First meeting of the NetCOLOR community
Canadian Space Agency, St-Hubert, Québec
17-18 November 2015

Introduction, Marcel Babin and Martin Bergeron

NetCOLOR's 6 objectives were presented, (i) Review the status of various current and future international ocean colour missions, (ii) Identify the opportunities for Canadian contribution to space missions and data utilisation technologies (iii) Establish a national strategy to update Canadian user needs (iv) Identify Canadian technological capacity, (v) Identify national priorities for research in the field of remote sensing, (vi) Improve the synergy within the academic, private, and government sectors.

It is important to ensure that there is no duplication of current efforts while creating a community of COLOR researchers and end-users in Canada. Increasing visibility of the community to CSA and end-users should also be a priority.

Deliverables:

- Inventory of the present capacity of the Canadian aquatic colour remote sensing community
- Identification of the priorities and the challenges for the Canadian aquatic colour remote sensing community
- Expand our network to other remote sensing technologies such as radar and other satellite platforms.

Canadian Space Agency Ocean Colour Activities and Support, Martin Bergeron

CSA Interest in COLOR: (i) to support our National EO community (government, academic, and private sectors), (ii) to enable end-users to exploit EO data (fisheries, ecosystem protection, coastal management, national security etc.) and (iii) to focus our investments (transition from scientific research to operational applications; support and access for missions that meet user requirements; global benefits). The CSA is interested in supporting Earth Observation activities of national and international relevance. CSA support for COLOR activities for societal benefits include Maintaining & developing capability, Applied development and data utilisation, Mission and technology development, National coordination and International coordination.

CSA has invested close to $10M in operationally focused science over the last 6 years. Canada is among the world leaders in EO satellite technology applications and utilizations. Since 2000, the Canadian Space Agency (CSA) and its Earth Observation Applications and Utilization (EOAU) division have managed three main EO-specific programs with well over 200 projects to-date. CSA provided support for Canadian government departments, industry and universities with regard to EO and ocean-related activities. Environment Canada, (EC) Fisheries and Oceans (DFO), and the Department of National Defence (DND) have made significant investments to operationalize EO opportunities with regard to ocean and coastal areas. Data access for Canada was achieved through the availability of ENVISAT-MERIS and a new agreement was signed on November 10 to provide full access to Sentinel-3 data. Canada will have access to the collaborative hub through Canada Centre for Mapping and Earth Observation (CCMEO-NRCAN).

The medium resolution (100m GSD) proto-operational visible and near-infrared (VNIR) hyperspectral microsatellite dedicated to observation of Canadian coastal and inland Waters (WATERSAT) is currently on standby, mainly due to the high cost of the platform and the lack of priorities identified by the community.

The EO Applications and Utilisation is a 3-pronged program, for Government research (GRIP), EO Applications development Program (EOADP) for Government and Industry, and Science and Operational Applications Research for RADARSAT-2 (SOAR), the Flight for the Advancement of Science & Technology (FAST). A long term space plan, and NetCOLOR could contribute to the identification of the priorities of this Space Plan.

For further information, please refer to M. Bergeron's presentation which will be posted on the NetCOLOR website (www.netcolor.ca)

An Introduction to MEOPAR – Doug Wallace

MEOPAR is a Network of Centres of Excellence, headquartered in Halifax with close to 25 partners across the country. MEOPAR's aim is to observe, monitor and model the Canadian Ocean. The Network intends to go through three funding cycles (15 years). The objective of the first 5-year mandate is to build capacity in terms of networking and research. The observation platform focuses mainly on gliders, but could be expanded to include other autonomous platforms, such as Argo floats. In terms of research, MEOPAR has 3 core areas namely *Observation*, *Prediction* and *Response*. Doug Wallace presented examples of MEOPAR research projects. Under the *Observation* component, funds are going towards the VENUS program, joint acquisition of equipment, satellite data services and other national programs. To date, more than 50 projects have been funded.

International Ocean Colour - Coordinating Group IOCCG – Venetia Stuart

The International Ocean Colour Coordinating Group (IOCCG) was created in 1996 prior to the launch of the NASA SeaWiFS satellite platforms. The secretariat is based at Bedford Institute of Oceanography (BIO, Department of Fisheries and Oceans) in Halifax. The rotating membership is composed of scientific experts and space agency representatives. There are currently 28 members from 15 different countries, providing a balance of data providers and end users, as well as a geographical diversity in the membership. The space agency representatives contribute financially and carry out decisions endorsed by the group. The research scientists, who each serve a 3---year term, address current research issues and make recommendations to the committee. The IOCCG meets once a year. The 2016 meeting will be held in Santa Monica and the 2017 meeting in Perth. The current IOCCG Chair is Stewart Bernard (South Africa). The group's mandate is to provide a common voice for the user community. Scientific working groups produce reports addressing issues of importance to the international COLOR community. To date, sixteen reports, one handbook and several brochures have been produced. The most recent report, which is presently

only available online, is that of the Polar Seas working group. Hard copies of all reports are available from the IOCCG office. Five working groups (Harmful algal blooms, Uncertainties in OC remote sensing, Earth observation in support of monitoring of global water quality, Intercomparison of atmospheric correction over optically complex waters and OC applications for biogeochemical, ecosystem and climate modelling) are currently active. To foster expertise in the use of OC data, the IOCCG coordinates and sponsors a variety of specialized OC training courses aimed at undergraduate and graduate students. The *Third Summer Lecture Series* will take place in Villefranche---sur---Mer, France July 18---30, 2016.. There is a high demand for the IOCCG training courses and only a small percentage of applicants are accepted. However, all of the course materials and presentations are available online for those people who are not selected for the course.
The continuity of the data stream of OC satellite data is a prime concern of the IOCCG. Satellites are currently in orbit and new satellites are scheduled to be launched in the coming year to ensure this continuity. IOCCG put in place the Ocean Colour Radiometry---Virtual Constellation (OCR---VC) framework to ensure continuity and comparison of satellite data. The goals of this framework are to provide high quality data sets through a concerted inter---agency effort in activities relating to inter---comparison (INSITU---OCR, IOCCG task force on satellite senor calibration), data harmonization, support the implementation of ECVs, facilitate timely and easy access to data and to build on capacity and outreach. In collaboration with NASA, IOCCG is charged with coordinating and revising in---situ measurement protocols. Finally, IOCCG holds biennial International Ocean Colour Science meetings (IOCS). The next meeting, hosted by ESA and EUMETSAT, will be held in Lisbon, Portugal from 15-19 May 2017.

Ferry Ocean Colour Observation Systems (FOCOS) – Maycira Costa

Phytoplankton production has changed, which is affecting the salmon foodweb in the Salish Sea off the coast of southern British Columbia and northern Washington State. There is a mismatch between the salmon outmigrants' demand for food and the timing, quantity and spatial extent of the food supply. Regular DFO cruises do not provide sufficient *in situ* measurements to validate satellite observations. To compensate for this deficiency, meteorological, biogeochemical and bio-optical instruments were installed aboard three ferries on the mid-Island (Duke Point to Tsawwassen) route, to provide a larger database for validation of satellite data. A new atmospheric correction was developed for the region. Using the SAS data onboard the ferries are planned to facilitate the validation of the atmospheric corrections. Presently, the UVic team is working with ONC (Ocean Networks Canada), to determine the best location to install the sensor aboard the Ferries to avoid shadowing and minimize undesirable sun angles. Other collaborators include the Pacific Salmon Foundation and MITACs. They are developing a library of spectral data and are hoping to have a fully autonomous system by early 2016. Data quality problems presently necessitate bi-weekly cleaning of the system to remove bio-fouling from the sensors and ensure good agreement between Ferry box data and laboratory measurements.
Problem: They are only sampling along one defined Ferry route, which does not provide much spatial diversity. For instance, the northern Salish Sea is very different from that in which the Ferry sails. The influence of the Fraser River and Puget Sound etc. must be taken into account when evaluating the bloom(s). BCFC passengers will be encouraged to install the ***Hydrocolor*** App on their phone so that they can acquire data in Georgia Strait outside the mid-Island Ferry route. Ten fishing vessels that work in different parts of the Strait and the Salish Sea will be equipped

with CTD, equipment to measure chlorophyll florescence and collect water samples. They will use ***HydroColor*** App collect reflectance. The data will be downloaded to the ONC site, which is publically available.

It is generally assumed that bloom conditions in the central Salish Sea are optimal in mid-march, whereas this year bloom conditions occurred in February. On July 18, 2015, the MODIS_Aqua satellite caught ta picture of the hardest algae bloom ever measured.

Earth Observation & Inland Water Quality Monitoring – Caren Binding
(presented by Marie Hélène Forget)
Freshwater covers about 8% of Canada's surface. There are 565 lakes >100 km^2 and more than 30000 lakes that are 3-99 km^2. The properties of these lakes are very variable. Environment Canada is responsible for monitoring the water quality. There are many inland waters that are subjects of national and international interest or are transboundary waters with federal commitments. The current areas of interest to EC are the Great Lakes-St Lawrence, Lake Winnipeg and Lake of the Woods. Earth observation is being used for monitoring plumes algal blooms, water clarity, submerged vegetation, oil slicks etc. However, there are problems when dealing with optically complex waters.

Water clarity in the Great Lakes has changes considerable in recent decades due to invasive species, nutrient management, climate and watershed changes. Secchi disk depths are most common historical record of clarity. Satellite data reflectance at 550 nm ($Rrs_{\sim 550}$) is being used to record algal blooms, suspended sediments and whiting events. Over 1300 matchups have been made between $Rrs_{\sim 550}$ and secchi depth (Zsd). Secchi depth increased in Huron, Michigan, and Ontario over time (80s- present), indicating improved water clarity. Lake Superior shows consistent clarity, whereas Zsd is very variable in Lake Erie.

Water clarity in Lake Ontario and Lake Michigan in September and October are driven by whiting events – precipitation of calcium carbonate, which is triggered by temperature and/or photosynthetic effects on pH. There has been a reduction in whiting events due to uptake by mussels in Lake Michigan. Lake Ontario continues to experience events (particularly in 2013/14).

Simple algorithm approach, based on assumption that Zsd and Rrs_{550} are driven by b_b works in Great Lakes system but breaks down in highly absorbing waters such as the south basin of Lake Winnipeg and an analytical approach must be used. Black water - negligible water leaving radiance due to strong absorption- develops as a consequence of spring melt and loadings.

There is widespread concern about the proliferation of algal blooms. Lake Winnipeg was declared Threatened Lake of the Year in 2013. In 2014, citizens of Toledo were warned against drinking municipal water, which is drawn from Lake Erie. There is renewed attention to reduce nutrient inputs on both sides of the Canada/US border. Remote sensing is being used for detection, monitoring and prediction of HAB.

Some cyanobacteria are known for producing toxins, which are colourless and cannot be seen from space. Others produce taste and odour compounds which impact water quality for drinking and recreation. Other effects of algal blooms: poor aesthetics, beach fouling, anoxic events (fish kill), and ecosystem impacts.

Surface blooms, cyanobacteria mats, are highly dynamic in space and time and induce large variability for in situ sampling and image validation. Buoyancy decreases mixing, cells appear at the surface and can be seen from space

Lake of the Woods is optically and hydrologically complex, experiencing intense cyanoblooms. The shallow turbid water has very high DOC levels. MERIS MCI is being used to monitor algal blooms in the lake. Intense blooms are observed during warm, dry years, Wind mixing and cell buoyancy lead to dynamic bloom conditions. There is a need to be able to predict HABS so that anthropogenic and tourist activities in the area can be curtailed during periods when conditions are conducive to promoting blooms.

Algal mats absorb heat and lead to temperature increase in the surface waters. This may be a positive feedback for cynaobacterial growth.

MERIS imagery of Lake Winnipeg is being used for near real time prediction of bloom prediction and annual reporting of quantitative bloom indices, intensity, area and duration

Winter diatom blooms are being studied on Lake Erie. L1 data from MERIS and NCI index are used to detect blooms within the ice.

Future directions for Environment Canada Remote Sensing team:

- Operational delivery of water quality products to end-users
- Use satellite derived water quality estimates to study biogeochemical processes and consequences of changes in climate, watershed use and ecosystem function
- Inclusion of Sentinel-3 into near real time image processing and delivery
- Further investigate use of hyperspectral applications for algal blooms – in anticipation of future sensors
- Expand geographic areas of interest to include priority watersheds

Remote sensing in the Arctic - Marcel Babin

The main limitations for using EO in Arctic environments: (i) Low sun elevation, (ii) elevated cloudiness, (iii) presence of sea ice, (iv) unusual inherent optical properties, (v) prevalence of deep chl maxima, (vi) underice bloom, (vii) photosynthetic parameters for PP computation. The current phenology of phytoplankton in Arctic was presented, which shows one (spring) or two (spring-fall) blooms limited by ice cover and light availability. Phytoplankton is a good sentinel about what is happening in the Arctic environment related to environmental changes. Break-up and freeze-up time determines the duration of the open-water period (break up now 28 days earlier and freeze up 20 days later than 20 years) coinciding with the seasonal light cycle, properties of the snow-ice system, nutrient availability and grazing by zooplankton. Anticipated changes in Arctic environment with global warming are: (i) decreased production at low latitude due to increased stratification, (ii) increased occurrence of fall blooms (lack of sea ice in

September during windy period which stirs up nutrients), (iii) earlier bloom in the seasonal ice zone, (iv) more intense spring bloom at high latitude. Studies based on satellite data and field measurements support all four predictions. What we can't do with OCRS is: i) see deep chlorophyll maxima, SCM is deeper and more prevalent in the Arctic Ocean. OCRS may also underestimate pan-Arctic PP by 50% (Hill et al.) However, we can extrapolate surface chlorophyll to depth (Ardyna et al 2013). Arrigo et al. also estimated that 75% of the chla occurs under the sea-ice in the Chukchi Sea (ICESCAPE) due to upwelling and meltponds. It is estimated that, 70% of the time, the spring bloom in the Chukchi Sea starts under the seaice before breakup. A large effort should be put towards the proper modelling of light transfer through snow, sea ice and ice algae, establish a threshold beyond which a phytoplankton bloom can develop underice, develop 1D and 3D models to compute underice PP.
DOP and DOC algorithms have been developed to look at trends in Arctic environment. In COLOR and salinity satellite data are being used to study the increase in particle export from the Mackenzie River. This permitted three domains to be identified (melt water (MW), sea water (SW) and river water (RW)) and to map the contribution of these water inputs to the Arctic Ocean from space. MW has low salinity and low CDOM, SW has high salinity and low CDOM and RW has low salinity and high CDOM. Some of the important questions are (i) is community composition changing, (ii) are there more nutrients to support PP and what are the physical processes, (iii) spatial variability. Canadian researchers are currently involved in several major research projects: SubIce (USA), GreenEdge (Canada), Transsiz (Germany), TARA (France). The datasets from these expeditions are very good. Recommendations (i) combine data from multiple polar orbiters to mitigate the impact of clouds on data availability, (ii) develop methods for flagging and correcting contamination of the signal by sea ice, (iii) improve atmospheric corrections

Atmospheric correction for Ocean Color data – Clémence Goyens

Atmospheric correction intends to correct for the interaction of the photons with aerosol and molecules, scattering at water surface, scattering by pure water and constituents, adjacency land and ice, and sub-pixel ice floes. It is a very complex system, which has been simplified by Gordon and Wang 1994 with the black pixel assumption. Other approached include a simple empirical fit between satellite and in situ data, a correction for NIR in-water contribution, spatial homogeneity in aerosol properties and modelled pw (lambda NIR), Using short wave infrared (SWIR) band in highly turbid waters, coupled ocean-atmosphere optimisation. Match-up exercises showed the relevance of these various approaches in different environmental conditions. According to the water masses, different atmospheric correction may be more efficient than others. To assess the adjacency effects on water leaving radiance, a simulation using 3DMCPOL was run with various adjacent types of land and ice. Ice and snow adjacency tend to overestimate chla concentration. Sub-pixel contamination by ice floes tends to underestimate chla concentration, by providing an overestimation of the atmospheric correction.

Deriving ecological information from ocean colour in optically complex waters - Susanne Craig

Standard approaches for deriving information from ocean colour involve the blue-green ratio algorithm. Optically complex waters are important in terms of the overall global economy (fisheries, water supply, etc.). The challenges of using OC in optically complex waters include the fact that non-covarying water constituents confound band ratio algorithms, empirically derived relationship in semi-analytical, complex atmospheric correction. Phytoplankton size is related to optical properties, which can then be related to trophic states, as represented by the Margalef diagram. Small sized organisms dominate in areas of low turbulence and low nutrients, larger sized phytoplankton dominate in highly turbulent, nutrient rich waters. As stratification increases in the North Atlantic, there is less nutrient availability, thus, mean cell size decreases. Smaller cells are associated with longer food chains and less efficient energy transfer. Larger cells sink, smaller cells associated with recycling in the water column, don't sink.

An Empirical Orthogonal Function (EOF) model for IOPs and chl was performed on Bedford Basin hyperspectral and MERIS waveband data and provided good agreement with in situ IOPs. EOF model was also used to extract information regarding the atmospheric correction. Cross validation proved that the model is applicable in most waters. Bedford Basin case studies using MERIS data proved that many pixels could be recovered using this approached compared to regular atmospheric correction. The PACE mission is scheduled for launched in 2022. A polarimeter or a second hyperspectral sensor for coastal applications will potentially accompany the hyperspectral OC sensors. It will be used for studying aquatic ecology, cloud chemistry, aerosols, response and influence on climate change processes, phytoplankton community composition and land-ocean exchange in coastal aquatic environments. NAAMES (North Atlantic Aerosols and Marine Ecosystem Study) is an atmospheric and oceanographic mission led by American scientists to study the effect of climate change on plankton production. There is limited contribution to the project by Canadians.

The Dalhousie group is also involved in a study using IOPs to ascertain the phytoplankton community composition and biogenic volatile organic compounds, in the area around Sable Island.

The potential for Landsat-based bathymetry in Canada – Anders Knudby

Radiative transfer simulations were performed in 3 sites (Baffin Bay, Hudson Bay and Boundary Bay). The simulations were initiated using VIIRS products, which were then inputted into a forward model of above-water remote sensing reflectance, sensor-environment noise was added to provide a model inversion with exhaustive search. Results from the simulation showed that in Boundary Bay, with low values of original depth, the modeled depth would be similar to the original depth whereas at higher bathymetric depth, the model would provide a wide range of modeled depths. The other two sites provided better agreement between the original and the modeled depths. Field tests showed a good agreement for depth less than 4m, where there is an overestimation of depth in areas with more than 4m. Field results did not directly coincide with LANDSAT images due to tide corrections.

It was surprising that the effect of zenith angle did not seem to be significant for Baffin Bay and Hudson Bay.

The role of Industry – Jim Hanlon

Government-Industry-Academic relationships are complex and it is rare that the three components would be involved simultaneously. Public-private partnerships (PPPs) provide an opportunity for Industry to satisfy R&D needs under the government approval. Government's strength including setting the regulatory regime, funding extra market activities, sustaining long-term data collection and retention and inter/intra government interaction. However, 5-year politically driven mandates are the major weakness. The need for public transparency can stifle innovation. The strength of academia is that it's independent and unbiased. Research is relatively low cost, subject to peer-review, highly competitive and creates new highly qualified personnel (HQP). Whereas the weakness of academia stems from the fact that it is difficult to create large teams, there is sub-optimal use of infrastructure; the research is often not practically relevant and slow to change direction. Research tends to be ad hoc. The strengths of Industry are that it is market driven and responsive, able to efficiently mobilize resources, rigorous in planning and implementation. However, it does not doesn't address the needs of the common good and planning horizons are less than 5 years. There is competitive pressure to push towards proprietary behaviour. A new model should include partnership between Public-Private-Academic Partnering (PPAP). Regarding the total ocean economy, about 5% is ocean-related, whereas Canada's GBP related to ocean is around 2,5%. Institute of Ocean Research Enterprise (IORE) intends to facilitate PPAP by connecting people, providing advocacy and developing infrastructure. Future directions should include big data and analytical, future vision of ocean data collection, AOPS as an 'all of government' asset with multiple roles such as military, constabulary, surveillance and, potentially, science. A new initiative in Halifax is the Centre for Ocean Venture and Entrepreneurship (COVE), which will provide an opportunity for academics to work along with private industry.

Using ocean colour to survey the Canadian oceans – Cesar Fuentes-Yaco

The Bedford Institute of Oceanography (BIO) has been monitoring the North Atlantic using ocean colour (OC) products since the earliest launch of sensors. This includes time-series include observations from CZCS, SeaWiFS, MODIS and MERIS. Many L3 (derived geophysical variables that have been aggregated/projected onto a well-defined spatial grid over a specific time period) and L4 (model output or results from analyses of lower level data –variables defined from multiple measurements) products are available from BIO's remote sensing services. These include L3: chla, PAR, diffuse attenuation coefficient, total suspended matter and detection of coccolithophores; L4: PP, phytoplankton phenology, interannual variability, impact of hurricanes, identification of ecological provinces, habitat mapping for species at risk, identification of high phytoplankton production-marine protected areas, water clarity for bathymetric mapping, significance for whales. One important innovation from the BIO group was to study the phenology of the phytoplankton bloom with recruitment of fish of interests to fisheries such as haddock and shrimp. It was proved that the timing of the phytoplankton bloom has a direct impact on recruitment. The impact of hurricanes was also studied and was linked to the abundance of diatoms before and after hurricane events. BIO has been able to high phytoplankton production areas designated for conservation that have been linked to maps of habitat suitability for whales. COLOR satellite data proved to be useful to bathymetric surveys from LIDAR observation by providing information on the clarity of the water column. DFO (BIO), CSA and other federal government agencies have been studying concepts that can meet the Canadian needs and priorities for EOS data. WATERSAT (hyperspectral microsatellite mission – Canadian Coastal and Inland Waters) has great potential for DFO, as it will provide ecological information on coastal waters and the health of coastal and freshwater ecosystems, monitor hazards, discharges, effluents, pollution and the presence of HABs.

ORCS in support of Marine Arctic conservation efforts – Simon Bélanger, ARCTUS

This study aims at highlighting the vulnerability of Arctic environment, with a focus on the resilience of the ecosystems under the ongoing pressures of climate change and anthropogenic activity. Under the *Rapid Assessment of Circum-Arctic Resilience* (RACER) program, the Arctic has been divided into 50 eco-regions, of which 27 target marine ecosystems. Step 1: Using satellite images, regions of high productivity can be mapped and diversity can be determined. Drivers (sea ice, wind, currents, geographical features, river input etc.) and key features care then identified. Step 2: Assess ecosystem resilience and evaluate how these regions will evolve in the context of climate change. Hot spots were defined based on primary production computation from COLOR data. Independently, DFO identified eight hot spots (Ecologically Biologically Significant Areas – EBSA) in Baffin Bay (Eastern Arctic) based on high PP and diversity from a literature review and *in situ* measurements. It was proven that ecosystem-based approaches are more appropriate for mapping these hot-spot regions. Long-term time series of COLOR combined to improved ecosystem modeling will improve the prediction of resilience. Beside PP, future COLOR products such as phytoplankton functional types and better spatial resolution will provide new opportunities to support these types of activities.

ARCTUS is a small private company that provides a link between the end user and the remote sensing community. It will be involved in the validation of Sentinel-3 images, through an ESA contract to ACRI. One person will be working full time for 5 years to validate L2 data with a full access to Sentinel-3 data. ARCTUS may provide a good opportunity to link Canadian RS activities to those of ESA.

RACER report available at http://www.panda.org/arctic/racer

40 years of water colour science in Canada: what happens now – Gary Borstad and Eduardo Loos

ASL is a medium sized company, based Victoria, BC with services in remote sensing and other applications such as modelling. Historical information regarding water color EO in Canada was provided, highlighting the first SST images in 1970, Jim Gower's IOS spectrometer to measure fluorescence and the development of the fluorescence line imager in 1983 which led to MERIS technology, the valorisation of CZCS data by Trevor Platt (BIO) and Bukata (EC) for PP and other phytoplankton-related topics. Expansion in this period benefitted small industry. The development of the CASI and the establishment of the CSA in late the 80's, along with the incorporation of Satlantic and the pioneering work done by CARTEL, DFO (Larouche -IML), BIO, and Environment Canada in the 1990s advanced the EO science. The formation of IOCCG in 1996 and subsequent publication of IOCCG reports unified the community. With cuts to DFO labs in the early 2000's and the retirement of expertise at the federal level, water colour groups are now dispersed. The decrease in government research capacity has been picked up at the university level. Government scientists should not do all of the R&D, but we need internal capacity for research-based decisions and monitoring. Universities have a central role to play in research and training of HQP, but the time frame of university and government projects is rarely the same. There is a need for both science and services in Canada, with an increased urgency in Arctic, coastal environment and inland waters.

Due to limited funding, water colour community will depend on European and American sensors, with 2 agreements in place to facilitate the access to data, the Canada-France cooperative Space agreement, and the CSA-ESA Sentinel-3 agreement. New federal government initiatives are promising to develop a national operation water colour program. One of the greatest challenges is how to make use of the large amount of data considering the limited resources at the federal government level. A solution would be to start with limited products provided operationally at the national level.

Additional comments were provided by Marcel Babin doing a comparison between the funding and operational systems in the 1980's and 2000's, where it appears that University have larger funding than in the 1980's with larger infrastructures to support but only with soft money providing limited access to professional staff.
Leading question is why there are three different paths of funding by CSA for research, which limits the collaboration between the three sectors. One recommendation could be to explain how we want the research and operational system to operate at CSA level but also at the government level, to ensure an operational use of the infrastructure.
For information, the GRIP program is being evaluated and will be redesigned

Venetia Stuart pointed out that GRIP funded DFO Ottawa to produce a national report regarding remote sensing in support of the department, which has been produced but is not yet available.

Action – NetCOLOR should access this report and distribute to the community.

Susanne Craig pointed out that there is no data repository in Canada, which limits the access to data. Pierre Larouche points out that GRIP has funded a data depository and delivery system, which was delivered, but DFO has not funded or encouraged their laboratory to contribute to this archiving system.

Action – NetCOLOR should encourage all the Canadian laboratories to archive their data in SeaBASS.

Georges Fournier pointed out that to make a fundamental change in the interaction between sectors will need a high-level management decision, and a way to facilitate this would be to prove that our products are of value, how society will benefit and how it can lead to innovative collaboration.

EU uses water clarity product in their water quality indices

Question raised by Marcel, who should cover the costs of innovation in water colour? Should we work in public-private partnership system? If so we should get together to develop an efficient research and operations plan.

Action – write the recommendations to high management about the views for an operational and innovative water colour community.

Martin Bergeron points out that a better coordination of the resources should be taking place within the COLOR community.

Emmanuel Devred points out that to use the water colour data and products, the non-expert needs access to the expertise in addition to the data.

Cesar Fuentes-Yaco points out that the BIO ocean colour group is willing to contribute to any COLOR related initiative.

Sentinel-3 toolbox for OLCI processing – Emmanuel Devred

The launch date for Sentinel 3 is expected to be 10 December 2015 at the earliest. The characteristics of the OLCI sensors were provided. It will cover a swath of 12700 km and have an orbit of 27 days. Its design lifetime is 6.5 yrs. Full coverage of the global ocean will take a little more than 2 days. ESA and EUMETSAT will concomitantly be responsible for the L1 data. L2 ocean and terrestrial images will be the responsibility of EUMETSAT and ESA, respectively. A CSA-ESA agreement was signed on November 10 for obtaining and disseminating Sentinel-3 data to Canadian users through the Canadian centre for Mapping and Earth Observation (CCMEO). However, it is unclear how this will take place operationally. The Sentinel application platform (SNAP) was presented, pointing out the interesting application that will allow the processing of COLOR, SST and altimetry data under the same platform, as well as data from different sensors. There is a 6-month decommission phase prior to the distribution of the data. Two teams have been selected for Cal/Val activities (UVic/DFO for Pacific and Atlantic waters and Takuvik/UQAR for Arctic waters). NetCOLOR should voice its needs to CCMEO in term of data requirements. A recommendation to CCMEO could be to unpackage the data to limit the size of the files.

Maycira inquired about the relationship between the Canadian community, ARCTUS and Sentinel 3 validation team. ARCTUS will be helping with the validation during the operational phase, but will not be supplying anything to the Canadian community.

Steve Harris - national point of contact - The person responsible for negotiating the CSA-ESA agreement explained the process for Canada through a collaborative hub connection rather than the scientific hub, which will speed up the acquisition process. There is a limited capacity for simultaneous downloads. Canada is considered to be a member state, the second category of users. CCMEO will have a single portal for data. So far, no archive is expected in Canada since the data will be archived in Canada, as a rolling archive (90 days). ESA will maintain a longer archive.

An application must be made to access ESA site. The geographical extent of data downloaded by CCMEO has not been defined.

We were hoping to have somebody from CCMEO present at the meeting to speak about data archiving, but nobody was available. NetCOLOR is in a position to write a letter to CCMEO asking for clarification as to whether we will have access to Sentinel 3 data. Emmanuel said that the data will be available thru ESA science hub or maybe NASA. The files will be extremely large; there will be a possibility to download maybe 10 images at a time. CCMEO has no data processing capability. Processing will be done at ECUMET, and will be available to Canadian scientists through CCMEO.

Emmanuel will be attending the MEOPAR data management meeting and will defend and raise the profile of the OC community.

Action – NetCOLOR should express their opinion regarding the archiving of the Sentinel-3 data

The size of the files being so large, it could be interesting to have CCMEO unbundle the data. Answer: in this case, maybe it would be better to go through the scientific hub

Action – to appoint a new DFO representative should be appointed to the scientific community, as Jim Gower will retire in the next three months.

Tiger team representative: DFO, CCMEO, Agriculture Canada, EC, DND

Action – to have the name of the representative on the Tiger Team.

Could academia be involved in the Tiger team, at this point, no option for academic to be involved, academics need to go through the NetCOLOR that will request the information from NetCOLOR

Approaches for NetCOLOR recommendations on CSA activities – Martin Bergeron

The networking activities have proved to be successful. Now we have to make sure to accomplish the 6 deliverables listed in the NetCOLOR proposal. A report should be prepared as a deliverable to the CSA that would include the national strategy, the national capacity and the priorities. The writing committee will have to ask for some direction from CSA as to what should be included in the report.

The writing committee should include representatives from the three sectors (private, academic and government).

Dennis Lorraine presented an example of a report written by CASCA (Canadian Astronomical Society):
CASCA has a membership of approximately 300 including academic and government, post-doc and students. The organisation initiated a collaborative process with the support of NSERC, NRC, CFI, CSA and organisations that fund and administer astronomical research. Input was provided

through a national call for a white paper. The committee identifies a decadal plan (Long Range Plan, LRP) for astronomy and astrophysics in Canada, which was released in released in 2000 and 2011. The plan includes priorities, required infrastructure, research capacity, etc. The report is currently under mid-term review. Although the LRP is not used by CSA, it allows the funding organisations to see the society's strengths, capacities, past performances, future goals. Everything must be identified in the LRP if there is any chance of funding.

www.Casca.ca/Irp2010

Discussion

This type of activity has been conducted for the Oceanography as ordered by the Council of Canadian Academies, identifying the Canadian priorities as the 20 main questions.
A major achievement of NetCOLOR was to bring people together. This could be broadened in future activities.

Having this long-term plan should not only be seen as a deliverable to CSA but also as a benefit to the community, as well for funding agencies.

The report could have 4 sections:

1. summary of the capacity (5p)
2. inventory of the capacity (1p description of each lab)
3. recommendations
4. funding opportunities

Any activities that NetCOLOR is conducting should be careful at not duplicating international effort. The strength of NetCOLOR resides in the coordination of the efforts, as a unified voice. We need to showcase the community in an effort to influence policy and funding priorities. We also need to identify gaps in the needs of end users that are not currently being served by the RS community.

The LRP writing committee should consist of a panel of five or six people from different, with a chairman. As with the IOCCG reports, we have to develop a framework, objectives and a timeline

Timeline:
TAKUVIK WILL COORDINATE – Debbie and Emmanuel will ask for papers, steering committee will form writing committee, synthesis, call for suggestions for recommendations, synthesize in collaboration with community members.

Writing committee:
Susanne Craig (Dalhousie), Cesar Fuentes-Yaco (BIO); Eduardo Loo (ASL), Venetia Stuart (IOCCG), Caren Binding (or other Environment Canada representative), Georges Fournier (DRDC), Simon Bélanger/Clémence Goyens (UQAR), Griet Neukermans (Takuvik/ULaval)
Martin Bergeron (CSA, ex-officio)

The report should be deliverable for the next NetCOLOR meeting in January 2017. Having the meeting in Ottawa will enable us to attract more (government) people.

The steering committee could meet by videoconference every 6 months

Marti Gali Tapias indicated that he is confused about opportunities for funding. CFI has an overview presentation on funding. Can we add this to the NetCOLOR site, or distribute to students –relevant to training of HQP

Action – get the CFI presentation regarding Canadian opportunities for funding

Respectively submitted by:

Marie-Hélène Forget
Debbie Christiansen Stowe
December 2015