

Working Group 34

INTERNAL DYNAMICS OF THE OCEAN

Report to SCOR, October 28, 1978 by A.R. Robinson

This report on the status of and plans for activities of WG 34 covers the period May 1977 to the present. The members of WG 34 are: L. Fomin (USSR); A. Gill, J. Gould (UK); J. Gonella (France); K. Hasselmann, G. Siedler (FRG); G. Needler (Canada); A. Robinson (Chairman), H. Stommel, P. Welander (USA). The terms of reference are: to identify the critical scientific problems in the internal dynamics of the ocean, to suggest the most appropriate ways to study them and to advise on the design of mid-ocean dynamic experiments.

Substantial mid-ocean dynamical experimental scientific progress has been accomplished during this period by the acquisition of a very large amount of observational field data on synoptic scale (or mesoscale) low frequency phenomena. Aspects of the design, coordination and implementation of the programs and experiments which have gathered these data have involved considerable input from WG 34 and/or its members. These new data now provide the opportunity for ocean scientists to advance the understanding of eddy dynamics and to apply that understanding to problems such as general circulation, regional dynamics and to transport phenomena of importance to biology, geochemistry and climate. This period has also seen continued acceleration in the theory and numerical modelling of eddy phenomenon. In order responsibly and efficiently to exploit the unique, novel and massive new data set, a concerted and coordinated effort is required now for the analysis, interpretation, synthesis, assessment, communication and dissemination of results.

The main field program of *POLYMODE*, planned and coordinated by the US/USSR Joint *POLYMODE* Organizing Committee, is nearly completed. The final US mooring array is scheduled for recovery in October 1979. The major USSR multiple ships and mooring effort which began in July 1977 ended in September 1978. The document *POLYMODE – An overview* (PM News 39, Nov. 1977) was prepared to describe the main field program at its start. Most of the proposed field work was accomplished. A summary of theoretical progress "*Investigation of the Synoptic Variability of the Ocean: Materials of the Joint Soviet–American Theoretical Institute POLYMODE 1976*" has been published (Marine Hydrophysical Institute of the Ukrainian SSR, Sevastapol, 1977). Joint data inventories, reports, publications and an atlas are planned. A scientific meeting for preliminary discussion of results is scheduled to occur in the USSR in the summer of 1979 and a final scientific symposium on eddy dynamics is planned in the USA in the summer of 1980 to end the *POLYMODE* program.

The Bedford Institute, of Canada, has been maintaining since early 1976 a 3 mooring deep water current meter array in two sequential locations to the north and east of US *POLYMODE* arrays II and III; the present site will be occupied until late 1978. Early in 1979 two years of current meter data will be ready for analysis from the 6 mooring array of British, French and West German *Northeast Atlantic Dynamics Study – NEADS* (SCOR Proceedings Vol. 12, Annex III); XBT-lines with synoptic (meso) scale sampling are also obtained by NEADS.

A specific proposal prepared by G. Metcalf, WHOI, Massachusetts together with C. Ebbesmeyer and Evans Hamilton, Seattle for obtaining synoptic (meso) scale XBT data in the southern hemisphere using FGGE drifter deploying ships as ships of opportunity (SCOR Proceedings Vol. 13, p. 10) for this purpose was endorsed by WG 34 (August 1978 - Appendix I). The proposal was prepared after an analysis of existing data by J. Gould, C. Ebbesmeyer and others.

The Report of the *JOC/SCOR Joint Study Conference on General Circulation Models of the Ocean and their relation to Climate* (Helsinki, 23-27 May 1977), supported by UNEP and UNESCO/IOC was issued through the Geneva GARP office in two volumes in November 1977. Refereed versions of most papers from the Proceedings have been prepared for publication in a special edition of *Dynamics of Atmospheres and Oceans* under the guidance of an editorial committee consisting of D.J. Baker, K. Hasselmann and A.R. Robinson. Thus, this conference will have generated a generally available and reliable review of the subjects of ocean modelling and the dynamics of climate for the scientific community.

Early in 1978, in response to a query by the President of SCOR, the Chairman requested the members to consider the function and role of WG 34 presently and, if need be, in the future. Some individual members remarks have been copied to the President. The WG is of the opinion i) that ongoing field projects do require some continued support, ii) that the international coordination of at least the initial phase of analysis and synthesis of the large new eddy data set is essential, and iii) that a review in depth of the status of eddy dynamics, including a definition of the most important next scientific problems, and a consideration of arrangements necessary for their accomplishment, is necessary and important. We therefore request that SCOR continues WG 34 at least until the SCOR General Meeting in 1980 in order to accomplish these three tasks and that its future be reviewed at that time in terms of a report to be based on task iii) above.

In order to accomplish the above tasks we propose that a subgroup of WG 34 meet during the summer of 1979, that some members of WG 34 together with other scientists meet during the IUGG/IAPSO General Assembly in Australia in 1979, and that a Working Symposium on Eddy Dynamics be held in the summer of 1980, to be coordinated with the final POLYMODE Scientific Symposium. The objectives of these proposed meetings are: 1) to contribute to the coordination of the analysis of the results of POLYMODE, NEADS and other readily available results from recent mid-ocean dynamics experiments on the synoptic (meso) scale low frequency variability, 2) to facilitate internationally the dissemination of the results of these programs and experiments, 3) to identify additional existing sources of data and other scientific information on the variability and to assess the overall status of knowledge of the phenomena, and 4) to identify processes and/or regions in the world ocean where scientific research on eddy dynamics is important and feasible in the immediate future and to consider areas of scientific or technical applicability of the existing physical knowledge of the variability.

SCOR WG 34 ENDORSEMENT FOR THE FGGE XBT MESOSCALE SCIENCE PROJECT

SCOR WG 34 has been charged with overseeing the research activity on the internal dynamics of the ocean. An important phenomenon which is receiving much attention is that of the energetics and regional distribution of mesoscale eddy activity (mesoscale eddies may be considered to be the oceanic analogue of the depressions and anticyclones which dominate the atmospheric wind field).

Studies of the mesoscale phenomenon fall into two major categories: those designed to observe in detail the structure of mesoscale features (on scales of a few hundred km) and those designed to investigate the oceanwide distribution of such features. The vast majority of the scientific effort toward both of these goals has been expended in the oceans of the northern hemisphere; in the Atlantic Ocean in the POLYGON, MODE, POLYMODE and NEADS programs, in the North Pacific as a byproduct of the NORPAX investigations. This concentration in the northern hemisphere is as a result of logistic rather than scientific constraints since much of the ocean area of the southern hemisphere is remote and rarely visited by either research or commercial shipping. There is no reason to suppose that mesoscale eddy features do not exist in both northern and southern hemispheres.

The FGGE affords an opportunity to make observations over large areas of the southern hemisphere. A technique which has proved to be of great benefit in identifying areas of mesoscale activity is that of deploying XBT probes at regular closely spaced intervals in order to provide temperature "sections" across ocean basins. By deploying probes at typically hourly intervals the mesoscale features can be adequately resolved in the upper 800 m of the water column. Experience has shown that these operations can be performed satisfactorily by most types of ships and the installation of the necessary launching and recording equipment is in general neither difficult nor expensive.

The outline proposal to deploy XBT probes from FGGE ships in 1979 is therefore one which the Working Group wishes to endorse. The redeployment of XBT equipment currently being used in the POLYMODE experiment will help to reduce the overall cost of the exercise and the experience gained by the proposers during POLYMODE will be of value in tackling both logistic and scientific problems.

SCOR WG 34 feels that this proposed experiment could add significantly to knowledge of the distribution of mesoscale eddy features in the oceans of the southern hemisphere and will, together with other ongoing programs, aid the advance of knowledge of the nature of the mesoscale phenomenon.

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