PRODUCTS AND SERVICE GUIDANCE

MARITIME OPERATIONS

Decision Needs Products and Services Primary Uners/Sakaholders Contegraphical Contegraphical Contegraphical Contegraphic data systems in contrasted approaches to critical ports of critical ports Columnic primary (Columnic primary) Columnic primary (Columnic primary) Columnic primary) Columnic primary (Columnic primary) Columnic primary) Columnic primary (Columnic primary) Columnic		WARTING OF ERATIONS										
Metiocan data systems in constrained approaches to orbital perms 1,2,3 US Casa Gazet, Ror Place, Marine Temperature Industry, Port Authorities, Audemic Researchers 4 4 4 4 4 4 4 4 4		Decision Needs	Products and Services		Primary Users/Stakeholders		Variables	Model Type			Operational requirements (i.e. 24/7, near real time, etc.)	Timeframe
Microcan data systems in constrained approaches to AIDM grains: It Court Guard Four Rises, Marrier Transportation Endurary, Prof. Authorities, Adodemic Researchers												
2 Oceanographic data south of St. Croix Oceanographic data busy 12,3 Target profit for the control of St. Croix Oceanographic data south of St. Croix Oceanographic data busy 12,3 Target profit for the control of St. Croix Oceanographic data busy 12,3 Target profit for the control of St. Croix Oceanographic data south of St. Croix Oceanographic data busy 12,3 Target profit for the control of St. Croix Oceanographic data busy 12,3 Target profit for the control of St. Croix Oceanographic data busy 12,3 Target profit for the control of St. Croix Oceanographic data busy 12,3 Target profit for the control of St. Croix Oceanographic data south of St. Croix Oceanographic data busy 12,3 Target profit for the control of St. Croix Oceanographic data south of St. Croix Oceanographic data busy 12,3 Target profit for the control of St. Croix Oceanographic data south of St. Croix Oceanographic data busy 12,3 Target profit for the control of St. Croix Oceanographic data south of St. Croix Oceanographic data busy 12,3 Target profit for the control of St. Croix Oceanographic data south of St. Croix Oceanographic data busy Oceanog	1			1,2,3	Transportation Industry, Port	4	wave direction, current profiles, water temperature Meteorological: wind speed, wind direction, air temperature, barometric		60 minutes		24/7	All
3 Visual data stream to gauge visibility and sea state Ceaterographic data busys from Neverders) 1,2,3 Transportation Industry, Port Authorities, Auchine (Researchers) 3 Meteorological Visibility 50 minutes 5	2	Oceanographic data south of St. Croix	Oceanographic data buoy	1,2,3	Transportation Industry, Port	3,4	wave direction, current profiles, water temperature Meteorological: wind speed, wind direction, air temperature, barometric		60 minutes		24/7	Second
4 Continue to improve CARICOOS sulte of wave, wind and circulation models 1,2,3 US Coast Goard, Pot Plinick, Marine Transportation fluidity, Port Authorities, Academic Researchers, NWS San Jan MYO 1,2,3 Authorities, Academic Researchers, NWS San Jan MYO 1,2,3 Authorities, Academic Researchers, NWS San Jan MYO 1,2,3 US Coast Goard, PR Emergency and Desater Management Acerby, Academic Researchers 1 Planning, implementation and expanding Observations 2 Hardening HF Radar network 2 Hardening HF Radar network 3 Resource deployment/management 4 CARICOOS particle tracking model 4 US Coast Goard, PR Emergency and Desater Management Acerby, Academic Researchers 4 US Coast Goard, PR Emergency and Desater Management Acerby, Academic Researchers 4 US Coast Goard, PR Emergency and Desater Management Acerby, Academic Researchers 5 Resource deployment/management 6 ARICOOS particle tracking model 7 CARICOOS particle tracking model 8 Expanding and enhancing observing assets Wind, wave and current observations and data products 1 Expanding and enhancing observing assets Wind, wave and current observations and data products 1 US Coast Goard, National Response Corporation R Emergency Management Agency, WITEMA US Coast Goard, National Response Corporation R Emergency Management Agency, WITEMA US Coast Goard, National Response Corporation R Emergency Management Agency, WITEMA US Coast Goard, National Response Corporation R Emergency Management Agency, WITEMA US Coast Goard, National Response Corporation R Emergency Management Agency, WITEMA US Coast Goard, National Response Corporation R Emergency Management Agency, WITEMA US Coast Goard, National Response Corporation R Emergency Management Agency, WITEMA US Coast Goard, National Response Corporation R Emergency Management Agency, WITEMA US Coast Goard, National Response Corporation R Emergency Management Agency, WITEMA US Coast Goard, National Response Corporation R Emergency Management Agency, WITEMA US Coast Goard, National Response Corporation R Eme	3	Visual data stream to gauge visibility and sea state		1,2,3	Transportation Industry, Port	3	Meteorological: Visibility		60 minutes		24/7	Timeframe dependent of funding
Planning implementation and expanding observations Expanding CARICOOS H Radar Network 1,2,3 US Coast Guard, PR Emergency and Disaster Management Acengy, Academic Researchers 1,2,3 Real-time ocean surface currents 9 60 minutes 6 & 2 km	4		CARICOOS SWAN, WRF and FVCOM models	1,2,3	Transportation Industry, Port Authorities, Academic Researchers,	1,2,3,4	wave direction, current profiles, water temperature Meteorological: wind speed, wind direction, air temperature, barometric		forecasts updated every		24/7	All
Disaster Management Acengy, Academic Researchers Refurbish and harden existing HFR Radar network Refurbish and harden existing HFR stations using practical and cost-effective solution (e.g., solar panels) Resource deployment/management CARICOOS particle tracking model A US Coast Guard, National Response COrporation R Remergercy responders (spills, SAR), Coastal managers L3 Spill Response Wind, wave and current observations and data products Wind, wave and current observations and data products Wind, wave and current observations and data products L2 Develop and improve a redundant sea state modeling and enhancing observing assets Develop and improve a redundant sea state modeling and enhancing States (circulation, SST and salinity forecasts) L3 Offshore Energy Disaster Management Acengy, Academic Researchers L2 Develop and improve a redundant sea state modeling and enhancing observing assets Disaster Management Acengy, Academic Researchers L2 Develop and improve a redundant sea state modeling and enhancing observing assets Disaster Management Acengy, Academic Researchers L2 Develop and improve a redundant sea state modeling and enhancing observing assets Disaster Management Acengy, Academic Researchers L2 Develop and improve a redundant sea state modeling and enhancing observing assets Disaster Management Acengy, Academic Researchers L2 Develop and Inspired Real-time ocean surface currents Particle trajectories Particle trajectories Particle trajectories Disaster Management Acengy, Academic Researchers L2 A Disaster Management Acengy, Academic Research	1.2 SAR and Rapid Response											
2 Hardening HF Radar network using practical and cost-effective solution (e.g., solar panels) 1.2.3 Disaster Management Acengy, Academic Researchers 1.2.3 Real-time ocean surface currents 9 60 minutes 6 & 2 km 1.2.3 Real-time ocean surface currents 9 60 minutes 6 & 2 km 1.2.3 Real-time ocean surface currents 9 60 minutes 6 & 2 km 1.2.3 Real-time ocean surface currents 9 60 minutes 6 & 2 km 1.2.3 Real-time ocean surface currents 9 60 minutes 6 & 2 km 1.2.3 Real-time ocean surface currents 9 60 minutes 6 & 2 km 1.2.3 Particle trajectories 1.2.3.4 Particle trajectories 2 Hourly High 1.2.3 Physical waves height, wave period, wave direction, current profiles, water temperature, salinity, water levels 1 Expanding and enhancing observing assets Wind, wave and current observations and data products 1.2.3 US Coast Guard, National Response Corporation & other contractors, PR- State Energency Management Agency, VITEMA 1.2.3 Particle trajectories 2 Hourly High 15 min (wind), hourly (waves, currents) offsis, water temperature, salinity, water levels Meteorological wind speed, wind direction, air temperature, barrometric pressure 1.2.3.4 Visional Response Corporation & other contractors, PR-State Energency Management Agency, VITEMA 1.2.3.4 Visional Response Corporation & other contractors, PR-State Energency Management Agency, VITEMA 1.2.3.4 We direction, current profiles, water temperature, barrometric pressure 1.2.3.4, Visional Response Corporation & other contractors, PR-State Energency Management Agency, VITEMA 1.2.3.4 We direction, current profiles, water temperature, barrometric pressure 1.2.3.4, Visional Response Corporation & other contractors, PR-State Energency Management Agency, VITEMA 1.2.3.4 Wind Altonal Response Corporation & other contractors, PR-State Energency Management Agency, VITEMA 1.2.3.4 Wind Altonal Response Corporation & other contractors, PR-State Energency Management Agency, VITEMA 1.2.3.4 Visional Response Corporation & other contractors, PR-St	1		Expanding CARICOOS HF Radar Network	1,2,3	Disaster Management Acengy,	1,2,3	Real-time ocean surface currents	9	60 minutes	6 & 2 km	24/7	All
Resource deployment/management CARICOOS particle tracking model 4 Corporation PR Emergency and Disaster Management Agency, Emergency responders (spills, SAR), Coastal managers 1.2,3.4 Particle trajectories 2 Hourly High High 1.3 Spill Response 1.4 US Coast Guard, National Response Corporation & other contractors, PR-State Emergency Management Agency, VITEMA 2 Develop and improve a redundant sea state modeling and analysis subsystem Provide accurate and timely wave, wind, water levels, circulation, SST and salinity forecasts 1.2,3.4 US Coast Guard, National Response Corporation & other contractors, PR-State Emergency Management Agency, VITEMA 1.2,3.4 US Coast Guard, National Response Corporation & other contractors, PR-State Emergency Management Agency, VITEMA 1.2,3.4 US Coast Guard, National Response Corporation & other contractors, PR-State Emergency Management Agency, VITEMA 1.2,3.4 US Coast Guard, National Response Corporation & other contractors, PR-State Emergency Management Agency, VITEMA 1.2,3.4 US Coast Guard, National Response Corporation & other contractors, PR-State Emergency Management Agency, VITEMA 1.2,3.4 Meteorological: wind speed, wind direction, air temperature, barometric pressure 1.2,3.4 Meteorological: wind speed, wind direction, air temperature, barometric pressure 1.2,3.4 Meteorological: wind speed, wind direction, air temperature, barometric pressure	2	Hardening HF Radar network	using practical and cost-effective solution (e.g.,	1,2,3	Disaster Management Acengy,	1,2,3	Real-time ocean surface currents	9	60 minutes	6 & 2 km	24/7	Timeframe dependent of funding
Expanding and enhancing observing assets Wind, wave and current observations and data products US Coast Guard, National Response Corporation & other contractors, PR-State Emergency Management Agency, VITEMA US Coast Guard, National Response Corporation & other contractors, PR-State Emergency Management Agency, VITEMA Physical: waves height, wave period, wave direction, current profiles, water temperature, palminty, water levels Meteorological: wind speed, wind direction, air temperature, barometric pressure Physical: waves height, wave period, wave direction, current profiles, water temperature, barometric pressure Physical: waves height, wave period, wave direction, current profiles, water temperature, barometric pressure 1.2,3,4 US Coast Guard, National Response Corporation & Other Contractors, PR-State Emergency Management Agency, VITEMA 1.2,3,4 US Coast Guard, National Response Corporation & Other Contractors, PR-State Emergency Management Agency, VITEMA 1.2,3,4 US Coast Guard, National Response Corporation & Other Contractors, PR-State Emergency Management Agency, VITEMA 1.2,3,4 US Coast Guard, National Response Corporation & Other Contractors, PR-State Emergency Management Agency, VITEMA 1.2,3,4 US Coast Guard, National Response Corporation & Other Contractors, PR-State Emergency Management Agency, VITEMA 1.2,3,4 US Coast Guard, National Response Corporation & Other Contractors, PR-State Emergency Management Agency, VITEMA 1.2,3,4 US Coast Guard, National Response Corporation & Other Corporation	3	Resource deployment/management	CARICOOS particle tracking model	4	Corporation PR Emergency and Disaster Management Agency, Emergency responders (spills, SAR), Coastal	1,2,3,4	Particle trajectories	2	Hourly	High	24/7	As required
US Coast Guard, National Response Corporation & other contractors, PR-State Emergency Management Agency, VITEMA Develop and improve a redundant sea state modeling and analysis subsystem Provide accurate and timely wave, wind, water levels, circulation, SST and salinity forecasts 1,2,3 US Coast Guard, National Response Corporation & other contractors, PR-State Emergency Management Agency, VITEMA US Coast Guard, National Response Network of State Emergency Management Agency, VITEMA US Coast Guard, National Response Network of State Emergency Management Agency, VITEMA US Coast Guard, National Response Network of State Emergency Management Agency, VITEMA Physical: waves height, wave period, wave direction, current profiles, water temperature, barometric pressure Physical: waves height, wave period, wave direction, current profiles, water temperature, barometric pressure Nodels are run Hedium to High Medium to High Models are run twice per day Nodels are run High Models are run twice per day Nodels are run High Models are run twice per day Nodels are run High Models are run twice per day Nodels are run High Models are run twice per day Nodels are run High Models are run twice per day Nodels are run High Models are run twice per day Nodels are run High Models are run twice per day Nodels are run High Models are run twice per day Nodels are run High Models are run twice per day Nodels are run High Models are run twice per day Nodels are run High Models are run High Models are run twice per day Nodels are run High Models are r	1.3 9	Spill Response										
Develop and improve a redundant sea state modeling and analysis subsystem Provide accurate and timely wave, wind, water levels, circulation, SST and salinity forecasts 1,2,3,4 US Coast Guard, National Response Corporation & Other contractors, PR-State Emergency Management Agency, VITEMA 1,2,3,4 1,2,3,4 US Coast Guard, National Response Corporation & Other contractors, PR-State Emergency Management Agency, VITEMA 1,2,3,4 Models are run twice per day High 1,2,3,4,7,9,10 Models are run twice per day High	1	Expanding and enhancing observing assets		1,2,3	Corporation & other contractors, PR- State Emergency	4	wave direction, current profiles, water temperature, salinity, water levels Meteorological: wind speed, wind direction, air temperature, barometric	1	hourly (waves, currents) data, hourly	4km	24/7	Timeframe dependent of funding
	2			1,2,3,4	Corporation & other contractors, PR-State Emergency	1,2,3,4	wave direction, current profiles, water temperature, salinity, water levels Meteorological: wind speed, wind direction, air temperature, barometric	1,2,3,4,7,9,10			24/7	All
	1.4 Offshore Energy											
Wave, ocean-thermal and current energy availability analysis Puerto Rico Digital Ocean Energy Atlas (modeling), observations from buoys and HFR stations Puerto Rico Digital Ocean Energy Atlas (modeling), observations from buoys and HFR stations Private and academic engineering community and state government Private and academic engineering community and state government 2,3,4 Private and academic engineering community, water levels (modeling), observations from buoys and HFR data: every hour direction, air temperature, barometric pressure Wave data: every hour Medium to HFR data: every hour Model output: Static images	1		(modeling), observations from buoys and HFR	1,2,3		2,3,4	wave direction, current profiles, water temperature, salinity, water levels Meteorological: wind speed, wind direction, air temperature, barometric	2,4	Current data: every hour HFR data: every hour Model output:		as required	As required
1.5 Port and Harbor Operations												
Development and implementation of port dashboard for the Port of Charlotte Amalie, St. Thomas and Port of San Juan. Development and implementation of port dashboard for the Port of Charlotte Amalie, St. Thomas and Port of San Juan. US Coast Guard, Port Pilots, Marine Transportation Industry, Port 3,4 wind speed & direction wind speed & direction & gusts	1	Port-specific products and decision support tools	dashboard for the Port of Charlotte Amalie, St.	1,2,3,4	Transportation Industry, Port	3,4	wind speed & direction &	1,2,3,4,9			24/7	All

PRODUCTS AND SERVICE GUIDANCE

COASTAL LIVING RESOURCES

		COASTAL LIVING RESOURCES									
	Decision Needs	Products and Services	Product Level	Primary Users/Stakeholders	Geographical Coverage	Variables	Model Type	Temporal Resolution	Spatial Resolution	Operational requirements (i.e. 24/7, near real time, etc.)	Timeframe
3.1	3.1 Ecosystem and Biodiversity Health										
1	Identify areas requiring active management/monitoring and documenting shore to shelf edge biogeochemical/water quality gradients	Acquire and deploy eco sensor ensembles in transitional to shallow waters	1,2,3	NOAA Coral Reef Monitoring Program, Jobos Bay National Estuarine Research Reserve, Caribbean Fishery Management Council, PR Sea Grant, PR Department of Natural and Environmental Resources, PR NOAA Coastal Management Program, Sociedad Ambiente Marino, USVI Dept. of Planning and Natural Resource, Academic Researchers, Mesophotic Coral Reef Monitoring Program, Southeast Area Monitoring and Assessment Program, USVI Territorial Coral Reef Monitoring Program	3,4	Physical: Temperature, Salinity Chemical: pH, DO, pCO2, colored disolved organic matter, turbidity		Every 30 minutes	In situ	Short-term deployments	Timeframe dependent of funding
2	Implement a mesophotic reef monitoring effort	Assess the impact of anthropogenic, chronic and extreme climatic events.	1,2,3	NOAA Coral Reef Monitoring Program, Jobos Bay National Estuarine Research Reserve, Caribbean Fishery Management Council, PR Sea Grant, PR Department of Natural and Environmental Resources, PR NOAA Coastal Management Program, Sociedad Ambiente Marino, USVI Dept. of Planning and Natural Resource, Academic Researchers, Mesophotic Coral Reef Monitoring Program, Southeast Area Monitoring and Assessment Program, USVI Territorial Coral Reef Monitoring Program	3,4	Biological: Zooplankton species and abundance, extent and condition of benthic habitats, pathogens		-	In situ	Short-term deployments	Timeframe dependent of funding
3.2	3.2 Coastal ecosystem threats										
1	Assess temporal and spatial expressions of biochemical anomalies from Sargasso inundation	Continue ongoing observational efforts using discrete sampling/analysis and sensors	1,2,3	NOAA Coral Reef Monitoring Program, Jobos Bay National Estuarine Research Reserve, Caribbean Fishery Management Council, PR Sea Grant, PR Department of Natural and Environmental Resources, PR NOAA Coastal Management Program, Sociedad Ambiente Marino, USVI Dept. of Planning and Natural Resource, Academic Researchers, Mesophotic Coral Reef Monitoring Program, Southeast Area Monitoring and Assessment Program, USVI Territorial Coral Reef Monitoring Program	3,4	Physical: Temperature, Salinity Chemical: pH, DO, pCO2		Point	In situ	Seasonal	All
2	Document changes in mangrove and benthic flora to extreme weather events and Sargasso inundation	Using high-resolution remotely sensed data and implement 20+ virtual buoys reporting remotely-sensed derived water quality data at sites of interes for fisheries and ecosystem monitoring	1,2,3	NOAA Coral Reef Monitoring Program, Jobos Bay National Estuarine Research Reserve, Caribbean Fishery Management Council, PR Sea Grant, PR Department of Natural and Environmental Resources, PR NOAA Coastal Management Program, Sociedad Ambiente Marino, USVI Dept. of Planning and Natural Resource, Academic Researchers, Mesophotic Coral Reef Monitoring Program, Southeast Area Monitoring and Assessment Program, USVI Territorial Coral Reef Monitoring Program	3,4	Physical: Ocean color/optical properties Chemical: Nutrients		Daily or when satellite data is available	In situ	-	Timeframe dependent of funding
3.3	3.3 Sustainable Fisheries										
1	Support to fisheries management	Assist the Caribbean Fishery Management Council in exploring the empirical relationships between CARICOOS hydrodynamic data and fisheries yield in the region	1,2,3	Caribbean Fishery Management Council, PR Sea Grant	2,3,4	Biological: Fish species and abundance		-	In situ	As required	All

PRODUCTS AND SERVICE GUIDANCE

CLIMATE VARIABILITY

		CLIVIATE VARIABILITY									
	Decision Needs	Products and Services	Product Level	Primary Users/Stakeholders	Geographical Coverage	Variables	Model Type	Temporal Resolution	Spatial Resolution	Operational requirements (i.e. 24/7, near real time, etc.)	Timeframe
4.1	Climate Trends and Variations in Ocean Proper	rties									
1	Resolve, understand and monitor upper- ocean dynamics to improve forecasting tropical cyclone intensification	Operate a network of six (6) underwater gliders (1 CARICOOS; 5 NOAA-AOML) in the Caribbean Sea and Tropical Atlantic Ocean in collaboration with NOAA-AOML	1,2,3	National Hurricane Center, National Weather Service (NWS), NWS San Juan WFO, Research Scientists, National Center for Coastal Ocean Science, PR Emergency and Disaster Management Agency	1,2	Physical: Temperature, Salinity Chemical: Dissolved oxygen	-	Every 3 hours during the Atlantic hurricane season	Surface to 1,000 meters	Seasonal	Timeframe dependent of funding
2	Document the response of oceanic environment to regianl and remote climating forcing	Deploy CARICOOS underwater glider to conduct seasonal profiles at the Caribbean Time Series station (CaTS) and target sub- and meso-scale structures including eddies, continental river plumes and marine heat waves	1,2,3	NOAA Coral Reef Monitoring Program, Jobos Bay National Estuarine Research Reserve, Caribbean Fishery Management Council, PR Sea Grant, PR Department of Natural and Environmental Resources, PR NOAA Coastal Management Program, Sociedad Ambiente Marino, USVI Dept. of Planning and Natural Resource, Academic Researchers, Mesophotic Coral Reef Monitoring Program, Southeast Area Monitoring and Assessment Program, USVI Territorial Coral Reef Monitoring Program	1,2	Physical: Temperature, Salinity Chemical: Dissolved oxygen	-	Every 3 hours	Surface to 1,000 meters	Seasonal	All
3	Assess the impacts of ocean acidification on the Caribbean coral reef ecosystems	Continue to provide support for the operation of the MapCO2 buoy located in La Parguera Marine Reserve	1,2,3	National Ocean Acidification Observing Network, NOAA Coral Reef Monitoring Program, Jobos Bay National Estuarine Research Reserve, Caribbean Fishery Management Council, PR Sea Grant, PR Department of Natural and Environmental Resources, PR NOAA Coastal Management Program, Sociedad Ambiente Marino, USVI Dept. of Planning and Natural Resource, Academic Researchers, Mesophotic Coral Reef Monitoring Program, Southeast Area Monitoring and Assessment Program, USVI Territorial Coral Reef Monitoring Program	4	Physical: Temperature, Salinity, Pressure Chemical: Dissolved oxygen, pH, pCO2,	-	Every hour	In situ	24/7	Timeframe dependent of funding
4	Assess of dissolved and particulate carbon fluxes	Conduct discrete bi-weekly water sampling and analysis at La Parguera Marine Reserve	1	National Ocean Acidification Observing Network, NOAA Coral Reef Monitoring Program, Jobos Bay National Estuarine Research Reserve, Caribbean Fishery Management Council, PR Sea Grant, PR Department of Natural and Environmental Resources, PR NOAA Coastal Management Program, Sociedad Ambiente Marino, USVI Dept. of Planning and Natural Resource, Academic Researchers, Mesophotic Coral Reef Monitoring Program, Southeast Area Monitoring and Assessment Program, USVI Territorial Coral Reef Monitoring Program	4	Chemical: Nutrients	-	Biweekly	In situ	-	
5	Initiate a comprehensive analysis to explore the role of climate variability in ocean conditions, regional weather patthers, among others	Analyze a wide range of oceand and weather variables from coastal and ocean historical data, numerical models, and satellite-derived data.	1,2,3	Jobos Bay National Estuarine Research Reserve, San Juan Bay Estuary Program, Sociedad Ambiente Marino	4	Physical: waves height, wave period, wave direction, current profiles, water temperature Meteorological: wind speed, wind direction, air temperature, barometric pressure	=	-	-	-	Timeframe dependent of funding
4.2 National and global data sets											
1	Continue to provide support for a long- term sustained observing network to track ocean, weather, and marine ecosystem chabges	Collaborate with regional and national agencies to help maintain long-time series data collection and synthesize new and existing data streams.	1,2,3	Research scientist, Environmental Managers	1,2,3,4	Physical: waves height, wave period, wave direction, current profiles, water temperature Meteorological: wind speed, wind direction, air temperature, barometric pressure Biological: Zooplankton species and abundance, extent and condition of benthic habitats, pathogens, Fish species and abundance	-	-		As required	-