Ocean Colour 2009 Africa:

"Methods and Applications of Ocean Colour Remote Sensing in African Coastal and Regional Seas".

(Zanzibar, Tanzania, Oct.12th – 23rd, 2009)

COURSE SYNOPSIS

In partnership with:

		Mon 12/10	Tue 13/10	Wed 14/10	Thu 15/10	Fri 16/10
9:00	*10:30*	welcome (N. Hoepffner) Opening (Dr. Kyewalyanga, IMS Director)	**Session 2:** ***M. Dowell*** Ocean colour in-water algorithm; empirical/ analytical regional & coastal waters algo.	**Session 3:** ***A. Bricaud*** Optical variability; case 1 / case 2 waters	**Session 4**: ***R. Doerffer*** Ocean Colour sensors; Atmospheric correction (processes)	**Session 5: N. Hoepffner** phytoplankton biomass - primary production carbon cycle
11:00	*12:30*	Intro to Satellite oceanography (N. Hoepffner)				
		LUNCH	LUNCH	LUNCH	LUNCH	LUNCH
14:00	*17:30* (18:00)	**Session 1:** ***S. Bernard*** In-water optics Basic theory and measurements/instrumentation	**practical 2:** Valborg Byfield BiLKO software	**practical 1:** ***R. Doerffer*** BEAM Envisat and MERIS Toolbox special seminar: **S.Bernard** - HABs	**practical 3:** *C. Whittle (+others)* SeaDAS / IDL software	**practical 3:** C. Whittle (+others) SeaDAS/ IDL software (cont.)

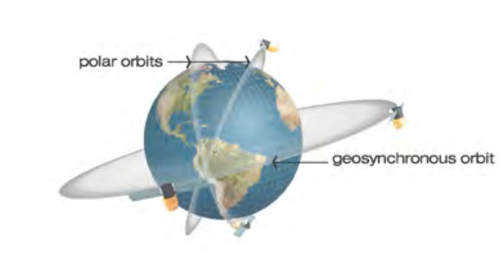
		Mon 19/10	Tue 20/10	Wed 21/10	Thu 22/10	Fri 23/10
9:00	*10:30*	**Session 6: Jesus Morales** OC applications to marine resources conservation and management; fisheries	**Session 7: N.Hoepffner** OC and water quality	**Session 9: Lucy Scott** optical radiometry in shallow water applications to habitat mapping	**practical cont.: Mini-project**	Final course conclusions Mini-projects presentation (10 min each)
11:00	*12:30*		**Session 8: V. Byfield** Marine data dissemination: GEONETCast			closing Training Course
		LUNCH	LUNCH	LUNCH	LUNCH	LUNCH
14:00	*17:30* (18:00)	**practical cont.: Mini-project** Supervision : C.Whittle, V. Byfield,….	**practical cont.: Mini-project**	**practical cont.: Mini-project** special seminar: Y. Shaghude Coral Reef Assessment	**practical cont.: Mini-project**	

Introductory Session (Oct.12 , 11:00 – 12:30)

Introduction to Satellite Marine Studies

Nicolas Hoepffner
Global Environment Monitoring Unit
Institute for Environment & Sustainability,
European Commission – Joint Research Centre, Ispra, Italy

Sophisticated satellite observations systems have significantly contributed to the objective of major international scientific programme aiming at a better understanding of the dynamics of the ocean, the biogeochemical cycles at the global and basin scales, as well as the climate system. Wind speed and direction, surface heat fluxes, momentum and material including carbon dioxide, the biological production of organic material, and the variability of surface currents are now being investigated from various satellite sensors. These observations in turn are used to initiate and constrain appropriate models of the upper ocean, based on advanced data assimilation techniques. A quick review of various ocean observation techniques will be presented with their specificity to address environmental issues in the coastal and marine waters.



Outline of the lecture:

- Orbital characteristics
- Image systems and sesnors
- Data transmission and storage
- Marine applications

This introduction will be followed by the projection of a film **“ The Science of Ocean Colour “** (30-40 min.) produced by Dr. Roland Doerffer

Lecture Sessions

Lecture Session 1 (Oct.12, 14:00 – 17:30)

Introduction to In –Water Optics: Theory and Measurements

Stewart Bernard
Ecosystem Earth Observation
Council for Scientific and Industrial Research, Cape Town, South Africa

The ability to describe and explain the behaviour of light in natural waters is fundamental to understanding the science and applications of ocean colour. The course will start by describing the nature of the underwater light field, and the principal bio-optical concepts and attributes needed to understand the behaviour of light in the sea. The session will then focus upon the interaction of light with the various dissolved or particulate substances present in the upper ocean, their optical properties and subsequent effects on the underwater light field, and how these processes impact upon ocean colour.

The module will encompass the following:

Introductory Theory

- Re-introduction to the nature of electromagnetic energy in the visible.
- Defining and describing the light field: the theory of radiative transfer, the angular structure of the light field, definitions and theory of apparent optical properties (AOPs).
- Defining and describing the optical properties of seawater constituents: definitions and theory of inherent optical properties (IOPs), absorption, elastic and inelastic scattering, the identity and character of primary IOPs in the sea.

Measurements & Modelling

- Measuring AOPs: typical instruments, techniques and applications; above and in-water radiometry, preliminary characterisation of common AOPs.
- Measuring IOPs: typical *in situ* and laboratory instruments, techniques and applications; absorption/scattering measurements and underlying theory, preliminary characterisation of common IOPs, a brief introduction to IOP modeling techniques.
- Reflectance and radiative transfer modeling – bringing it all together by modeling AOPs based on IOPs and their underlying constituent character.

The focus will be on allowing students to gain a descriptive (as opposed to mathematical) understanding of in-water bio-optics, and use this to approach remotely sensed ocean colour from an analytical perspective. Examples using different applications in a variety of oligotrophic and coastal systems will be used.

Lecture Session 2 (Oct. 13, 09:00 -12:30)

Ocean Colour In-Water Algorithms

Mark Dowell
Global Environment Monitoring Unit
Institute for Environment & Sustainability,
European Commission – Joint Research Centre, Ispra, Italy

This session on in-water algorithms will trace the history of the development of algorithmic methods applied to Ocean Colour data starting with the very first algorithms applied to global datasets obtained from the CZCS sensor.

We will outline the evolution of algorithm development as the knowledge on the optical properties of both open ocean and coastal waters have improved over the last three decades. Additionally we will examine the mathematical and statistical approaches (neural networks, non-linear optimisation, spectral un-mixing, principal component analysis etc.) that have been explored to make best use in using the radiometric quantities measured by the sensors in retrieving the relevant geophysical quantities of interest.

Specific attention will be placed on underlining the complexities of applying such methods in coastal regions (which is of specific interest to many of the applications considered in the present course), and considerations will be made on the limitation and uncertainties that need to be understood.

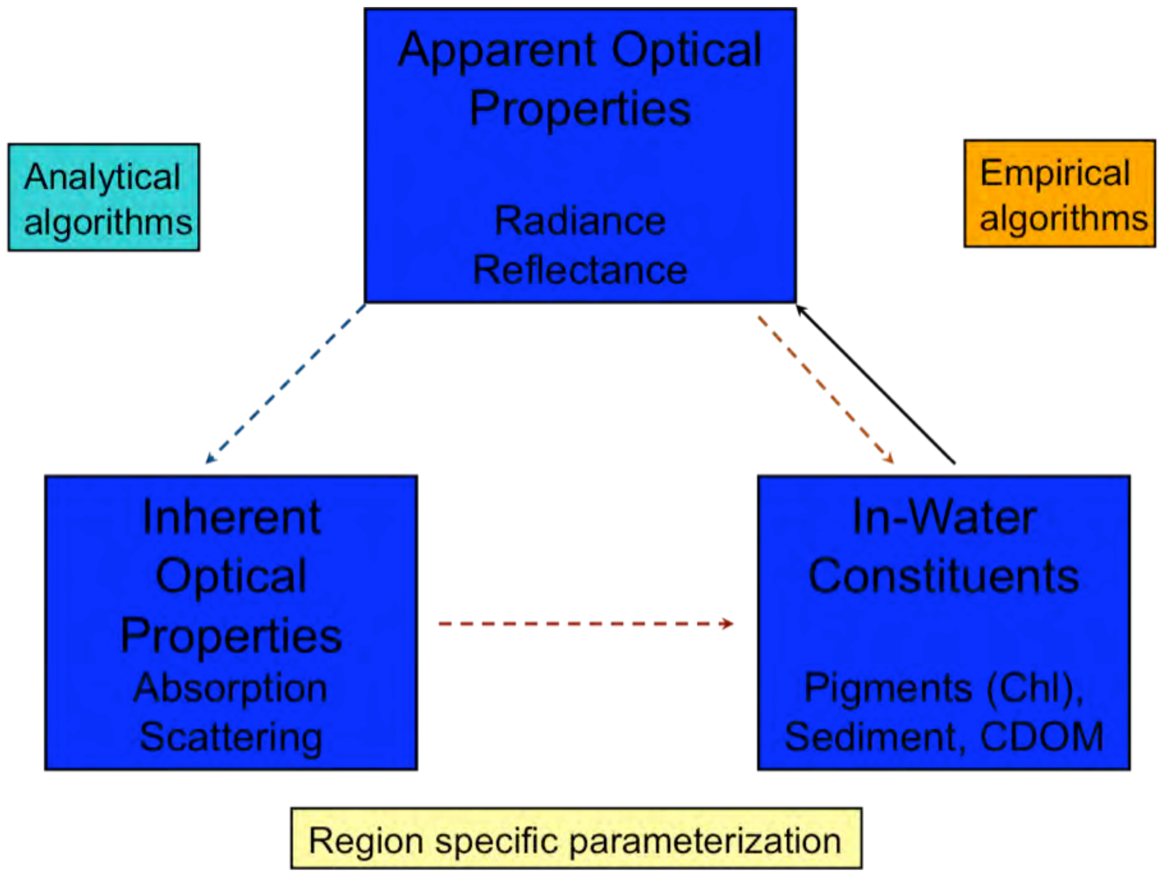
Furthermore we will analyse the parallel progress of both the empirical and semi-analytical method, and consider the merits and deficiencies of each of these, providing a clear understanding of the difference between these methods and their practical application in the operational processing of data (see flowchart below).

Complimentary to this we will specifically consider the results from an intensive round robin inter-comparison of different semi-analytical methods (performed by the IOCCG).

In considering all of these various aspects of different available algorithms we will underline which algorithms have been considered for routine processing by the major space agencies (and why ?).

Continuing we shall address the relative benefit of using standard global coverage products compared to regional algorithms and visa versa, and explore various alternatives for the implementation of regional algorithms. Here we will investigate the "minimum requirements" for the implementation of such regional algorithms (i.e. required datasets, “Level” of satellite data required, computing knowledge, infrastructure).

Finally we will make some considerations on the future direction for research on these topics. And deal with any real world examples/questions that participants may have and want to address.



Lecture Session 3 (Oct.14, 09:00 -12:30)

Optical variability of Case 1 and Case 2 waters

Annick Bricaud
Laboratoire d'Océanographie de Villefranche,
CNRS and Université Pierre et Marie Curie, Villefranche-sur-mer, France

The « optical variability » of marine waters usually refers to two categories of optical properties : (1) the « inherent optical properties (IOPs) » which depend only on the medium itself, and are independent from illumination conditions, and (2) the « apparent optical properties (AOPs) », which depend both on the IOPs and on the geometrical structure of the light field, and which allow the light propagation within the ocean and its return toward the atmosphere (and consequently ocean color) to be predicted. The « radiative transfer equation » (RTE) establishes the exact relationship linking the two categories of properties. Therefore, understanding or modeling the optical variability of marine waters requires the knowledge of their IOPs, and of their sources of variability.

The fundamental IOPs are the absorption coefficients, the volume scattering function and the source function (see Session 1). Other IOPs, such as total scattering, backscattering or attenuation coefficients, are derived from these fundamental IOPs. The IOPs of the various substances are additive, therefore the bulk IOPs of marine waters can be predicted by summing the contributions of individual components.

« Case 1 » waters are oceanic or coastal waters containing only phytoplankton and associated biogenous (particulate and dissolved) matter. Even in these waters, there exist numerous sources of optical variability :

- the absorption and scattering properties of phytoplankton depend on pigment composition, refractive index, size and shape of cells, and are therefore highly variable with phytoplanktonic species ;
- for a given population, the IOPs depend on the physiological state of cells, and therefore on environmental factors (light, nutrients…), which induces for some IOPs a large diel variability;
- the non-algal compartment includes various components : biogenous detritus, heterotrophic bacteria, viruses, colored dissolved organic matter (CDOM)... These components have variable absorption and scattering properties, and their relative proportions are also variable in natural waters.

Sources of optical variability are still more numerous in « Case 2 » waters, which are those waters (essentially coastal waters) affected by terrigenous or anthropogenic inputs. In these waters, in addition to phytoplankton and associated detrital matter, other components (mineral particles of terrestrial or atmospheric origin, terrigenous CDOM…) have variable specific optical properties, due to variations in composition, refractive index, particle size and shape. The relative proportions of these components are also highly variable, thus contributing to the large optical variability of bulk absorption and scattering in these waters (see Figure).

Various empirical or semi-analytical parameterizations have been proposed for the absorption and scattering properties of Case 1 and Case 2 waters. We will review these parameterizations, and the actual amplitude of « biological noise », resulting from the above mentioned sources of variability.

Finally we will describe, using simple bio-optical models, how the variability of IOPs impacts the AOPs of marine waters, and particularly ocean color.

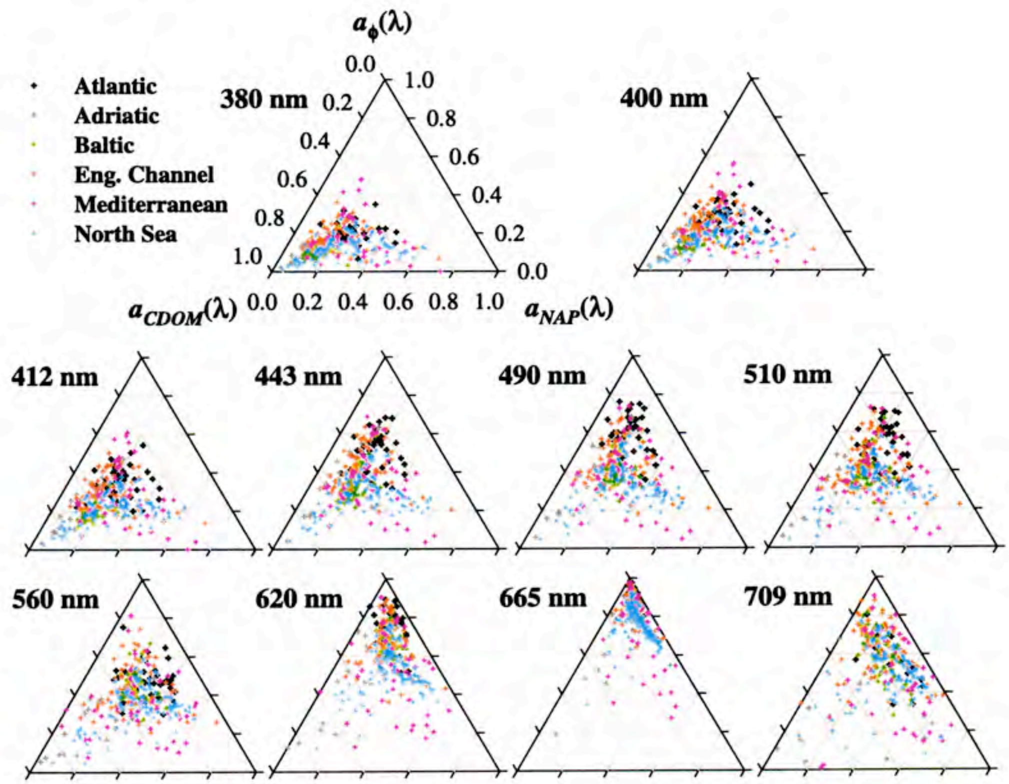


Figure : Ternary plots illustrating the relative contributions of phytoplankton, non-algal particles (NAP) and colored dissolved organic matter (CDOM) to total absorption in European waters (Babin et al. 2003).

Lecture Session 4 (Oct.15, 09:00 -12:30)

Introduction to Ocean Colour Sensors, Atmospheric Correction

Roland Doerffer
GKSS Institute for Coastal Research
Max-Planck-Str.1, 21502 Geesthacht, Germany

The lecture of this section of the course will provide an introduction into ocean colour satellite sensors, their characteristics, requirements and calibration. This will lead to the next most critical step in ocean colour remote sensing: the retrieval of the water leaving radiance from the top of atmosphere (TOA) radiance. Since most of the TOA radiance stems from the direct and the specularly reflected path radiance, small errors in the correction of the influence of the atmosphere translates into a large error in the retrieval of the water leaving radiance and in turn in the retrieval of inherent optical properties and concentrations. The different steps will be illustrated mainly for the Medium Resolution Imaging Spectrometer MERIS on ENVISAT.

Lecture Outline:

Basic Principles of ocean colour satellite sensors

Past, present and future sensors

Calibration of sensors and accuracy issues

Principles of atmospheric correction

Special requirements for atmospheric correction for coastal waters

Validation procedures

MERIS on ENVISAT

MERIS products for coastal waters

Continuity: ESA’s SENTINEL program

Introduction into BEAM Software

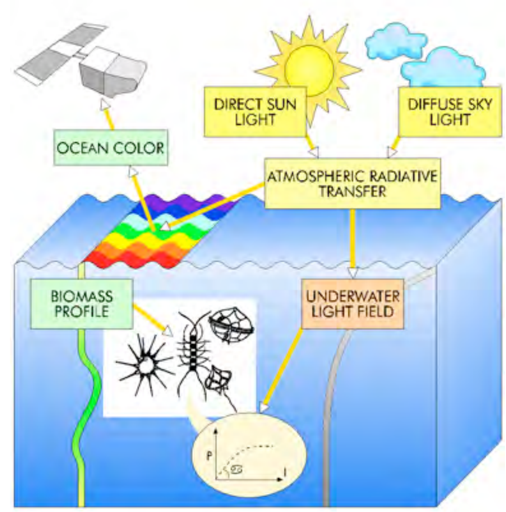
Lecture Session 5 (Oct. 16, 09:00 -12:30):

Ocean Colour Applications to the Marine Carbon Cycle

Nicolas Hoepffner
Global Environment Monitoring Unit
Institute for Environment & Sustainability,
European Commission – Joint Research Centre, Ispra, Italy

Life in the ocean stems primarily from the conversion by phytoplankton of the radiant energy from the sun into biochemical energy, i.e. the process of photosynthesis. This energy will then be used for the production of organic matter through the primary reduction of inorganic carbon in the upper layer of the ocean (so-called Primary Production).

Different formulations exist for calculation of primary production at a given location. These models can be differentiated by their degree of complexity and explicit resolution in depth, time, and irradiance. However, an exact mathematical representation of primary production lies commonly in the response of phytoplankton photosynthesis to irradiance. In this session, the terminology and models of the P-I relationships will be reviewed. Emphasis will be put into models used in the calculation of daily-water-column primary production and the model inputs.



There are two significant aspects of this task which are not directly amenable to remote sensing, the first being vertically resolving the chlorophyll profile and the second the determination of the photosynthetic parameters. In broad terms two distinct fields of thought have developed on how to best address this limitation of the satellite-based primary production estimates. The first approach strives to identify "environmental proxies" (such as temperature or trophic state) to map out the required parameters the second makes the use of biogeographical template of provinces for the oceans as a means to assign the required parameter in the model parameterization. Specific items presented will include

- Requirement for mapping primary production at synoptic scale
- Limitations of satellite datasets in addressing primary production

- Conceptual basis of different approaches
- Biogeochemical Provinces for parameter assignment
- Dynamic Provinces

The variability in the space-time domain and long-term changes in the marine primary production has important consequences on the major biogeochemical cycles and the distribution of marine resources. We will see that the role of satellite is determinant to understanding the carbon seasonal cycle and its variability.

Lecture Session 6 (Oct.19, 09:00-12:30):

Ocean Colour Applications to Marine Resources Conservation and Management - Fisheries

Jesus Morales
Global Environment Monitoring Unit
Institute for Environment & Sustainability,
European Commission – Joint Research Centre, Ispra, Italy

The recent ecosystem-based approach proposed by FAO in 2002 was adopted by the UN World Sustainability Conference (Johannesburg, 2002), and included in the Millennium objectives Project. From a scientific point of view, the methodological procedures of the new ecosystem-based approach are still under discussion, actually giving a high priority to the implementation of operational ecosystem indicators. From a remote sensing perspective, a critical issue for application of this technique in the ecosystem-based approach involves the identification and functional ecology knowledge of the pelagic ecosystems under exploitation, with an special attention to the behaviour of the species along their life cycle, as well as the food webs interaction.

The presentation will be divided in two main topics: i) relevant aspects of physical and biological oceanography within the life cycle of marine fisheries species; ii) potentialities and constraints of the physical principals involved in remote sensing for its application in the exploitation and conservation of marine biological resources.

In the first part of the presentation, we will search those physical or biological marine processes related to the reproduction and feeding patterns of pelagic species. Thus, the food availability for young larvae is critical for fish recruitment, the quality and quantity of food is driven by environmental (e.g. climate change), physical (fronts, currents, upwelling, etc.) and biological processes (plankton blooms, etc.) processes (Figure 1).

Several hypotheses linking environmental and biological processes has been proposed in the last century, the most relevant ones will be briefly explained and discussed from a remote sensing perspective. The ecological background, needed to discriminate the most relevant physical ocean features involved in the protection and management of marine living resources, will be discussed

The second part of the presentation will be focused on the remote sensing techniques used in fisheries applications. An historical review of the remote sensed data will show us how the sea surface temperature (SST) has been used as indicator of many of the physical oceanographic features we were looking for.

Also, how the ocean colour data has extended the knowledge on the pelagic ecosystem introducing the biological component and more realistic information about the ecology of the upper layer of the water column and not only the ocean skin information provided by the SST image data.

A synoptic comparison about advantages and disadvantages offered by each single source of information (SST, ocean colour, altimetry data) from a fisheries perspective will be used as introduction for the discussion on the realistic and not potential use, of remote sensing in fishery sciences.

Some examples of operational applications of single or assimilated remote sensed data will serve as basis for an open discussion and understanding of the current situation of this field.

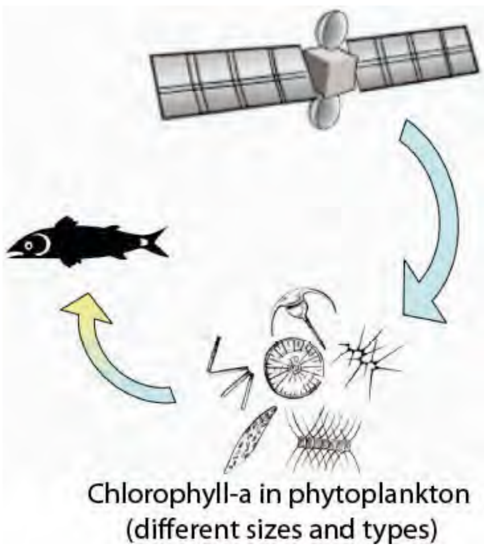


Figure 1. Original from Wilson et al. In press IOCCG Report 8

Lecture Session 7 (Oct.20 , 09:00-10:30):

Water quality monitoring & coastal zone management

Nicolas Hoepffner
Global Environment Monitoring Unit
Institute for Environment & Sustainability,
European Commission – Joint Research Centre, Ispra, Italy

All water systems, inland surface waters, estuaries, coastal waters, are exposed to an increasing external pressure, natural or anthropogenic. These pressures are interconnected in many ways and are acting simultaneously to affect the quality of the waters with loss of habitats and biodiversity, deterioration of the ecosystems, often posing human health at risk.
In this session, the applications of ocean colour to assess the following coastal issues will be introduced:

Water turbidity or water transparency

Identifying water turbidity from space can be made by examining the amount of reflectance in the visible region. The reflectance percentage over two spectral bands can be, in turn, correlated with attenuation, Secchi disk depth and total suspended matter although the relationships will vary regionally and depends on the optical properties of the water.

Particles transport and coastal erosion

The total concentration of scattering matter is estimated based on the total scattering coefficient and a scattering efficiency by arbitrary size particle averaged over a given size distribution. This provides new application for using the scattering coefficients derived from ocean colour satellites to understand the variability of the size distribution in coastal waters, to understand how river-born particles are delivered and dispersed in the ocean, to monitor changes in the size distribution of the particles with physical processes.

Eutrophication

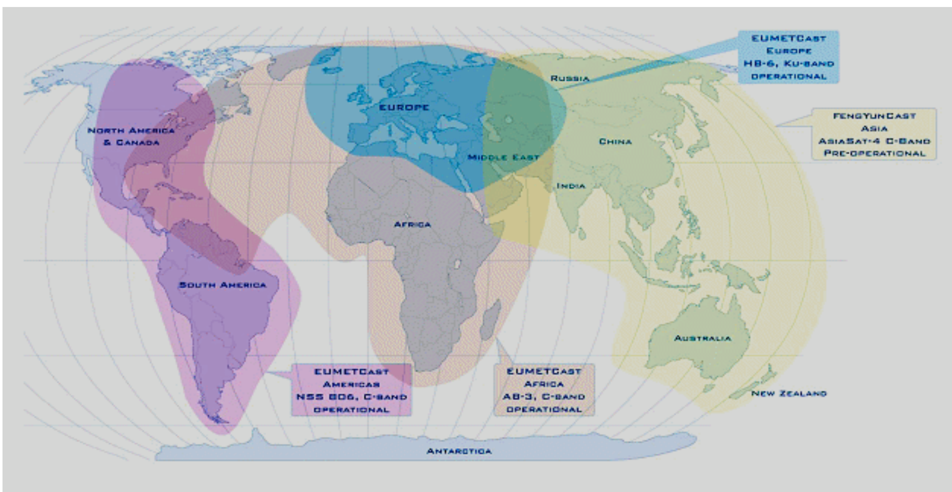
The process of eutrophication is the ecosystem response to an excess of nutrients commonly issued from human activities through river runoff, direct inputs from urban and industrial waste treatment, and atmospheric pollution. It results as some anomalous production of organic material due to an intensification of phytoplankton photosynthesis. This, in turn, can reduce the water transparency and oxygen availability at depth, causing irreversible loss of habitats and species mortality.

Lecture Session 8 (Oct.20 , 11:00-12:30):

Data dissemination system for Marine Resource Management: Introduction to GEONETCast

Valborg Byfield
Ocean Observing & Climate Division
National Oceanographic Centre
Southampton, SO14 3ZH, United Kingdom

GEONETCast is a near real time, global network of satellite-based data dissemination systems designed to distribute essential environmental data to diverse communities around the world. Using low-cost receiving stations and software tools, users have access to a range of data products and information as a basis for environmental monitoring and sound resource management.



Funded by the European Community 7th Framework Programme, DevCoCast is a GEONETCast project that aims to involve developing countries in the GEONETCast initiative by setting up a strong network of data user and providers. Marine data disseminated via DevCoCast include *in-situ* Earth observation data for the seas around Africa from the ChloroGIN project. The data are produced by MA-RE (South Africa), the Plymouth Maritime Laboratory (PML) in the UK, and the EC Joint Research Centre (JRC) in Italy and is broadcast via EUMETCast.

This lecture will take a closer look at marine data and training materials available via GEONETCast, with particular emphasis on the marine data from the DevCoCast project.

Lecture Session 9 (Oct.21, 09:00-12:30):

Introduction to remote sensing of coral reefs

Lucy Scott
African Coelacanth Ecosystem Program
South African Institute for Aquatic Biodiversity
Private Bag 1015, Grahamstown 6140, South Africa

Scale of interest (global to community-scale)

Indirect remote sensing

Sea Surface Temperature and coral bleaching
Coral reef connectivity
Case study: land-reef and reef-reef connectivity matrices using ocean color data

Direct remote sensing

Sensors: airborne and spaceborne, multispectral and hyperspectral
The status of hyperspectral technology for coral reef assessment
Benthic mapping using multispectral data: geomorphology and habitat mapping and accuracy
Resource assessment using habitat maps
Habitat suitability ecological modeling using remote sensing products
Case studies
Stock assessment of benthic commercial resources using field and remote sensing data
Definition of Marine Protected Areas
East-Africa, Madagascar and Indian Ocean islands geomorphology mapping

An introduction to Geographic Information Systems

Introduction to GIS concepts and principles
An overview of different types of marine and coastal data
Using remote sensed data for coastal management

Special Seminars

Wednesday 14 October evening (time: to be defined)

Introduction to Harmful Algal Blooms and Ocean Colour

Stewart Bernard,
Ecosystem Earth Observation
Council for Scientific and Industrial Research, Cape Town, South Africa

Ocean colour radiometry offers considerable potential for the observation of harmful algal blooms (HABs) – HAB-related observations are often seen as high impact motivating factors for ocean colour and/or bio-optical components of coastal observing systems. However, effective HAB detection, monitoring and analysis requires an appreciation of the sizable uncertainties associated with ocean colour applications in the optically complex coastal zone. There is also a need for observation systems to be cognisant of the ecological role of the wide variety of potentially harmful algal blooms across global coastal ecosystems; and information regarding the suitability of available ocean colour techniques for HAB application to different ecosystems. This module aims to provide a short "consumer's guide" to ocean colour- based harmful algal bloom methods; summarising various HAB ecosystem types, and the state of knowledge with regard to potentially suitable ocean colour techniques.

The module will encompass the following:

Summary of HAB-prone Ecosystems based on GEOHAB Core Research Structures

- HAB events and species in upwelling, eutrophic, stratified and embayment systems.
- HABs as ecologically significant phenomena within these systems: types, impact and controlling/forcing mechanisms.
- HABs as phytoplankton functional types: exploring the mandala and intaglio.

Summary of Current and Emerging HAB related OC techniques

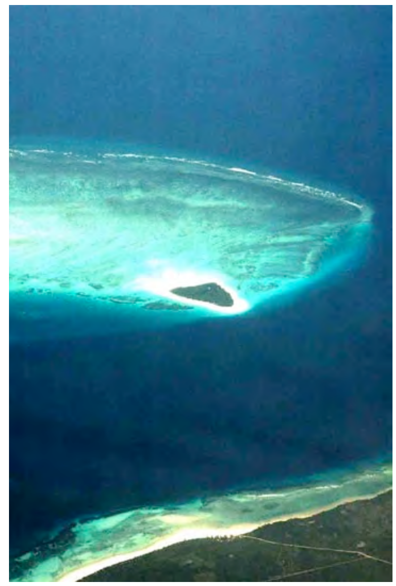
- Methodological challenges for OC application in coastal and inland waters
- Empirical algorithms: simple biomass detection with standard products, regional empirical, red wavelength algorithms for high biomass detection, simple TOA algorithms...
- Anomaly/change detection techniques: empirical types using anomalies relative to climatologies for operational detection e.g. Gulf of Mexico...

- Bright water techniques: simple operational, i.e. non-quantifiable, detection of abnormally high turbidity waters that can circumstantially be associated with given groups such as harmful cyanobacteria...
- Spectral discrimination techniques: reflectance anomaly approaches, optical water type classification techniques...
- Semi-analytical inversion algorithms: use of inversion algorithms, both inherent optical property and biogeochemically focused, including phytoplankton functional type approaches...

Oct.21 (time to be defined)

Mapping of coral reef threats in Tanzania

Y.W. Shaghude, C.A. Muhando, M.S. Shalli and M.Mangora
Institute of Marine Sciences
P.O Box 668
ZANZIBAR



The stakeholders' interview survey data collected from five pilot study sites (Tanga, Dar es Salaam, Mafia, Unguja and Pemba) along the coast of Tanzania was used to elucidate the current leading coral reefs threats in Tanzania. The major objective of this study which was conducted under the auspices of the GEF/World Coral Reef Targeted Research for Capacity Building and Management (CRTR) through its East African Centre of excellence was to establish a GIS database highlighting the major coral reef threats in Tanzania. Though fishing is dominated by small vessels (dug-out canoes and out-rigged canoes) their concentration on shallow water environment, including coral reefs was identifies as the biggest threat to coral reefs. The fast increasing number of fishers due to lack of appropriate alternative employment opportunities, dwindling stock sizes, coupled by free access have increased the use of destructive fishing practices. On the Tanzania mainland, especially Tanga and Dar es Salaam, dynamite fishing ranked highest, while in Unguja and Pemba (Zanzibar) and Mafia (Tanzania Mainland), the use of dragnets ranked highest. Small mesh nets, anchor damage, boat anchorage, coral mining and trampling were ranked second. Sewage discharge, industrial pollution, Oil pollution, and poison fishing were ranked third. Lack of quantitative data of land based pollutants reaching coral reefs or their linkages (indicators) on coral reef health complicated the ranking of land based threats. Vulnerable coral reef areas were therefore ranked according to their proximity to threats rather than the actual influence of the threats. Much better approaches are required to evaluate vulnerability indices based on both natural and anthropogenic disturbances.

Practical Sessions

Practical Session 1 (Oct. 13 , 14:00 -17:30):

The UNESCO-Bilko image processing software

Valborg Byfield
Ocean Observing & Climate Division
National Oceanographic Centre
Southampton, SO14 3ZH, United Kingdom

This Bilko practical uses 1 km resolution chlorophyll and SST data produced by the Marine Remote Sensing Unit (MRSU) of the University of Cape Town for ChloroGIN and the DevCoCast Project to demonstrate how the software may be used to create temporal composite of daily data. Using 4km and 9km chlorophyll products from NASA, the practical also looks briefly at tools available for studying time series of ocean colour data.
These includes the use of median filtering to fill minor data gaps caused, for example by scattered cloud, Hovmöller diagrams to study propagating features such as eddies, and Principal Components Analysis (also known as Empirical Orthogonal Function analysis) to study patterns of interannual variability.

The software is free to registered users, and can be downloaded from the Bilko website at www.unesco.bilko.org by logging in and following links to the download area of the site.

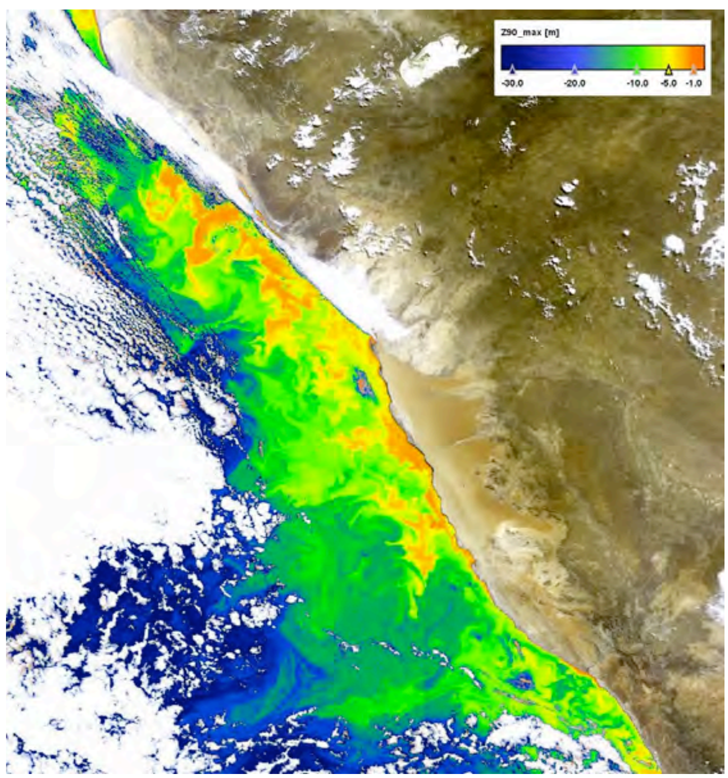
Practical Session 2 (Oct.14, 14:00 -17:30):

Introduction into Ocean Colour Remote Sensing of Coastal waters using MERIS and BEAM Software

Roland Doerffer
GKSS Institute for Coastal Research
Max-Planck-Str.1, 21502 Geesthacht, Germany

For the analysis of MERIS data we will use the BEAM software in the exercise part. BEAM is a modular image processing and analysis software, which is mainly dedicated to data of imaging ENVISAT sensors, but which can be applied also to sensors of other missions and which can be extended by users through the plug in concept.

For the introduction we will use level 1 (toa radiances) and level 2 data (bio-geophysical products) and will also generate L2 products from L1 data using the case 2 water processor, which is part of BEAM. In the final step we will create a chlorophyll or suspended matter map in the form of a micro project.



The image shows the light penetration depth along the coast of Namibia, determined from a MERIS scene of May 21, 2008 using the BEAM C2R processor.

Exercises with BEAM

Basic functions of BEAM

Analysis of MERIS level 1 and level 2 scenes

Case 2 water processor: from level 1 to level 2

Implementation of own procedures in BEAM

Validation of MERIS data using BEAM

Micro project: Production of a chlorophyll and suspended matter map using BEAM

Practical Session 3 (Oct. 15 and 16 , 14:00 -17:30):

Training on SeaDAS image processing software

Christo Whittle
Department of Oceanography
University of Cape Town
Rondebosch, 7700 Cape Town, South Africa

The SeaWiFS Data Analysis System (SeaDAS) is a comprehensive image analysis package for the processing, display, analysis, and quality control of ocean color data.
The SeaDAS Virtual Appliance (SeaDAS v.5.4) allows Microsoft Windows users to run SeaDAS on their systems within a virtual Linux machine. The appliance runs on Windows XP and Vista systems and includes a fully functional version of SeaDAS within a streamlined Linux environment. Installation is extremely simple and requires no knowledge of Linux. One might expect SeaDAS to run much slower in a virtual environment, but we have been pleased to find impressive performance results indicating SeaDAS VA runs nearly as fast as a standard installation.

The SeaDAS source code is publicly available, and if any group is interested in porting SeaDAS to another platform, the development team will be happy to give any kind of assistance possible.

The Interactive Data Language (IDL) from Research System Inc. (RSI) is used to build all the GUI and display-related programs in SeaDAS. Purchasing an IDL license is no longer required in order to run SeaDAS. Instead, users may choose to use "runtime" SeaDAS, which makes use of an IDL embedded license that is provided with the SeaDAS package. SeaDAS also includes prebuilt Hierarchical Data Format (HDF) libraries developed primarily at the National Center for Supercomputing Applications (NCSA). These are required when building certain SeaDAS programs. Vendor C and FORTRAN77 compilers are required only if you want to modify the source code and rebuild the executables.

Mini - Projects

Students will be grouped, possibly in teams of 2, and will undertake an ‘informal’ ocean colour project. The goal of the mini-project is to demonstrate some of the skills acquired during the Ocean Colour Course.

The topic for the project is selected together by the students and tutors. In case students have a pre-defined project idea and already have a data-set on which they want to work, they are encouraged to bring it with them.

Material for the project will be available in the form of regional and/or global satellite data from different ocean colour sensors and processing levels. Computers will be available and will be equipped with the software used during the practical sessions.

Some examples of the tasks to be conducted during the projects are the following:

- Data extraction for a specific area and/or period.
- Application of atmospheric correction algorithms.
- Evaluation of the water optical properties.
- Derivation of bio-geo-chemical products (e.g. Chlorophyll-a and Primary Production).
- Image binning in space and time.

On Friday 23/10/2009 each team/participant will give a 5 to 10 minutes informal presentation, where all group members are invited to talk, and also submit a final project summary document.

Note: The final structure of the mini-projects will be further discussed on Friday 16/10/2009 afternoon.