

**SCOR Working Group on Ocean Time Series:**  
**Coordination and Integration of Science Objectives, Methods,**  
**Databases and Capacity Building Efforts**

**Abstract**

A SCOR Working Group (WG) on Ocean Time Series is an effective and visible mechanism to bring together similar but uncoordinated observing programs dispersed around the world. This WG is timely because of initiatives such as OceanSITES, ANTARES and POGO, which seek to link scientists conducting time-series efforts. The SCOR WG will complement these initiatives and define a framework for addressing new scientific questions of global and climate change scope that require time series of comprehensive, physical and biogeochemical oceanographic observations, as well as ensuring analytical integrity in the collection of biogeochemical variables. The WG and framework will help link and coordinate international oceanographic time series programs, compare and unify methods, and provide a common philosophy and protocols for sharing information among time-series programs and with the public. The WG will explore the utility of time-series programs for international capacity building, and assist new time-series programs to facilitate their success. The effort will contribute toward a better international research infrastructure focused on understanding the link between regional and global oceanographic processes.

**Rationale and Scientific Background**

Frequent and repeated measurements collected over a long time are necessary to understand phenomena in the ocean that change irregularly and at different time rates in ways that are impossible to document from a single field expedition (GCOS, 1997). Time series are also required to differentiate long-term trends from events or changes occurring over months and seasons. Unfortunately, most ship-occupied ocean time series have focused on a few parameters, such as temperature and salinity, some biogeochemical variables, and few exceed several years. Yet, a small number of these sites exist around the world where the temporal variability of both physical and biogeochemical ocean properties has been observed simultaneously for periods of time of the order of a decade.

A truly global observatory requires coordination of the international community, trained scientific and technical personnel, compatible methodologies and robust partnerships. In the past, the significant efforts required to maintain each comprehensive time series have precluded efforts to link programs scientifically and logistically. These time series struggle with management and funding constraints, and, in order to sustain the basis for scientific observations of the program, outreach to the community and to the public are frequently limited. SCOR provides a unique umbrella to hold an international dialogue on how to coordinate these programs to address larger-scale science questions, ensuring the data generated from the ship-occupied time-series locations are comparable and for addressing conceptual and human capacity problems that hinder global and climate-scale research. These are dimensions for which the proposed SCOR WG would complement scientific initiatives like OceanSITES (<http://kela.soest.hawaii.edu/OceanSITES/>), ANTARES (<http://www.antares.ws>), and POGO (<http://ocean-partners.org/>). The SCOR WGs, by its very nature, is not a research program but it can help focus research

questions and activities for the future. Therefore, the SCOR WG and these initiatives are not in any type of direct competition and rather they would all benefit from each other.

The following are considered model time series observing programs:

**BATS:** The oldest time series, dating back to 1954. Monthly measurements continue to be taken at and near the original Hydrostation S, located some 28 km southeast of Bermuda. BATS data show a clear link between biogeochemical cycles in the Sargasso Sea, El Niño-Southern Oscillation (ENSO), and the North Atlantic Oscillation (NAO) (Lomas and Bates, 2004) (<http://www.bbsr.edu/cintoo/bats/bats.html>).

**HOT:** HOT has conducted near-monthly cruises since 1988 to station ALOHA, approximately 100 km north of Oahu, Hawaii. Their findings show tight links between biogeochemical processes, including primary production, and seasonal variations and to the ENSO (<http://hahana.soest.hawaii.edu/hot/intro.html>).

**CARIACO:** A continental margin time series started in 1995 in the anoxic Cariaco Basin, Venezuela, to help interpret the paleoclimate record stored in its sediments. One of the major findings of CARIACO has been identifying this upwelling location as a source of carbon dioxide (Muller-Karger et al., 2004). (<http://www.imars.usf.edu/CAR/index.html>).

**ESTOC:** This European series was initiated in 1994 approximately 100 km north of the Canary Islands, Spain. ESTOC has documented Meddies (Mediterranean salt lenses), and the influence of African upwelling and Saharan dust on regional oceanography (<http://www.noc.soton.ac.uk/animate/data/estoc/estocdescription.php>).

### **Terms of Reference**

We propose to establish a SCOR Working Group on Ocean Time Series which visit their study locations regularly by ship and that undertake both physical and biogeochemical measurements. The Working Group would define a framework for collaboration, coordination, methods assessment, capacity building, data exchange and future funding opportunities. The vision is to address ocean science questions of global- and climate-scale scope. The product will be a plan for coordinating such programs and for linking oceanographic time series with land and atmosphere time-dependent data collection efforts. This Working Group will complement the efforts of POGO to integrate the continental-scale ANTARES time series group into the Group on Earth Observations (as a contribution to GOOS), and provide a means to address methods standardization, maintenance of analytical integrity and capacity building, something necessary in these projects that experience considerable personnel turnover. It will also help communication between these separate programs; enhance communication between researchers with common interests, and between researchers and the broader public. The Working Group will help define the important and continuing role of SCOR in advancing ocean sciences through time series efforts.

Specifically, the objectives are to:

- Identify scientific questions that require coordination among the time series and link all major established efforts, as well as emerging and planned ocean time-series efforts
- Review current oceanographic time-series sampling methods, and, to the extent required, define standard methods and strategies to use time-series programs to build technical human capacity.
- Identify logistical problems and provide solutions. Define funding issues and outline a coordinated strategy for sustainable funding, including identifying new sources of funding
- Coordinate a major publication encompassing time-series work done in the past decades and their major findings. Also, generate several layman publications to educate the general public on time series
- Link this Working Group with the currently funded SCOR WG115 ("Standards for the survey and analysis of plankton") and integrate their relevant findings.

**Working Group Membership**

The working group will have ten Full Members and five Associate Members. Full Members are recruited from key ship-occupied time-series stations, including the ANTARES network. Associate members incorporate emerging or potential time-series programs and ensure better global representation. Proposed members are listed below.

<b>Full Members</b>	<b>Time Series/Program</b>
Frank Muller-Karger (University of South Florida, USA) – Proposed WG Chair	CARIACO (Carbon Retention in a Colored Ocean)
David Antoine (Laboratoire D’Océanographie de Villefranche, France)	BOUSSOLE (Bouéé pour l’acquisition de Séries Optiques à Long Terme)
Eduardo Klein (Universidad Simón Bolívar, Venezuela)	CARIACO (Carbon Retention in a Colored Ocean)
Ruben Escribano (Universidad de Concepción, Chile)	COPAS Time Series
Mike Lomas (Bermuda Biological Station for Research, Bermuda)	BATS (Bermuda Atlantic Time-Series Program)
David Karl (University of Hawaii, USA)	HOT (Hawaii Ocean Time-Series)
Julio Morell (University of Puerto Rico Mayaguez, Puerto Rico)	CaTS (Caribbean Time-Series Station)
Doug Wallace (IFM-GEOMAR , Germany)	CV (Cape Verde Time Series Site )
Marimar G. Villagarcia (Instituto Canario de Ciencias Marinas, Spain)	ESTOC (Estación Europea de Series Temporales del Océano)
Salvador A. Gaeta (Instituto Oceanográfico, Universidad de São Paulo, Brazil)	OPISS (IOUSP)

<b>Associate Members</b>	<b>Time Series/Program</b>
Scott Nodder (New Zealand)	NIWA (National Institute for Water and Atmospheric Research)
Ruben Negri (Argentina)	INIDEP (Instituto Nacional de Investigación y Desarrollo Pesquero )
Susumu Honjo (Woods Hole Oceanographic Institution, representing Japan)	J-PAC (Joint North Pacific Research Center)
Shuba Sathyendranath (Canada)	POGO Program (Partnership for Observation of the Global Oceans)

### **Working Group Activities**

This SCOR WG will perform the following activities over a period of three years to accomplish the Terms of Reference. The WG will conduct its business through one formal meeting per year and a minimum of two annual team-wide teleconferences; additional teleconference meetings will address specific issues in subcommittee structure. Virtual meetings will use sophisticated Internet video-conferencing freeware including Skype (<http://www.skype.com>) and VRVS (<http://www.vrvs.org>).

The first joint teleconference will be held in January 2007. During this conference, the working group will review the terms of reference and membership, and refine a strategy to address each objective. The timing and potential locations for face-to-face meetings will be discussed. Definition of subcommittees to meet the Terms of Reference, creation of an agenda and logistics for the first face-to-face meeting will be discussed during the first joint teleconference and in subsequent communications with WG members.

The first formal meeting of the WG will be in May 2007, in conjunction with the CARIACO Time-Series annual meeting, in Venezuela. The expected outcome of the first formal meeting will be to review each time series, an implementation plan to achieve the terms of reference, and define tasks for each working group member or subcommittees.

The year 2 formal meeting will be held in conjunction with a CARIACO-BATS meeting during August 2008, likely in Bermuda. An outline of the major publication will be completed, as well as identification of potential layman publications.

A final physical WG meeting will be planned to summarize the major outcome of the SCOR WG. At this time, the drafts of the final publication will be reviewed and final assignments made. We will consider holding this final meeting to coincide with an AGU conference or other major science meeting, to ensure effective participation and exposure of findings at low cost.

Separate funding from POGO will be sought to cover general expenses and additional participant support in annual meetings, especially international students who would be tasked with helping organize the logistics of each meeting, reporting during the meeting, and collating the outcome. This will help expose a new generation to time-series programs and science leaders.

## **References**

- GCOS Report No. 41. 1997. Joint GCOS GOOS WCRP Ocean Observations Panel for Climate (OOPC). UNESCO. 18-20 March. Baltimore, Maryland, USA.
- Lomas, M. and N. R. Bates. 2004. Potential controls on the interannual partitioning of organic carbon during the winter/spring phytoplankton bloom at BATS. *Deep-Sea Res. II* 51: 1619-1636.
- Muller-Karger, F. E., R. Varela, R. Thunell, Y. Astor, H. Zhang, and C. Hu. 2004. Processes of Coastal Upwelling and Carbon Flux in the Cariaco Basin. *Deep-Sea Research II. Special Issue: Views of Ocean Processes from the Sea-viewing Wide Field-of-view Sensor (SeaWiFS) Mission: Volume 2 - Edited by D. A. Siegel, A. C. Thomas and J. Marra. Vol 51/10-11 pp 927-943.*