Bermuda Biological Station For Research, Inc.
Bermuda Atlantic Time-series Study

Chapter 1. Introduction

The Joint Global Ocean Flux Study (JGOFS) is an international and multi-disciplinary study with the goal of understanding the role of the oceans in global carbon and nutrient cycles. The Scientific Council on Ocean Research describes this goal for the internationa program: "To determine and understand the time-varying fluxes of carbon and associated biogenic elements in the ocean, and to evaluate the related exchanges with the atmosphere, sea floor and continental boundaries." As part of this effort in the United States, the National Science Foundation funded two time-series stations, one in Bermuda and the second in Hawaii. The Bermuda Time-series is administered by the Bermuda Biological Station for Research, Inc. (BBSR). Dr. Anthony H. Knap, Director of BBSR, is the principal investigator. Dr. Anthony F. Michaels joined the program in September, 1989 and has been co-principal investigator since 1993. Co-ordination of BATS activities was undertaken by Dr. Dennis Hansell from September 1992 - December 1993, and from July 1995 to date by Dr. Deborah Steinberg.

The objectives of the U.S.JGOFS-sponsored Bermuda Atlantic Time-series Study (BATS) are: (1) to observe and interpret the annual and interannual variability in the biology and chemistry of the mixed layer and euphotic zone, (2) to observe and interpret the annual and interannual variability in the rates of particle flux and the apparent rates of particle remineralization over the entire water column, (3) to understand the interrelationships between the biological and chemical processes involved in (1) and (2) above and the physical characteristics of the water column and (4) to provide data on global trends of selected oceanic properties over decadal time scales.

Data collection for the Bermuda Atlantic Time-series Study began in October, 1988, with a gradual phase-in of the current set of measurements over a two to three month period. This manual describes the methods for the suite of measurements being routinely made during the ninth year of sampling. Also included are methods for hand nutrients (Chapters 9 -12), for use when an AutoAnalyser is not available. Reports of data collected over twelve month periods are available up to BATS 72 (September 1994). From BATS 73 onwards, five-year data reports will be produced. These data reports also include updates on methods if they are altered or if new measurements are added. Data can be accessed via the World Wide Web, through the homepage of the Bermuda Biological Station (URL - http://www.bbsr.edu) using a link to a data extraction program (URL- http://www.bbsr.edu/~ctd). The digital data are available on an anonymous ftp account or can be requested from BBSR (rod@bbsr.edu or bahr@bbsr.edu). The appropriate ftp account is ftp.bbsr.edu (198.116.90.3). The user should Log in as anonymous and use his/her own account name as the password. The BATS data are in pub/BBSR/BATS, with each BATS

year after that. The data are also available through NODC (Woods Hole Oceanographic Institution), and are presently being integrated into the JGOFS Data Management System, information for which can be obtained from Christine Hammond at WHOI (chammond@whoi.edu).

The time-series program as it developed was the joint effort of a number of people from different institutions. Early on, Dr. Paul Wassman provided scientific assistance in the first months. The primary production and sinking flux measurements were developed and carried out under a subcontract to Drs. George A. Knauer, Steve E. Lohrenz and Vernon A. Asper at the Center for Marine Science at the University of Southern Mississippi, until February 1991. Merritt Tuel (USM) participated on nearly every cruise during this period to perform these measurements. Samples were also collected and dispersed to Dr. Hugh Ducklow (Horn Point Ecological Laboratories) for enumeration of bacteria by Helen Quinby until February 1991, and to Dr. Peter Brewer (Woods Hole Oceanographic Institution) for the measurement of total carbon dioxide until September 1990. HPLC pigments were analyzed by Dr. Robert Bidigare (currently at the University of Hawaii) from October 1989 - September 1990. Each of these measurements were gradually transferred to BBSR personnel as the program developed. At the date of publication of this manual, all measurements are made in Bermuda at BBSR. BATS personnel who are or who have been involved with the program include:

Frederick Bahr	Sept 93 - present	Frances Howse	April 91- Sept 96
Rhonda Kelly	May 93 - Nov 94	Rodney Johnson	Sept 88 - present
Dr. Nicholas Bates	Jan 91 - present	Sarah Goldthwait	June 96 - present
Susan Becker	Jan 94 - Feb 95	Rebecca Little	Jan 94 - May 96
Steven Bell	June 96 - present	Ru Morrison	July 96 - present
Margaret Best	May 91 - Nov 92	Karen Orcutt	Feb 95 - present
Peter Countway	Feb 95 - May 96	Marta Sanderson	May 96 - present
Elizabeth Caporelli	Sept 93 - Dec 96	Rachael Sherriff-Dow	Sept 88- Nov 94
Matthew Church	May 94 - April 96	Jens Sorensen	April 90 - Nov 93
Ann Close	May 90 - Aug 94	Shannon Stone	Nov 94 - present
Alice Doyle	Jan 92 - June 96	Cathy Rathbun	April 96 - present
Kjell Gundersen	Sept 88 - present	Tye Waterhouse	Jan 93 - Feb 94
Melodie Hammer	June 91 - Sept 93		

This manual represents the fourth iteration of the BATS methods manual. The changing character of the manual reflects the constant efforts to improve the quality of analysis. The first three manuals, dated March 1990, June 1991 and March 1993 are archived and available at BBSR. This fourth revision is available from the U.S. JGOFS Planning Office. Most alterations in methods are minor. Where major changes have occurred, a substantial period of overlap, when both analyses are performed on the same samples, is conducted to verify that both methods give the same result or to document the magnitude of the change in result.