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University College Cork, Ireland
Coláiste na hOllscoile Corcaigh

Utilising Earth Observation to support Blue Growth & Risk Management in the Caribbean

23 - 26 January, 2018
Bay Gardens Hotel, St. Lucia

Workshop Report

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Finalised on 30th April, 2018

Thank you!

The #EOCaribbean2018 team would like to take this opportunity to thank our colleagues who travelled to Rodney Bay for your contributions. Your efforts have helped us immensely, in our drive to produce a roadmap and recommendations which could have actual impact in the Caribbean region. We finished the Rodney Bay workshop encouraged at the enthusiasm with which attendees engaged in the discussions, your concise and clear positive feedback and constructive comments, observations, encouragement, and considered guidance and cautions.

We hope this document provides you some insight and recollections of the #EOCaribbean2018 event, and adequately reflects the intensity of the discussions, and the depth of knowledge and experience you brought to addressing the Caribbean's issues over the four days.

Rory, Shona and the #EOCaribbean2018 team.



Participants and teachers at the #EOCaribbean2018 workshop

Overview

Funded by the European Space Agency, the "*Utilising Earth Observation to support Blue Growth and Risk Management in the Caribbean*" course (#EOCaribbean2018) brought together specialists in Blue Growth, climate change adaptation and risk reduction with experts in the application of Earth Observation Data to address real world Caribbean challenges and identify future supports for Caribbean ambitions.

The event was hosted by the Organisation of Eastern Caribbean States Commission and Future Earth Coasts in collaboration with University College Cork, the University of the West Indies, University of South Florida, ACRI-HE, the Inter-American Development Bank, the World Bank and Terrasigna.

The 4-day intensive workshop took place between the 23rd and 26th January, 2018 in St. Lucia. Government experts in environment, planning, fisheries and natural resources explored the Caribbean's Blue Growth opportunities, and the Risks to any Blue Growth achievements made by island states. The workshop contained both a training element (in Earth Observation data potential and usage) and a roadmap development element. Participants frankly discussed and examined the regional issues, identified Earth Observation support opportunities, and barriers which impinge island states from realising these opportunities.

Throughout the week, participants identified and refined a number of systemic actions that island states, international financing institutions, the European Space Agency, and the OECS Commission can take to ensure EO-derived information support and services are targeted correctly to help unlock the Caribbean's sustainable Blue Growth potential, and help ensure these achievements are protected and resilient. Participants also identified a range of systemic actions which, if taken would enhance Earth Observation data usage across the region. These detailed actions are contained in this report.

These actions form the basis of the "*Supporting Blue Growth and Risk Management through Earth Observation*" Roadmap. Each brief summarises the actions outlined here, with a greater level of detail and options for implementation available by following the thematic linkages in the actions tables below.

Agenda

Tuesday January 23rd

Welcome address
Introduction to the regional context
Introduction to workshop, expectations and outcomes
Barriers to be overcome
Introduction to the potential of Earth Observation
Data from Earth Observation – the fundamentals

Wednesday January 24th

Narrative 1 - ***Fisheries and Aquaculture***
- Regional F&A Context
- Example EO Applications
- Tool demonstration - SAFI
- Opportunities, Barriers and Actions Discussion

Narrative 2 - ***Maritime Safety and Security***
- Regional MS&S Context
- Example EO Applications
- Opportunities, Barriers and Actions Discussion

Blue Growth Issue & Opportunity

Protecting Achievements

Thursday January. 25th

Narrative 3 - ***Sargassum issues & opportunities***
- Regional F&A Context
- Example EO Applications
- Tool demonstration - SAWS
- Opportunities, Barriers and Actions Discussion

Narrative 4 - ***Climate Change Resilience and Adaptation***
- Regional CCR&R Context
- Example EO Applications
- Opportunities, Barriers and Actions Discussion

Blue Growth Issue & Opportunity

Protecting Achievements

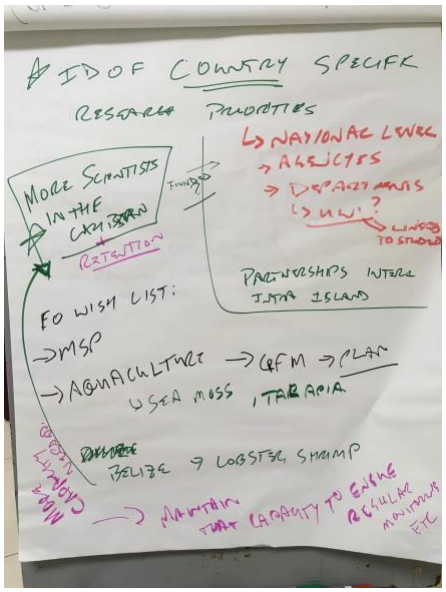
Friday January 26th

Enabling blue growth and risk mitigation in the Caribbean
Demonstration of Big Data Earth Observation tools
Systemic Approach to enabling Blue Growth & Risk Management
Exploiting Earth Observation opportunities: Future needs

Roadmap Development

Discussions

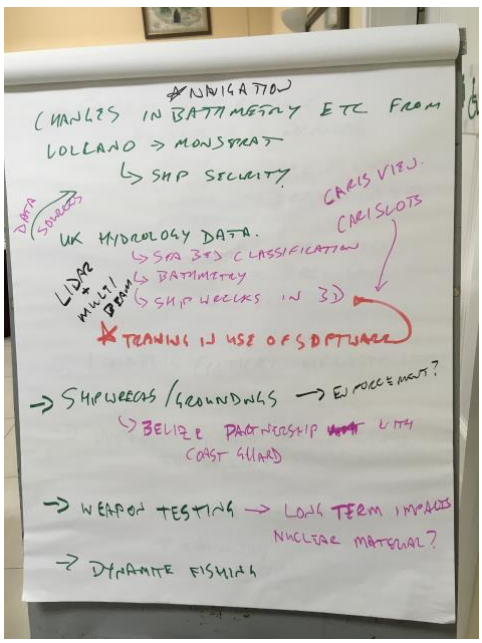
Every narrative session in the workshop was followed by an intense discussion amongst breakout groups to identify Blue Growth opportunities, issues, and potential for synergies to be developed with Earth Observation data. The same was also done for aspects related to protecting island states achievements, in the areas of Maritime Security, and in Climate Change Risk Reduction and Adaptation.



Meanwhile, days one and four focused on larger group discussions, identifying the regional, trans-thematic needs, and systemic issues being faced. Topics touched upon here included data sharing, data flow across the region, procedural barriers to decision support information, policy development activities, gaining political momentum to support Earth Observation data use, capacity building, regional expertise and skill networks amongst others.

During the final day, the needs, opportunities and barriers noted over the course of the previous three days were scrutinised by the participants, who derived actions which could address each one, suggested stakeholders involved in implementing these actions, and an indication of the immediacy of action implementation. With regard to two tranches of actions, discussion in Day 4 was not possible due to time constraints. These were reviewed subsequently by participants online, and the organisers would like to thank those who participated online for their efforts in refining the final group of actions.

The 164 identified actions are listed below. These have been analysed further, and have been distilled into the high-level roadmap document which this report underpins. This is available as an accompaniment to this report, with the high level actions mentioned within linked to the actions outlined here.



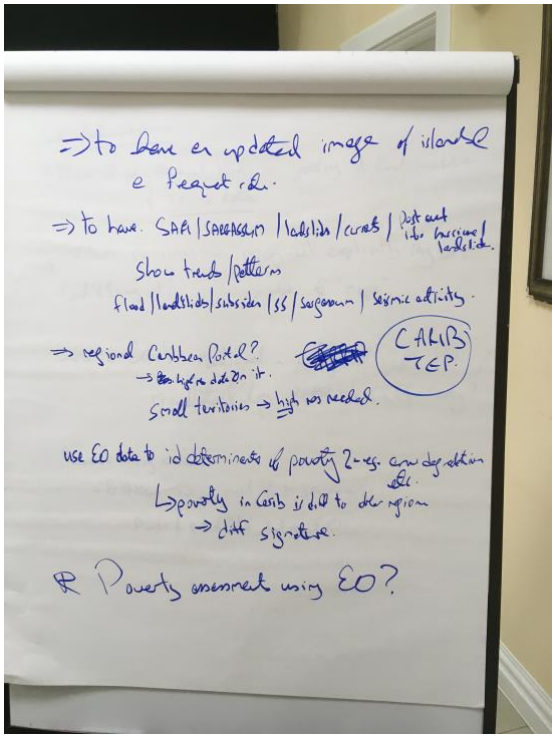
Materials

All lectures given, as well as supporting documentation, were distributed to participants and are being made available as a zipped, downloadable file. Email Rory Scarrott (UCC) on r.scarrott@ucc.ie to obtain a copy.

Identified Actions

The following pages detail the refined actions agreed upon over the course of the roadmap development by the participants in the #EOCaribbean2018 Workshop. The actions are grouped according to the sections in the Roadmap developed, i.e.:

1. Specific Actions for Fisheries and Aquaculture,
2. Specific actions for addressing Maritime Safety and Security,
3. Specific actions for *Sargassum* Influxes into Coastal Systems,
4. Specific actions for Climate Change and Risk Reduction,
5. Actions to address Data needs, education and training,
6. Actions to address systemic needs and adopting a holistic approach.



These groupings are colour coordinated with the Roadmap briefing sections, which are therefore underpinned by a range of potential detailed options and key activities required to deliver roadmap goals.

Note that thematically-focused sections 1 to 4 are also underpinned by actions held in 5 and 6 which are more systemic in nature, and could underpin the research suggested for the thematic initiatives.

All actions are also contained in an excel spreadsheet which is available accompanying this report, to aid efficient identification and collation of actions underpinning a roadmap goal if required.

Roadmap Section	Targeting	Issue/Opportunity addressed:	#EOCaribbean2018 -recommended Action	Addressing							Primary Focus	Action Code
				Data	Planning & Policy	Outreach	Education & Training	Research	Space	Collaboration		
Fisheries & Aquaculture	**Aquaculture Viability**	Need for support in MSP and aquaculture development and management.	**Investigate the potential to include EO support into national Maritime Spatial Planning and aquaculture planning procedures in key example Caribbean island states.**		X			X			Research	FA022
	Aquaculture Viability	Unclear how viable aquaculture is in the Caribbean region.	**Conduct a study on viability of different aquaculture potential in the Caribbean using EO plus in situ plus species research**					X	X		Research	FA042
	Commercial Fishstocks	Need to address illegal trawling.	**Investigate potential EO applications which can flag potentially illegal trawling activities to responsible Caribbean island state authorities**		X			X	X		Research	FA001
	Commercial Fishstocks	Need to change from unsustainable inshore fishing practices to pelagic fisheries.	**Conduct EO demonstration study to guide optimum FAD placement.**		X			X			Research	FA017
	Commercial Fishstocks	Potential for marine stakeholders to exploit nursery grounds using EO information on sargassum. Noted that as sensitive nursery grounds, appropriate data sensitivities and security would apply.	**Conduct a study investigating the negative and positive impacts of the provision of EO-derived data supports for fisheries, ensuring stakeholder engagement**		X	X		X			Research	FA018
	Commercial Fishstocks	Lack of correlation between landing data, fishing locations and fish stocks.	**Identify applications of EO to enhance fishery-obtained data in order to identify optimal species specific fishing locations**	X				X	X		Research	FA023
	Commercial Fishstocks	Need for local/regional study to make the connection between parameters of relevant fish stock and recruitment.	**Conduct studies to investigate and identify the relationships between EO-derivable ocean measurement parameters, and relevant fish stock levels and recruitment**					X	X		Research	FA027
	Commercial Fishstocks	Lack of data on niche characteristics of key species.	**Conduct research to collect these data with regard to recognised species considered key to Caribbean fisheries management and monitoring**	X				X			Research	FA028
	Commercial Fishstocks	Participants noted the need for a number of EO-applicable fisheries-focused studies to be conducted. Need to research temperature and key species distribution change, for example flying fish. Perceived reduction in large pelagics, e.g. swordfish. Need for varying time scale studies.	**Conduct a study on Caribbean sea temperature changes and key species distribution changes (beginning with Flying Fish).**					X			Research	FA035

Roadmap Section	Targeting	Issue/Opportunity addressed:	#EOCaribbean2018 -recommended Action	Addressing							Primary Focus	Action Code
				Data	Planning & Policy	Outreach	Education & Training	Research	Space	Collaboration		
Fisheries & Aquaculture	**Commercial Fishstocks**	Participants noted the need for a number of EO-applicable fisheries-focused studies to be conducted. Need to research temperature and key species distribution change, for example flying fish. Perceived reduction in large pelagics, e.g. swordfish. Need for varying time scale studies.	**Ensure research is inter- and intra-annual.**					X	X		Research	FA037
	Commerical Fishstocks	Participants noted the need for a number of EO-applicable fisheries-focused studies to be conducted. Need to research temperature and key species distribution change, for example flying fish. Perceived reduction in large pelagics, e.g. swordfish. Need for varying time scale studies.	**Conduct a study to investigate possibility of using EO data to support research into the perceived reductions in large pelagic species numbers (such as swordfish).**					X	X		Research	FA036
	Critical Habitats	Concerned with data reliability. Validation of existing data sources, e.g. UKHO bathymetry. Localised coastal terrain, e.g. black sand can affect EO data, e.g. transparency.	**Ensure an Investigation into the impact of local sediments on EO data processing outputs, and possible validation/corrections needed is conducted in the initial round of exercises.**	X				X	X		Research	FA015
	Critical Habitats	Local mangrove and coral health (participants queried "are there correlations between mangrove / coral health and marine parameters?).	**Research possible correlations with EO derived marine parameters (e.g. temperature) with coral health (bleaching) and mangrove health.**					X	X		Research	FA019
	Critical Habitats	Need for proxy to monitor inland water body status, e.g. through turbidity or mangrove health.	**Conduct small island focused lake studies on water quality, and the potential of EO-derived data to support monitoring and management.**					X	X		Research	FA025
	Critical Habitats	Need for increase in coral reef monitoring and management. Need for reef health study.	**Investigate possible EO applications to monitor and support management of coral reefs.**					X	X		Research	FA032
	Critical Habitats	Need for increase in coral reef monitoring and management. Need for reef health study.	**Conduct a reef health assessment study, incorporating all available reef monitoring data, coupled with EO data to extrapolate to un-surveyed areas measured by satellite-sensors.**					X	X		Research	FA033
	Invasive Species	Lionfish as an invasive species. Question raised - Can we monitor or predict abundance? Noted lack of data in niche characteristics of invasive species, e.g. lionfish.	**Conduct research to obtain Lionfish niche habitat characteristics information.**					X			Research	FA009

Roadmap Section	Targeting	Issue/Opportunity addressed:	#EOCaribbean2018 -recommended Action	Addressing							Primary Focus	Action Code
				Data	Planning & Policy	Outreach	Education & Training	Research	Space	Collaboration		
Fisheries & Aquaculture	**Invasive Species**	Lionfish as an invasive species. Question raised - Can we monitor or predict abundance? Noted lack of data in niche characteristics of invasive species, e.g. lionfish.	**Conduct a habitat prediction study using EO data in combination with in-situ and species-niche requirement data to determine the maximum potential distribution of lionfish across the Caribbean region.**	X				X	X		Research	FA010
	Invasive Species	Lionfish as an invasive species. Question raised - Can we monitor or predict abundance? Noted lack of data in niche characteristics of invasive species, e.g. lionfish.	**Validate the predicted distribution for lionfish presence / absence (use citizen science to log presence of absence where possible).**					X			Research	FA011
	Invasive Species	Lionfish as an invasive species. Question raised - Can we monitor or predict abundance? Noted lack of data in niche characteristics of invasive species, e.g. lionfish.	**Track and model potential habitat movement with developing ocean state changes.**					X			Research	FA012
	Invasive Species	Lionfish as an invasive species. Question raised - Can we monitor or predict abundance? Noted lack of data in niche characteristics of invasive species, e.g. lionfish.	**Conduct studies to model presence of, and validate, other invasive species of concern to Caribbean island states.**					X			Research	FA013
	Pollution	Water Pollution is highlighted as an issue.	**Conduct demonstration exercises where EO is applied to addressing water pollution issues.**			X		X	X		Research	FA003
	Pollution	Impact of land based pollution sources on coastal waters.	**Conduct studies to interconnect the land and sea pollution inclusive of the following aspects:** **· interrelations coast>land>sea,** **· short term and long term patterns,** **· impact of significant events such as rainfall,** **· impacts of coastline change,** **· impact of changes which are both seasonal and inter-annual,** **ensuring, where possible, the study utilises both available in-situ data and EO-derived data where appropriate.**					X			Research	FA034

Roadmap Section	Targeting	Issue/Opportunity addressed:	#EOCaribbean2018 -recommended Action	Addressing							Primary Focus	Action Code
				Data	Planning & Policy	Outreach	Education & Training	Research	Space	Collaboration		
Maritime Safety & Security	**Detection & Response**	Challenges in applying the polluter pays principal. Currently it is difficult to identify the ship that is polluting. Oil fingerprinting is needed.	**Develop the capacity to do oil fingerprinting as a centralised agency.**		X			X	X	X	Research	MS002
	Detection & Response	Polluter pays. Currently difficult to identify the ship that is polluting. Oil fingerprinting is necessary.	**Investigate the potential of EO data to detect vessels and oil spills to back-up oil fingerprinting and a developed regional agency.**		X			X	X	X	Research	MS003
	Detection & Response	Challenges in identification of oil spills and illegal bilge dumping.	**Demonstrate how SAR data may be used to detect and monitor pollution.**			X		X			Research	MS017
	Detection & Response	At the moment islands only have the capability to respond to a Tier 1 spill.	**Scope how islands could respond to higher oil spill severity tiers.**		X			X		X	Research	MS020
	Detection & Response	Current vessel collisions within member state jurisdictions.	**Scope the data available concerning key vessel collision incidents, assessing information potential.**					X			Research	MS021
	Situational Monitoring	Reef health affected by ship groundings and human.	**Investigate ship groundings and reef damage, and how EO can contribute to documenting these human activities impacts on reef health.**					X	X		Research	MS007
	Situational Monitoring	Safety at sea, lives lost, boats disappear, course unknown. Need for salvage and recovery of shipwrecks.	**Investigate the pre-existing use of modelling data to track circulation patterns for search and rescue and salvage missions.**					X			Research	MS008
	Situational Monitoring	Volcanic activity causing areas to be inaccessible due to dangerous working conditions.	**Scope EO capabilities of observing these areas without need for in-situ collection.**					X	X		Research	MS011
	Situational Monitoring	Maritime border security issues regarding the transport of illegal drugs to the USA.	**Investigate the use of EO data in monitoring transboundary illegal activities.**		X			X	X	X	Research	MS014
	Situational Monitoring	Monitoring illegal activity at sea.	**Scope the production of maritime awareness information from complimentary sources e.g. SAR data, AIS, LRIT.**					X	X		Research	MS016

Roadmap Section	Targeting	Issue/Opportunity addressed:	#EOCaribbean2018 -recommended Action	Addressing							Primary Focus	Action Code
				Data	Planning & Policy	Outreach	Education & Training	Research	Space	Collaboration		
Sargassum Influxes into Coastal Systems	**Biology**	Need for research into where it comes from, why it occurs and how frequent it is likely to be	**Research Sargassum as a topic regionally - multidisciplinary incorporating socio-economic impact ($), biology, projection, trends, monitoring, in-situ and eo data sources, the movement and possible prediction, and impact ($) of sargassum,**					X			Research	SA003
	Biology	Need for sargassum volume to be predictable in order for the biofuel opportunity to be harnessed	**Ensure biomass per pixel is reported.**			X		X			Research	SA019
	Information Delivery	Lack of clarity as to what can be done with this information, and how it can be implemented.	**Develop apps which distribute Sargassum information.**	X		X		X		X	Research	SA007
	Information Delivery	Prediction would be useful, however timing needs to line up with regional ocean governance discussions (Feb)	**Scope the potential for Sargassum prediction delivery by early February.**	X	X			X			Research	SA008
	Strategic Collaboration	Need for a cross sectoral approach, and community engagement in order for effective long term management of Sargassum	**Include all stakeholders in any effort in dealing with the sargassum issues.**			X		X		X	Collaboration	SA001
	Trends	Unable to coordinate adequate response without sargassum forecasting	**Research sargassum forecasting.**					X	X		Research	SA002

Roadmap Section	Targeting	Issue/Opportunity addressed:	#EOCaribbean2018 -recommended Action	Addressing							Primary Focus	Action Code
				Data	Planning & Policy	Outreach	Education & Training	Research	Space	Collaboration		
Climate Change & Risk Reduction	**Infrastructure for Resilience**	Issue: inadequate data Opportunity: Virtual buoys for sea level could be useful in Caribbean, for example to help in locating setebacks etc.	**Request for virtual buoys, and suitable locations (Related to 5 C's).**	X				X			Research	CR005
	Infrastructure for Resilience	Need for vulnerability index/webGIS using EO derived products, enabling them to generate vulnerability estimations, e.g. reef health, mangrove health, coastal erosion, flooding, inundation, coastal management. There is a need for higher resolution in Land cover change, vegetation and DEMs.	**Investigate possibility of OECS vulnerability index/webGIS using EO derived data.**	X				X	X		Research	CR012
	Infrastructure for Resilience	Need for vulnerability index/webGIS using EO derived products, enabling them to generate vulnerability estimations, e.g. reef health, mangrove health, coastal erosion, flooding, inundation, coastal management. There is a need for higher resolution in Land cover change, vegetation and DEMs.	**Development of Caribbean centric EO processing tools and altimetry products and DEMs.**	X				X	X		Research	CR013
	Regional Ecological Change	Interest in EO's possible contribution to biological diversity change analysis, including mapping of invasive species.	**Scope the availability and suitability of Bio Mass estimation tools and how they may be used to access Bio Mass change due to climate events.**					X			Research	CR027
	Regional Ecological Change	Interest in EO's possible contribution to biological diversity change analysis, including mapping of invasive species.	**Scope possible projects for mapping and monitoring marine protected areas and migrational patterns of fish and sea turtles.**					X			Research	CR028
	Regional Historical Trends	Historical storm surge data specific to the Caribbean region required.	**Scope the potential for historical storm surge data to guide long term planning for critical infrastructure placement.**		X			X			Research	CR006
	Regional Historical Trends	A need to validate the effectiveness of soft and hard coastal defences.	**Research past extreme weather events and the spatial and economical damage sustained with regards to soft and hard coastal defences.**					X			Research	CR025
	Risk Assessment	EO is currently not currently being used in hazard mapping and planning of critical infrastructure.	**Use EO data as a step towards the efficient use of resources in response to hazards and critical infrastructure, for example avoid future shelters being located in flood plains.**		X			X			Research	CR004
	Risk Assessment	Currently unable to detect subsurface oceanic tectonic or landslide activity in a timely fashion.	**Investigate whether possible to use surface expressions to detect underwater tectonic and landslide activity, e.g gravity waves.**					X			Research	CR009
	Risk Assessment	Islands are unique, therefore, uniform approach to climate risk assessment is unlikely in the short term.	**Focus EO for risk assessment on individual islands or along common risk threats (short term).**					X	X		Research	CR020
	Risk Assessment	Unsure if EO data would be useful to assessing socioeconomic climate-driven issues.	**Explore the scope of EO contributions in poverty assessments and migration patterns of people and food markets.**					X	X		Research	CR026

Roadmap Section	Targeting	Issue/Opportunity addressed:	#EOCaribbean2018 -recommended Action	Addressing							Primary Focus	Action Code
				Data	Planning & Policy	Outreach	Education & Training	Research	Space	Collaboration		
Data needs, education & training	**Addressing Data Gaps**	GIS is available, baseline maps not high resolution enough for small islands states.	**Develop and distribute a suite of baseline satellite imagery for small islands states in GIS databases.**	X		X			X		Data	CR023
	Addressing Data Gaps	EO is one piece of the puzzle. Data is needed to complete the picture. Not sure how reliable the data is, including information from fisheries. Large amount of EO data collectors, but is there synergy?	**Collate identified optimum data sources for Caribbean fisheries and aquaculture on one open data portal, which guides users to the data source.**	X							Data	FA049
	Addressing Data Gaps	Concerned with data reliability. Validation of existing data sources, e.g. UKHO bathymetry. Localised coastal terrain, e.g. black sand can affect EO data, e.g. transparency.	**Ensure EO-derived bathymetry product validation (against for example UKHO charts) is conducted in the initial round of exercises.**	X				X			Data	FA014
	Addressing data gaps	Catch datasets are not available (where and abundance of catches).	**Conduct research to collect these datasets (use stats office).**	X				X			Data	FA029
	Addressing Data Gaps	Lack of mean sea level baseline data or archives.	**develop this baseline, if possible validate using past tide gauge data from previous projects.**	X				X			Data	FA040
	Addressing Data Gaps	Need to demonstrate EO effectiveness in acquisition of locally relevant data. Islands need frequently updated free high resolution data.	**Demonstrate the continuance of EO data to in situ data using drones as mid-level. Potential focus on agriculture infrastructure. (Possible research/demonstration project).**	X		X	X				Data	GE002
	Addressing Data Gaps	Safety at sea, lives lost, boats disappear, course unknown. Need for salvage and recovery of shipwrecks.	**See if further EO data is necessary.**	X				X			Data	MS009
	Addressing Data Gaps	Need for updated nautical charts.	**Investigate if update using EO can complement LIDAR and multibeam data as a potential data source.**	X				X			Data	MS004
	Data Access	Unclear how historical EO information can be collected on past events. A lack of historical flood maps and spatial trend analysis. Need for the development of historical flood maps for both ocean and land sourced flooding. A lack of data to feed into early warning systems for extreme weather events.	**Develop a brief informing island state operators how to do so and who to contact.**	X	X	X	X			X	Data	CR002

Roadmap Section	Targeting	Issue/Opportunity addressed:	#EOCaribbean2018 -recommended Action	Addressing							Primary Focus	Action Code
				Data	Planning & Policy	Outreach	Education & Training	Research	Space	Collaboration		
Data needs, education & training	**Data Infrastructure**	Currently have beach profile information, but don't have a software to visualise and store the data.	**Investigate possibility of using C-TEP to visualise and store beach profile data.**	X		X		X			Data	CR029
	Data Infrastructure	Any inclusion of oceanic-EO research would need to sit within a framework of ocean observation in the Caribbean	**Recognise UWI's potential to be an ocean data hub as a core part of this framework.**	X	X						Data	FA046
	Data Infrastructure	Need to know about apps that will help disaster management, including landslide, flood, storm surge, sargassum etc as well as poverty, shipping activities, etc.	**Discuss the creation of a Caribbean portal to address all of these points with rich EO data (high resolution).**	X						X	Data	GE018
	Data Infrastructure	Opportunity: preference towards web based system that is easy to browse for government officials including all outputs from EO & GIS units. Keep it Simple and users happy to interact with it.	**Investigate the possibility of Carib-TEP (similar sexy google map front-end user interface) including parameters mentioned throughout this document.**	X		X		X	X		Data	GE022
	Data Infrastructure	Lack of communication between departments within one nation.	**Make an effort to move data from individual computers to a national database.**	X	X						Data	GE035
	Data Infrastructure	Island states showed interest in virtual buoy placement.	**Explore possible Caribbean locations.**	X				X			Data	SA016
	Data Mapping & Gap Identification	Fish stock science is not developed enough to inform policy. We do not have the data.	**Map current available data, identify data gaps, and strategies to address (can use EO data).**	X	X			X			Data	FA002
	Data Mapping & Gap Identification	EO is one piece of the puzzle. Data is needed to complete the picture. Not sure how reliable the data is, including information from fisheries. Large amount of EO data collectors, but is there synergy?	**Conduct a data mapping exercise, identifying data relevant to fisheries and aquaculture in the Caribbean, where it is held, who holds it, and data source quality.**	X							Data	FA005
	Data Mapping & Gap Identification	High resolution coastal data need.	**Identify and map out sources of high-resolution (satellite-derived, lidar and drone-derived) EO data currently attainable within the means of Caribbean island states.**	X		X					Data	FA016

Roadmap Section	Targeting	Issue/Opportunity addressed:	#EOCaribbean2018 -recommended Action	Addressing							Primary Focus	Action Code
				Data	Planning & Policy	Outreach	Education & Training	Research	Space	Collaboration		
Data needs, education & training	**Data Mapping & Gap Identification**	Any inclusion of oceanic-EO research would need to sit within a framework of ocean observation in the Caribbean.	**Conduct a data mapping exercise identifying data on the Caribbean held locally and over the world.**	X							Data	FA047
	Data Mapping & Gap Identification	Lack of clarity, who is actually using EO? Unsure how it should be used into the future.	**Participants asked to highlight who is using it? how they use it? and what is needed to use EO data.**	X		X			X		Data	SA017
	Data Mapping & Gap Identification	Currently a wish-list for EO support: pollution discharge, e.g. wastewater. Potential connection with mangrove health; need for early warning systems for underwater tectonic activity.	**Discuss possibilities regarding regarding how EO can contribute to these issues.**	X		X	X	X			Data	MS005
	Data Sharing	Is there information needed which is currently not being collected?	**Produce a report on the availability/quality/ownership of data in the Caribbean area.**	X							Data	GE001
	Data Sharing	Needs to be an acknowledgement of spatial data privacy and sharing issues (acquisition, utilisation, storage, collection, architecture) (inter-departmental, international, regionally) which could impact synergy applications. Issue identified - data security. Need a structure to preserve data and skills - over dependence on one/two individuals. No backup of all island capacity. Issue identified - data & skills resilience.	**Host an action oriented regional workshop reaching consensus on data architecture and resilience, (Output: Further refine roadmap and identify priority actions); Possibility of inviting external partners.**	X						X	Data	GE006
	Data Sharing	Lack of communication between nations.	**Establish a central, focal point within the region including a repository of all available GIS data, and frequent one-to-one communication with nations.**	X	X					X	Data	GE036
	Data Sharing	Issue identified: Island stakeholders feel they give data freely without return in a useful format. Potential impact on in-situ data sharing. Opportunity: for mutually beneficial data use.	**Discuss potential regional and international data sharing policy to clarify data privacy and data issues. Ensuring a transparent mechanism of benefit return.**	X	X						Data	GE004
	Data Sharing	Plenty bodies to be involved, but lack of architecture to implement.	**Discuss formalisation of process to move into policy, and make opportunities a reality. Need agreement on an architecture.**	X	X						Data	SA010

Roadmap Section	Targeting	Issue/Opportunity addressed:	#EOCaribbean2018 -recommended Action	Addressing							Primary Focus	Action Code
				Data	Planning & Policy	Outreach	Education & Training	Research	Space	Collaboration		
Data needs, education & training	**Data Sharing**	There is no oceanographic hub here in the Caribbean.	**Create the infrastructure for collaboration, including a home for Oceanography in the Caribbean.**	X	X		X			X	Data	SA011
	Goal-based Capacity Building	Lack capacity of processing and interpreting raw data.	**Short term priority - deliver training.**				X				Education & Training	CR014
	Goal-based Capacity Building	Lack capacity of processing and interpreting raw data.	**Long term: develop regional capability (skills and equipment).**	X	X		X		X		Education & Training	CR016
	Goal-based Capacity Building	Staff and skill retention issue, risk of overturn, overdependence on individuals. Opportunity to synergistically address under broader the Human Resourcing challenge.	**Train a wider range of persons in core required skills.**		X		X				Education & Training	GE032
	Mainstreaming EO Skills Capacity	Lack of availability of EO-centric education at key third level courses which build local governance capacity.	**Investigate the inclusion of an RS course in CERMES to raise EO awareness.**				X				Education & Training	FA020
	Regional Applilcation Application Characteristic	Unable to access EO data relevant to marine safety and security, in a user friendly manner.	**Investigate NRT delivery of EO data to the Caribbean.**					X	X		Space	MS023
	Thematic EO Training	Lack of human capacity to incorporate EO techniques.	**Address the gap, targeted capacity building such as formal training following the guidance provided by participants in:** **· Thematic focus,** **· Event aspects (e.g. using both their own and EO data),** **· Hands-on experience with using actual EO-derived data and applying it.**				X				Education & Training	FA038
	Thematic EO Training	Issue with perception: EO is too complex to use "too complex for earthlings". Need to dispel the myth and demonstrate it can be used by end users.	**Conduct capacity building activities with the Caribbean Fisheries and Aquaculture data using community, demonstrating the usage and application of EO data to complement and enhance their existing data usage activities.**			X	X	X			Education & Training	FA048
	Thematic EO Training	The workshop in Saint Lucia felt more like a scoping exercise, but participants want solutions now not later.	**Have workshops with hands on experience in how you can use EO data now (not in a few years), specifically tailored to the regional level.**			X	X			X	Education & Training	GE015

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				Data	Planning & Policy	Outreach	Education & Training	Research	Space	Collaboration		
Data needs, education & training	**Thematic EO Training**	Participants expect hands on workshop with solutions now, not a scoping exercise.	**Improved capacity building, hands on training where participants can bring their own dataand explore the use of EO portals/platforms.**				X				Education & Training	GE017
	Thematic EO Training	Lack of training to fully use pre-existing and given data.	**Target marine safety and security geospatial training.**				X				Education & Training	MS006
	Thematic EO Training	Unable to access EO data relevant to marine safety and security, in a user friendly manner.	**Develop the human capacity to integrate EO into maritime surveillance.**					X			Education & Training	MS024
	Thematic EO Training	Need to use existing skill sets, e.g. meteorology.	**Conduct regional skill mapping exercise regarding Sargassum.**				X				Education & Training	SA009
	Thematic EO Training	Need for EO use and sargassum education to focus on the long term and at all levels of education.	**Incorporate EO and Sargassum education at all levels.**			X	X				Education & Training	SA012
	Training Delivery Approach	Participation in the workshop needs to be targeted far better. Workshop invite message needs clarity.	**Future workshops should ensure clarity in invitation. Invites: technicians or planning, etc.**				X		X		Education & Training	GE016
	Training Delivery Approach	Opportunity to communicate benefits of EO through a two-page brief for policy makers, taking out any unnecessary jargon.	**Deliver training in brief preparation, (communication specialists or graphic designers).**			X	X				Education & Training	GE020
	Training Delivery Approach	Participants unclear as to how all learning can be put into effect when they go home and speak with leaders.	**Mark as a general observation concerning workshop design.**				X				Education & Training	GE026
	Training Delivery Approach	There is a need for online training in order to extend reach.	**Islands need to consulted regarding specific training needs. Training need to be delivered and video recorded for repetitive use.**				X				Education & Training	GE028

Roadmap Section	Targeting	Issue/Opportunity addressed:	#EOCaribbean2018 -recommended Action	Addressing							Primary Focus	Action Code
				Data	Planning & Policy	Outreach	Education & Training	Research	Space	Collaboration		
Adopting a systemic & holistic approach	**Caribbean Engagement**	Unclear how small island states can request Copernicus data, specifically during large impact events.	**Inform island states about copernicus disaster register**	X	X				X	X	Space	CR001
	Caribbean Engagement	Participants note the revisit time (of sensors) is not sufficient.	**Respond to data need specifications with a list of potential EO sensors (or sensor combinations) which could meet the need**						X		Space	FA007
	Collaboration Infrastructure	Design targeted policies and programs using EO data linked to socio-economic and administrative data.	**Foster collaboration between agencies (similar to national Anguilla statistical advisory arrangement)**	X	X					X	Collaboration	GE023
	Collaboration Infrastrucutre	Lack of communication between departments within one nation.	**Establish a key contact point within each nation who has a holistic view of all GIS efforts**	X	X	X				X	Collaboration	GE034
	Decision-maker-tailored Information Delivery	R3I (RRRI) project identified that different islands have different risks, some similarities and differences. National stakeholders are important here.	**Clarify EO support capacity for common risks**			X		X	X	X	Outreach	CR019
	Decision-maker-tailored Information Delivery	Unclear how governments can use EO products for ocean governance in the Caribbean.	**Develop a position paper outlining how Caribbean governments could use EO for ocean governance**		X	X			X		Outreach	FA041
	Decision-maker-tailored Information Delivery	Opportunity to communicate benefits of EO through a two-page brief for policy makers, taking out any unnecessary jargon.	**Create a two page brief of what EO can do, aspirations concerning the data. Very concise, which can be used as an advocacy tool to inform policy. Must be specific to the region (at multiple levels - nations, OECS, CARICOM, CLMN). Included specific focus on disasters.**		X	X			X		Outreach	GE021
	Decision-maker-tailored Information Delivery	Policy makers provided with information are likely to ask “so what?”	**Add to policy brief action issue framing**			X					Outreach	GE024
	Decision-maker-tailored Information Delivery	Recommendations by planning committees (including EIAs) can be overruled by seniors.	**Use EO information to further brief seniors.**		X	X	X				Outreach	GE029
	Decision-maker-tailored Information Delivery	Implementation of ambitions requires ministerial approval.	**Develop information supports to brief ministers effectively on opportunities and rational for investment**		X	X			X		Outreach	MS028
	Framework Development & Implementation	Islands are unique, therefore, a uniform approach to climate risk assessment is unlikely in the short term.	**Long term: move towards advantageous harmonisation of assessment and management**		X						Policy & Planning	CR021
	Framework Development & Implementation	Unclear how viable aquaculture is here	**If needed, develop a policy framework**		X						Policy & Planning	FA043
	Framework Development & Implementation	Any inclusion of oceanic-EO research would need to sit within a framework of ocean observation in the Caribbean	**Develop a framework for ocean observation in the Caribbean, to guide ocean observation efforts, target resources, research and data gathering strategically, and provide sector-specific data access points tailored to Caribbean needs.**	X	X	X					Policy & Planning	FA045

Roadmap Section	Targeting	Issue/Opportunity addressed:	#EOCaribbean2018 -recommended Action	Addressing							Primary Focus	Action Code
				Data	Planning & Policy	Outreach	Education & Training	Research	Space	Collaboration		
Adopting a systemic & holistic approach	**Framework Development & Implementation**	Not all vessel positions are known - this is a search and rescue issue.	**Investigate the scope for EO to feed into a regional safety policy.**		X			X		X	Policy & Planning	MS012
	Framework Development & Implementation	Incomplete boundary delimitations complicates the implementation of maritime safety and security procedures.	**Further implement ECROP recommendations.**		X						Policy & Planning	MS029
	Framework Development & Implementation	Multiple cross sectoral stakeholders are vital to sargassum discussions and use of EO.	**Develop all frameworks engaging with all key stakeholders - academia (UWI, CIMH, CARICOM -5 Cs, virtual blue university campus - CROP), OECS, CRFM, Climate, fisheries, RSS (observations in terms of aviation), funding bodies (WB, IDB, ESA, NASA), GIS professionals/organisations, Environmental NGOs, CANARI research, Carpha, TNC.**		X	X				X	Policy & Planning	SA014
	Human Resources	Lack of communication between departments within one nation.	**Departments need to have a go to technical point for EO data and then identify and utilize existing network connection in order to disseminate information.**		X	X				X	Policy & Planning	GE027
		Lack of department expertise in EO analysis.			X							
	Human Resources	Supervisors need to be convinced EO is worth investment (consultant voice sometimes deemed more dependable than internal).	**Accredit learning and achievements for courses to add weight to voice.** **Prioritise regionally, to convince supervisors of importance.**		X		X				Policy & Planning	GE030
	Long Term Challenges	Marine plastics. "Could be more plastic than fish in the ocean by 2030."	**Set as a challenge: Can EO provide information for monitoring marine plastics?**					X	X		Space	FA004
	Long Term Challenges	Participants note the revisit time (of sensors) is not sufficient.	**If need is currently unmet – integrate the stipulation on revisit time into future novel sensor specifications to see if it can be addressed.**						X		Space	FA008
	Network Development	R3I (RRRI) project identified that different islands have different risks, some similarities and differences. National stakeholders are important here.	**develop network for common risk communities to communicate.**	`		X				X	Collaboration	CR018
	Network Development	No awareness of EO capabilities across Caribbean stakeholders.	**Create a network for EO end users in the Caribbean, with focus on knowledge transfer.**			X	X			X	Collaboration	FA024
	Network Development	Issue: need for a database of expertise.	**Create a database of expertise.**							X	Collaboration	GE007
	Network Development	Lack of communication between nations.	**Creation of a forum - perhaps whatsapp or facebook group.**							X	Collaboration	GE037
	Network Development	Opportunity to create a Regional Caribbean Sargassum monitoring program.	**Investigate if this would have long term governmental support.**		X			X		X	Collaboration	SA018

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				Data	Planning & Policy	Outreach	Education & Training	Research	Space	Collaboration		
Adopting a systemic & holistic approach	**Policy & Planning Support**	Overfishing monitoring.	**Investigate the use of EO data and in situ data to monitor adherence to the closed season fishing policies.**		X			X	X		Research	MS013
	Policy & Planning Support	Need for information for urban planning at the coast.	**Scope development of EO information supports for foreshore developments.**									MS010
	Procedure for Information Utilisation	Regional fisheries policy (CRFM) exists, therefore any EO initiatives must align with this.	**Ensure any EO-product and service development for fisheries support coordinates with the CRFM.**		X				X		Policy & Planning	FA026
	Procedure for Information Utilisation	Unclear how viable aquaculture is here.	**Ensure initial EO work is carried out to specifically inform policy planning framework which already exists, targeting EO activities at the state initially.**		X			X			Policy & Planning	FA044
	Procedure for Information Utilisation	Decision makers reluctant to use data in decisions.	**Encourage decision makers to utilise data to make an informed decision and increase accountability (e.g. Grenada).**		X						Policy & Planning	GE011
	Procedure for Information Utilisation	Decision makers reluctant to use data in decisions.	**Enhance the knowledge of the decision makers.**		X		X				Policy & Planning	GE012
	Procedure for Information Utilisation	With EO information provision, there is an unclear structure for enforcement response procedure.	**Develop a response infrastructure which can react to EO-derived information. Noting that transferrable structures may already exist.**		X		X	X			Policy & Planning	MS018
	Procedure for Information Utilisation	Lack of clarity as to what can be done with this information, and how it can be implemented.	**Determine who gets the information.**	X	X	X				X	Policy & Planning	SA005
	Procedure for Information Utilisation	Lack of clarity as to what can be done with this information, and how it can be implemented.	**Determine how the response to Sargassum information can be implemented.**		X			X			Policy & Planning	SA006
	Procedure for Information Utilisation	Need for regional sargassum contingency plan.	**Develop a regional sargassum contingency plan.**		X						Policy & Planning	SA013
	Procedure for Information Utilisation	Supervisors need to be convinced EO is worth investment (consultant voice sometimes deemed more dependable than internal).	**Prioritise regionally, to convince supervisors of importance.**		X						Policy & Planning	GE031
	Regional Application Characteristics	Lack capacity of processing and interpreting raw data.	**Short term: deliver finished products rather than raw data, e.g. coral health, mangrove health, inundation, wave height, etc.**			X		X	X		Space	CR015
	Regional Application Characteristics	Limited budget means little access to software licences.	**Ensure priority remains on free software alternatives. Identify software available.**							X	Space	CR022

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				Data	Planning & Policy	Outreach	Education & Training	Research	Space	Collaboration		
Adopting a systemic & holistic approach	**Regional Application Characteristics**	Need for future EO products to map and utilise existing infrastructure. (Concerning disaster risk management, there is already a policy to share resources between islands post disaster, therefore, a legacy of sharing resources and an existing system of communications for doing so).	**Any EO product or service development must integrate into this system.**	X	X			X	X		Space	GE014
	Regional Research Prioritisation & Approach	R3I (RRRI) project identified that different islands have different risks, some similarities and differences. National stakeholders are important here.	**build on RRRI project.**		X				X		Policy & Planning	CR017
	Regional Research Prioritisation & Approach	EO is currently not a part of Caribbean research priorities.	**Identify country specific research priorities in which EO could support, and develop third level research centric response with UWI.**		X						Policy & Planning	FA021
	Regional Research Prioritisation & Approach	Need for participatory approaches, e.g. habitat studies should feedback to Caribbean actors who contribute building trust and honesty through exchange.	**Enshrine participative approach in research activities, calls, approaches and evaluation.**		X	X					Policy & Planning	FA030
	Regional Research Prioritisation & Approach	Academic institutions (for example CERMES and St. Augustine) possibly not fully utilised as regional training hubs. Is the connection between campuses being utilised?	**Explore which topics EO could feed into. Discuss enhancing the connection between academic institutions. Possibility of new training.**		X		X			X	Policy & Planning	GE008
	Regional Research Prioritisation & Approach	There is a lack of coast guard/marine police resources and funding.	**Investigate the applications of EO to support marine policing initiatives and further resource optimal use.**		X						Policy & Planning	MS015
	Regional Research Prioritisation & Approach	EO should not create something entirely new.	**Ensure that any developments of products/services are done within the context of treaty obligations, existing contingency plans (regional oil spill contingency plan), existing protocols (under Cartagena Convention) and the existence of regional maritime advisors.**		X	X			X	X	Policy & Planning	MS019
	Stakeholder Engagement	Decision makers reluctant to use data in decisions.	**Engage with the public to influence decision makers. Foster conversation for civic engagement.**			X					Outreach	GE010
	Stakeholder Tailored Information Delivery	Need for a reference guide, including all relevant satellites and sensors for the Caribbean. Confusion as to what is available.	**Create a user friendly reference guide informing (thematically focused language) parameters available directing to data streams you need to access, e.g. parameters to do with climate change.**		X	X	X				Outreach	CR011
	Stakeholder Tailored Information Delivery	Opportunity for EO derived information to inform the development of OECS and member state negotiating positions at WTO talks.	**Develop coherent information supports, e.g. estimating biomass production.**		X	X			X		Outreach	FA031
	Stakeholder Tailored Information Delivery	EO data are not accessible or interpretable to decision makers and stakeholders.	**Translate data products to accessible information for different audiences. Ensure data product development engages with stakeholders and targeted audiences (viably).**		X	X					Outreach	GE009

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Adopting a systemic & holistic approach	**Stakeholder Tailored Information Delivery**	Interest in a Caribbean EO Expo.	**Explore with multiple EO organisations and product providers the potential to hold an EO expo which delivers a range of information and products targeted at: politicians, tourism, fishermen, farmers, recreational boaters.**			X	X				Outreach	GE033
	Stakeholder Tailored Information Delivery	Need information as accessible as google earth, with metadata.	**Scope the development a comprehensive, intuitive, data searching, accessible, parameter focused identification portal.**	X		X					Outreach	MS001
	Strategic Collaboration	Many stakeholders need to be involved in any national/regional initiative.	**Identify these key stakeholders including: GIS specialists, fisheries, tourism, planning and disaster management. Other may include aquaculture, environmental, meteorological, police/security.**			X				X	Collaboration	CR024
	Strategic Collaboration	Decision makers distanced from the data.	**Ensure decision services are integrated Decision Support Systems which decision makers can interact with.**	X						X	Collaboration	FA039
	Strategic Collaboration	Need to know about apps that will help disaster management, including landslide, flood, storm surge, sargassum etc as well as poverty, shipping activities, etc.	**Scope potential links to ICAN (Caribbean Marine Atlas-INVEMAR).**							X	Collaboration	GE019
	Strategic Collaboration	There are a number of stakeholders involved in developing tailored support services for Caribbean marine safety and security.	**Ensure the following stakeholders are represented MS&S discussions: Police, Navy, Coast Guard, Fisheries Depts, Environmental Depts, Port Authorities, GIS Offices, NGOs, Research Institutions, OECS connections to National ocean governance actors.**			X				X	Collaboration	MS027
	Strategic Collaboration	There is an existing Sargassum monitoring tool, SaWS, which may feed into a Caribbean platform.	**Assess and investigate collaborative work with any existing Sargassum EO projects.**							X	Collaboration	SA020
	Strategic Discourse	Need for a discussion on the application of commercial sensitivity considerations with regard to data sharing and use (EO, statistical, in-situ, drone).	**Create a space for data sharing/accessibility discussion. (link with creation of policy framework).**	X	X						Policy & Planning	GE003
	Strategic Discourse	There are a number of stakeholders involved in developing tailored support services for Caribbean marine safety and security.	**Create a conversation space for all relevant stakeholders to discuss product development.**		X					X	Policy & Planning	MS026
	Strategic Discourse	Sargassum causes many issues for the Caribbean region, however it is also a very important ecosystem.	**Create a space for regional discussion on the pros and cons of sargassum options, e.g. removal, "do-nothing" approach, etc.**		X						Policy & Planning	SA004

Contact

For further information on the workshop, or clarifications on the derived actions, training elements delivered, or the workshop network established, please do not hesitate to contact:



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