PRODUCTS AND SERVICE GUIDANCE

MARITIME OPERATIONS

	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
1.1 Safe and Efficient Commercial Shipping and Recreational and Tourism Support Activities											
1	Metocean data systems in constrained approaches to critical ports	Small and easy deployable data buoys or ATON systems	1,2,3	US Coast Guard, Port Pilots, Marine Transportation Industry, Port Authorities, Academic Researchers	4	Physical: waves height, wave period, wave direction, current profiles, water temperature Meteorological: wind speed, wind direction, air temperature, barometric pressure		60 minutes		24/7	All
2	Oceanographic data south of St. Croix	Oceanographic data buoy	1,2,3	US Coast Guard, Port Pilots, Marine Transportation Industry, Port Authorities, Academic Researchers	3,4	Physical: waves height, wave period, wave direction, current profiles, water temperature Meteorological: wind speed, wind direction, air temperature, barometric pressure		60 minutes		24/7	Second
3	Visual data stream to gauge visibility and sea state	Real-time camera aboard all CARICOOS oceanographic data buoys (non-Waveriders)	1,2,3	US Coast Guard, Port Pilots, Marine Transportation Industry, Port Authorities, Academic Researchers	3	Meteorological: Visibility		60 minutes		24/7	Timeframe dependent of funding
4	Continue to improve CARICOOS suite of wave, wind and circulation models	CARICOOS SWAN, WRF and FVCOM models	1,2,3	US Coast Guard, Port Pilots, Marine Transportation Industry, Port Authorities, Academic Researchers, NWS San Juan WFO	1,2,3,4	Physical: waves height, wave period, wave direction, current profiles, water temperature Meteorological: wind speed, wind direction, air temperature, barometric pressure		Hourly forecasts updated every 12 hours	Medium to High	24/7	All
1.2 SAR and Rapid Response											
1	Planning, implementation and expanding observations	Expanding CARICOOS HF 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	24/7	All
2	Hardening HF Radar network	Refurbish and harden existing HFR stations using practical and cost-effective solution (e.g., solar panels)	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	24/7	Timeframe dependent of funding
3	Resource deployment/management	CARICOOS particle tracking model	4	US Coast Guard, National Response Corporation PR Emergency and Disaster Management Agency, Emergency responders (spills, SAR), Coastal managers	1,2,3,4	Particle trajectories	2	Hourly	High	24/7	As required
1.3 Spill Response											
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 Emergency Management Agency, VITEMA	4	Physical: waves height, wave period, wave direction, current profiles, water temperature, salinity, water levels Meteorological: wind speed, wind direction, air temperature, barometric pressure	1	15 min (wind), hourly (waves, currents) data, hourly forecasts	4km	24/7	Timeframe dependent of funding
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	Physical: waves height, wave period, wave direction, current profiles, water temperature, salinity, water levels Meteorological: wind speed, wind direction, air temperature, barometric pressure	1,2,3,4,7,9,10	Models are run twice per day	Medium to High	24/7	All
1.4 Offshore Energy											
1	Wave, ocean-thermal and current energy availability analysis	Puerto Rico Digital Ocean Energy Atlas (modeling), observations from buoys and HFR stations	1,2,3	Private and academic engineering community and state government	2,3,4	Physical: waves height, wave period, wave direction, current profiles, water temperature, salinity, water levels Meteorological: wind speed, wind direction, air temperature, barometric pressure	2,4	Wave data: every hour Current data: every hour HFR data: every hour Model output: Static images	Medium to High	as required	As required
1.5 Port and Harbor Operations											
1	Port-specific products and decision support tools	Development and implemetation of port dashboard for the Port of Charlotte Amalie, St. Thomas and Port of San Juan.	1,2,3,4	US Coast Guard, Port Pilots, Marine Transportation Industry, Port Authorities	3,4	wave height period & direction wind speed & direction & gusts	1,2,3,4,9			24/7	All

PRODUCTS AND SERVICE GUIDANCE

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 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 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 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

	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 Properties											
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	-