-S sections (about 10 days/cruise) plus temperature and current moorings. These would extend at least over one Special Observing Period, and possible collaboration has been discussed with Australian oceanographers, who are also contemplating a drifter programme.

The USSR is developing a programme in the eastern Pacific.

US Oceanographers in the NORPAX programme are developing a programme in the tropical Pacific which will culminate in a major effort during FGGE. Pilot studies will include a three month field programme commencing in October 1977 which will be designed to provide information on the space and timescales of variation of the velocity and density fields.

Indian Ocean

Scientific Background: In the Indian Ocean several oceanic processes may be important in determining the distribution of temperature at the sea surface, and hence feedback from ocean to atmosphere. Besides local air-sea interaction, these include upwelling off the southern coast of the Arabian peninsula, and the formation and eastward spreading of upwelled water at the northern end of the Somali Current. The latter process depends strongly on the speed and position of the current itself, which is closely connected to the equatorial current system, and both are driven by the monsoon winds.

These are all especially appropriate subjects for study within the FGGE oceanographic programme. Some of them - e.g., development of the mixed layer in the Arabian Sea and Bay of Bengal, and some aspects of the equatorial circulation - can be tackled on a large scale, using widely spaced observations or a small number of roving ships. Others, perhaps equally important for FGGE and where there seem to be good prospects of significant advance at present - e.g., the dynamics of the Somali Current and its connection to the equatorial circulation - are so complex in space and vary so rapidly in time that detailed local studies are needed to explore them adequately. Some other oceanic phenomena outside the tropics - e.g., the Agulhas current system - can be most effectively studied during FGGE in regional surveys of relatively small scale. As a necessary part of the development of an oceanographic programme for FGGE, a series of pilot experiments has been under way for some years and is continuing. These include the oceanographic components of ISMEX-73 and MONSOON-77 (USSR, India), repeated bathythermograph sections using tankers of opportunity (USA, South Africa), several sets of observations of the vertical structure of currents near the equator (USA), and some long time-series of

subsurface current off the coast of East Africa (USA, FRG). Analysis of historical collections of sea-surface data, and development of specific numerical models for parts of the Indian Ocean, also have important influences on future plans.

Present plans include the following:

- It is hoped that it may be possible to occupy hydrographic sections across the equator east of 90°E in both SOP's by Australian oceanographers.

- One French ship will work in the Indian Ocean between the equator and 10°S during SOP II. Detailed plans are being formulated.

- Participation of India with US scientists in a mixed-layer experiment in the northwest Indian Ocean during SOP II, and with USSR research vessels in a multi-ship survey after SOP II occupying seven zonal sections in the western Indian Ocean between the equator and 20°N.

- A multi-ship survey of the Agulhas current system from 25°S to 35°S, and from the coast of Africa to 45°E, during SOP II is anticipated.

- The possible participation of UK institutes with USA in a multi-ship survey of the Somali Current is being explored. Tentative plans are being made for a multi-ship survey of the Somali Current and its relationship to the equatorial current system, and for a study of the upwelling region south of Socotra, during SOP II. Participation with India in mixed-layer experiment.

Clearly some of the above plans are closely related to some of the aims of CINCWIO[+)], since the same physical phenomena need to be understood, though there are differences of timing. The oceanographic observations need to extend longer than SOP II in the southwest monsoon, and an oceanographic survey of the biologically productive region off the coast of Kenya and

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+) IOC Workshop Report N° 7 to initiate planning for a co-operative investigation in the North and Central Western Indian Ocean (CINCWIO).

Tanzania should be made in November-January, before SOP I.

Further Development of the Oceanographic Programmes

Although the programmes for the three oceans are being developed separately SCOR Working Group 47 will develop whatever unity there may be among the three plans by trying to treat the theoretical aspects in a unified way. Below is a summary of the relevant meetings planned during 1977/78 which will substantially influence the further development of the oceanographic plans:

Date	Place	Meeting
28 February - 10 March 1977	Miami	Workshop (SCOR WG 43) on quasi synoptic spatial observations
11 March 1977	Miami	SCOR WG 47 Oceanographic Programmes during FGGE (Atlantic Ocean Panel)
23-27 May 1977	Helsinki	SCOR/JOC Study Conference on General Circulation Models of the Ocean and their relation to Climate
28 May 1977	Helsinki	SCOR Committee on Oceanography and GARP
May 1977	Helsinki	SCOR WG 49 on Mathematical Modelling of Oceanic Processes (Panel on Equatorial Modelling)
27 June - 12 August 1977	La Jolla	FINE (FGGE INDEX NORPAX EQUATORIAL) Workshop
June/August 1977	La Jolla	SCOR WG 47 (Pacific and Indian Ocean Panels)
July 1977	Sao Paulo	Western tropical Atlantic and Brazilian coastal current Programme (SCOR WG 47, Atlantic Ocean Panel)
July/August 1977		Symposium on the Agulhas Current
16-20 May 1978	Kiel	GATE Oceanography and Surface Layer Meteorology Symposium
(not yet decided)		Second session of the Joint IOC/WMO Subgroup of Experts on IGOSS Products and Services in support of GARP (1st session, Geneva, 18-20 October 1976)
June 1978	Paris	SCOR WG 47 (Atlantic Ocean Panel)

As already pointed out in the introductory section on basic concepts, the ongoing planning phase for FGGE related oceanographic programmes will benefit from a number of marine projects that are underway within the International Decade of Ocean Exploration (i.e., CUEA, JASIN, NORPAX, POLYMODE, etc.). As soon as the operational phase turns into a co-ordinated project implementation, during 1977/78/79, hopefully the Scientific Committee on Oceanic Research (SCOR) and the Intergovernmental Oceanographic Commission (IOC) will endorse their proposal that the GARP Activity Office with the help of oceanographic staff within this unit take all necessary action to incorporate these oceanographic programmes into the overall FGGE operation plan.

ANALYSIS OF THE STATUS OF THE COMMITMENTS TO THE TROPICAL WIND OBSERVING AND OTHER SHIPS AND THE REQUIREMENTS FOR NAVAID SOUNDING EQUIPMENT

Ocean	Country	SOP-1	SOP-2	Need Navaid	Remarks
ATLANTIC					
	Belgium	†	†	Yes	TWOS/WAMEX
	Brazil	p	p		GATE or other Navaid
	Brazil	p	p		GATE or other Navaid
	France*	f	f		part-time, share Navaid
	German Dem.Rep.	-	f	Yes	
	Germany Fed.Rep	f	f		radar and Navaid
	Germany Fed.Rep	f	f		merchant ship, Navaid
	Germany Fed.Rep	†	†		research ship
	Ivory Coast	†	†	Yes	
	Mexico	f	f		GATE Navaid
	Nigeria	p	p	Yes	700 tons
	Spain	f	f	Yes	
	UK**	†	†	Yes	SOP-1 or 2, Atlantic or Indian
	USA	p	p	Yes	SOP-1 or 2
	USSR	f	f		radar
	USSR	f	f		radar
INDIAN					
	Australia	†	†	Yes	
	France*	-	f		part-time, share Navaid
	Indonesia	f	f	Yes	300-ton fisheries research
	USA	p	p		Navaid
	USSR	f	-		radar
	USSR	f	-		radar
	USSR	f	-		radar

Please see footnotes on next page.

[Extract from JOC-XIII/Doc.3]
(cont'd)

Ocean	Country	SOP-1	SOP-2	Need Navaid	Remarks
PACIFIC					
	Colombia	f	f	Yes	GATE Navaid in USA
	France*	f	f		part-time, share Navaid, SOP-1 or 2.
	Hong Kong***	t	t	Yes	merchant vessel (Pacific/ Indian)
	Japan	-	f		radar
	Japan	-	f		will use AMTEX Navaid
	Mexico	f	f	Yes	
	Peru	p	p	Yes	
	Philippines	f	f	Yes	
	Philippines	t	t	Yes	
	USA	p	p	Yes	
	USA	p	p	Yes	
	USA	p	p	Yes	
	USA	p	p	Yes	
	USSR	f	f		radar
	USSR	f	f		radar
	USSR	f	-		radar
	South Pacific Commission****				

f - firm p - probable t - tentative

* Total of 6 ship-months in all oceans during both SOPs

** Information provided by the Institute of Oceanographic Sciences

*** Several other countries have indicated that their merchant vessels are potential participants in the TWOS, if Navaid equipment is provided.

**** The South Pacific Commission has expressed interest in helping to solicit co-operation of appropriate ships in that area

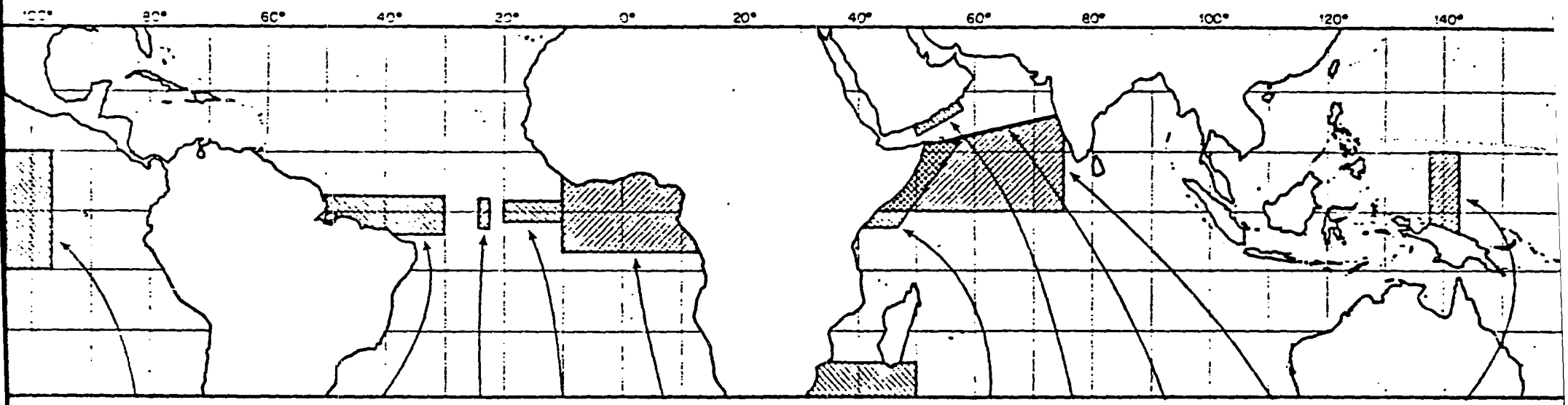
FOOTNOTE: Additional ships have been committed to the FGGE, but at present they do not plan to operate in the zone assigned to TWOS.

[Extract from JOC-XIII/Doc. 3]

SHIPS COMMITTED TO THE GLOBAL EXPERIMENT OUTSIDE THE TWOS ZONE

Country	Region	Period	Remarks
India (f)	Arabian Sea	May-June	2 ships, need Navaid
India (f)	Bay of Bengal	July-August	2 ships, need Navaid
Italy (t)	Arabian Sea	15 Jan-15 March	Need Navaid
Senegal (p)	Near Dakar	SOP-I, SOP-II	Need Navaid
New Zealand (f)	10^{o}S-60^{o}S, 150^{o}-165^{o}W	FGGE	Has upper-air but no wind-finding
USSR (f)	north of 10^{o}N	SOP-I	5 radar ships
USSR (f)	north of 10^{o}N	SOP-II	3 radar ships

Fig. 1 – Areas of probable intensive oceanographic investigations during the FGGE in tropical waters (as known in early 1977)



Two ships working ar[illegible] tails under development (US)

One large research ship, plus smaller support vessel, during SOP's (Brazil)

One large research ship, probably one SOP (US)

One large research ship (GDR)

One large ship, both SOP's (FRG)

Two ships, CIPREA (France)

Multiple ship survey during FGGE

One ship*, SOP II Somali Current

* contingent upon additional ship from collaborating nation

One ship, SOP II (US)

One roving ship, mixed layer expt. SOP II (MONEX panel) (US, India)

2 ships, SOP II 7 EW sections, joint USSR-India

combine

One ship, 40d SCP II (Japan)

LIST OF ACRONYMS

AMTEX	Air-Mass Transformation Experiment
CINCWIO	Cooperative Investigations in the North and Central Western Indian Ocean
CLIMAP	Climate, Long-Range Investigation, Mapping, and Prediction Project
CUEA	Coastal Upwelling Ecosystems Analysis
FINE	FGGE INDEX NORPAX EQUATORIAL
FGGE	First GARP Global Experiment
GARP	Global Atmospheric Research Programme
GATE	GARP Atlantic Tropical Experiment
GEOSPECS	Geochemical Ocean Section Study
ICSU	International Council of Scientific Unions
IDOE	International Decade of Ocean Exploration
IGOSS	Integrated Global Ocean Station System
IOC	Intergovernmental Oceanographic Commission
IODE	International Oceanographic Data Exchange
ISOS	International Southern Ocean Studies
JASIN	Joint Air/Sea Interaction Project
JOC	Joint Organizing Committee for GARP
MODE	Mid-Ocean Dynamics Experiment
MONEX	Monsoon Experiment
MONSOON-77	Monsoon Experiment (USSR/India)
NAVAID	Navigational Aid (Wind-finding equipment)
NORPAX	North Pacific Experiment
POLYMODE	Expanded Mid-Ocean Dynamics Experiment
SCOR	Scientific Committee on Oceanic Research
SOP	Special Observing Periods
TEMA	Training, Education, and Mutual Assistance in the marine sciences
TWOS	Tropical Wind Observing Ships
WAMEX	West African Monsoon Experiment
WMO	World Meteorological Organization
WWW	World Weather Watch