Chlorophyll Globally Integrated Network (ChloroGIN)

ChloroGIN Workshop

Kochi, India, 18 - 19 February 2010

Minutes

1. Summary

A total of 51 participants from over twenty countries attended the two-day ChloroGIN workshop. Participants were updated on the status of the six ChloroGIN nodes, i.e. ChloroGIN-Europe, ChloroGIN-Indian Ocean, ChloroGIN-Antares, ChloroGIN-Africa, ChloroGIN-Canada, ChloroGIN-Asia as well as Global ChloroGIN. Discussions also ensued on the need to establish a ChloroGIN Secretariat which would consolidate existing efforts related to *in situ* measurements and dissemination of remotely-sensed data. Participants were introduced to the new FARO initiative, which, if funded by the Canadian Space Agency, would overarch both the ChloroGIN and SAFARI (Societal Applications in Fisheries and Aquaculture using Remotely-sensed Imagery) projects and provide support for a joint international Secretariat for ChloroGIN and SAFARI. It was also agreed that a proposal should be submitted to the Group on Earth Observations (GEO) for additional funding for various ChloroGIN activities. The expansion of the ChloroGIN network to new countries and other regions of the globe were also discussed. Based on on-going activities in the region and interest expressed at the meeting, a Northeast Asia node was added to ChloroGIN. Possible extension of ChloroGIN to fresh-water bodies was also discussed, and the participants welcomed the possible addition of a lakes node to ChloroGIN. Participants then split into three discussion groups: i) *In situ* measurements; ii) Funding, branding and membership criteria; and iii) Remote sensing and dissemination. The discussions focussed on the needs of the diverse ChloroGIN nodes regarding *in situ* measurements and remote-sensing data, and also on the preparation of the ChloroGIN funding proposal to GEO.

2. Session 1: Introduction & Regional Summaries, Trevor Platt, Co-Chairman, ChloroGIN, Plymouth Marine Laboratory, UK

2.1 Introduction to Workshop

The point of origin of ChloroGIN was a meeting in Argentina in 2003. The meeting was supported by IOCCG (International Ocean Colour Coordinating Group) and POGO (Partnership for Observation of the Global Oceans) with the intention to develop a network of ocean colour and *in situ* measurements in South America. The network was called Antares and has been very successful, despite limited funds. The development of the Antares initiative and its extension to other regions was promoted by Shubha Sathyendranath, especially within GEO. In 2006, with sponsorship from GEO and GOOS and additional support from POGO and PML (Plymouth Marine Laboratory, UK), a meeting was organised in UK with the idea of strengthening and expanding the Antares initiative to a global network. Laboratory protocols for measuring chlorophyll concentration were investigated at the workshop, and an inter-comparison of measurement techniques used by participating laboratories was undertaken, with a report on the

intercomparison prepared under the leadership of Vivian Lutz. During this meeting, the technical support for satellite imagery was also enhanced. Since that time, no additional financial support has been available for the network. ChloroGIN was immediately accepted by GEO within a GEO task (it now resides in GEO task EC-09-01c). In the meanwhile, the SAFARI initiative was established, and is a significant component of GEO task AG-06-02 in the agriculture Societal Benefit Area (SBA). SAFARI has also come to be seen as a leading marine programme within GEO. The interconnections between GEO and SAFARI are well recognised.

Because of the lack of financial support in various regions, the *in situ* observing element within ChloroGIN has not progressed as rapidly as it should have. Since the CSA funding from SAFARI is coming to an end in March 2010, this represents an opportunity for re-thinking the programme in the context of global ecosystem management and food security. Ecosystem-based management with respect to fisheries is now generally accepted. Furthermore, there are increased concerns regarding global food security: Shubha Sathyendranath and Trevor Platt had attended the OECD (Organisation of Economic Co-operation and Development) meeting in Paris in November 2009 regarding food security and informed the meeting of the ChloroGIN network and the SAFARI project, which were positively perceived by the participants. The IOCCG monograph on remote sensing and fisheries (IOCCG Report 8) was very much appreciated by the attendees of the OECD meeting.

In the European Commission (EC), there is now a requirement that nations produce ecological indicators for the ocean and coastal environment on a regular basis, according to the Marine Strategic Framework Convention. There is thus a demand to be more sensitive to the outreach and dissemination of the current products, as well as the development of other indicators derived from satellite data. Shubha Sathyendranath had taken the lead in submitting a concept paper to GEO for potential funding for various ChloroGIN and SAFARI activities. After review, GEO had accepted the concept paper with some recommendations. The group could now proceed to submit a full proposal to GEO, on the understanding that GEO will approach various agencies for potential funding for the activities.

In summary, Trevor Platt noted that it was time to make a major reassessment and take a major step forward with respect to the vision of the programme. The present report summarises the group's discussions related to these goals, including the plan for a proposal writing, a vision for the next phase of ChloroGIN and a scheme for bringing ChloroGIN and SAFARI together without losing their individual identities. The ultimate goal of the workshop was to broaden the regional nodes of ChloroGIN and to strengthen the existing ones.

Mark Dowell pointed out that there had been a number of training courses carried out within the ChloroGIN umbrella, some of which were linked to GMES initiatives.

2.2. ChloroGIN-Europe and Chlorogin.org, Shubha Sathyendranath, Plymouth Marine Laboratory, UK

Expressions of gratitude were offered to Dr. Meenakumari for the excellent organisation of the SAFARI symposium and the ChloroGIN workshop. It was also noted that INCOIS (Indian National Centre for Ocean Information Services) was a major sponsor of the ChloroGIN

workshop, in addition to GEO, CSA and NCEO (National Centre for Earth Observations, UK). Dr. Shubha Sathyendranath pointed out that it was important to refine the definition of "What is ChloroGIN" and to broaden the group of active participants in ChloroGIN.

The Joint Research Centre (JRC) and Plymouth Marine Laboratory (PML) are active within the ChloroGIN initiatives. Contributions include maintaining the website, provision of satellite data for Europe and Africa, and training initiatives. JRC has contributed by organising training courses every two years that address ChloroGIN objectives, within the framework of the Europen Commission with respect to the ACP countries (Africa, Caribbean, Pacific). The next training programme is planned for 2011.

Through various European resources, a series of capacity building initiatives will be undertaken in Africa, including the marine component of the GEO NetCast system within the European project DevCoCast, the marine component of which is led by ChloroGIN members. Another new European Union Project, called EAMNet (Europe–Africa Marine Network) envisaged many capacity-building activities in Africa, including various types of fellowships, training courses and academic programmes. A new initiative within ESA (European Space Agency) is CoastColour, with on going activities aimed at improving MERIS chlorophyll products for coastal environments globally. ChloroGIN has been identified as a user and CoastColour aimed to meet the requirements of various user groups identified within the project from many regions. Participants were encouraged to keep in touch with CoastColour, and there was particular interest in identifying users from India and South America.

The attention of the participants was drawn to the next GEO ministerial summit, which is scheduled to take place in Beijing, 3-5 November 2010. GEO had expressed an interest in showcasing capacity-building tasks through a video, which would emphasise the perspectives of the user community. ChloroGIN was a potential contributor, but the deadline to submit ideas to GEO was 22 February 2010. Shubha Sathyendranath also informed the participants of the call from GEO in 2009 inviting concept papers on capacity building. A concept paper had been submitted on behalf of ChloroGIN and SAFARI, which had been accepted, so that there was an opportunity to submit a full proposal to GEO, for which the deadline was 1st May 2010. Once the proposal was submitted, GEO would explore various potential funding sources. Other sources of financing include the Canadian Space Agency (CSA), through the FARO project, which could provide funding for an international secretariat. In addition, there was a possibility that NASA (National Aeronautics and Space Administration, USA) could carry out HPLC analysis of samples collected under the ChloroGIN programme.

Milton Kampel enquired whether ChloroGIN would address inland waters, and Shubha Sathyendranath replied positively, noting that there was another task within GEO that addressed Water Quality of Inland and Coastal waters (WA-08-01g). There was a definite advantage to linking such related projects through an over-arching initiative to improve synergy and limit duplication. Many members of ChloroGIN were also active participants of the Water Quality task.

2.3. ChloroGIN-Indian Ocean, Srinivas Kumar, Indian National Centre for Ocean Information Services, India

INCOIS produces satellite data products for ChloroGIN; nine countries that are members of IOGOOS are recipients of the products. Bangladesh could become a member of ChloroGIN-Indian Ocean. The SATCORE Network has started a time-series of *in situ* measurements. The data belongs to the PI's for one year after which it will be made available globally through a specifically-developed website. The data are sent to INCOIS, which is responsible for uploading it to the website

There was a general consensus that ChloroGIN-India has advanced impressively over the past two years, and that they have addressed most of the components of ChloroGIN. The difference with the other nodes is related to the availability of resources. Mark Dowell suggested that Global-ChloroGIN should think of a more systematic framework for *in situ* observations. ChloroGIN-Indian Ocean could be a model for the other nodes.

Action 1: Srinivasa Kumar - ChloroGIN-Indian Ocean to provide the financial figures required to achieve such a successful network (i.e., instruments, human resources, field work)

2.4. ChloroGIN-Antares, Eduardo Santa Maria, Universidad Autónoma de Baja California, Mexico

Distribution of satellite images for Latin America was provided by the group of Frank Muller-Karger (University of South Florida) and the network also maintained *in situ* time series measurements at various locations around Latin America. The network faced difficulties in raising sustained funding for time-series observations and for capacity building. Questions were raised regarding possible financing sources through ChloroGIN.

Trevor Platt raised the idea of linking coastal times series with the appropriate LMEs (Large Marine Ecosystems). Funds could be available from the Global Environment Fund (GEF). Chlorophyll data could be used as indicators and the group could request funds for an array of coastal stations by specifying which LME they were associated with.

Mark Dowell raised the question of reprocessing of satellite data. Both NASA and ESA had undertaken full reprocessing of ocean-colour satellite data recently. He wondered whether ChloroGIN had the capability to do the reprocessing of ChloroGIN data. Srinivas Kumar responded that it was necessary to reprocess data. This had not yet been done for the Indian Ocean node, but INCOIS planned to address this issue.

2.5. ChloroGIN-Africa, Stewart Bernard, Council of Scientific and Industrial Research, South Africa

ChloroGIN-Africa was led by South Africa (CSIR and University of Cape Town) and the two initial partners of ChloroGIN-Africa were IMS (Institute of Marine Science, Zanzibar, Tanzania) and NatMIRC (Ministry of Fisheries and Marine Resources, Namibia). New members have recently been added. The minimum requirement for a research group to obtain ChloroGIN

membership was to conduct routine and sustained chlorophyll measurements. Currently, it is difficult to achieve the *in situ* time-series requirements. There was interest expressed by the Mauritius Oceanography Institute (MOI) to contribute *in situ* data to the ChloroGIN-Africa network. EAMNet, the EU project related to DevCoCast, was due to start in March 2010 and aimed to increase the number of satellite-data receiving stations in African countries, over and above those supported by DevCoCast. The project would also provide access to new high-capacity data storage systems, which should facilitate near real-time services.

Applications in various countries were summarized. PML currently processes data for various African regions and the main focus is on high-resolution data from MODIS (Moderate Resolution Imaging Spectroradiometer) and MERIS (Medium Resolution Imaging Spectrometer Instrument). JRC was providing data through the GIS-based AMIS (Africa Marine Information System) project. MARE (Marine Research Institute, Cape Town) is the main driver of data for Africa. There are 14 regions around Africa, with fully-operational processing chains, and hopefully the ability to reprocess the data. Climate change is a major big driver impacting on decision makers in South Africa. A lot of the resources for Africa have come through the EU Framework 7 Project (FP7). ChloroGIN will play a major role in the Marine Remote Sensing Unit (MRSU) in Cape Town.

Trevor Platt pointed out the explicit need for indicators in inland waters and wondered how the networking of inland waters could be approached on a global scale. Margareth Kyewalyenga pointed out that there was a group working on Lake Victoria. FAO (Food and Agrciculture Organisation) could also be contacted.

Regarding products, users adopted the ecosystem perspective. Vivian Lutz suggested that satellite products should be developed in conjunction with *in situ* products, for validation. It was also suggested that the PI (photosynthesis-irradiance) parameters be included as a requirement for *in situ* time series.

2.6. ChloroGIN-Canada, Trevor Platt, Bedford Institute of Oceanography, Canada

In Canada, the time series was based on SeaWiFS (by now a rather fragile mission). Meanwhile, CSA had made an arrangement with ESA to provide full-resolution MERIS data on both Canadian coasts. The data were collected and distributed around the country. The expertise to interpret MERIS data was limited in Canada. Moreover, the manpower to construct the *in situ* time-series and upload the data onto a website no longer resides with Trevor Platt. However, the effort in Canada was quite consistent with what Stewart Bernard outlined for South Africa. Most of the efforts from Trevor Platt's group were put towards development of ecosystem indices, and ecological consequences of inter-annual variations. Advances had been made on ecological indicators that could be extracted from time series. A complementary *in situ* database is available in Canada, which included photosynthesis-irradiance (PI) measurements, absorption spectra and HPLC (High Performance Liquid Chromatography) pigments. CSA was interested in the operational usage of remote sensing products within government departments and Trevor Platt and Shubha Sathyendranath planned to submit a proposal for operational indicators. In summary, ChloroGIN Canada has a SeaWiFS time series, an enormous database of *in situ* data in archive form, a strong oceanographic expertise to interpret temporal variations, and an optical

expertise for interpretation of results. Funding from CSA was available to continue related research. In addition, ChloroGIN-Canada expects to have funding from CSA to maintain a secretariat for ChloroGIN and SAFARI. There is an audience on a world scale that requires ecological indicators, and the only way to get them is by remote sensing. Canadian satellite data were available on a website, but the website is not up-to-date and deos not follow the ChloroGIN template.

2.7. ChloroGIN-Asia, Joji Ishizaka, Nagoya University, Japan

ChloroGIN-Asia could be divided in two regions, Northeast Asia and Southeast Asia.

JAXA (Japan Aerospace Exploration Agency) and NPEC (Northwest Pacific Environment Center) distributes near real time MODIS data of Northeast Asian area, and they can be the NE Asia node of ChloroGIN. NPEC is CEARAC (Coastal Environmental Assessment Regional Activity Centre) of NOWPAP (North West Pacific Action Plan, with four member states, namely the People's Republic of China, Japan, the Republic of Korea and the Russian Federation), which is a Regional Seas Programme of the UNEP (United Nations Environment Programme).

ChloroGIN-SE Asia remains to be defined but there was interest from at least Vietnam, Malaysia, Indonesia and Philippines to join the node. Presently, JAXA and NPEC have not distributed satellite data of Southeast Asian area, but JAXA is now planning to distribute the data. There may be a possible collaboration with SEAFDEC (South East Asia Fisheries Development Centre in Japan) to collect *in situ* data.

The Southeast Asian Global Ocean Observing System (SEAGOOS) was formally established in October 2003 at the SEAGOOS Summit held in Kuala Lumpur, Malaysia. That programme includes a pilot project on new generation of SST for South East Asia.

2.8. Other relevant initiatives

POGO – The Partnership for Observation of the Global Oceans has planned to hold its 2012 meeting in Cape Town. It could be an opportunity to highlight ChloroGIN-Africa activities to POGO members.

OCR-VC - The Ocean Colour Virtual Constellation under CEOS (Committee on Earth Observation Satellites) is recognised as a GEO task. Mark Dowell suggested that a meeting of participants of all GEO tasks related to the use of ocean-colour data could lead to the creation of an overarching task.

FARO – Fisheries Applications of Remotely-sensed Ocean colour represented the acronym of the proposal submitted to CSA for renewal of funds for SAFARI in addition to new funds for a combined international secretariat for both SAFARI and ChloroGIN.

3. Session 2: Strategic Development

3.1. Update on Potential funding opportunities through GEO for capacity building, Shubha Sathyendranath

In response to a GEO call for submission of concept papers, a pre-proposal was submitted in 2009, which would combine many SAFARI and ChloroGIN activities, if funding were available. The concept paper was accepted and the opportunity now existed for ChloroGIN and SAFARI to proceed to submit a full proposal, for the deadline of 1 May 2010.

Proposed elements included:

1. Establishment and development of *in situ* time series stations in waters around Latin America and in the Indian Ocean rim countries.
2. Extension of ChloroGIN Southeast Asia.
3. Improvement of data dissemination in a timely fashion in member countries of ChloroGIN, especially through the internet.
4. International symposium on the benefits of Earth Observations for Fisheries and Aquaculture.
5. Workshops and outreach to policy makers and the user community.
6. A global set of synoptic, calibrated, consistent satellite data for ecosystem studies in coastal waters of developing countries.
7. Establishment of an International Secretariat for ChloroGIN to improve promotion and coordination of activities.

The plan was to organise the proposal in various stand-alone modules, which would allow the funding agencies to select aspects of the work that best suited their mandate.

The ChloroGIN network represented at the meeting agreed to submit a proposal. No budget indicators were provided by GEO, since GEO does not have any funds for these activities, but GEO was prepared to submit a request to potential funding agencies on behalf of ChloroGIN. The proposal must address societal benefit areas as identified by GEO. Nidhi Nagabhatla (World Fish) has submitted a pre-proposal for inland waters on fisheries and water quality applications. The ChloroGIN proposal could perhaps be coordinated with this proposal.

Action 2: ChloroGIN members are requested to propose additional potential funding sources.

3.2. Details of potential Canadian Funding, Trevor Platt

Under the SSOP (Strategic Sector Opportunity Program) of the Canadian Space Agency, Trevor Platt has requested ~$175 pa for 3 years to cover the continuation of SAFARI the coordination of the ChloroGIN network. If the project is approved, the funds can be used for the international secretariat to be hosted in Canada, for reports, brochures, meetings, and development of website but not for field work in a foreign country.

3.3. Break-out Sessions

The workshop participants split into three groups to focus on developing various activities of ChloroGIN as part of the integrated long-term strategic vision for both regional networks and the

network as a whole. Each group discussed various aspects of the material to be included in the proposal to GEO.
The three breakout groups discussed the following items:

i) ChloroGIN *in situ* component – common protocols, inter-comparison, NASA HPLC analysis (number of samples etc.), priorities and cost/benefit of different observations, census of existing resources.
ii) Funding, outreach to users as well as policy makers, representation, "branding", criteria for ChloroGIN membership.
iii) Remote sensing and dissemination: *in situ* data upload, reprocessing, input of *in situ* data into web portals, new products for specific sets of users e.g. ecological indicators, pilot studies, web portal update.

The conclusions of these deliberations of the breakout groups are summarised below.

4. Reports from the breakout groups

4.1. Vision: John Field, Co-chair, ChloroGIN, Marine Research Institute, South Africa

John Field summarised the vision and objectives of ChloroGIN as follows:

Vision:
ChloroGIN is an international network to assess the state of marine, coastal and inland-water ecosystems for the benefit of society; promoting for that purpose in-water observations in synergy with ocean-colour and related satellite observations.

Objectives:

1. To provide time series of ecosystem indicators for management of fisheries, aquaculture, coastal zones and inland water bodies.
2. To enhance *in situ* observations to characterise local conditions, including sub-surface water properties for assessing water quality, ecological status and potential for human use. Essential also for ground-truthing of satellite observations.
3. To develop and supply value-added products needed for management by local authorities, regional and national governments.
4. To develop tools and techniques for analysis of ChloroGIN products for assessing regime shifts, climate change and climate variability, and the status of fisheries, ocean, coastal and inland water ecosystems, as a basis for policy implementation.
5. To communicate ChloroGIN products of ecosystem state widely to potential users in society and in policy-making bodies.
6. To help train and develop a new generation of scientists with the skills to develop and maintain the ChloroGIN vision.
7. To achieve these objectives by means of an international network of both developed and developing countries.
8. To liaise and cooperate with other Earth Observation groups nationally, regionally and internationally.

4.2. Group I - *In situ* measurements: Vivian Lutz, Instituto Nacional de Investigación Pesquero, Argentina

4.2.1. Observations Priorities

The group discussed priorities for *in situ* observations, over and above chlorophyll measurements, which is the minimum requirement for membership in CloroGIN. The following priorities were identified:

1. Biogeochemical observations
2. Inherent optical properties (IOPs)
3. Apparent optical properties (AOPs)

It was recommended that the webpage should include brief documents outlining technical aspects to consider for each type of measurement (to enhance awareness of difficulties; advantages and disadvantages).

Action 3: Stewart Bernard
For the proposal: write a few lines justifying the order of priority of measurements (1 month)
For the webpage: Technical aspects (3 to 6 months)

The priorities were categorized further into recommended core measurements and additional measurements that would add further value to the core measurements.

4.2.2. Core Measurements:

Chlorophyll-a (extracted fluorescence)
Sea Surface Temperature
Coloured Dissolved Organic Matter (measured in a spectrophotometer, using10 cm pathlength,)
Particulate absorption spectra
Suspended Sediment Concenctration
Secchi Disk

4.2.3. Value-added measurements:

Photosynthesis-irradiance experiments
Spectral reflectance measurements at the sea surface

A committee will write the minimum specifications for these types of measurements

Action 4: Write a few sentences justifying these measurements for the GEO proposal.
Vivian Lutz to lead and to send the text within 1 month to Marie-Hélène Forget.

4.2.4. Minimum requirements to join ChloroGIN:

The group agreed that, all ChloroGIN members should be able to run all the core measurements, so the requirements for maintaining an *in situ* ChloroGIN site would include a minimum number of trained people to carry out the work (minimum 4 per station). Therefore, the proposal should include a budget for the funds required to acquire the instruments and train people to make these measurements at all the participating laboratories (if they did not already exist).

4.2.5. Protocols

It was proposed that the recommended protocols for each of the measurements should be posted on the webpage. This would require further discussions at a later stage. Furthermore, each station should upload the step-by-step protocol that they are using, as well as a measure of precision (based on 10 replicate measurements, for example). It was required to run an inter-comparison among all the stations, to improve on the initial intercomparison that was done in Plymouth.

Action 5: (a) Marie-Hélène Forget to carry out a survey to find out which partners are able to perform these core and value-added measurements (i.e. have the instruments and trained personnel).
(b) Stewart Bernard, Vivian Lutz and Aneesh Lotliker to write the recommended protocols for the website (within 6 months)

4.2.6. Position of the station

The group discussed the issues to consider when selecting the location of time-series stations and recommended that the sites should be selected bearing in mind the following criteria:

1. Ecological and bio-optical relevance for the region
2. Need to avoid adjacency effect from the coast for related satellite observations, which implied that the site should be at least 5 km from the coast
3. The site should be sufficiently deep to avoid bottom reflectance being a problem for the related satellite observations.

4.2.7. Sampling frequency

Once a month is recommended as the minimum sampling frequency for time-series stations.

4.2.8. Low cost instruments

Encourage the development of scientific prototypes of low cost instruments for the ChloroGIN network.

Action 6: Stewart to include a section in the proposal to GEO on the development of low-cost instruments (1 month – no more than 2 pages)

4.2.9. NASA's offer to analyze HPLC Samples from ChloroGIN sites

The group also discussed the offer from NASA to explore the possibility of providing HPLC analysis for samples from ChloroGIN sites. The group recommended that samples from the sites which had a complete set of measurements should be given higher priority for the NASA analysis. They also recommended that those stations that already have an HPLC should send selected duplicate samples to NASA for an intercomparison. It was also decided that this opportunity would be pursued outside of the proposal to GEO.

Action 7: Carry out a survey to assess which of participants have: i) a more complete set of measurements which could be enhanced by having HPLC samples analyzed by NASA; ii) Already have an HPLC, and were interested in running an intercomparison with the NASA facility for HPLC analysis. The following people could gather the relevant information from each node:

Vivian Lutz - Antares
Stewart Bernard - Africa
Aneesh Lotliker - India
Joji Ishizaka -NE Asia
Marie-Hélène Forget -Canada

4.2.10. Training and Education

The group recommended that the proposal budget should include funds for:

1. Masters or PhD students to develop their thesis work at some of the stations (priority for those who require personnel).
2. One super-technician per region to run the calibrations of the instruments.
3. Training programs.

Action 8 (for proposal): Articulate justification for training and education. Marie-Hélène Forget in consultation with regional representatives

4.3. Group II: Funding, outreach and criteria for ChloroGIN membership: Milton Kampel, National Institute for Space Research, Brazil

4.3.1. Branding

The group discussed how the visibility and identity of ChloroGIN could be enhanced, and recommended that:

- GOOS – Regional Alliances should have links to ChloroGIN regional nodes
- Each regional node must indicate clearly who is their representative
- Have a common set of material about ChloroGIN, such as power point slides, posters, and brochures for the use of all members for dissemination of information regarding the network.
- Have a ChloroGIN presence at the POGO booth at the GEO Ministerial meeting

4.3.2. Potential Funding Sources

The group also discussed potential funding sources, and the following organizations were identified. They are grouped according to whether their interests are global, regional or national.

1. Entities with global scope: GEF (Global Environment Fund), Asia Development Bank
2. National and Regional: Development Fund Agencies, DG Development of European Commission, US AID, Canadian Space Agency
3. National: GEO National Principal, National Aid and Development Agencies

4.3.3. Funding

A proposal for funding from GEF/LME must be elaborated in modules, so that each module could stand-alone if necessary: eg., capacity building, *in situ* measurements, remote-sensing data. The proposal to GEF must be *trans-boundary* i.e. the approach must be clear about going beyond geopolitical boundaries, to consider a more ecological approach.

Coastal and Inland Water Quality WG (SG) of GEO should be contacted to verify the interest in joining the efforts. If positive, this should also be a module in the general proposal. The contact can be made through Tiit Kutser.

4.3.4. Outreach

The group also discussed various ways of reaching the user community. The following steps were discussed.

- Production of a video. The plan of GEO to create a video in connection with the GEO summit was noted. It would be beneficial to have ChloroGIN examples to be highlighted in the video. Good examples had to be identified for the video and appropriate case studies must be recommended by the regional nodes. ChloroGIN did not have the resources to produce the video, but the possibility of GEO producing the video had to be explored.
- ChloroGIN brochure must be updated, including the new members and regional nodes. It is also necessary to update the text and to produce it in different languages
- Hold a workshops for end-users and policy makers
    - Regional nodes should organize meetings with stake-holders to consult them about the mode of regional operations to facilitate applications (to be included in the proposal to GEO)
    - In this context, ChloroGIN-India Ocean can be used as an example or as a pilot-case to be followed
- Training courses: regional nodes should organize at least one training course every two years.
- Visiting professors and post-grad programs and students are also to be encouraged.

4.3.5. Requirements for the incorporation of new members to the ChloroGIN network

It is the wish of all founder members of ChloroGIN, that the network expands its coverage around the globe by incorporating new participants. All interested parties, fulfilling the specific

requirements, can apply to become members of the network by sending a letter to one of the members of the ChloroGIN 'Executive' committee. The Executive committee could rotate periodically. The group also identified the following criteria to be satisfied, for membership to ChloroGIN:

Specific requirements to become a member of the ChloroGIN network

1. Contribute to the development of at least **one full time series** in a country, such as the initial ChloroGIN stations or contribute satellite data processing in a systematic and sustained manner.
2. Agree to **share data** that are of relevance to the objectives of the network, such as those required for the regional interpretation of satellite data.
3. Agree to **share equipment or expertise** with the aim of optimizing resources within the network.
4. **Express their written consent** to follow all the principles stated in the ChloroGIN 'Terms of Reference', and their intended contribution to the ChloroGIN network.

Further details regarding requirements to become a member of the **ChloroGIN** network were also proposed.

1. All new time-series must collect, process and distribute sea surface temperature and chlorophyll data.
2. The regional node can determine what other variables should be also sampled.
3. For water-quality monitoring, the required variables should include total suspended matter and coloured dissolved organic matter.
4. It is recommended that the new members incorporate ocean-colour remote sensing in their routine work, at least at the level of an end user.
5. Institutions which are not running a time-series yet, but have the intention to do that, will be temporarily accepted as an associate member.
6. Recommended minimum sampling frequency is monthly.
7. All members should adopt GEO data policy and formats.
8. Sub-nodes may have a different institution for the *in situ* and satellite component.

Full members are those who take the full set of proposed measurements
Associate members are those who aspire to do that within the next 5 years

4.3.6. ChloroGIN meetings

It was recommended that

- Executive committee should meet once a year. It is important to identify a point-of-contact for each node.
- The whole community should meet every 3 years.

4.3.7. Representation

The group noted that there was value in being recognized as a member of a global network working towards common goals. It was therefore recommended that the Chairman could write a

Letter of recognition as a Member for those members who would find such a document useful, for example in local funding-raising efforts.

4.3.8. Considerations for new networks

The group also discussed the potential to engage other groups that were not represented at the meeting, and it was noted that interest was expressed at the IOCCG-15 meeting (Scarla Weeks) for a Pacific Islands node. Whereas a North-East Asia node was identified at the meeting with Joji Ishizaka as the contact person, a node for South-East Asia was yet to be developed. The participants at the meeting from the region were requested to explore possibilities. It was also suggested that NOAA (National Oceanic and Atmospheric Administration) and NASA (Paul DiGiacomo and Paula Bomptempi) be contacted to explore possibility of a US node, while recognizing that University of South Florida was providing satellite data coverage for the Antares node.

4.3.9. Networking with other GEO Tasks and Conference of the Parties (CoP)

The group recognized that there were obvious links between ChloroGIN and many other tasks within GEO, and it was recommended that the synergies among these initiatives be strengthened. The relevant tasks/activities include:

- Coastal and In-land Water Quality working group
- SAFARI
- Coastal Zone Community of Practice (CZCP)
- Ocean Colour Radiometry –Virtual Constellation (OCR-VC)

The group also discussed how this synergy might be achieved. The options were: to establish an overarching task that would link these initiatives or to use the CZCP or the OCR-VC to provide the links. It was noted that OCR-VC was planning to organize a meeting of some 10-15 people with representatives from these various groups.

Several action items were proposed:

Action 9: Draft funding proposal for GEO taking into account the vision articulated at the Kochi workshop and the Terms of Reference from the PML meeting: Shubha Sathyendranath, Nick Hoepffner, Marie-Hélène Forget, Milton Kampel and others by end of April 2010.
Action 10: Update the brochures and poster in different languages (English, French, Spanish, Portuguese, Japenese): Mark Dowell, Milton Kampel, Stewart Bernard - September 2010.
Action 11: Regional nodes to identify the point-of-contact (and an alternate): - end of April 2010.
Action 12: The regional nodes representatives will comprise the ChloroGIN Executive committee, which should meet once a year.
Action 13: The whole community should meet once every 3 years. The occasion could be a ChloroGIN Symposium.
Action 14: Regional nodes should also have regional meetings every 2 years.
Action 15: Contact Steve Greb about having an 'Inland water' node in ChloroGIN, joining the GEO proposal – Tiit Kutser - end February 2010.

Action 16: Regional nodes must give good examples or case studies for the video GEO is proposing: Regional representatives – April 2010.
Action 17: Contact and include the stakeholders in the networking process.
Action 18: The Executive committee, after being established, will write the "Requirements for the incorporation of new members to the ChloroGIN network" and the updated Terms of reference. Make these available for the whole community, and post on the website.
Action 19: Contact NOAA (Paul de Giacomo and Cara Wilson) and NASA (Paula Bontempi, Gene Feldman) about having a US node in ChloroGIN: Mark Dowell – February 2010.
Action 20: OCR-VC workshop of GEO Task relating to Ocean Colour: Mark Dowell - end of 2010, beginning of 2011.
Action 21: Contact GOOS PICO (Panel for Integrated Coastal Observations of the Global Ocean Observing System: Paul DiGiacomo, Zeca Muelbert) and inform about ChloroGIN activities: John Field, Milton Kampel – March 2010.

4.4. Group III: Remote sensing and dissemination: Nicolas Hoepffner, Joint Research Centre, Ispra

This working group addressed questions regarding *in situ* data upload, reprocessing, web portal updata, input of *in situ* data into web portals, new products for specific users e.g., ecological indicators, and pilot studies.

4.4.1. New Products - Indicators

In addition to geophysical products such as SST, chlorophyll, diffuse attenuation coefficient at 490 nm (Kd_{490}) at daily, weekly and monthly time scales, it was important to give priority to indicators that are easy to understand and use by the whole community including decision makers. Some important indicators were identified:

4.4.2. Indicators

- Bloom indicators - timing and magnitude of bloom – (e.g. case study in the N. Atlantic Platt & Sathyendranath 2008 methodology)
- Frontal zone – mesoscale features
- PFZs (Potential Fishing Zones); identification of mesoscale features
  Additional variables (e.g. wind, currents) may be required for ocean features analysis , verify with ChloroGIN mandate case study in Indian Ocean to support fisheries. This point was agreed by the overall meeting. Additional variables (e.g. winds, SSH, etc) from other platforms are therefore recommended.
- PFTs (Phytoplankton functional types) such as Trichodesmium, coccolithophores, diatoms – e.g. INCOIS making RTI (Red Tide Index) for HABs (Harmful Algal Blooms) as a first step and HAB index in South Africa
- Water quality related indicators (eutrophication index, water transparency) case study in Europe (Oxyrisk)
- Primary Production estimates
- Regional Chl and SST anomalies (implies long satellite data time series)

Note: indicators should not be developed blindly, but derived from sound and peer-reviewed analysis proposed for specific regions

Action 22: Identify peer-reviewed methodologies (likely to be regional) for each indicator and evaluate its potential application to other regions/nodes. Action for satellite providers in each node (jointly with Trevor Platt).
For the proposal, it is recommended to rely on existing value-added products: fronts (India), growing season (N. Atlantic), harmful algal blooms (S. Africa) and eutrophication (Europe)

4.4.3. Remote Sensing of inland waters and (near)-coastal waters

The group strongly recommended collaboration with the inland water community. However, the ChloroGIN network currently lacks expertise in that domain and it will be required to establish requirements that are specific to that community. There is a requirement of high resolution satellite data at pixel resolution of 250-300 m, for near coastal and inland studies. CoastColour, an ESA initiative, was interested to identify additional ChloroGIN and SAFARI regions that would benefit from high-resolution MERIS data. The appropriate indicators would be related to water quality, e.g., turbidity, water transparency, eutrophication index and primary production.

Action 23: Current ChloroGIN members and participants of the Kochi workshop (e.g., Srinivas Kumar, Tiit Kutser, Margaret Kyewalyanga) with some expertise or contacts in inland waters to identify investigators in the inland remote sensing area (1st semester); contact Inland and coastal water algorithm WG– report to WG 3
Action 24: Organize a round table discussion and workshop with the identified community to establish product requirements and case studies (2nd semester): request action from Inland and Coastal Water Algorithm WG
Action 25: provide information on remote-sensing data requirements and specific study sites to support Mark Dowell's proposal to complement ESA CoastColour initiative (2nd semester, ideally following the workshop)

4.4.4. In situ data upload in regional websites

It was recommended that each node should build up a database with minimum data requirement (i.e. core measurements) such as chlorophyll (fluorometric), temperature and Secchi disk and upload the data. It was also recommended that a mirror server be implemented for each regional node to safeguard data access (note that this applies to satellite data as well). Quality control and formatting would have to be harmonized between all nodes. Good examples are the CALCOFI data base (easily usable ASCII files) or the SeaBASS data format.

Action 26: Each node to identify coordinator for assembling *in situ* measurements, checking for quality and format before up load to website. Regular update of the websites is recommended.

ChloroGIS is the proposal to develop an Information system within ChloroGIN which would combine satellite and *in situ* data to provide useful information on the marine ecosystem. The system would also include other layers of information such as satellite data other than ocean colour. Funds are needed do develop this open-source software for multiple data analysis (good

examples are the websites of PML and AMIS). There is also a requirement to harmonize system architecture.

Action 27: Include the harmonisation of the system architecture in proposal to GEO. Steve Groom and/or Stewart Bernard.

It was suggested that the proposal to GEO should include a semi-annual "ChloroGIN Newsletter" on the main website summarizing recent activities conducted within each node.

Action 28: JRC to coordinate with other nodes for inputs to newsletter. Nicolas Hoepffner

List of acronyms:

ACP	Africa, Caribbean, Pacific
AMIS	Africa Marine Information System
AOPs	Apparent Optical Properties
CalCOFI	California Cooperatice Oceanic Fisheries Investigation
CEARAC	Coastal Environmental Assessment Regional Activity Centre
CEOS	Committee on Earth Observation Satellites
ChloroGIN	Chlorophyll Globally Integrated Network
CSA	Canadian Space Agency
CSIR	Council of Scientific and Industrial Research, South Africa
CZCP	Coastal Zone Community of Practice
DevCoCast	GEONETCast for and by Developing Countries
EAMNet	Europe–Africa Marine Network
EC	European Commission
ESA	European Space Agency
EU	European Union
FAO	Food and Agriculture Organization
FARO	Fisheries Applications of Remotely-sensed Ocean colour
FP7	Seventh Framework Programme
GEF	Global Environment Fund
GEO	Group on Earth Observation
GMES	Global Monitoring for Environment and Security
GOOS	Global Ocean Observing System
HABs	Harmful Algal Blooms
HPLC	High Performance Liquid Chromatography
INCOIS	Indian National Centre for Ocean Information Services, India
IMS	Institute of Marine Science, Tanzania
IOCCG	International Ocean-Colour Coordinating Group
IOGOOS	Indian Ocean – Global Ocean Observing System
IOPs	Inherent optical properties
JAXA	Japan Aerospace Exploration Agency
JRC	Joint Research Centre, Italy
LMEs	Large Marine Ecosystems
MARE	Marine Research Institute, South Africa
MERIS	Medium Resolution Imaging Spectrometer Instrument
MODIS	Moderate Resolution Imaging Spectroradiometer
MOI	Mauritius Oceanography Institute
MRSU	Marine Remote Sensing Unit
NASA	National Aeronautics and Space Administration, USA
NatMIRC	Ministry of Fisheries and Marine Resources, Namibia
NCEO	National Centre for Earth Observations, UK
NOWPAP	North West Pacific Action Plan
OCR-VC	The Ocean Colour Virtual Constellation
OECD	Organisation of Economic Co-operation and Development
PFTs	Phytoplankton Functional Types

PFZs	Potential Fishing Zones
PML	Plymouth Marine Laboratory, UK
POGO	Partnership for Observation of the Global Oceans
RTI	Red Tide Index
SAFARI	Societal Applications in Fisheries and Aquaculture using Remotely-sensed Imagery
SATCORE	Satellite Coastal & Oceanographic Research
SBA	Societal Benefit Area
SeaBASS	SeaWiFS Bio-optical Archive and Storage System
SEAFDEC	South East Asia Fisheries Development Centre in Japan
SeaWiFS	Sea-viewing Wide Field-of-view Sensor
SSOP	Strategic Sector Opportunity Program
SST	Sea Surface Temperature
US AID	United States Agency for International Development

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