First IOC Training Course
on the Applications of Satellite
Remote Sensing to Marine Studies

University Simón Bolivar
Caracas, Venezuela, 24-28 September 1990
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1. **INTRODUCTION**

The First IOC Training Course on the Applications of Satellite Remote Sensing to Marine Studies took place at the University Simon Bolivar, 15 km from Caracas. It was attended by 24 trainees from eight Caribbean countries and seven lecturers.

The content and progress of the course were placed under Dr. Tom Allan's responsibility on behalf of IOC. The general organization was provided by the IOC and IOCARIBE Secretariats through Mr. Yves Tréglos and Dr. Fernando Robles, respectively. As for local arrangements, they were organized by INTECMAR, University Simón Bolivar, through MSc Ricardo Molinet.

The Chairman of IOCARIBE, Prof. Hernán Perez Nieto, and the Head of the Department of the Environment's Image Processing Laboratory, Venezuela, sat in on much of the course.

The List of Participants is included as Annex II to this Report.

2. **COURSE PROGRAMME**

The five-day programme was modified on the last day to accommodate presentations from participants who had been encouraged to come prepared to make brief presentations of their own work; therefore, during the final morning, reports were heard from Colombia, Cuba, Mexico, Trinidad and Venezuela. The complete programme of the Course is given in Annex I.

3. **TRAINEEs AND LECTURERS**

The trainees were enthusiastic and very willing to learn.

The teachers were acknowledged experts in their own fields and had been carefully selected to provide comprehensive coverage of all major aspects of remote sensing of the marine environment.

The interaction between teachers and students worked well. Not only were the students introduced to a number of new techniques but in several cases, they were able to take away copies of the software on floppy disks.

It was a distinct advantage having a "regional" teacher in the team. Mr. Frank Müller-Karger reported his satellite investigations on the fate of the effluents discharged from the Orinoco which were of direct interest to many of the countries represented.

Likewise all teachers had taken pains to direct their presentations towards Caribbean applications. For example, special analyses of the annual and semi-annual wind and wave fields, derived from GEOSAT over the Caribbean area had been commissioned.

4. **COURSE EVALUATION**

The standard of the lectures was high - a fact readily recognized by the participants.

The course succeeded on several levels:

It was extremely well-organized. Logistics - from setting up 3 computers (2 IBM PC's + 1 Apple Mac) for demonstrations, to arrangements for photocopying, transport, lunch and receptions - ran smoothly. The setting of the University campus was particularly pleasant. A programme of lectures to avoid duplication and ensure adequate coverage had been agreed with each lecturer in advance.

The computer-based UNESCO teaching manual "Some Marine Applications of Satellite and Airborne Remote Sensing" (presented on 5 floppy disks) proved very popular and a copy was requested by every trainee.
The two videos shown - one (in Spanish) on ESA's ERS-1 and the other on GEOSAT were well received. There was considerable interest in the forthcoming ERS-1 programme and general feeling that Caribbean countries may be missing out.

One of the major goals of these courses must be to create opportunities for people engaged in regional environmental research and management to participate in co-operative programmes with laboratories already advanced in remote sensing techniques. At this course, several useful contacts were made and collaborative projects discussed - in particular, future use of ocean colour and temperature measurements in the Caribbean, and the participation of Caribbean countries in future satellite calibration/validation programmes.

The opportunity was also taken to examine ways in which the participants thought a greater degree of co-ordination could be achieved in the area of the Caribbean and these were discussed in open forum during the final day. General Conclusions and Recommendations agreed are listed in section 7 and 8 respectively.

In summary, all participants were anxious to become more closely involved in on-going remote sensing programmes. Suggestions included the installation of a dedicated Caribbean satellite receiving station (limited initially to NOAA AVHRR reception); and establishing a regional network of marine information centres to archive high level satellite products.

The course would not have been the success it undoubtedly was, without a well-co-ordinated effort within the IOC and IOCARIBE Secretariats, and within the lecture team - and between these two activities. In retrospect, it seems almost to have been an advantage to be constrained to operate in a short time-frame, since the decision of holding the course was taken on 27 April 1990 only, which left less than 5 months to organize it altogether. There was little time for prevarication - especially when compromises had to be found to overcome a few initial misunderstandings. Starting only at the beginning of May the lists of potential trainees and teachers were quickly over-subscribed and by mid-July a line had to be drawn.

Towards the end of the course, a questionnaire was circulated (Annex III) designed to gauge the reaction of the students to the course and to try to benefit from any suggestions they could make for future improvements. Their responses are analyzed in Annex IV. In summary, they demonstrate that the participants were pleased with the content of the course - but more than half thought the duration should be extended from one to two weeks.

5. GENERAL CONCLUSIONS

Courses like this, that combine specialists from countries well-developed in remote sensing technology with people involved in regional environmental investigations, are essential if these regional scientists, managers and teachers are to benefit fully from the newly emergent satellite-derived information which will continue to increase throughout the coming decade.

Where possible, courses should be planned to last for two weeks rather than one, and involve an introduction to some of the basic theory as well as specialized presentations directed to the region, plus presentations of the participants on investigations. Where appropriate - and time permitting - the courses should address specific areas of application such as fisheries, pollution control and aquaculture, with which they are associated.

The Course participants concluded that involvement of Caribbean countries in satellite programmes would be greatly enhanced if:

(i) a dedicated Caribbean satellite receiving station were installed;

(ii) a network of Caribbean regional satellite data archives were created.

Satellite calibration and validation programmes could create opportunities for a greater participation by regional centres in on-going satellite programmes.
Steps should be taken to initiate more joint programmes between the different Caribbean research institutes. By forming a Caribbean grouping - possibly recognized at a political level - it may be easier to negotiate access to satellite-derived marine information.

6. RECOMMENDATIONS

A feasibility study should be carried out to assess the costs and benefits of installing an AVHRR station in the Caribbean. If this were to be a joint study involving the participation of several countries, the IOCARIBE Secretariat could play an important co-ordinating role.

Individual research centres with the necessary facilities should be encouraged to investigate how they might participate more actively in satellite validation programmes. Already a number of research organizations in Europe and the USA are involved in these programmes, and contact with them should be encouraged.

IOCARIBE should initiate a feasibility study on the creation of a network of satellite data archives using facilities that already exist or that could be enhanced at modest cost.

As a first step IOCARIBE should commission a global inventory of remote sensing data archive and distribution centres relevant to Caribbean marine activities.

The momentum and interest created by this first course should not be allowed to wither. The possibilities for holding further courses in other developing regions of the world should be studied without delay.

Within the South American continent, investigations should be made in countries bordering the Eastern Pacific (Chile, Peru) to ascertain their potential interest in the application of current satellite remote sensing technology and the extent of their support for a course directed to the particular marine activities of that region.
ANNEX I

COURSE PROGRAMME AND TIMETABLE

Monday 24 September

08.30       Introductory words by:
            Dr. Freddy Malpica, Dean of U.S.B.
            Dr. Fernando Robles, IOC Senior Assistant Secretary for IOCARIBE
            Dr. Hernán Perez Nieto, Chairman IOCARIBE

09.45 - 10.30       Overview of marine remote sensing (Tom Allan)

10.30 - 11.00       COFFEE BREAK

11.00 - 11.55       Evolution or remote sensing Systems (William Emery)

12.00 - 12.55       Fundamentals of RS - Visible/IR (Vittorio Barale)

13.00 - 14.30       LUNCH

14.30 - 15.30       Analysis techniques - Visible IR data (Frank Müller Karger)

15.30 - 16.00       Discussion

Tuesday 25 September

09.30 - 10.30       Applications of ocean colour (phytoplankton, patchiness) (V. Barale)

10.30 - 11.00       COFFEE BREAK

11.00 - 11.55       Applications of ocean colour (global CZCS & N Atlantic) (F. Müller Karger)

12.00 - 12.55       Applications of sea surface temperature (W. Emery)

13.00 - 14.30       LUNCH

145.30 - 15.30      Ocean colour data - Demonstration (F. Müller Karger)

15.30 - 16.30       SST data - Demonstration (W. Emery)

Wednesday 26 September

09.30 - 10.00       Introduction to microwave RS (T. Allan)

10.00 - 10.30       Synthetic aperture radar & theory of scatterometry (William Alpers)

10.30 - 11.00       COFFEE BREAK

11.00 - 11.55       Surface features imaged by SAR (W. Alpers)

12.00 - 12.55       Overview of microwave sensors - past and future programmes (Trevor Guynmer)

13.00 - 14.30       LUNCH

14.30 - 15.30       Applications of SAR & airborne measurements (W. Alpers)
15.30 - 16.00  Video of ERS-1 + demonstrations

**Thursday 27 September**

09.30 - 10.30  The radar altimeter and the measurement of surface topography (Robert Cheyney)

10.30 - 11.00  COFFEE BREAK

11.00 - 11.55  Measurements of waves and wind (T. Guymet)

12.00 - 12.55  Ocean circulation (R. Cheyney)

13.00 - 14.30  LUNCH

14.30 - 15.30  Regional studies: (R. Cheyney)
- El Niño
- Caribbean
- Gulf Stream

15.30 - 16.00  Demonstrations

**Friday 28 September**

09.30 - 10.30  Regional programmes

Presentations from: Colombia, Cuba, Mexico, Trinidad & Tobago, Venezuela

10.30 - 11.00  COFFEE BREAK

11.00 - 11.30  Orbits sampling, synergy & models (T. Allan)

11.30 - 12.00  Future programmes (T. Guymet, V. Barale, R. Cheyney)

12.00 - 12.30  Caribbean requirements for: Marine information, Data reception and Regional centres

12.30 - 13.00  Recommendations
ANNEX II

LIST OF PARTICIPANTS

TRAINNEES

Mr. Rubén APARICIO CASTRO
Instituto Oceanográfico de Venezuela
Universidad de Oriente
Apartado Postal 245
Cumaná, Edo. Sucre
VENezuela
Tel: (58)(93) 653606
Fax: (58)(93) 662785/663412

Carlos Luis BRENES RODRIGUEZ
Universidad Nacional
Departamento de Fisica
Sección de Oceanografía, Heredia
Apartado 86-3000
COSTA RICA
Tel: (37) 6363 (ext.2344)
Fax: 011-506-380086

Leo BREWSTER
Coastal Conservation Project Unit
Savannah Lodge, Garrison
St. Michael
BARBADOS
Tel: 429-8638/429-6933

Mario CAPALDO
Dirección de Hidrografía y Navegación
Observatorio Cajigal
Apartado Postal 6745
Caracas
VENezuela
Tel: (58) 24832432/24831613
Fax: (58) 2410729

José Henry CARVAJAL
INGEOMINAS
Carrera 3, No. 8-116
Apartado Aéreo 2732
Cartagena
COLOMBIA
Tel: (57)(53)655438/655439
Fax: (57)(53)655438

Humberto I. CARVAJAL-CHITTY
Instituto de Recursos Naturales
Universidad Simón Bolivar
Apartado 89000
Sartenejas-Caracas
VENezuela
Tel: (58) 29073149/29073051
Fax: (58) 29621410

Ernesto DIAZ
Ministerio del Ambiente
Dirección de Ordenación del Territorio
Centro Simón Bolivar,
Torre Sur, Piso 9
Caracas
VENezuela
Tel: (58) 24081545/24081546
Fax: (58) 24836118

Jorge Iván EUAN AVILA
Centro de Investigación y Estudios Avanzados del
I.P.N. Unidad Mérida,
Carretera Antigua a Progreso, Km.6,
P. 97310, Apartado Postal 73
CORDEMEX, Mérida, Yucatán
MEXICO
Tel: (52) 26-0212/26-0399
Fax: (52) 99-260943
Tlm: 753654 CIEMME

Gustavo R. GOMEZ H.
Dirección General Sectorial de Pesca y
Acuicultura
Ministerio de Agricultura y Cría (MAC)
Parque Central, Torre Este,
Piso 10, Caracas
VENezuela
Tel: (58) 25090279/25090397

John GRIFFITH
Institute of Marine Affairs
Hilltop Lane, Chaguaramas
P.O. Box 311
Carenage Post Office
TRINIDAD & TOBAGO
Tel: (1)(809)63442914
Fax: (1)(809)6344433
Tlm: IMA.LIBRARY

Jorge GUTIC
Fundación Científica Los Roques
Av. El Estanque, Transversal B
Qta. Los Muchachos, Country Club
Apartado 1139
Caracas 1010-A
VENezuela
Tel: (58) 261-3461/32-6771
Fax: (58) 261-3461
Omar LIZANO R.
Universidad de Costa Rica
Centro de Investigaciones en Ciencias del Mar
(CIMAR)
San José
COSTA RICA
Tel: (506)24-3710

Alberto MARTIN Z.
Universidad Simón Bolívar
Instituto de Tectología y Ciencias Marinas
Apartado 89000
Caracas
VENEZUELA
Tel: (58)(2) 9073218
Fax: (58)(2) 9621695

Nelson MELO G.
Departamento de Teledetección
Centro de Investigaciones de Geodesía,
Cartografía y Teledetección, ICGC
Instituto Cubano de Geodesía y Cartografía
Loma Y 39 Nuevo Vedado
La Habana
CUBA
Tel: (53)38888/39966 Ext.69
Tlx: 511255

Gustavo MONTES U.
Dirección de Geografía y Cartografía de las
Fuerzas Armadas (DIGECAFA)
Fuerte Tiuna, El Valle
Caracas, D.F.
VENEZUELA
Tel: (58) 682-0991
Fax: (58) 682-3405

Julio M. MORELL M.
Universidad de Puerto Rico
Departamento de Ciencias Marinas
P.O. Box 5000
Mayaguez 00709
PUERTO RICO
Tel: (809) 899-4297
899-3838

Carlos A. PARRA LLANOS
Centro de Investigaciones Oceanográficas e
Hidrográficas (CIOH)
Apartado Aéreo 7600
Cartagena
COLOMBIA
Tel: (57)(53) 680642/680643
Fax: (57)(53) 680706
Tlm: TOGA.COLOMBIA

Patricia RAVELO
Instituto de Ingeniería, CPDI
Carretera Nacional Hoyo La Puerte, Baruta
Apartado 40.200
Caracas 1040-A
VENEZUELA
Tel: (58) 962-1244/1155
Fax: (58) 962-1025
Tlm: 21685 INING

INSTRUCTORS
Tom ALLAN
T.D. Allan Associates
71, Bushridge Lane
Godalming, Surrey, GU7-1QQ
UNITED KINGDOM
Tel: (44)(4868)25559
Fax: (44)(4868)23882

Werner ALPERS
University of Hamburg
Institute of Oceanography
Tropowitzstr 7
D-2000, Hamburg 54
GERMANY
Tel: (49)(40)4123-5432
Fax: (49)(40)4123-5713
Tlx: 212586
Tlm: IFM HAMBURG

Robert CHENEY
NOAA National Ocean Service
N.C.G11 Rockville, MD 20852
U.S.A.
Tel: (1)(301)4438556
Fax: (1)(301)4685714
Tlm: NOAA GEOSAT (OMNET)

William EMERY
University of Colorado
CCAR Box 431
Boulder, CO. 80309
U.S.A.
Tel: (1)(303)492-8591
Fax: (1)(303)492-2825
Tlm: W.EMERY/OMNET;
EMERY/OMNET;
@ORBIT.COLORADO.EDU;
BEMERY/NASAMAIL
Trevor GUYMER
Institute of Oceanographic Sciences
(James Rennell Centre for Ocean Circulation)
Wormley, Godalming, Surrey GU8 5UB
UNITED KINGDOM
Tel: (42)-868-4141
Fax: (42)-868-3066
Tlm: IOS.WORMLEY
Tx: 858833 OCEANSG

Frank E. MULLER-KARGER
University of South Florida
Dpt. Marine Science
140 7th Avenue, South
St. Petersburg, FL 33701
U.S.A.
Tel: (813)8939186/8939625
Fax: (813)8939189
Tlm: FMULLER.KARGER/OMNET
(CARI@CARBON.marine.usf.edu;
CARIB@MSL1.marine.
usf.edu:internet)

SECRETARIAT

Fernando ROBLES
Intergovernmental Oceanographic Commission
(IOC)
Sub-Commission for the Caribbean and Adjacent
Regions (IOCARIBE)
P.O. Box 1108
Cartagena de Indias
COLOMBIA
Tel: (57)(53)650395/646399
Fax: (57)(53)650395
Tlm: IOCARIBE.SEC

David A. SALAS DE LEON
Universidad Nacional
Autónoma de México
Instituto de Ciencias del Mar y Limnología
Apartado Postal 70-305
04510 México D.F.
MEXICO
Tel: (52)(5)5-50-5864
Fax: (52)(5)5-48-2582
Tlm: CICME 1760155

Roselena SANCHEZ
Universidad Francisco de Miranda
Centro de Investigaciones Marinas (CIMAR)
Plaza Antillana, Ed.Antigua Aduana
La Vela de Coro, Edo. Falcón
VENEZUELA
Tel: (58)(68)78639
Fax: (58)(68)515352/513776
ANNEX III

QUESTIONNAIRE FOR COURSE EVALUATION BY TRAINEES

This is the first IOC Course on Remote Sensing. Your comments will help us determine how useful it was to you and how it might be improved in future. You may remain anonymous if you wish. Thanks for your help.

Please tick one box:

1. I found the course: a) very useful  
   b) satisfactory  
   c) of limited usefulness

2. I was satisfied with the overall balance
   or
   I would have preferred more emphasis on: a) VIS/IR  
   b) microwave

3. I found the demonstrations: a) very useful  
   b) satisfactory  
   c) of limited usefulness

If (c), demonstrations could be improved by:

____________________________________________________________________
____________________________________________________________________
____________________________________________________________________
____________________________________________________________________

4. I found the technical level of lectures: a) just about right  
   b) too high  
   c) too low

5. The duration of the course was: a) just about right  
   b) too short  
   c) too long

If (b) or (c) what should the duration be:

____________________________________________________________________

6. What sort of additional aids would you prefer (tick more than one if you wish):
   a) list of references  
   b) copies of all lecture notes  
   c) a selection of copies of visual aids  
   d) a course "textbook" distributed beforehand  
   e) a collection of short abstracts of each talk
7. My main field of interest is in the area of:
   a) coastal studies
   b) coastal management
   c) marine biology
   d) physical oceanography
   e) education
   f) other
   please specify __________________________

8. How could this interest be enhanced through regional/sub-regional co-operation (please comment):

_________________________________________________________________________
_________________________________________________________________________
_________________________________________________________________________
_________________________________________________________________________
_________________________________________________________________________
_________________________________________________________________________
ANNEX IV

ANALYSIS OF ANSWERS TO THE QUESTIONNAIRE

1. All trainees expressed satisfaction with the course; a majority found it "very useful".

2. 70% thought the balance of the contents right; 24% would have liked more on visible/IR and 6% more in microwaves.

3. 82% found the computer demonstrations useful. Suggestions for improvements included:
   * Specially prepared manuals to accompany some of the demos.
   * More basic information on how to generate the images used in the majority of demos.
   * More examples directed to specific applications.

4. 94% found the level of lectures OK, 6% too high.

5. 55% thought the duration of the course should be two weeks rather than one. None thought it too long.

6. This question was probably incorrectly framed; it should have asked for a preferred priority. Instead, not surprisingly, the students between them opted for every sort of additional aid.

7. The majority of students listed more than one field of interest. They broke down as follows:

<table>
<thead>
<tr>
<th>Field</th>
<th>%</th>
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<tbody>
<tr>
<td>Coastal studies</td>
<td>31</td>
</tr>
<tr>
<td>Coastal management</td>
<td>21</td>
</tr>
<tr>
<td>Marine biology</td>
<td>18</td>
</tr>
<tr>
<td>Physical Oceanography</td>
<td>18</td>
</tr>
<tr>
<td>Education</td>
<td>5</td>
</tr>
<tr>
<td>Image processing</td>
<td>5</td>
</tr>
<tr>
<td>Fisheries</td>
<td>2</td>
</tr>
</tbody>
</table>

   100%

8. The many and varied answers to this question was discussed in open forum following presentations from five of the countries represented. Most of these are incorporated in the Conclusions and Recommendations.
ANNEX V

LIST OF "NATIONAL REPRESENTATIVES" TO WHOM COPIES OF DEMONSTRATION SOFTWARE AND VIDEOS WERE SENT

For full address of the contact points, see Annex II (List of Participants).

<table>
<thead>
<tr>
<th>Name</th>
<th>Country</th>
</tr>
</thead>
<tbody>
<tr>
<td>APARICIO CASTRO, Ruben</td>
<td>Venezuela</td>
</tr>
<tr>
<td>BREWSTER, Leo</td>
<td>Barbados</td>
</tr>
<tr>
<td>EUAN AVILA, Jorge Ivan</td>
<td>Mexico</td>
</tr>
<tr>
<td>GRIFFITH, John</td>
<td>Trinidad &amp; Tobago</td>
</tr>
<tr>
<td>LIZANO, Omar</td>
<td>Costa Rica</td>
</tr>
<tr>
<td>MELO, Nelson</td>
<td>Cuba</td>
</tr>
<tr>
<td>MORELL, Julio</td>
<td>Puerto Rico</td>
</tr>
<tr>
<td>PARRA LLANOS, Carlos</td>
<td>Colombia</td>
</tr>
<tr>
<td>RAVELO, Patricia</td>
<td>Venezuela</td>
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# ANNEX VI

## LIST OF ACRONYMS

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>AO</td>
<td>Announcement of Opportunity</td>
</tr>
<tr>
<td>AVHRR</td>
<td>Advanced Very High Resolution Radiometer</td>
</tr>
<tr>
<td>CZCS</td>
<td>Coastal Zone Colour Scanner</td>
</tr>
<tr>
<td>GSFC</td>
<td>Goddard Space Flight Centre (USA)</td>
</tr>
<tr>
<td>ERS-1</td>
<td>Earth Remote Sensing Satellite</td>
</tr>
<tr>
<td>ESA</td>
<td>European Space Agency</td>
</tr>
<tr>
<td>IOCARIBE</td>
<td>IOC Sub-Commission for the Caribbean and Adjacent Regions</td>
</tr>
<tr>
<td>IR</td>
<td>Infra-red</td>
</tr>
<tr>
<td>NOAA</td>
<td>National Oceanographic and Atmospheric Administration (NOAA)</td>
</tr>
<tr>
<td>PI</td>
<td>Principal Investigator</td>
</tr>
<tr>
<td>UNESCO</td>
<td>United Nations Educational, Scientific and Cultural Organization</td>
</tr>
</tbody>
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