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# SCOR/IODE/MBLWHOI Library Workshop on Data Publication

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Participants

**Abstract:**

A meeting was convened by the Scientific Committee on Oceanic Research (SCOR), the International Oceanographic Data and Information Exchange (IODE) of the Intergovernmental Oceanographic Commission (IOC) and the Marine Biological Laboratory/Woods Hole Oceanographic Institution Library (MBLWHOI Library) on 2 April 2010 to advance the two use cases that had been developed over the past two years by the SCOR/IODE activity on data publication. Increased access to data is becoming increasingly important to stimulate data reuse and to get data into the public domain, where it can contribute to discussions of important science issues, including the ocean's role in climate change and the global carbon cycle, marine biodiversity, fisheries, harmful algal blooms, and others. The meeting noted progress in the two use cases, on publishing data related to traditional journal articles and data held by data centres, and made plans for future cooperation between data centres and libraries.

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**TABLE OF CONTENTS**

|   |           |
|---|-----------|
| <b>1. SESSION 1: PILOT PROJECT REPORTS.....</b>   | <b>1</b>  |
| 1.1 SUMMARY OF THE SCOR/IODE ACTIVITIES.....  | 1         |
| 1.2 USE CASE 2: MBLWHOI LIBRARY - A WOODS HOLE DATA REPOSITORY FOR DATA SUPPORTING PUBLISHED ARTICLES .....       | 2         |
| 1.3 USE CASE 1: DATA PUBLICATION AND CITATION FROM THE POINT OF VIEW OF BODC AS A “TYPICAL” IODE DATA CENTRE..... | 3         |
| <b>2. SESSION 2: TAKING THE PROCESS FORWARD .....</b>   | <b>6</b>  |
| <b>3. SESSION 3: DATA PUBLICATION TECHNICAL ISSUES.....</b>   | <b>8</b>  |
| 3.1 WHAT SHOULD LIE AT THE END OF A DOI? .....  | 8         |
| 3.2 DATA PUBLICATION CONTENT STANDARDS AND QUALITY ASSURANCE .....  | 8         |
| <b>4. GAP ANALYSIS AND NAVEL GAZING.....</b>  | <b>9</b>  |
| 4.1 CRITICAL ANALYSIS OF THE SCOR/IODE DATA CITATION AND PUBLICATION PROCESS SO FAR.....                          | 9         |
| 4.2 DATA PUBLICATION ISSUES NOT SO FAR ADDRESSED .....  | 10        |
| <b>5. CLOSING OF THE MEETING .....</b>  | <b>11</b> |

**ANNEXES**

[ANNEX I: Agenda of the Meeting](#)

[ANNEX II: List of Participants](#)



The Intergovernmental Oceanographic Commission (IOC) of UNESCO celebrates its 50th anniversary in 2010. Since taking the lead in coordinating the International Indian Ocean Expedition in 1960, the IOC has worked to promote marine research, protection of the ocean, and international cooperation. Today the Commission is also developing marine services and capacity building, and is instrumental in monitoring the ocean through the Global Ocean Observing System (GOOS) and developing marine-hazards warning systems in vulnerable regions. Recognized as the UN focal point and mechanism for global cooperation in the study of the ocean, a key climate driver, IOC is a key player in the study of climate change. Through promoting international cooperation, the IOC assists Member States in their decisions towards improved management, sustainable development, and protection of the marine environment.

## 1. SESSION 1: PILOT PROJECT REPORTS

This Session was chaired by Dr Gwen Moncoiffé (see agenda in Annex I). She invited all participants to introduce themselves. The list of participants is attached as Annex II. It was noted during the introductions that the approaches developed should strive for “larger carrots and small sticks”, in other words, that there should be a focus on incentives for data publication and less on penalties for not submitting data. It was also noted that the Global Biodiversity Information Facility (GBIF: <http://www.gbif.org/>) is about to issue a report on data publication.

### 1.1 Summary of the SCOR/IODE activities

This agenda item was introduced by Dr Moncoiffé. She recalled that what was to become the SCOR/IODE initiative on data publication started in December 2006 at the Second SCOR Summit of International Marine Research Projects (see [http://www.scor-int.org/Project\\_Summit\\_2/ProjCoord2.htm](http://www.scor-int.org/Project_Summit_2/ProjCoord2.htm)). The meeting brought together representatives of most large-scale international ocean research projects (e.g. SOLAS, GEOTRACES, IMBER, GLOBEC, etc.). The meeting considered what constituted the major barriers to data sharing and greater data submission to national and global databases, and identified a need to create a formal process to ensure that scientists get credit for releasing their data and for every time the data are used by others. To this aim, the meeting recommended that SCOR form a Panel on Ocean Data Publication and Incentives.

In 2008, SCOR and IODE began to work together on this issue and the "SCOR/IODE Workshop on Data Publishing" (17-18 June 2008, IOC Project Office for IODE) was organised. The objectives of the meeting were to (i) Describe current status of data citation and publication in oceanography; (ii) Identify problem areas; (iii) Identify interoperability issues of current data citation and publication practices; and (iv) Formulate suggestions to address problem areas. The meeting concluded that the following actions were needed:

- (i) Build new infrastructure and new approaches to data publication;
- (ii) Increase the availability of the data used for figures, tables and statistical analyses in traditional journal articles;
- (iii) Encourage the expansion of journals which specialise in “data publications” or “data briefs”; i.e. journals where data/datasets are described rather than interpreted.
- (iv) Requirement for data repositories to serve as archive of data related to journal articles;
- (v) Use persistent identifiers to anchor data in repositories to be used/published in publications;
- (vi) SCOR and IODE to work with existing data centres to promote the development of data repositories at the institutional, national and/or regional level.

The report of the meeting is available as IOC Workshop Report No. 207 at <http://www.iode.org/wr207>.

In December 2008, a meeting was organized with ocean science journal editors in San Francisco, USA with representatives present from *Earth System Science Data* (ESSD), *Fisheries Oceanography*, *Earth and Planetary Science Letters*, *Journal of Geophysical Research-Oceans*, *Biogeosciences* and *Progress in Oceanography*. Written input was received also from the *Journal of Plankton Research*, *Oceanography*, and *Palaeoceanography*.

The meeting came to the following conclusions:

- (i) The effort was worthwhile and many of the editors consulted want to stay involved in the discussions and participate in the development of the ideas;

- (ii) The idea of the peer review of datasets requires more discussion and careful consideration;
- (iii) The process of publication of data briefs or other stand-alone papers describing data sets is being tested by ESSD. The SCOR/IODE effort should focus for now on issues related to providing the digital backbone for data related to traditional publications;
- (iv) More attention needs to be given to how digital object identifiers (DOIs) can best be used to link journal articles and datasets;
- (v) It is important to know whether fields outside ocean sciences are pursuing data publishing.

In March 2009 (IOC Project Office for IODE, Oostende, Belgium, 9-11 March 2009) a meeting was held to develop use cases. The meeting included participants from BCO-DMO, BODC, WDC-MARE, IODE, and Elsevier. The use cases identified were:

- Use Case 1: Creating data publications from existing and future holdings at national data centres.
- Use Case 2: Providing the “digital backbone” for traditional journal publications.

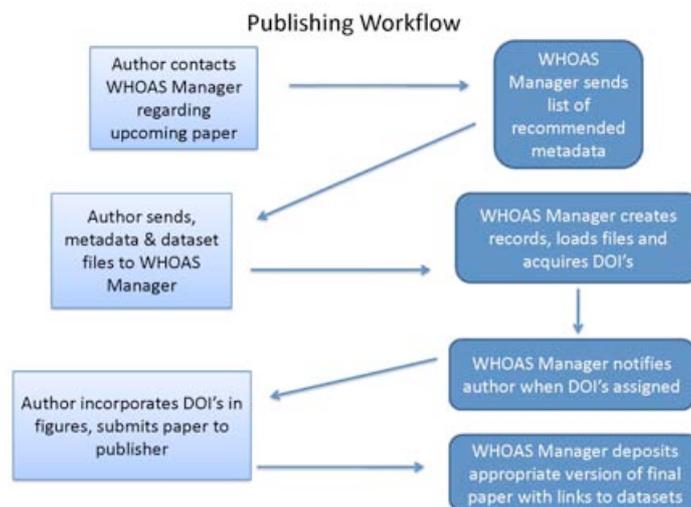
Pilot projects were chosen to test the processes for data publication in the two cases. While BODC worked on developing Use Case 1, a meeting was organized by the MBLWHOI Library in Woods Hole, Massachusetts, USA to further develop the pilot project for Use Case 2. Progress on these two Use Cases will now be presented.

## **1.2 Use Case 2: MBLWHOI Library - A Woods Hole Data Repository for Data Supporting Published Articles**

Ms Lisa Raymond introduced the efforts of the MBLWHOI Library of the Woods Hole Oceanographic Institution and Marine Biological Laboratory to develop a data repository for data supporting published articles, specifically focusing on the “backbone data” used to generate the figures and tables in an article. This work is supported by a George Frederick Jewett Foundation grant. Ms Raymond recalled that the “Data Attribution and Provenance Workshop” was held in Woods Hole, in April 2009 and involved stakeholders that included scientists, data managers and librarians. It was concluded that data must be discoverable, citeable and available on the Internet. Resources, standards and workflows must be defined to support publisher and funding agency mandates. It was agreed that as an action item the Library should develop a process to deposit data.

A number of important questions were raised: (i) Where should data be deposited? It was decided to use the Woods Hole Open Access Server (WHOAS) as the data repository; (ii) What metadata scheme should be used? The group came to the consensus that Dublin Core alone was not sufficient, so it was augmented with Darwin Core and “Woods Hole Core”; (iii) Provenance was identified as important as well. In this regard it was noted that the selected repository software platform DSpace generates provenance information upon ingestion of data items and is widely available in the library community. Information generated includes file size, date, depositor name and checksum. Other information can be accommodated in existing Dublin Core fields; (iv) For persistent identifiers (essential!) it was noted that the MBLWHOI Library has an existing relationship with CrossRef (<http://www.crossref.org>); and (v) An important hurdle identified was the issue of versioning of data sets. Concerns were raised at the meeting about how corrections and updates to a data set would be handled. For the purposes of this project any change to a data set would lead to a new data set, new metadata and a new DOI.

The project developed a workflow as illustrated in Figure 1.



**Figure 1: MBLWHOI repository workflow**

Preliminary work on trials with the repository has been carried out by Peter Wiebe (WHOI), and by Peter Smith and his group (MBL). Experience so far has suggested that it is important to start discussions of data publication early in the publication process and for test cases to select papers that have relatively few figures and tables, to ease the author burden of assembling the datasets.

Ms Raymond identified the following ongoing challenges:

- Researcher concerns regarding reuse and misuse of data
- Proprietary file types
- Responsibility for quality control of data
- Additional work for authors

The Meeting congratulated the MBLWHOI Library on the results of the pilot activity and called on the Library to prepare documentation that will assist others to implement similar systems. The MBLWHOI Library has plans to share their experiences and progress at meetings of marine libraries. It was further noted that the creation of metadata remains a stumbling block at the scientist level. The meeting remarked, however, that metadata creation should be considered a process rather than a one-time event. Dr Lowry remarked further that, in the UK case, it is the task of BODC, and not scientists, to define the metadata. The Meeting thus concluded that there exist several models and mechanisms for the creation of the metadata. One participant noted that the more automated the creation of metadata, the better.

### **1.3 Use Case 1: Data publication and citation from the point of view of BODC as a “typical” IODE data centre**

This agenda item was introduced by Dr Roy Lowry.

Dr Lowry explained that he had considered the issue of data publication as a data centre and how their method of work would fit the needs. He recalled that BODC is the IODE National Oceanographic Data Centre for the United Kingdom. BODC is funded by the National Environment Research Council (NERC) to be the UK’s marine data centre and part of the Marine Environmental Data Information Network (MEDIN). In addition, BODC ingests data from international research projects (e.g. GEOTRACES) and receives funding from international activities such as SeaDataNet. Dr Lowry

identified the important difference between data set serving and data publication, as they do not follow the same process.

**Dataset Serving**—Data centres are primarily in the business of dataset serving. In general, BODC takes data from many sources and “atomizes” these into a common schema. Several processes are then applied, such as quality control, adding flags, etc. Data thus evolve as a continuous process and there is a never a final form of a “data atom”. This process is resource intensive. Data are discovered via an x,y,z,t parameter search and the data set delivered will vary depending on the parameters specified and when the data are served, as they may be updated in the system over time.

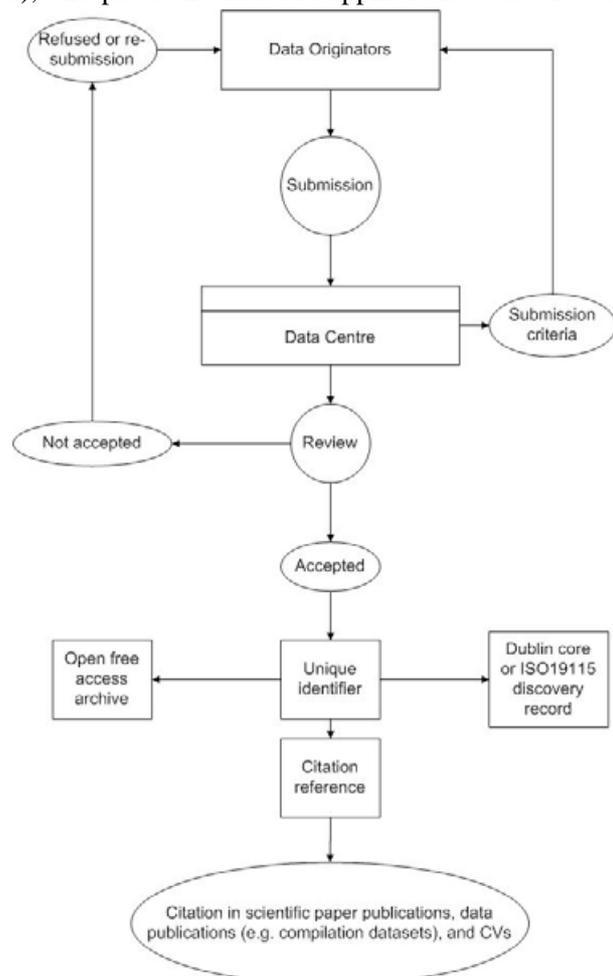
**Data Publication**—On the other hand, in the concept of the data publication the data set must be static and a request for a particular data set should always result in the same response. The dataset has a literature citation conforming to a standardised, globally recognised syntax. The dataset has a permanent identifier (URN) that resolves to a location on the internet (URL) from where the data may be obtained without authentication or authorisation.

Data centre involvement in data publication can be considered at three levels of service: bronze, silver, and gold.

**Bronze Level**—The data centre publishes whatever is submitted, as it was submitted, with no quality control or processing. The data centre would obtain a DOI, prepare and publish a discovery metadata record (Dublin Core, ISO19115 profile or FGDC), and place the data as supplied on a server at the DOI resolution URL.

**Silver Level**—The data centre checks that data submissions conform to data publication standards. At this level, a data centre would provide a service that is a direct analogue of the peer review of a journal article and is described in the 2008 SCOR/IODE report. This is the level of service that would probably be of interest to data centres, as it has a good balance of costs to the centre and benefits in terms of ingestion of data and service to their national ocean science communities and agencies. This level of service would require that data centres be linked to DSpace repositories because data centres cannot provide the e-repository function. The data centre would carry out the functions as for bronze level of service, plus would conduct standard conformance checking, work with the originator to rectify shortcomings, and certify standards conformance. Figure 2 shows the silver-level process.

**Gold Level**—The data centre ingests the submission with full quality control and metadata enhancement before publishing it as a snapshot. This level of service implies a full accession ingestion process, including reformatting data, however it is submitted; point-by-point quality assessment and issue flagging; standardising semantics such as parameter labels; preparation of evaluation and usage metadata; incorporation into a common schema;



**Figure 2: Silver Level Service**

and snapshot instantiation for publication. This gold level service is often provided by data centres for datasets which are supported either by the data centre's core funding or through project mandate. In the past, however, many data sets ingested by the data centre were never published and thus no credit was given. Such data sets could now be published and thus revived using the following process:

- Identification of candidate subsets of ingested data
- Snapshot instantiation to a standard that would pass silver-level quality checks
- Publication in a DSpace repository

This process could possibly be undertaken in close collaboration with data originators wishing to produce data publications such as an ESSD paper or a data brief in the journal *Geochemistry, Geophysics, Geosystems* (<http://www.agu.org/journals/gc/>) from data they have previously lodged with the data centre.

The following table summarizes the advantages and disadvantages of the three service levels.

|                     | <b>Advantages</b>  | <b>Disadvantages</b>  |
|---------------------|--|---|
| <b>Bronze Level</b> | <ul style="list-style-type: none"> <li>• Cheap</li> <li>• Turnaround within days feasible</li> </ul>   | <ul style="list-style-type: none"> <li>• Published datasets exposed to technological redundancy</li> <li>• No protection against retention of worthless data</li> </ul> |
| <b>Silver Level</b> | <ul style="list-style-type: none"> <li>• Relatively cheap</li> <li>• Easily integrated into scientific publication process, including timescale compatibility</li> <li>• Enhanced data management standards in the scientific community</li> </ul> | <ul style="list-style-type: none"> <li>• Risk of datasets being exposed to technological redundancy, particularly the semantics</li> </ul>                              |
| <b>Gold Level</b>   | <ul style="list-style-type: none"> <li>• Future reusability of data virtually guaranteed</li> </ul>  | <ul style="list-style-type: none"> <li>• Expensive</li> <li>• Long timescales</li> </ul>  |

Dr Lowry noted that Argo had expressed interest in data publishing. An important question would be how to define a data set in this case, as the Argo database changes daily as profiles are added. Dr Lowry also noted that data centres are well equipped to help create metadata and to help scientists prepare data publications for deposit in DSpace-type repositories (see <http://www.dspace.org/>). Qualified groups of experts can also create metadata through the process of “qualified social tagging”.

BODC (and probably most data centres) would not be interested in facilitating the management of highly processed data relating to tables and figures in papers (Use Case 2 of the SCOR/IODE/MBLWHOI Library activity), as there would be no advantage for data ingestion. But, it should be of interest to libraries.

Data centres cannot necessarily provide all the e-Repository infrastructure for their data publication activities because of physical limitations on storage capacity, resource issues related to developing the necessary infrastructure, and management unwillingness to support data duplication. The SCOR/IODE/MBLWHOI Library process needs to engage in the development of an international network of providers of e-Repository infrastructure for data publication. Under what terms and conditions would such resource be available? Standards would be required to ensure interoperability among repositories.

Dr Lowry presented the following conclusions:

1. Guidelines are needed to direct data centres on how they can become engaged in the data publication process and used to engage a network of data centres in the activity.
2. Standards need to be developed for dataset submissions that are to be published as is by data centres.
3. International e-Repository infrastructure is required and the SCOR/IODE/MBLWHOI Library process needs to find ways to develop this.
4. The digital library community and data editors need to be engaged in the publication of processed data behind tables and figures (Use Case 2).
5. Journal editors and the library community need to declare the standard way for citing datasets used in journal publications.

Mr Pissierssens informed the participants that IODE developed the OceanDocs e-repository system (<http://www.oceandocs.net>). OceanDocs is an e-repository (electronic repository) of scientific publications related to marine science and oceanography. The IODE OceanDocs is the central repository of a global network of national and regional repositories. OceanDocs enables researchers to deposit the full text of their works: articles, conference papers, technical reports, working papers, theses, and more. The information managers and librarians of the participating institutes will help the researchers with the submission of their publications. OceanDocs includes not only a central repository hosted by the IOC Project Office for IODE in Oostende, Belgium, but also national and regional nodes (e.g. the Institute of Biology of the Southern Seas E-repository in Ukraine, the Digital Repository Service at the National Institute of Oceanography in India, etc.). The central repository in Oostende, Belgium, includes institutional repositories of 15 countries in Africa and 9 countries in Latin America).

## 2. SESSION 2: TAKING THE PROCESS FORWARD

This Session was chaired by Lisa Raymond. She invited Roy Lowry to present his Road Map Proposal. Dr Lowry identified the following requirements:

- (i) Guidelines explaining to data centres what is involved in engagement with data publication
- (ii) Data centre engagement in the data publication process
- (iii) Published dataset standards guidelines
- (iv) Establishing e-Repository infrastructure
- (v) Published dataset citation standard
- (vi) Engagement of journal editors in processed dataset publication

Creating awareness, interest and commitment of the data centres was identified as a considerable issue. In this regard it was noted that interest and commitment must be achieved beyond the IODE NODC community, as well as beyond oceanography. The IODE network was therefore seen as one of several conduits; the World Data System (WDS) of the International Council for Science (ICSU) and American Geophysical Union and European Geosciences Union would be others to consider.

The Meeting noted that the upcoming 22<sup>nd</sup> International CODATA Conference, 24-27 October 2010 (Stellenbosch, Cape Town, South Africa) (<http://www.codata2010.com/call-for-session-organizers.php>) would be an appropriate venue to promote the SCOR/IODE/MBLWHOI Library initiative and to avoid too many parallel initiatives related to data publishing. It was therefore recommended to submit a paper to the CODATA Conference on the initiative.

**Dr Ed Urban was requested to investigate the possible presentation of a paper on the SCOR/IODE/MBL/WHOI initiative at the 22<sup>nd</sup> International CODATA Conference.**

After lengthy discussions the Meeting agreed on the following timeline for the way forward:

- (i) **Prepare project brief that describes objectives, technical approach and expected outcomes of the data publication pilot activity (existing documentation prepared by MBLWHOI Library should be used). Deadline: May 2010 (Roy Lowry, Lisa Raymond)**
- (ii) **Organize technical discussions on compatibility/modification of OceanDocs metadata scheme for data publication pilot project. Deadline: April/May 2010 (Lisa Raymond and Marc Goovaerts; Project Leader OceanDocs)**
- (iii) **Propose a session for the Fall AGU Meeting (Peter Fox, Cyndy Chandler, Lisa Raymond , Anna Gold? Session proposals are due by 27 May)**
- (iv) **Identify a small number of marine libraries and data centres (IODE and others) willing and able to participate in a data citation pilot activity. The marine libraries should already be operating or using an e-repository (OceanDocs). The two use cases will be put out as a challenge for joint work between data centres and libraries. The challenge will be elaborated in a more detailed document. Deadline: May/June 2010 (IODE Secretariat and SCOR to coordinate)**
- (v) **Meeting/Training Course for participating marine libraries/data centres. Deadline: July-September 2010 (IODE Secretariat to implement through OceanTeacher Academy)**
- (vi) **Start pilot activity using MBLWHOI Library methodology and work flow with identified marine libraries and data centres. Deadline: start from August 2010 (coordinated by MBL/WHOI and BODC)**
- (vii) **Present preliminary report on progress of pilot project at 22<sup>nd</sup> International CODATA Conference (24-27 October 2010) (presenter to be identified; abstract must be submitted by 30 April)**
- (viii) **Present progress report on pilot project at IODE 50<sup>th</sup> Anniversary Scientific Conference (provisional 21-22 March 2011)**
- (ix) **Present progress report on pilot project at IODE-XXI and discuss formal establishment of Pilot Project on Data Citation (with more extended participation) (provisional 23-26 March 2011)**

It was noted that it would be desirable to bring together data centres to promote the data publication concept. The Meeting did not come to a conclusion on the best way to do so. A dedicated conference could be considered. Other possible opportunities could be the IODE 50<sup>th</sup> Anniversary Scientific Conference and/or IODE-XXI in March 2011.

The Meeting stressed the importance of involving publishers in the pilot activity as soon as possible, but noted that it would be desirable to achieve practical progress and demonstrate feasibility prior to involving publishers. The IODE 50<sup>th</sup> Anniversary Scientific Conference could be an appropriate venue to invite the Publishing community. The Meeting also noted the importance to involve not only commercial publishers but also open-source publishers such as Copernicus (<http://publications.copernicus.org/>) as their goals and objectives may be closer to the project's (**Ed Urban to coordinate**).

The Meeting also recommended contacting ICSTI, the International Council for Scientific and Technical Information (<http://www.icsti.org>) as they may be interested in participating. They have done a pilot project on data publication. In this regard it was noted that ICSTI's 2010 Summer Conference will be held in Helsinki on 10-11 June. (**Ed Urban to coordinate**).

## 3. SESSION 3: DATA PUBLICATION TECHNICAL ISSUES

### 3.1 What should lie at the end of a DOI?

The Meeting considered the question “what lies at the end of a DOI” and identified the following answers: (i) URL of the homepage of a Web data delivery system; (ii) Deep URL into a Web data delivery system; (iii) URL of a zip file; (iv) URL of a CF-compliant NetCDF file; and (vi) Archival Information Package (AIP) as specified in the Open Archival Information System (OAIS) model. One important point to note is that DOIs are one tool that we are trying to use for many different jobs. A major issue is whether the link from the DOI is accessible to a human only, or also to a software agent. The ideal situation for a link to data would be to be able to download data with only a few clicks of the mouse. CrossRef is an example of a system that provides machine-readable metadata.

It was noted that there are a number of DOI registration agencies. They are listed on [http://www.doi.org/registration\\_agencies.html](http://www.doi.org/registration_agencies.html). “The primary role of Registration Agencies (RAs) is to provide services to Registrants - allocating DOI name prefixes, registering DOI names and providing the necessary infrastructure to allow Registrants to declare and maintain metadata and state data. This service is expected to encompass quality assurance measures, so that the integrity of the DOI system as a whole is maintained at the highest possible level (delivering reliable and consistent results to users). This includes ensuring that state data are accurate and up-to-date and that metadata are consistent and complies with both DOI system Kernel and appropriate Application Profile standards”.

The journal *Earth System Science Data* (ESSD) (<http://earth-system-science-data.net/>) was mentioned as an example of a Journal that provides DOIs to data sets. Example article: <http://www.earth-syst-sci-data-discuss.net/3/55/2010/essdd-3-55-2010.html>

Example: doi: 10.3334/CDIAC/otg.CARINA.AMS.V1.2

Links to: [http://cdiac.ornl.gov/ftp/oceans/CARINA/CARINA\\_Database/CARINA.AMS.V1.2/](http://cdiac.ornl.gov/ftp/oceans/CARINA/CARINA_Database/CARINA.AMS.V1.2/)

### 3.2 Data publication content standards and quality assurance

This agenda item was introduced by Peter Fox.

Dr Fox started his presentation with the Micro Life Cycle of data, illustrated in Figure 3.

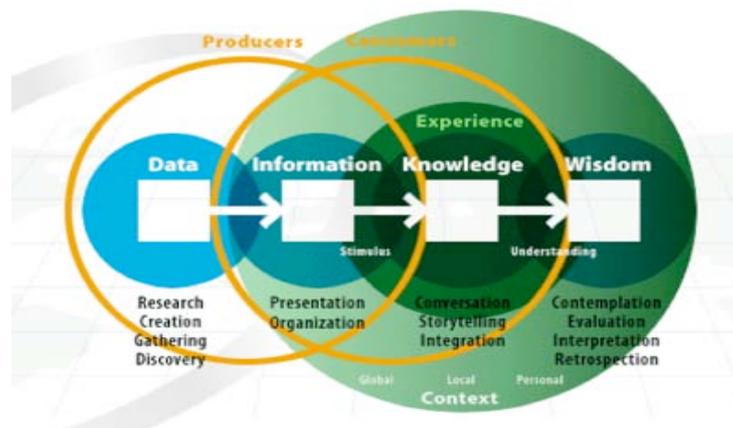


Figure 3 : Micro Life Cycle of Data

Publication is both a noun and a verb. What we are trying to publish is a complex e-science object. Dr Fox suggested the term “publication data publication.” An important consideration is how we define the relevant authorities and the continuum between self-publication and authoritative (e.g. by a third-

party source) publication? A related issue is what is the content that is to be published and eventually cited. A well-worn phrase is that one person's metadata is another person's data and vice versa. For the topic of this section, that is, content standards, the real key is “mashing up” of standards – meaning that as many, any or all standards can be used, especially when encoded in XML-based languages (i.e. use of namespaces). The goal is that standards should be invisible to users.

In establishing a reputable publication, should the quality be defined as an engineering process or a science process? The answer is likely to depend on who is using the citation. In the emerging world of open data (i.e. by publishing), can *transparency* be a proxy for quality assurance? The expertise, knowledge, or measurement abilities of the person that collected the data often engenders the trust. Dr Fox also introduced the theme of workflow. In other communities people publish “workflows,” but the term workflow varies by communities. How could one test if a workflow is competent without data?

In regard to the architectural foundations of publication and citation if there was to be wide-spread adoption, the Web/Internet world is one of the few scale-free environments supporting many application fields (including science). If we can use “Web” principles, including the peer and social sense of “trust,” the issue will be solved. We have not yet reached that point in scientific circles.

Dr Fox concluded by identifying a few questions to stimulate discussion:

- There are enough standards already, pick one and use it!
- What do you mean there are no applications/tools to work with the standards?
- What do you mean “use a library (bibliometric) format, this is my science data”?
- Cross-walking metadata “standards,” can we (or do we need to) do it?
- Are you questioning the quality of my data?

One of the emerging questions was: Who are the stakeholders of the libraries and the data centres? There are a variety of stakeholders of libraries, including individual scientists, government agencies, the public, policymakers, educational institutions, environmental organizations, and others, potentially the same type of stakeholders that access traditional libraries. As access becomes more straightforward, the same users may increasingly seek information from data centres.

Regarding the importance of standards, the conclusion was that users do not usually care about standards but they do care about being able to import data into their familiar tools (e.g. ODV, Matlab, etc). Having a standard that enables interoperability is therefore more important than having a standard for the sake of having a standard. Using the scale-free nature of the Web, we might be able to address some of our issues that are otherwise unscalable.

## 4. GAP ANALYSIS AND NAVEL GAZING

This Agenda Item was chaired by Dr Ed Urban.

### 4.1 Critical analysis of the SCOR/IODE data citation and publication process so far

Dr Lowry noted that during the past two years little practical progress had been achieved in the activity, possibly because at previous meetings the marine libraries had not been fully involved. The involvement of the MBLWHOI Library, their small-scale project, and the realization by the data centres that this issue was an ideal candidate for close collaboration between data centres and marine libraries made the concrete output of this Meeting very promising.

## 4.2 Data publication issues not so far addressed

This Agenda Item was introduced by Alex Dorsk. Mr Dorsk presented a brief report on the experience achieved with the WHOAS (Woods Hole Open Access Server). A first question was “Why aren't people banging down our doors to deposit data?” During the WHOAS experiences it was found that users encounter challenges during the data citation process. Responding to many of these challenges involve understanding users and their specific situations. Often these challenges do not relate to the repository but to general problems in data management.

Data depositors have to place data in a repository, which may take time to do, or they may not even know that repositories exist. Some of these barriers include data organization (deciding which data are backbone data, separating data, packaging data), metadata management (deciding which metadata are necessary, packaging metadata, generating metadata), and knowledge (knowing what a repository is, knowing which repositories exist, knowing how to use a repository). We have begun to define the intersections between data centres and libraries in data publication, which will be crucial for moving forward.

These were some of the experiences with WHOAS that exemplified these barriers:

### On Understanding repositories:

- Users don't know that repositories exist
- Users think a repository is a tool for managing data throughout its lifecycle, like a virtual workdesk
- Users think that they have to know how to use repositories

### On managing data:

- Users can't easily separate out publishable chunks of data
- Users have concerns about data ownership and control

### On managing metadata:

- Users don't know what metadata to include
- Users don't have time or expertise to generate metadata

### What methods do we have available to overcome the barriers?

**Tools:** tools can be created to help users overcome barriers. An example was given that described creating a Webform to guides users through the process of creating metadata.

**Outreach:** efforts can be made to educate scientists about data citation and repositories. An example was given, developing a “*Scientist's guide to repository metadata*”. The Meeting agreed on the need for such a guide. **Alex Dorsk agreed to prepare content for OceanTeacher in this regard. It is expected that this will be a “phase 2” project after we have feedback from successful use cases.**

**The Meeting further agreed to share the report of this Meeting with publishers and requested all participants to contact publishers and inform them of the URL of the report when available. (Deadline: when report is available, By: All)**

## 5. CLOSING OF THE MEETING

Dr Lowry summarized that it has been hard to make progress in bringing data centre and library paradigms together, but we have begun to see how the two institutions could work together, without replicating roles or competition. It is important to think about end users of the data in the process, including active researchers.

The participants expressed their great appreciation to Cathy Norton, who had started the WHOAS initiative and had approached IOC/IODE to have this joint Meeting. It was regretted that Cathy had not been able to participate in the meeting, due to health reasons. The Meeting expressed the hope that Cathy would soon be able to participate in the planned activities as well as in the 2011 IODE events.

The Meeting thanked the IOC for hosting the Meeting at IOC/UNESCO Headquarters. The Meeting was closed on 2 April 2010 at 16h45.

**ANNEX I**

**AGENDA OF THE MEETING**

1. **SESSION 1: PILOT PROJECT REPORTS**
  - 1.1 Summary of the SCOR/IODE Activities
  - 1.2 Use Case 2: MBLWHOI Library - A Woods Hole Data Repository for Data Supporting Published Articles
  - 1.3 Use Case 1: Data publication and citation from the point of view of BODC as a 'Typical' IODE Data Centre
2. **SESSION 2: TAKING THE PROCESS FORWARD**
3. **SESSION 3: DATA PUBLICATION TECHNICAL ISSUES**
  - 3.1 What should lie at the end of a DOI?
  - 3.2 Data publication content standards and quality assurance
4. **GAP ANALYSIS AND NAVEL GAZING**
  - 4.1 Critical analysis of the SCOR/IODE data citation and publication process so far
  - 4.2 Data publication issues not so far addressed
5. **CLOSING OF THE MEETING**

## ANNEX II

### LIST OF PARTICIPANTS

Cyndy CHANDLER  
Informatics Specialist  
Woods Hole Oceanographic Institution  
(WHOI)  
MS 36, Woods Hole, MA, 02543  
United States  
Tel: +1-508-289-2765  
Fax: +1-508-457-2169  
Email: [cchandler@whoi.edu](mailto:cchandler@whoi.edu)

Alexander DORSK  
Systems/Data Librarian  
Woods Hole Oceanographic Institution  
MBLWHOI Library  
United States  
Tel: +1 508-289-2538  
Email: [adorsk@whoi.edu](mailto:adorsk@whoi.edu)

Peter FOX  
Professor  
Rensselaer Polytechnic Institute  
Tetherless World Constellation  
110 8th St, Troy, NY 12180  
United States  
Tel: +1-518-276-4862  
Fax: +1-518-276-4464  
Email: [pfox@cs.rpi.edu](mailto:pfox@cs.rpi.edu)

Christopher FREELAND  
Director  
Center for Biodiversity Informatics  
4344 Shaw Blvd., St. Louis, MO  
63110  
United States  
Tel: +1-314-518-2412  
Fax: +1-314-577-0897  
Email: [chris.freeland@mobot.org](mailto:chris.freeland@mobot.org)

Anthony GODDARD  
Informatics Analyst  
Marine Biological Laboratory (MBL)  
WMBLWHOI Library  
7 MBL St, Woods Hole, MA, 02543  
United States  
Tel: +1-508-564-3855  
Email: [agoddard@mbl.edu](mailto:agoddard@mbl.edu)

Roy LOWRY  
British Oceanographic Data Centre  
Joseph Proudman Building  
6 Brownlow Street  
Liverpool  
L3 5DA  
United Kingdom  
Email: [rkl@bodc.ac.uk](mailto:rkl@bodc.ac.uk)

Mike MCCANN  
Software Engineer  
Monterey Bay Aquarium Research  
Institute  
Information Applications  
7700 Sandholdt Road  
Moss Landing CA 95039  
United States  
Tel: +1-408-775-1769  
Fax: +1-408-775-1646  
Email: [mccann@mbari.org](mailto:mccann@mbari.org)

Holly MILLER  
Project Leader  
Marine Biological Laboratory  
MBLWHOI Library  
7 MBL Street, Woods Hole, MA  
02540  
United States  
Tel: +1-508-289-7632  
Email: [hmill@mbl.edu](mailto:hmill@mbl.edu)

Stephen MILLER  
Head, Geological Data Center  
Scripps Institution of Oceanography,  
UC San Diego (SIO)  
9500 Gilman Drive Mail Code 0214  
La Jolla 92093  
United States  
Tel: +1-619-548-0784  
Email: [spmiller@ucsd.edu](mailto:spmiller@ucsd.edu)

Gwenaëlle MONCOIFFÉ  
Marine Data Scientist  
British Oceanographic Data Centre  
Joseph Proudman Building  
6 Brownlow Street  
Liverpool  
L3 5DA

United Kingdom  
Email: [gmon@bodc.ac.uk](mailto:gmon@bodc.ac.uk)

Thomas MORITZ  
1968 1-2 South Shenadoah Street, Los  
Angeles, CA 90034-1208  
United States  
Tel: +1-310-963-0199  
Email: [tom.moritz@gmail.com](mailto:tom.moritz@gmail.com)

Linda PIKULA  
Chair, IODE Group of Experts on  
Marine Information Management (GE-  
MIM)  
Regional Librarian  
NOAA Central and Regional Libraries  
(NCL)  
4301 Rickenbacker Causeway  
Miami Florida 33149  
United States  
Tel: +1-305-361-4429  
Fax: +1-305-361-4552  
Email: [linda.pikula@noaa.gov](mailto:linda.pikula@noaa.gov)

Lisa RAYMOND  
Assistant Library Director, WHOI  
Woods Hole Oceanographic Institution  
MBLWHOI Library  
360 Woods Hole Road, Woods Hole,  
MA 02543  
United States  
Tel: +1-508-289-3557  
Fax: +1-508-457-2156  
Email: [lraymond@whoi.edu](mailto:lraymond@whoi.edu)

Greg REED  
Co-Chair IODE  
Australian Ocean Data Centre Joint  
Facility Fleet Headquarters Wylde  
Street Building 89  
Garden Island Potts Point NSW 2011  
Australia  
Tel: +61 2 9359 3141  
Fax: +61 2 9359 3120  
Email: [greg@metoc.gov.au](mailto:greg@metoc.gov.au)

Kate ROBERTS  
Assistant Director Information  
Systems  
University of Tasmania (eMarine  
Information Infrastructure)  
University of Tasmania  
Private Bag 21  
Hobart TAS 7001  
Australia

Email: [Kate.Roberts@utas.edu.au](mailto:Kate.Roberts@utas.edu.au)

Ed URBAN  
Executive Director  
Scientific Committee on Oceanic  
Research (SCOR)  
College of Earth, Ocean, and  
Environment  
Robinson Hall, University of Delaware  
Newark, DE 19716  
United States  
Tel: +1-302-831-7011  
Fax: +1-302-831-7012  
Email: [ed.urban@scor-int.org](mailto:ed.urban@scor-int.org)

Ian WOOD  
PhD Student  
Australian National University ( ANU)  
Canberra, ACT 0200  
Australia  
Tel: +61 4 240 17499  
Fax: +61 2 612 50010  
Email: [ian.wood@anu.edu.au](mailto:ian.wood@anu.edu.au)

### **IOC Secretariat**

IOC SECRETARIAT  
Peter Pissierssens  
Head, IOC Project Office for IODE  
Intergovernmental Oceanographic  
Commission of UNESCO (IOC)  
Wandelaarkaai 7/61  
8400 Oostende  
BELGIUM  
Tel: +32 59 34 01 58  
Fax: +32 59 79 52 20 or Fax: +32 59  
34 01 52  
E-mail: [p.pissierssens@unesco.org](mailto:p.pissierssens@unesco.org)

# IOC Workshop Reports

The Scientific Workshops of the Intergovernmental Oceanographic Commission are sometimes jointly sponsored with other intergovernmental or non-governmental bodies. In most cases, IOC assures responsibility for printing, and copies may be requested from:

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| No.       | Title  | Languages                                | No.       | Title  | Languages                                    | No.       | Title   | Languages             |
|-----------|--|--|-----------|--|--|-----------|---|-----------------------|
| 1         | CCOP-IOC, 1974, Metallogensis, Hydrocarbons and Tectonic Patterns in Eastern Asia (Report of the IDOE Workshop on); Bangkok, Thailand, 24-29 September 1973  | E (out of stock)                         |           | 5-9 June 1978 (UNESCO reports in marine sciences, No. 5, published by the Division of Marine Sciences, UNESCO)   |  | 40        | 24-29 September 1985. IOC Workshop on the Technical Aspects of Tsunami Analysis, Prediction and Communications; Sidney, B.C., Canada, 29-31 July 1985.  | E                     |
| 2         | CICAR Ichthyoplankton Workshop, Mexico City, 16-27 July 1974 (UNESCO Technical Paper in Marine Sciences, No. 20).  | E (out of stock)<br>S (out of stock)     | 20        | Second CCOP-IOC Workshop on IDOE Studies of East Asia Tectonics and Resources; Bandung, Indonesia, 17-21 October 1978  | E  | 40 Suppl. | First International Tsunami Workshop on Tsunami Analysis, Prediction and Communications, Submitted Papers; Sidney, B.C., Canada, 29 July-1 August 1985.   | E                     |
| 3         | Report of the IOC/GFCM/ICSEM International Workshop on Marine Pollution in the Mediterranean; Monte Carlo, 9-14 September 1974.  | E, F<br>E (out of stock)                 | 21        | Second IDOE Symposium on Turbulence in the Ocean; Liège, Belgium, 7-18 May 1979.   | E, F, S, R                                   | 41        | First Workshop of Participants in the Joint   | E                     |
| 4         | Report of the Workshop on the Phenomenon known as 'El Niño'; Guayaquil, Ecuador, 4-12 December 1974.   | E (out of stock)<br>S (out of stock)     | 22        | Third IOC/WMO Workshop on Marine Pollution Monitoring; New Delhi, 11-15 February 1980.   | E, F, S, R                                   |           | FAO/IOC/WHO/IAEA/UNEP Project on Monitoring of Pollution in the Marine Environment of the West and Central African Region (WACAF/2); Dakar, Senegal, 28 October-  |                       |
| 5         | IDOE International Workshop on Marine Geology and Geophysics of the Caribbean Region and its Resources; Kingston, Jamaica, 17-22 February 1975   | E (out of stock)<br>S                    | 23        | WESTPAC Workshop on the Marine Geology and Geophysics of the North-West Pacific; Tokyo, 27-31 March 1980.  | E, R   | 43        | 1 November 1985.  | E                     |
| 6         | Report of the CCOP/SOPAC-IOC IDOE International Workshop on Geology, Mineral Resources and Geophysics of the South Pacific; Suva, Fiji, 1-6 September 1975   | E  | 24        | WESTPAC Workshop on Coastal Transport of Pollutants; Tokyo, Japan, 27-31 March 1980.   | E (out of stock)                             |           | IOC Workshop on the Results of MEDALPEX and Future Oceanographic Programmes in the Western Mediterranean; Venice, Italy, 23-25 October 1985.  |                       |
| 7         | Report of the Scientific Workshop to Initiate Planning for a Co-operative Investigation in the North and Central Western Indian Ocean, organized within the IDOE under the sponsorship of IOC/FAO (IOFC)/UNESCO/ EAC; Nairobi, Kenya, 25 March-2 April 1976. | E, F, S, R                               | 25        | Workshop on the Inter-calibration of Sampling Procedures of the IOC/ WMO/UNEP Pilot Project on Monitoring Background Levels of Selected Pollutants in Open-Ocean Waters; Bermuda, 11-26 January 1980.          | E (Superseded by IOC Technical Series No.22) | 44        | IOC-FAO Workshop on Recruitment in Tropical Coastal Demersal Communities; Ciudad del Carmen, Campeche, Mexico, 21-25 April 1986.  | E (out of stock)<br>S |
| 8         | Joint IOC/FAO (IPFC)/UNEP International Workshop on Marine Pollution in East Asian Waters; Penang, 7-13 April 1976   | E (out of stock)                         | 26        | IOC Workshop on Coastal Area Management in the Caribbean Region; Mexico City, 24 September- 5 October 1979.  | E, S   | 44 Suppl. | IOC-FAO Workshop on Recruitment in Tropical Coastal Demersal Communities, Submitted Papers; Ciudad del Carmen, Campeche, Mexico, 21-25 April 1986.  | E                     |
| 9         | IOC/CMG/SCOR Second International Workshop on Marine Geoscience; Mauritius 9-13 August 1976.   | E, F, S, R                               | 27        | CCOP/SOPAC-IOC Second International Workshop on Geology, Mineral Resources and Geophysics of the South Pacific; Noumea, New Caledonia, 9-15 October 1980.  | E  | 45        | IOCARIBE Workshop on Physical Oceanography and Climate; Cartagena, Colombia, 19-22 August 1986.   | E                     |
| 10        | IOC/WMO Second Workshop on Marine Pollution (Petroleum) Monitoring; Monaco, 14-18 June 1976  | E, F<br>E (out of stock)                 | 28        | FAO/IOC Workshop on the effects of environmental variation on the survival of larval pelagic fishes. Lima, 20 April-5 May 1980.  | E  | 46        | Reunión de Trabajo para Desarrollo del Programa "Ciencia Oceánica en Relación a los Recursos No Vivos en la Región del Atlántico Sud-occidental"; Porto Alegre, Brasil, 7-11 de abril de 1986.              | S                     |
| 11        | Report of the IOC/FAO/UNEP International Workshop on Marine Pollution in the Caribbean and Adjacent Regions; Port of Spain, Trinidad, 13-17 December 1976.   | E, S (out of stock)                      | 29        | WESTPAC Workshop on Marine Biological Methodology; Tokyo, 9-14 February 1981.  | E  | 47        | IOC Symposium on Marine Science in the Western Pacific: The Indo-Pacific Convergence; Townsville, 1-6 December 1966   | E                     |
| 11 Suppl. | Collected contributions of invited lecturers and authors to the IOC/FAO/UNEP International Workshop on Marine Pollution in the Caribbean and Adjacent Regions; Port of Spain, Trinidad, 13-17 December 1976  | E (out of stock), S                      | 30        | International Workshop on Marine Pollution in the South-West Atlantic; Montevideo, 10-14 November 1980.  | E (out of stock)<br>S                        | 48        | IOCARIBE Mini-Symposium for the Regional Development of the IOC-UN (OETB) Programme on 'Ocean Science in Relation to Non-Living Resources (OSNLR)'; Havana, Cuba, 4-7 December 1986.                        | E, S                  |
| 12        | Report of the IOCARIBE Interdisciplinary Workshop on Scientific Programmes in Support of Fisheries Projects; Fort-de-France, Martinique, 28 November-2 December 1977.  | E, F, S                                  | 31        | Third International Workshop on Marine Geoscience; Heidelberg, 19-24 July 1982.  | E, F, S                                      | 49        | AGU-IOC-WMO-CPPS Chapman Conference: An International Symposium on 'El Niño'; Guayaquil, Ecuador, 27-31 October 1986.   | E                     |
| 13        | Report of the IOCARIBE Workshop on Environmental Geology of the Caribbean Coastal Area; Port of Spain, Trinidad, 16-18 January 1978.   | E, S                                     | 32        | UNU/IOC/UNESCO Workshop on International Co-operation in the Development of Marine Science, and the Transfer of Technology in the context of the New Ocean Regime; Paris, France, 27 September-1 October 1982. | E, F, S                                      | 50        | CCALR-IOC Scientific Seminar on Antarctic Ocean Variability and its Influence on Marine Living Resources, particularly Krill (organized in collaboration with SCAR and SCOR); Paris, France, 2-6 June 1987. | E                     |
| 14        | IOC/FAO/WHO/UNEP International Workshop on Marine Pollution in the Gulf of Guinea and Adjacent Areas; Abidjan, Côte d'Ivoire, 2-9 May 1978   | E, F                                     | 33        | Workshop on the IREP Component of the IOC Programme on Ocean Science in Relation to Living Resources (OSLR); Halifax, 26-30 September 1963.  | E  | 51        | CCOP/SOPAC-IOC Workshop on Coastal Processes in the South Pacific Island Nations; Lae, Papua-New Guinea, 1-8 October 1987.  | E                     |
| 15        | CCPS/FAO/IOC/UNEP International Workshop on Marine Pollution in the South-East Pacific; Santiago de Chile, 6-10 November 1978.   | E (out of stock)                         | 34        | IOC Workshop on Regional Co-operation in Marine Science in the Central Eastern Atlantic (Western Africa); Tenerife, 12-17 December, 1963.  | E, F, S                                      | 52        | SCOR-IOC-UNESCO Symposium on Vertical Motion in the Equatorial Upper Ocean and its Effects upon Living Resources and the Atmosphere; Paris, France, 6-10 May 1985.  | E                     |
| 16        | Workshop on the Western Pacific, Tokyo, 19-20 February 1979.   | E, F, R                                  | 35        | CCOP/SOPAC-IOC-UNU Workshop on Basic Geo-scientific Marine Research Required for Assessment of Minerals and Hydrocarbons in the South Pacific; Suva, Fiji, 3-7 October 1983.                                   | E  | 53        | IOC Workshop on the Biological Effects of Pollutants; Oslo, 11-29 August 1986.  | E                     |
| 17        | Joint IOC/WMO Workshop on Oceanographic Products and the IGOS Data Processing and Services System (IDPSS); Moscow, 9-11 April 1979.  | E  | 36        | IOC/FAO Workshop on the Improved Uses of Research Vessels; Lisbon, Portugal, 28 May-2 June 1984.   | E  | 54        | Workshop on Sea-Level Measurements in Hostile Conditions; Bidston, UK, 28-31 March 1988.  | E                     |
| 17 suppl. | Papers submitted to the Joint IOC/WMO Seminar on Oceanographic Products and the IGOS Data Processing and Services System; Moscow, 2-6 April 1979.  | E  | 36 Suppl. | Papers submitted to the IOC/FAO Workshop on the Improved Uses of Research Vessels; Lisbon, 28 May-2 June 1984  | E  | 55        | IBCCA Workshop on Data Sources and Compilation, Boulder, Colorado, 18-19 July 1988.   | E                     |
| 18        | IOC/UNESCO Workshop on Syllabus for Training Marine Technicians; Miami, U.S.A., 22-26 May 1978 (UNESCO reports in marine sciences, No. 4 published by the Division of Marine Sciences, UNESCO)   | E (out of stock), F, S (out of stock), R | 37        | IOC/UNESCO Workshop on Regional Co-operation in Marine Science in the Central Indian Ocean and Adjacent Seas and Gulfs; Colombo, 8-13 July 1985.   | E  | 56        | IOC-FAO Workshop on Recruitment of Penaeid Prawns in the Indo-West Pacific Region (PREP); Cleveland, Australia, 24-30 July 1988.  | E                     |
| 19        | IOC Workshop on Marine Science Syllabus for Secondary Schools; Llantwit Major, Wales, U.K.,  | E (out of stock), S, R, Ar               | 38        | IOC/ROPME/UNEP Symposium on Fate and Fluxes of Oil Pollutants in the Kuwait Action Plan Region; Basrah, Iraq, 8-12 January 1984.   | E  | 57        | IOC Workshop on International Co-operation in the Study of Red Tides and Ocean Blooms; Takamatsu, Japan, 16-17 November 1987.   | E                     |
|           |  |  | 39        | CCOP (SOPAC)-IOC-IFREMER-ORSTOM Workshop on the Uses of Submersibles and Remotely Operated Vehicles in the South Pacific; Suva, Fiji,  | E  | 58        | International Workshop on the Technical Aspects of the Tsunami Warning System; Novosibirsk, USSR, 4-5 August 1989.  | E                     |
|           |  |  |           |  |  | 58 Suppl. | Second International Workshop on the Technical Aspects of Tsunami Warning Systems. Tsunami Analysis, Preparedness,  | E                     |

| No.       | Title   | Languages        | No.       | Title  | Languages                   | No.        | Title  | Languages |
|-----------|---|------------------|-----------|--|-----------------------------|------------|--|-----------|
| 59        | Observation and Instrumentation. Submitted Papers; Novosibirsk, USSR, 4-5 August 1989. IOC-UNEP Regional Workshop to Review Priorities for Marine Pollution Monitoring Research, Control and Abatement in the Wider Caribbean; San José, Costa Rica, 24-30 August 1989. | E, F, S          | 83        | Meeting for the Organization of an International Conference on Coastal Change; Bordeaux, France, 30 September-2 October 1992. IOC Workshop on Donor Collaboration in the Development of Marine Scientific Research Capabilities in the Western Indian Ocean Region; Brussels, Belgium, 12-13 October 1992. | E                           | 103        | Liège, Belgium, 5-9 May 1994. IOC Workshop on GIS Applications in the Coastal Zone Management of Small Island Developing States; Barbados, 20-22 April 1994.   | E         |
| 60        | IOC Workshop to Define IOCARIBE-TRODERP proposals; Caracas, Venezuela, 12-16 September 1989.  | E                | 84        | Workshop on Atlantic Ocean Climate Variability; Moscow, Russian Federation, 13-17 July 1992.   | E                           | 104        | Workshop on Integrated Coastal Management; Dartmouth, Canada, 19-20 September 1994.  | E         |
| 61        | Second IOC Workshop on the Biological Effects of Pollutants; Bermuda, 10 September-2 October 1988.  | E                | 85        | IOC Workshop on Coastal Oceanography in Relation to Integrated Coastal Zone Management; Kona, Hawaii, 1-5 June 1992.   | E                           | 105        | BORDOMER 95: Conference on Coastal Change; Bordeaux, France, 6-10 February 1995.   | E         |
| 62        | Second Workshop of Participants in the Joint FAO-IOC-WHO-IAEA-UNEP Project on Monitoring of Pollution in the Marine Environment of the West and Central African Region; Accra, Ghana, 13-17 June 1988.  | E                | 86        | International Workshop on the Black Sea; Varna, Bulgaria, 30 September - 4 October 1991.   | E                           | 105 Suppl. | Conference on Coastal Change: Proceedings; Bordeaux, France, 6-10 February 1995.   | E         |
| 63        | IOC/WESTPAC Workshop on Co-operative Study of the Continental Shelf Circulation in the Western Pacific; Bangkok, Thailand, 31 October-3 November 1989.  | E                | 87        | Taller de trabajo sobre efectos biológicos del fenómeno «El Niño» en ecosistemas costeros del Pacífico Sudeste; Santa Cruz, Galápagos, Ecuador, 5-14 de octubre de 1989.   | S only (summary in E, F, S) | 106        | IOC/WESTPAC Workshop on the Paleographic Map; Bali, Indonesia, 20-21 October 1994.   | E         |
| 64        | Second IOC-FAO Workshop on Recruitment of Penaeid Prawns in the Indo-West Pacific Region (PREP); Phuket, Thailand, 25-31 September 1989.  | E                | 88        | IOC-CEC-ICSU-ICES Regional Workshop for Member States of Eastern and Northern Europe (GODAR Project); Obninsk, Russia, 17-20 May 1993.   | E                           | 107        | IOC-ICSU-NIO-NOAA Regional Workshop for Member States of the Indian Ocean - GODAR-III; Dona Paula, Goa, India, 6-9 December 1994.  | E         |
| 65        | Second IOC Workshop on Sardine/Anchovy Recruitment Project (SARP) in the Southwest Atlantic; Montevideo, Uruguay, 21-23 August 1989.  | E                | 89        | IOC-ICSEM Workshop on Ocean Sciences in Non-Living Resources; Perpignan, France, 15-20 October 1990.   | E                           | 108        | UNESCO-IHP-IOC-IAEA Workshop on Sea-Level Rise and the Multidisciplinary Studies of Environmental Processes in the Caspian Sea Region; Paris, France, 9-12 May 1995.   | E         |
| 66        | IOC ad hoc Expert Consultation on Sardine/Anchovy Recruitment Programme; La Jolla, California, U.S.A., 1989.  | E                | 90        | IOC Seminar on Integrated Coastal Management; New Orleans, U.S.A., 17-18 July 1993.  | E                           | 108 Suppl. | UNESCO-IHP-IOC-IAEA Workshop on Sea-Level Rise and the Multidisciplinary Studies of Environmental Processes in the Caspian Sea Region; Submitted Papers; Paris, France, 9-12 May 1995.   | E         |
| 67        | Interdisciplinary Seminar on Research Problems in the IOCARIBE Region; Caracas, Venezuela, 28 November-1 December 1989.   | E (out of stock) | 91        | Hydroblack'91 CTD Intercalibration Workshop; Woods Hole, U.S.A., 1-10 December 1991.   | E                           | 109        | First IOC-UNEP CEPOL Symposium; San José, Costa Rica, 14-15 April 1993.  | E         |
| 68        | International Workshop on Marine Acoustics; Beijing, China, 26-30 March 1990.   | E                | 92        | Réunion de travail IOCEA-OSNLR sur le Projet « Budgets sédimentaires le long de la côte occidentale d'Afrique » Abidjan, Côte d'Ivoire, 26-28 juin 1991.   | E                           | 110        | IOC-ICSU-CEC regional Workshop for Member States of the Mediterranean - GODAR-IV (Global Oceanographic Data Archeology and Rescue Project) Foundation for International Studies, University of Malta, Valletta, Malta, 25-28 April 1995.   | E         |
| 69        | IOC-SCAR Workshop on Sea-Level Measurements in the Antarctica; Leningrad, USSR, 28-31 May 1990.   | E                | 93        | IOC-UNEP Workshop on Impacts of Sea-Level Rise due to Global Warming. Dhaka, Bangladesh, 16-19 November 1992.  | E                           | 111        | Chapman Conference on the Circulation of the Intra-Americas Sea; La Parguera, Puerto Rico, 22-26 January 1995.   | E         |
| 69 Suppl. | IOC-SCAR Workshop on Sea-Level Measurements in the Antarctica; Submitted Papers; Leningrad, USSR, 28-31 May 1990.   | E                | 94        | BMTC-IOC-POLARMAR International Workshop on Training Requirements in the Field of Eutrophication in Semi-enclosed Seas and Harmful Algal Blooms, Bremerhaven, Germany, 29 September-3 October 1992.  | E                           | 112        | IOC-IAEA-UNEP Group of Experts on Standards and Reference Materials (GESREM) Workshop; Miami, U.S.A., 7-8 December 1993.   | E         |
| 70        | IOC-SAREC-UNEP-FAO-IAEA-WHO Workshop on Regional Aspects of Marine Pollution; Mauritius, 29 October - 9 November 1990.  | E                | 95        | SAREC-IOC Workshop on Donor Collaboration in the Development of Marine Scientific Research Capabilities in the Western Indian Ocean Region; Brussels, Belgium, 23-25 November 1993.  | E                           | 113        | IOC Regional Workshop on Marine Debris and Waste Management in the Gulf of Guinea; Lagos, Nigeria, 14-16 December 1994.  | E         |
| 71        | IOC-FAO Workshop on the Identification of Penaeid Prawn Larvae and Postlarvae; Cleveland, Australia, 23-28 September 1990.  | E                | 96        | IOC-UNEP-WMO-SAREC Planning Workshop on an Integrated Approach to Coastal Erosion, Sea Level Changes and their Impacts; Zanzibar, United Republic of Tanzania, 17-21 January 1994.   | E                           | 114        | International Workshop on Integrated Coastal Zone Management (ICZM) Karachi, Pakistan, 10-14 October 1994.   | E         |
| 72        | IOC/WESTPAC Scientific Steering Group Meeting on Co-Operative Study of the Continental Shelf Circulation in the Western Pacific; Kuala Lumpur, Malaysia, 9-11 October 1990.   | E                | 96 Suppl. | IOC-UNEP-WMO-SAREC Planning Workshop on an Integrated Approach to Coastal Erosion, Sea Level Changes and their Impacts; Submitted Papers 1. Coastal Erosion; Zanzibar, United Republic of Tanzania 17-21 January 1994.   | E                           | 115        | IOC/GLOSS-IAPSO Workshop on Sea Level Variability and Southern Ocean Dynamics; Bordeaux, France, 31 January 1995.  | E         |
| 73        | Expert Consultation for the IOC Programme on Coastal Ocean Advanced Science and Technology Study; Liège, Belgium, 11-13 May 1991.   | E                | 96 Suppl. | IOC-UNEP-WMO-SAREC Planning Workshop on an Integrated Approach to Coastal Erosion, Sea Level Changes and their Impacts; Submitted Papers 2. Sea Level; Zanzibar, United Republic of Tanzania 17-21 January 1994.   | E                           | 116        | IOC/WESTPAC International Scientific Symposium on Sustainability of Marine Environment: Review of the WESTPAC Programme, with Particular Reference to ICAM, Bali, Indonesia, 22-26 November 1994.  | E         |
| 74        | IOC-UNEP Review Meeting on Oceanographic Processes of Transport and Distribution of Pollutants in the Sea; Zagreb, Yugoslavia, 15-18 May 1989.  | E                | 97        | IOC Workshop on Small Island Oceanography in Relation to Sustainable Economic Development and Coastal Area Management of Small Island Developing States; Fort-de-France, Martinique, 8-10 November, 1993.  | E                           | 117        | Joint IOC-CIDA-Sida (SAREC) Workshop on the Benefits of Improved Relationships between International Development Agencies, the IOC and other Multilateral Inter-governmental Organizations in the Delivery of Ocean, Marine Affairs and Fisheries Programmes; Sidney B.C., Canada, 26-28 September 1995. | E         |
| 75        | IOC-SCOR Workshop on Global Ocean Ecosystem Dynamics; Solomons, Maryland, U.S.A., 29 April-2 May 1991.  | E                | 98        | IOC-UNEP-WMO-SAREC Planning Workshop on an Integrated Approach to Coastal Erosion, Sea Level Changes and their Impacts; Submitted Papers 1. Coastal Erosion; Zanzibar, United Republic of Tanzania 17-21 January 1994.   | E                           | 118        | IOC-UNEP-NOAA-Sea Grant Fourth Caribbean Marine Debris Workshop; La Romana, Santo Domingo, 21-24 August 1995.  | E         |
| 76        | IOC/WESTPAC Scientific Symposium on Marine Science and Management of Marine Areas of the Western Pacific; Penang, Malaysia, 2-6 December 1991.  | E                | 99        | IOC-SAREC Field Study Exercise on Nutrients in Tropical Marine Waters; Mombasa, Kenya, 5-15 April 1994.  | E                           | 119        | IOC Workshop on Ocean Colour Data Requirements and Utilization; Sydney B.C., Canada, 21-22 September 1995.   | E         |
| 77        | IOC-SAREC-KMFRI Regional Workshop on Causes and Consequences of Sea-Level Changes on the Western Indian Ocean Coasts and Islands; Mombasa, Kenya, 24-28 June 1991.  | E                | 100       | IOC-SOA-NOAA Regional Workshop for Member States of the Western Pacific - GODAR-II (Global Oceanographic Data Archeology and Rescue Project); Tianjin, China, 8-11 March 1994.   | E                           | 120        | International Training Workshop on Integrated Coastal Management; Tampa, Florida, U.S.A., 15-17 July 1995.   | E         |
| 78        | IOC-CEC-ICES-WMO-ICSU Ocean Climate Data Workshop Goddard Space Flight Center; Greenbelt, Maryland, U.S.A., 18-21 February 1992.  | E                | 101       | IOC Regional Science Planning Workshop on Harmful Algal Blooms; Montevideo, Uruguay, 15-17 June 1994.  | E                           | 121        | Atelier régional IOC-CERESCOR sur la gestion intégrée des zones littorales (ICAM), Conakry, Guinée, 18-22 décembre 1995.   | F         |
| 79        | IOC/WESTPAC Workshop on River Inputs of Nutrients to the Marine Environment in the WESTPAC Region; Penang, Malaysia, 26-29 November 1991.   | E                | 102       | First IOC Workshop on Coastal Ocean Advanced Science and Technology Study (COASTS);  | E                           | 122        | IOC-EU-BSH-NOAA-(WDC-A) International Workshop on Oceanographic Biological and Chemical Data Management, Hamburg, Germany, 20-23 May 1996.   | E         |
| 80        | IOC-SCOR Workshop on Programme Development for Harmful Algae Blooms; Newport, U.S.A., 2-3 November 1991.  | E                |           |  | E                           | 123        | Second IOC Regional Science Planning Workshop on Harmful Algal Blooms in South America; Mar del Plata, Argentina, 30 October-1 November 1995.  | E, S      |
| 81        | Joint IAPSO-IOC Workshop on Sea Level Measurements and Quality Control; Paris, France, 12-13 October 1992.  | E                |           |  | E                           | 124        | GLOBEC-IOC-SAHFOS-MBA Workshop on the Analysis of Time Series with Particular Reference to the Continuous Plankton Recorder Survey; Plymouth, U.K., 4-7 May 1993.  | E         |
| 82        | BORDOMER 92: International Convention on Rational Use of Coastal Zones. A Preparatory   | E                |           |  | E                           | 125        | Atelier sous-régional de la COI sur les ressources marines vivantes du Golfe de Guinée; Cotonou, Bénin, 1-4 juillet 1996.  | E         |

| No. | Title  | Languages | No. | Title  | Languages                   | No. | Title   | Languages                     |
|-----|--|-----------|-----|--|-----------------------------|-----|---|-------------------------------|
| 126 | IOC-UNEP-PERSGA-ACOPS-IUCN Workshop on Oceanographic Input to Integrated Coastal Zone Management in the Red Sea and Gulf of Aden, Jeddah, Saudi Arabia, 8 October 1995.  | E         |     | Workshop on Atmospheric Inputs of Pollutants to the Marine Environment Qingdao, China, 24-26 June 1998   |                             | 187 | Geological and Biological Processes at deep-sea European Margins and Oceanic Basins, Bologna, Italy, 2-6 February 2003  | E                             |
| 127 | IOC Regional Workshop for Member States of the Caribbean and South America GODAR-V (Global Oceanographic Data Archeology and Rescue Project); Cartagena de Indias, Colombia, 8-11 October 1996.  | E         | 154 | IOC-Sida-Flanders-SFRI Workshop on Ocean Data Management in the IOCINCWIO Region (ODINEA project) Capetown, South Africa, 30 November-11 December 1998.  | E                           | 188 | Proceedings of 'The Ocean Colour Data' Symposium, Brussels, Belgium, 25-27 November 2002  | E                             |
| 128 | Atelier IOC-Banque Mondiale-Sida/SAREC-ONE sur la Gestion Intégrée des Zones Côtières ; Nosy Bé, Madagascar, 14-18 octobre 1996.   | E         | 155 | Science of the Mediterranean Sea and its applications UNESCO, Paris 29-31 July 1997  | E                           | 189 | Workshop for the Formulation of a Draft Project on Integrated Coastal Management (ICM) in Latin America and the Caribbean (LAC), Cartagena, Colombia, 23-25 October 2003  | E F<br>(electronic copy only) |
| 129 | Gas and Fluids in Marine Sediments, Amsterdam, the Netherlands; 27-29 January 1997.  | E         | 156 | IOC-LUC-KMFRI Workshop on RECOSCIX-WIO in the Year 2000 and Beyond, Mombasa, Kenya, 12-16 April 1999   | E                           |     | Taller de Formulación de un Anteproyecto de Manejo Costero Integrado (MCI) en América Latina y el Caribe (ALC), Cartagena, Colombia, 23-25 de Octubre de 2003   |                               |
| 130 | Atelier régional de la COI sur l'océanographie côtière et la gestion de la zone côtière ;Moroni, RFI des Comores, 16-19 décembre 1996.   | E         | 157 | '98 IOC-KMI International Workshop on Integrated Coastal Management (ICM), Seoul, Republic of Korea 16-18 April 1998   | E                           | 190 | First ODINCARSA Planning Workshop for Caribbean Islands, Christchurch, Barbados, 15-18 December 2003  | E<br>(electronic copy only)   |
| 131 | GOOS Coastal Module Planning Workshop; Miami, USA, 24-28 February 1997   | E         | 158 | The IOCARIBE Users and the Global Ocean Observing System (GOOS) Capacity Building Workshop, San José, Costa Rica, 22-24 April 1999   | E                           | 191 | North Atlantic and Labrador Sea Margin Architecture and Sedimentary Processes — International Conference and Twelfth Post-cruise Meeting of the Training-through-research Programme, Copenhagen, Denmark, 29-31 January 2004                                  | E                             |
| 132 | Third IOC-FANSA Workshop; Punta-Arenas, Chile, 28-30 July 1997   | S/E       | 159 | Oceanic Fronts and Related Phenomena (Konstantin Fedorov Memorial Symposium) — Proceedings, Pushkin, Russian Federation, 18-22 May 1998  | E                           | 192 | Regional Workshop on Coral Reefs Monitoring and Management in the ROPME Sea Area, Iran I.R., 14-17 December 2003  | E<br>(under preparation)      |
| 133 | Joint IOC-CIESM Training Workshop on Sea-level Observations and Analysis for the Countries of the Mediterranean and Black Seas; Birkenhead, U.K., 16-27 June 1997.   | E         | 160 | Under preparation  |                             | 193 | Workshop on New Technical Developments in Sea and Land Level Observing Systems, Paris, France, 14-16 October 2003   | E<br>(electronic copy only)   |
| 134 | IOC/WESTPAC-CCOP Workshop on Paleogeographic Mapping (Holocene Optimum); Shanghai, China, 27-29 May 1997   | E         | 161 | Under preparation  |                             | 194 | IOC/ROPME Planning Meeting for the Ocean Data and Information Network for the Central Indian Ocean Region   | E<br>(under preparation)      |
| 135 | Regional Workshop on Integrated Coastal Zone Management; Chabahar, Iran; February 1996.  | E         | 162 | Workshop report on the Transports and Linkages of the Intra-american Sea (IAS), Cozumel, Mexico, 1-5 November 1997   | E                           | 195 | Workshop on Indicators of Stress in the Marine Benthos, Torregrande-Oristano, Italy, 8-9 October 2004   | E                             |
| 136 | IOC Regional Workshop for Member States of Western Africa (GODAR-VI); Accra, Ghana, 22-25 April 1997.  | E         | 163 | Under preparation  |                             | 196 | International Coordination Meeting for the Development of a Tsunami Warning and Mitigation System for the Indian Ocean within a Global Framework, Paris, France, 3-8 March 2005   | E                             |
| 137 | GOOS Planning Workshop for Living Marine Resources, Dartmouth, USA; 1-5 March 1996.  | E         | 164 | IOC-Sida-Flanders-MCM Third Workshop on Ocean Data Management in the IOCINCWIO Region (ODINEA Project), Cape Town, South Africa, 29 November - 11 December 1999  | E                           | 197 | Geosphere-Biosphere Coupling Processes: The TTR Interdisciplinary Approach Towards Studies of the European and North African Margins; International Conference and Post-cruise Meeting of the Training-Through-Research Programme, Morocco, 2-5 February 2005 | E                             |
| 138 | Gestión de Sistemas Oceanográficos del Pacífico Oriental; Concepción, Chile, 9-16 de abril de 1996.  | S         | 165 | An African Conference on Sustainable Integrated Management; Proceedings of the Workshops, An Integrated Approach, (PACSIKOM), Maputo, Mozambique, 18-25 July 1998  | E, F                        | 198 | Second International Coordination Meeting for the Development of a Tsunami Warning and Mitigation System for the Indian Ocean, Grand Baie, Mauritius, 14-16 April 2005  | E                             |
| 139 | Sistemas Oceanográficos del Atlántico Sudoccidental, Taller, TEMA;Furg, Rio Grande, Brasil, 3-11 de noviembre de 1997  | S         | 166 | IOC-SOA International Workshop on Coastal Megacities: Challenges of Growing Urbanization of the World's Coastal Areas; Hangzhou, P. R. China, 27 -30 September 1999  | E                           | 199 | International Conference for the Establishment of a Tsunami and Coastal Hazards Warning System for the Caribbean and Adjacent Regions, Mexico, 1-3 June 2005  | E                             |
| 140 | IOC Workshop on GOOS Capacity Building for the Mediterranean Region; Valletta, Malta, 26-29 November 1997.   | E         | 167 | IOC-Flanders First ODINAFRICA-II Planning Workshop, Dakar, Senegal, 2-4 May 2000   | E                           | 200 | Lagoons and Coastal Wetlands in the Global Change Context: Impacts and Management Issues — Proceedings of the International Conference, Venice, 26-28 April 2004 (ICAM Dossier N° 3)  | E                             |
| 141 | IOC/WESTPAC Workshop on Co-operative Study in the Gulf of Thailand: A Science Plan; Bangkok, Thailand, 25-28 February 1997.  | E         | 168 | Geological Processes on European Continental Margins; International Conference and Eight Post-cruise Meeting of the Training-Through-Research Programme, Granada, Spain, 31 January - 3 February 2000  | E                           | 201 | Geological processes on deep-water European margins - International Conference and 15th Anniversary Post-cruise Meeting of the Training-Through-Research Programme, Moscow/Zvenigorod, Russian Federation, 29 January-4 February 2006                         | E                             |
| 142 | Pelagic Biogeography ICoPB II. Proceedings of the 2nd International Conference. Final Report of SCOR/IOC Working Group 93; Noordwijkerhout, The Netherlands, 9-14 July 1995.   | E         | 169 | International Conference on the International Oceanographic Data & Information Exchange in the Western Pacific (IODE-WESTPAC) 1999, ICWIP '99, Langkawi, Malaysia, 1-4 November 1999   | E<br>(electronic copy only) | 202 | Proceedings of 'Ocean Biodiversity Informatics': an international conference on marine biodiversity data management Hamburg, Germany, 29 November-1 December 2004   | E                             |
| 143 | Geosphere-biosphere coupling: Carbonate Mud Mounds and Cold Water Reefs; Gent, Belgium, 7-11 February 1998.  | E         | 170 | IOCARIBE-GODAR-I Cartagena, Colombia, February 2000  | under preparation           | 203 | IOC-Flanders Planning Workshop for the formulation of a regional Pilot Project on Integrated Coastal Area Management in Latin America, Cartagena de Indias, Colombia, 16-18 January 2007  | E<br>(electronic copy only)   |
| 144 | IOC-SOPAC Workshop Report on Pacific Regional Global Ocean Observing Systems; Suva, Fiji, 13-17 February 1998.   | E         | 171 | Ocean Circulation Science derived from the Atlantic, Indian and Arctic Sea Level Networks, Toulouse, France, 10-11 May 1999 (Under preparation)  | E                           | 204 | Geo-marine Research along European Continental Margins, International Conference and Post-cruise Meeting of the Training-through-research Programme, Bremen, Germany, 29 January-1 February 2007  | E                             |
| 145 | IOC-Black Sea Regional Committee Workshop: 'Black Sea Fluxes' Istanbul, Turkey, 10-12 June 1997.   | E         | 172 | The Benefits of the Implementation of the GOOS in the Mediterranean Region, Rabat, Morocco, 1-3 November 1999  | E, F                        | 205 | IODE/ICAM Workshop on the development of the Caribbean marine atlas (CMA), United Nations House, Bridgetown, Barbados, 8-10 October 2007  | E<br>(electronic copy only)   |
| 146 | Taller Internacional sobre Formación de Capacidades para el Manejo de las Costas y los Océanos en le Gran Caribe. La Habana, - Cuba, 7-10 de Julio de 1998 / International Workshop on Management Capacity-Building for Coasts and Oceans in the Wider Caribbean, Havana, Cuba, 7-10 July 1998 | S/E       | 173 | IOC-SOPAC Regional Workshop on Coastal Global Ocean Observing System (GOOS) for the Pacific Region, Apia, Samoa, 16-17 August 2000   | E                           | 206 | IODE/JCOMM Forum on Oceanographic Data Management and Exchange Standards, Ostend, Belgium, 21-25 January 2008   | (Under preparation)           |
| 147 | IOC-SOA International Training Workshop on the Integration of Marine Sciences into the Process of Integrated Coastal Management, Dalian, China, 19-24 May 1997.  | E         | 174 | Geological Processes on Deep-water European Margins, Moscow-Mozhenka, 28 Jan.-2 Feb. 2001  | E                           | 207 | SCOR/IODE Workshop on Data Publishing, Ostend, Belgium, 17-18 June 2008   | (Under preparation)           |
| 148 | IOC/WESTPAC International Scientific Symposium - Role of Ocean Sciences for Sustainable Development Okinawa, Japan, 2-7 February 1998.   | E         | 175 | MedGLOSS Workshop and Coordination Meeting for the Pilot Monitoring Network System of Systematic Sea Level Measurements in the Mediterranean and Black Seas, Haifa, Israel, 15-17 May 2000 (Under preparation)   | E                           | 208 | JCOMM Technical Workshop on Wave Measurements from Buoy, New York, USA, 2-3 October 2008 (IOC-WMO publication)  | (Under preparation)           |
| 149 | Workshops on Marine Debris & Waste Management in the Gulf of Guinea, 1995-97.  | E         | 176 | Abstracts of Presentations at Workshops during the 7 <sup>th</sup> session of the IOC Group of Experts on the Global Sea Level Observing System (GLOSS), Honolulu, USA, 23-27 April 2001 (Under preparation)   | E                           |     |   |                               |
| 150 | First IOCARIBE-ANCA Workshop Havana, Cuba, 29 June-1 July 1998.  | E         | 177 | Geosphere/Biosphere/Hydrosphere Coupling Process, Fluid Escape Structures and Tectonics at Continental Margins and Ocean Ridges, International Conference & Tenth Post-cruise Meeting of the Training-through-Research Programme, Aveiro, Portugal, 30 January-2 February 2002 (Under preparation) | E                           |     |   |                               |
| 151 | Taller Pluridisciplinario TEMA sobre Redes del Gran Caribe en Gestión Integrada de Áreas Costeras Cartagena de Indias, Colombia, 7-12 de septiembre de 1998.   | S         | 178 | Under preparation  |                             |     |   |                               |
| 152 | Workshop on Data for Sustainable Integrated Coastal Management (SICOM) Maputo, Mozambique, 18-22 July 1998   | E         | 179 | Under preparation  |                             |     |   |                               |
| 153 | IOC/WESTPAC-Sida (SAREC)   | E         | 180 | Abstracts of Presentations at Workshops during the 7 <sup>th</sup> session of the IOC Group of Experts on the Global Sea Level Observing System (GLOSS), Honolulu, USA, 23-27 April 2001 (Under preparation)   | E                           |     |   |                               |
|     |  |           | 181 | Under preparation  |                             |     |   |                               |
|     |  |           | 182 | Under preparation  |                             |     |   |                               |
|     |  |           | 183 | Under preparation  |                             |     |   |                               |
|     |  |           | 184 | Under preparation  |                             |     |   |                               |
|     |  |           | 185 | Under preparation  |                             |     |   |                               |
|     |  |           | 186 | Under preparation  |                             |     |   |                               |
|     |  |           | 186 | Under preparation  |                             |     |   |                               |

| No. | Title   | Languages                          |
|-----|---|------------------------------------|
| 209 | Collaboration between IOC and OBIS towards the Long-term Management Archival and Accessibility of Ocean Biogeographic Data, Ostend, Belgium, 24–26 November 2008  | <i>(Under preparation)</i>         |
| 210 | Ocean Carbon Observations from Ships of Opportunity and Repeat Hydrographic Sections (IOCCP Reports, 1), Paris, France, 13–15 January 2003  | E<br><b>(electronic copy only)</b> |
| 211 | Ocean Surface pCO <sub>2</sub> Data Integration and Database Development (IOCCP Reports, 2), Tsukuba, Japan, 14–17 January 2004   | E<br><b>(electronic copy only)</b> |
| 212 | International Ocean Carbon Stakeholders' Meeting, Paris, France, 6–7 December 2004  | E<br><b>(electronic copy only)</b> |
| 213 | International Repeat Hydrography and Carbon Workshop (IOCCP Reports, 4), Shonan Village, Japan, 14–16 November 2005   | E<br><b>(electronic copy only)</b> |
| 214 | Initial Atlantic Ocean Carbon Synthesis Meeting (IOCCP Reports, 5), Laugavátn, Iceland, 28–30 June 2006   | E<br><b>(electronic copy only)</b> |
| 215 | Surface Ocean Variability and Vulnerability Workshop (IOCCP Reports, 7), Paris, France, 11–14 April 2007  | E<br><b>(electronic copy only)</b> |
| 216 | Surface Ocean CO <sub>2</sub> Atlas Project (SOCAT) 2nd Technical Meeting Report (IOCCP Reports, 9), Paris, France, 16–17 June 2008   | E<br><b>(electronic copy only)</b> |
| 217 | Changing Times: An International Ocean Biogeochemical Time-Series Workshop (IOCCP Reports, 11), La Jolla, California, USA, 5–7 November 2008  | E<br><b>(electronic copy only)</b> |
| 218 | Second Joint GOSUD/SAMOS Workshop, Seattle, Washington, USA, 10–12 June 2008  | E<br><b>(electronic copy only)</b> |
| 219 | International Conference on Marine Data management and Information Systems (IMDIS), Athens, Greece, 31 March–2 April 2008   | E                                  |
| 220 | Geo-marine Research on the Mediterranean and European-Atlantic Margins. International Conference and TTR-17 Post-cruise Meeting of the Training-through-research Programme, Granada, Spain, 2–5 February 2009 | E<br><b>(electronic copy only)</b> |
| 221 | Surface Ocean CO <sub>2</sub> Atlas Project Pacific Regional Workshop, Tsukuba, Japan, 18–20 March, 2009  | E<br><b>(electronic copy only)</b> |
| 222 | Surface Ocean CO <sub>2</sub> Atlas Project Atlantic and Southern Oceans Regional Meeting, Norwich, UK, 25–26 June, 2009  | E<br><b>(electronic copy only)</b> |
| 223 | Advisory Workshop on enhancing forecasting capabilities for North Indian Ocean Storm Surges, Indian Institute of Technology (IIT), Delhi, New Delhi, India, 14–17 July 2009                                   | E<br><b>(electronic copy only)</b> |
| 224 | 2009 International Nutrients Scale System (INSS) Workshop Report, Paris, France, 10–12 February 2009  | E<br><b>(electronic copy only)</b> |
| 225 |   | <i>In preparation</i>              |
| 226 |   | <i>In preparation</i>              |
| 227 |   | <i>In preparation</i>              |
| 228 |   | <i>In preparation</i>              |
| 229 |   | <i>In preparation</i>              |
| 230 | SCOR/IODE/MBLWHOI Library Workshop on Data Publication, Paris, France, 2 April 2010   | E<br><b>(electronic copy only)</b> |

## **Intergovernmental Oceanographic Commission (IOC)**

United Nations Educational, Scientific and Cultural Organization (UNESCO)

1, rue Miollis, 75732 Paris Cedex 15, France

Tel: +33 1 45 68 39 83

Fax: +33 1 45 68 58 12

<http://ioc.unesco.org>

IOC Project Office for IODE

Wandelaarkaai 7

8400 Oostende, Belgium

Tel: +32 59 34 21 34

Fax: + 32 59 34 01 52

<http://www.iode.org>