JGOFS Synthesis Plan 1998-2003 (*last update: February 2000*)

JGOFS developed a plan for synthesising the observations into a global picture of large-scale fluxes with the help of modelling techniques already existing or that must be developed. Two, complementary kinds of activity are initiated: First, interpolation between all the data collected to provide a simple assessment of fluxes. Second, understanding and prediction obtained from the development and application of "hybrid" biogeochemical process/general circulation models that can define the current biogeochemical state of the ocean and predict its future evolution in response to global change and other externally imposed perturbations.

Introduction

The Joint Global Ocean Flux Study has been, without doubt, the most successful interdisciplinary biogeochemical ocean project yet undertaken. It transcended cultures, politics and economic boundaries to bring together oceanographic talent, research ships and other resources from all parts of the world. The research elements of regional Process Studies and Time Series Studies are perhaps the most often associated with JGOFS. No less critical elements of the JGOFS strategy are the surface ocean surveys and the synoptic view of ocean colour made from satellites. The recent satellite data, in fact, promise to revolutionise our knowledge of ocean biological variability. With a successful completion of its observation phase, JGOFS promises to provide a unique data set on the status of the global ocean during 1990s. Along with the observations, significant advances in biogeochemical modelling have found important application in studies of carbon cycling and transport on regional and global scales.

The Joint Global Ocean Flux Study project is now rapidly approaching a closure of its intensive field observations, but the project will not end there. A continuing effort is needed to ensure that the observations are fully exploited to achieve JGOFS scientific goals. One of the many legacies that JGOFS bequeaths to future generations will be extensive biogeochemical and physical data sets collected during its high profile and successful 10-year field campaign that began in 1989. However, future generations will not judge JGOFS on its data sets and its interdisciplinary research alone. The real measure of success will rest entirely on its ability to synthesise its data sets in order to improve ocean carbon models and to be able to predict future ocean carbon cycling scenarios accurately.

Background

The 12th Scientific Steering Committee began restructuring discussions for a global synthesis-modelling phase, which is expected to continue well past the end of its last field campaign. The SSC envisions that the final phase will require 5 to 6 years to successfully complete its two scientific goals and objectives. This phase intends to provide national researchers with the time and resources needed to complete the best possible descriptions and interpretations of JGOFS data sets. The cost of which is expected to be on part of a Process Study. The target date for completion is early 2004.

With the shift from fieldwork towards synthesis, the Thirteenth Scientific Steering Committee restructured the Planning Groups for synthesis, which includes modelling and data products and renamed them Synthesis Groups. In part, they are responsible for the international perspective of national activities over the respective regions. Their goals are:
(*1*) to enhance national synthesis efforts,
(*2*) to identify JGOFS biogeochemical data and related data sets in the regions,

(*3*) to assist the development and validation of regional models of ocean biogeochemistry, and
(*4*) to report their efforts internationally. Regional synthesis will provide snap shots of the temporal and spatial scales of the ocean's biogeochemical regimes and boundaries.

Rigorous time and space descriptions of the biogeochemical regimes and their boundaries are needed to develop present one-dimensional models into three-dimensional models that can describe the biogeochemical state of the global ocean as it varies in time and space. Biogeochemical data from the fieldwork are being released to the community and appearing at national ocean data centres, on CD-ROMs and/or distributed data systems.

Restructuring the Scientific Steering Committee

The Thirteenth SSC decided that the SSC must participate directly in the integration of the Synthesis Groups and as such agreed to accept additional tasks. The efficacy of the restructure process ensures global integration of regional regimes. The restructured Fourteenth SSC will include ocean carbon and ecosystem modellers, and representatives from the Ocean Carbon Modelling Intercomparison Project (OCMIP) and International Ocean Colour Co-ordination Group (IOCCG).

The Thirteenth SSC also modified Point 2 of its Terms of Reference, to include:
(*1*) Oversee the integration and modelling activities of the four regional Groups and all task teams with similar activities, such as Data Management, CO_2 Advisory Panel, etc.;
(*2*) Liaise with IGBP Program Elements and Framework Activities as well as with international ocean programs with extensive ocean data sets and global ocean-climate observing systems;
(*3*) Identify critical scientific gaps in our knowledge of ocean biogeochemistry that may significantly compromise carbon monitoring and modelling carbon in Earth's oceans;
(*4*) Organise synthesis, modelling and training workshops; and
(*5*) Publish international book(s), glossy brochure(s) and other data products.

Synthesis Plan

With these new efforts, the 13th SSC produced a Synthesis Plan with an overarching goal and specific objectives for synthesis that provides a practical guide for assessing success.

Goal

To develop an integrated, quantitative view of the biogeochemical cycle of carbon in the ocean, indicating the roles of biota, physical transport, air-sea exchange and particle settling and remineralisation, and including estimates of uncertainties.

This goal will be achieved through the following products that serve as JGOFS synthesis objectives:

Objectives

1. Ensure that all JGOFS observations are lodged with organisations, which can guarantee long-term stewardship. Provide web-based information on the availability and access mechanisms to all JGOFS data. Encourage the development of Web-based data delivery systems.

2. Create a new synthesis of ocean biogeochemical regimes from the major JGOFS Regional Process, Time Series and Global Survey studies, with special emphasis on biogeochemical processes and ecological community structure, and including the mechanisms

controlling primary production, carbon, macro- and micronutrient cycling, and carbon export from the upper ocean

3. Develop a hierarchy of coupled, biogeochemical-physical circulation models of varying ecosystem complexity, and use them to enhance understanding of natural variability and anthropogenic changes in the carbon cycle over decennial or centennial time scales.

4. Building on Objective 3, assess the capability of 3-dimensional ocean carbon cycle models with biogeochemistry to simulate observed global inventories, seasonal cycles and fluxes of carbon, nutrients and functional groups, and to evaluate current rates of carbon remineralisation and ocean forcing over time scales. The models will be constrained, calibrated and validated using JGOFS and other pertinent global and regional data sets (e.g., JGOFS/WOCE global survey of CO_2 and tracers, pCO_2, ocean colour, particle fluxes and deep ocean cores)

5. Assess the contribution of continental margins and seas to CO_2 sequestration and the horizontal flux of carbon across the ocean - continental margin boundary.

6. Utilise ocean colour observations from satellites, aircraft, moorings, and towed vehicles to provide a global picture of the seasonal cycles of phytoplankton biomass, primary and new production

7. Make recommendations on the development and implementation of future global ocean observing systems for detection of changes in the ocean carbon cycle and impacts on marine ecosystems, as one aspect of global change

At the 10th IGBP meeting, the Officers recommended that mature Core Projects launch a concerted effort towards synthesis of scientific knowledge. To encourage IGBP-wide synthesis, they also invited specific projects to bid for Secretariat funds to aid in the task. Products should be specifically targeted towards the Second IGBP Congress, the IGBP Book Series, the IGBP Science Series, and that culminate at the IGBP Millennium. Within JGOFS, such efforts have started:
(*1*) SSC and Planning Groups restructured,
(*2*) Synthesis Plan written, and
(*3*) Workplan and Timeline tentatively approved (see below)

A First **JGOFS Synthesis Workshop** took place 25-29 October 1998 in Southampton, UK, with two goals: To produce a glossy JGOFS Brochure (tentative title: Ocean Biogeochemistry and Climate Change), and to draft chapters for a Cambridge University Press book (tentative titled: JGOFS Synthesis and Related Research) as part of the IGBP Book Series. This workshop involved most SSC members and invited contributors. Workshop participants contributed with "white papers", figures and illustrations for the brochure and book as follows:

• Ocean biogeochemical regimes:
- Regional primary and new production,
- Role of community structure & function,
- Water column remineralisation,
- Air-sea carbon dioxide exchange,
- Feedback processes in regulating production and exchange,
- Role of continental margins,
- Role of deep-ocean fluxes,
- Ocean biogeochemical models,
- Future ocean biogeochemistry challenges,

• Integrated understanding of carbon cycling in the ocean.