interactions. The program, dubbed Tropic Heat, seeks to 'measure and model the seasonal and interannual time-scale evolution of the heat and mass budgets of the central Pacific equatorial upper ocean.' The proposal, which has been sent to the National Science Foundation for review, calls for the program to begin in January 1983.

The result of discussions at two Tropical Upper Ocean Circulation Meetings during the past 18 months, the program aims to clarify further the air-sea interactions that have in recent years been linked to climate. One such phenomenon is the Southern Oscillation, a quasiperiodic fluctuation of atmospheric pressure in tropic and subtropic regions.

'Climatologists have identified areas of large spatial scale inhomogeneities of seasonal heating of the lower atmosphere,' according to the report 'Tropic Heat: A Study of the Tropical Pacific Upper Ocean Heat, Mass, and Momentum Budgets.' These climatologists 'speculate that linked to these atmospheric climate patterns are corresponding patterns of temporal, latitudinal, longitudinal, and vertical heat transports in the ocean. It is important to learn where and how the seasonal and anomalous heat storage and transport occurs in the ocean.' The central Pacific equatorial region was selected as the proposed study site because it is among the most active centers of air-sea interactions that have been tied to the winter climate of North America.

The research program, if approved, would rely heavily on satellite techniques for the 'remote sensing of the heat flux' and for the transmission of data from moored and drifting sensors. Report editor Pearn Niiler, at Oregon State University, emphasized that the proposed program depends on satellite data 'in a very strong way.' Using drifting buoys in the ocean on a large scale as planned for the program also is relatively new, he said. He also stressed that the Tropic Heat program would enable scientists to learn how best to measure small-scale turbulence (on the order of 1 cm^2) near the equator and how to carefully estimate the uncertainties associated with the turbulence. 'Our goal is to parameterize the turbulence in terms of larger-scale quantities, which are both easier to monitor and are resolvable in models,' the report explains.

Tropic Heat also aims to measure the horizontal advection of heat and momentum by both Eulerian and Lagrangian techniques and to develop and understand thermodynamic modeling of equatorial dynamics. Details of the program are spelled out in the report.

Close ties to the activities of the Equatorial Pacific Ocean Climate Study (EPOCS) of the National Oceanic and Atmospheric Administration are envisioned by the program's proponents. Furthermore, the principal investigators view the proposed study as the beginning of the Pacific-wide Southern Oscillation Study that has been outlined by the National Academy of Sciences.—*BTR*

Books

Carbon Cycle Modelling

Scope Rep. 16, B. Bolin (Ed.), John Wiley, New York, xiv + 390 pp., 1981.

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Reviewed by James C. G. Walker

The Scientific Committee on Problems of the Environment (SCOPE) was established in 1969 by the International Council of Scientific Unions (ICSU) to assemble, review, and assess information on man-made environmental changes and the effects of these changes on man. The work of this committee has already resulted in 17 books dealing with a wide range of environmental problems, with particular emphasis on the needs of developing countries. The global carbon cycle was described and analyzed in SCOPE Report 13, published in 1979. The volume under review, SCOPE Report 16, carries this analysis further. It presents the results of a workshop on carbon cycle modeling held at Scripps Institution of Oceanography in March 1979. The goal of the workshop was to assess the status of quantitative models of the global carbon cycle, to compare the predictions of different models, to develop methods for testing the reliability of these predictions, and to suggest how future models might be made more realistic.

The first chapter is a synthesis of the conference prepared by B. Bolin, A. Björkström, C. D. Keeling, R. Bacastow, and U. Siegenthaler. It provides a useful overview of the methods, approximations, and uncertainties of carbon cycle modeling. The second chapter, by Bacastow and Björkström, presents a detailed comparison of the three most commonly used models of the oceanic part of the carbon cycle. These models differ in the complexity of their representations of heterogeneity in the ocean and in their formulations of transport. It is shown that the predictions of the models are similar once their parameters have been appropriately calibrated. Chapter 3 presents recommendations concerning symbols and notation along with a glossary of specialized terms.

The fourth chapter consists of short contributions by a number of authors. It presents graphical and tabular summaries of data that might be used for the validation of models of the carbon cycle. These data include histories of carbon dioxide concentration at the ground and in the upper troposphere; release of carbon dioxide from fossil fuel burning and cement production; isotopic composition of industrial sources; bomb production of ^{14}C; and compilations of GEOSECS results on the spatial distributions of alkalinity, total carbon, dissolved oxygen, nutrients, and ^{14}C in the world ocean. For the carbon cycle modeler, these data tabulations by themselves would justify purchase of the book.

The first four chapters, occupying 221 pages, give this book its distinct character. Chapter 5, with a further 165 pages, is conventional: 'Contributions by Conference Participants.' These contributions, as might be expected, vary in quality and interest and are not recognizably related to one another or to any overall design. Such problems may be unavoidable, but there is other evidence of weak editorial control. Typographical errors are unusually abundant, about one per page on average, and missing references are disturbingly common.

But perhaps the most troublesome feature of this book is its suggestion of sterility of thought. Directions for the future seem to involve subdivision of the model biosphere (biota and environment) into an ever greater number of reservoirs, with little or no research, theoretical or experimental, on the rate laws for the transfer of carbon between reservoirs. First-order transfer processes are almost universally assumed. They can almost never be correct where life is involved. The effort that is being expended on studying the response of increasingly complex linear models can bear little fruit if important transfer processes are intrinsically nonlinear. A reduction in computer budgets might benefit this field of research.

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AGU

Robert R. Bennett Memorial to GIFT Fund

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The many personal friends, colleagues, and professional associates of the late Robert R. Bennett have joined in establishing a memorial in his honor. In recognition of his vigorous support of the American Geophysical Union, they have contributed in his memory to AGU's 'Girding for Tomorrow' program. His name will be inscribed on a list of honorees that will be displayed on a plaque in the AGU headquarters in Washington, D.C.

Bennett, who received his M.S. in geology from the University of Nebraska in 1939, formerly directed groundwater research in the Water Resources Division of the U.S. Geological Survey. He was nationally and internationally recognized as an outstanding scientist in hydrogeology and groundwater hydrology. He was a pioneer authority in the development and application of analog- and digital-computer simulations that aid in the analysis