

SCOR WG 56

EQUATORIAL UPWELLING PROCESSES

Report of Chairman, H. Rotschi

During the first half of 1978 the WG 56 held two meetings: a plenary one at Las Palmas in April, during the CINECA Symposium and a meeting of the physical panel at Kiel, in May, during the GATE Symposium.

Plenary meeting at Las Palmas

Two plenary sessions were held on Wednesday 12th of April and on Thursday 13th of April.

Participants were: O. Brown, P. Hughes and H. Rotschi of the physical panel, R.T. Barber, R. Jimenez, R. Boje, B. Voituriez of the biological panel. Other participants were D.W. Stuart, chairman of the WG 55, J.J. O'Brien chairman of the WG 49, R.L. Smith and M. Tomczak.

Replacement of M. Stevenson who was unable to accept the invitation to become a member of the physical panel

It was felt that the WG would benefit by the participation of a theoretician with a good insight into the problems of mathematical modelling and that close liaison with WG 49 "Equatorial Modelling" should be encouraged. Bearing in mind the need for a replacement for M. Stevenson it is proposed to the SCOR Executive Committee that Dr D. Moore, who is chairman of the equatorial panel of WG 49 be appointed a member of the physical panel of WG 56.

Appointment of a chairman to both the physical and the biological panels

D. Halpern was appointed chairman of the physical panel and R.T. Barber was appointed chairman of the biological panel.

Inventory of the spatial and temporal variability of equatorial upwelling in the three Oceans

All oceans manifest equatorial upwelling thermal signatures, when viewed in a mean taken over many years. However, temporal and spatial scales for equatorial upwelling are not well known. It seems to be a seasonal event (July–August) in the Atlantic east of 20°W, while only sporadically occurring west of this meridian. The large scale wind field pattern in the Pacific produces a longer lived, more classical Ekman divergence driven upwelling in the equatorial region. Past work in the Pacific (east of 180°) has shown the equatorial upwelling to be a permanent feature. Only recently has weak equatorial upwelling been identified as a semi-permanent (April–October) part of the circulation in the western Pacific. Indian ocean circulation is dominated by the annual monsoon winds. Upwelling is primarily a coastal event although there is evidence that strong upwelling is sometimes present in the eastern part of the basin; monsoon winds are favourable for Ekman driven upwelling for at least 75% of the year.

Much remains to be observed about equatorial upwelling at shorter time and space scales. Thus it is probably not possible at this time to generalize our limited knowledge to other situations. However, many theories of equatorial circulation presently exist which require verification. Subsequently, the most fruitful approach would appear to be the acquisition of physical, chemical, and biological data sets pertinent to equatorial upwelling situations.

Before planning this type of approach an inventory, as complete as possible, of the existing observational evidence on variability both in time and space is necessary, and priority must be given to reviews of our state of knowledge. The General Assembly of the IUGG in December 1979 at Canberra, during which Professor J. O'Brien will convene a session on equatorial circulation, would be a good opportunity for such reviews. Professor O'Brien proposed to have an invited paper on the physical variability of the equatorial upwelling in the Pacific by M.M.F. Jarrige of Orstom Noumea and in the Atlantic by C. Colin of Orstom Abidjan, and to invite a British Scientist to contribute a paper on variability in the Indian Ocean. (Subsequently Dr J.C. Swallow was invited to contribute this latter paper).

A similar review of the biological aspects of the equatorial upwelling should be undertaken but information in this field is scarce and more dispersed. The process of reviewing might take longer and it is proposed to appoint a group which would have the responsibility to plan the work and distribute tasks among concerned and willing scientists. Considering the important contribution of Soviet oceanography to the study of the productivity mechanisms in the equatorial upwelling zones, Dr Vinogradov will be asked to make the first proposals for the appointment of the group. It is further noted that in the oriental Pacific high productivity is not always bound to the presence of an equatorial thermal front, and special attention should be paid to this feature.

Finally, the hope has been expressed that Dr J. Walsh will ensure the connection between WG 56 and WG 59 on mathematical models in biological oceanography and will be successful in trying to accelerate the study of equatorial models.

Planning of investigations during FGGE

Attention was drawn to the American-French project of investigation of the seasonal and secular variability of the thermal structure in the upper waters of the equatorial Pacific from 20°S to 20°N (EQUAPAC) and it was felt that this programme would bring a noticeable contribution to the knowledge of the variability of the conditions in the equatorial region and that such research should be encouraged as well as the use of ships of opportunity routing along interesting paths, such as the 20 ships of opportunity which are used by J.R. Donguy at Orstom in Noumea to study the equatorial surface temperature and salinity.

It is also noticed that satellite data which are normally discarded contain extremely interesting information and the scientific community should try to persuade the authorities concerned to preserve these data for future exploitation because, for many reasons, the equatorial region needs to be more thoroughly studied and satellite temperatures are a fundamental tool.

Coupling of equatorial processes with coastal upwelling

Concerning the coupling between equatorial upwelling and coastal upwelling three points were evidenced:

- there is a wide spectrum of phenomena

- the Atlantic ocean is of special interest because of the annual existence of a phenomenon which is the Atlantic equivalent of El Niño
- the boundary phenomena are extremely important

This gives special interest to the requirement expressed by SCOR WG 55 of surface temperature maps of the Pacific equatorial region, between 5°N and 5°S, on a daily basis, with a definition of ¼° in latitude and 1° in longitude, based on satellite data.

WG 56 wishes to support this proposal which it feels should be extended in the Atlantic ocean to the latitudes 5°N – 10°S, in the Pacific to 10°N – 15°S and in the Indian ocean to 15°N – 5°S.

This requirement gives further support to the proposal contained in the preceding item of systematic preservation of satellite temperature data pertaining to the equatorial zone.

Finally, it was agreed that the successful implementation of a regional programme such as ERFEN was of primary importance for the developing countries concerned.

Inventory of scientists engaged in active research on the various aspects of equatorial upwelling

Due to the intense investigations which were devoted in the past to the study of the equatorial region, by many countries and many groups, the known projects such as EQUAPAC and CIPREA, and the fact that the post-IDOE programme is likely to pay special attention during the next decade, to the equatorial dynamics, it seems that a large scientific community will be concerned with the work of WG 56 and that the latter could benefit considerably by closer association with interested scientists. It is thus proposed to make an inventory of all those scientists who are actually or will be in the near future actively engaged in the study of the various aspects, (mathematical modelling, hydrodynamics, hydrology, chemistry, biochemistry, production at various trophic levels) of the equatorial upwelling.

To achieve this aim, each member of the WG is invited to list the scientists of his country, whom he knows could and would be willing to contribute to the work of the WG.

Physical panel meeting 18 May 1978 Kiel

After a brief welcoming statement by the Chairman of WG 56 Physical Panel, Dr D. Halpern, the following agenda was agreed upon:

- (a) List of attendees
- (b) Terms of reference
- (c) Membership of Physical and Biological Panels
- (d) Las Palmas meeting report
- (e) Individual reports

Participants. Members of the Panel attending the meeting were Drs O. Brown, D. Halpern, P. Hughes and D. Moore. Dr H. Rotschi was unable to attend and sent his regrets. Dr R. Boje of WG 56 Biological Panel attended. Eleven observers attended.

Terms of Reference

- (a) With regard to the first term of reference, no changes were recommended.
- (b) With regard to the second term of reference, a modification was recommended:

To investigate the coupling of equatorial upwelling processes with the coastal upwelling in the adjacent areas along eastern boundaries of the ocean in association with relevant WG's such as 36, 49, 55 and 59.

- (c) With regard to the third term of reference, it was recommended to delete "in particular those of FGGE (through WG 47 of SCOR)". The modified third term of reference to become

"To suggest lines of multi-disciplinary enquiry into processes of equatorial upwelling for the planning of future expeditions".

- (b) With regard to the second term of reference, a modification was recommended:

To investigate the coupling of equatorial upwelling processes with the coastal upwelling in the adjacent areas along eastern boundaries of the ocean in association with relevant WG's, such as 36, 49, 55 and 59.

Physical Panel Membership

- (a) It was agreed that an expanded membership of the physical panel would provide greater representation of the equatorial upwelling activities pursued by the international community. It was agreed that D. Halpern would discuss this with H. Rotschi, Chairman of SCOR WG 56.

- (b) During D. Halpern's visit to Moscow on 26 May, the question of expanded membership was discussed with Dr K. Federov, President of SCOR. Because of the financial constraints imposed upon SCOR, it was decided to postpone appointing additional members and that interested individuals be made corresponding members.

Las Palmas Report

- (a) Review of equatorial upwelling. Drs C. Colin (Abidjan) and F. Jarrige (Noumea) were commended for their willingness to prepare summaries of equatorial upwelling processes in the Atlantic and Pacific Oceans, respectively. It was agreed that a review should also be made of equatorial upwelling processes in the Indian Ocean, and that a search for a candidate to prepare the Indian Ocean portion of the final report begin immediately.

- (b) Satellite sea surface temperature charts. Drs O. Brown and J.O'Brien have begun discussions with the U.S. National Oceanic and Atmospheric Administration to archive satellite-derived sea surface temperature measurements made within maximum resolution in time and space throughout the tropical oceans. These data will provide extremely useful information for the study of equatorial upwelling processes, and Drs Brown and O'Brien were encouraged by the attendees of the meeting to pursue this activity vigorously.

Individual Reports

(a) Dr A. Mesquita (Brazil)

Brazil plans to install meteorological instrumentation and a tide gauge at St Paul Rocks.

(b) Dr H. Lass (German Democratic Republic)

GDR plans to continue oceanographic research in the Atlantic after FGGE.

(c) Dr Ph. Hisard (France)

France plans to initiate an XBT Ship-of-Opportunity program in the Atlantic similar to the one conducted by the Noumea Orstom Laboratory.

(d) Dr P. Hughes (United Kingdom)

The UK has plans for equatorial oceanographic research in the Indian Ocean in 1981.

Membership

Since the Las Palmas meeting D. Moore has accepted to become a member of the physical panel and took part to the Kiel meeting. Dr P. Hughes, to the regret of the Chairman, has resigned. Dr K. Striggow of the SCOR Commission of the German Democratic Republic has requested the appointment of Dr H.U. Lass as a member of the physical panel. It is proposed to discuss this matter at the next meeting of the WG 56.

Satellite sea-surface temperature charts

Following the Las Palmas and Kiel meetings, an official request has been presented by the Chairman to Dr F. Webster for the archiving by NOAA of the daily SST data between 5°N and 10°S in the Atlantic, 10°N and 15°S in the Pacific and 15°N and 5°S in the Indian Ocean.

Review of equatorial upwelling

Drs C. Colin, F. Jarrige and J. Swallow have accepted to present SCOR WG 56 sponsored papers at the IUGG Canberra meeting reviewing the equatorial upwelling physical variability respectively in the Atlantic, the Pacific and the Indian oceans.

No funding by IUGG being available, it has been asked to invitees to get funding from national sources. Considering the travel costs to Australia, this might shown somewhat difficult so it is asked whether SCOR could contribute to the travel expenses of Drs Colin, Jarrige and Swallow to the extend of the order of at least US \$1000 per person which would cover about half the cost of the trip.

Biological aspects of the equatorial upwelling

Dr M. Vinogradov has been requested by the Chairman to make the first proposals for the appointment of the group which will have the responsibility to plan the work of reviewing and to distribute the redactional task.

Directory of individuals interested in equatorial upwelling processes

A notice has been published in the Bulletin of the American Meteorological Society, Transactions of the American Geophysical Union, and Limnology and Oceanography asking interested scientists to contact Dr D. Halpern or R.T. Barber.

Next meeting

There is a feeling that both panels should meet together in the early 1979. It is believed that a three days meeting could be organized, the first and third days being devoted to plenary sessions and the second to panel meetings. If this meeting were to be held at UNESCO in Paris, as has been suggested, the total travel cost would be of the order of US \$12000 plus per diem.