Atlantic Seafloor Partnership for Integrated Research and Exploration (ASPIRE)

Charleston Bump "4D Ocean Cube" Exploration Program

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Willing to attend Workshop: Yes

Target Names: Charleston Bump, a deepwater (2,300 feet with over 400 feet of vertical relief) bottom feature located 80 to 100 miles southeast of Charleston, SC

Geographic Area of Interest within the North Atlantic Ocean: Southwest Atlantic

Relevant Subject Areas: Biology, Geology, Chemistry, Physical Oceanography, Ocean Engineering including satellite and hyper-spectral remote sensing, underwater communications, modeling, Big Data analysis and autonomous vehicles.

Description of Topic or Region Recommended for Exploration:

In the 2016 National Ocean Exploration Forum Final Report "Beyond the Ships 2010-2025" Paul Gaffney (Vice Admiral, USN retired) and Jesse Ausubel (The Rockefeller University) put forth a vision for ocean exploration campaigns defined as "a strategically planned set of activities to characterize a yet-to-be-explored or underexplored geographic area, selected to meet sponsor requirements and maximize potential scientific opportunity, and often spanning several years and involving multi sponsors and performers. Rather than limiting observation to a single subject or sense, campaigns can characterize an area or volume of ocean in terms of marine life, chemistry, geology and geophysics, history and archeology, and bathymetry include dynamic measurements and sample collection, and record observations using a broad range of methods of perception, including hearing, smell, touch, taste, and sight, as extended by advanced technologies. Necessity as well as opportunity favors movement to campaigns beyond ships." This idea is atypical for NOAA Ocean Exploration, as an OE expedition would be an initial phase of this broader activity as it is envisioned. However, this kickoff expedition for a future campaign would be both broadening and compelling within the Ocean Exploration portfolio, as a science-led but engineering/technology-focused exploration.

Considering the above, the University of South Carolina (USC) recommends ASPIRE consider a "4D Ocean Cube" approach to the ocean campaign model as a means for addressing the need for understanding and sustaining an "energy and ecological balance" within a 4D Ocean Cube of the three spatial dimensions along with time. The spatial extent of Ocean Cube encompasses a surface area (we propose 25x25 mile square for the Charleston Bump) and a depth dimension that includes air-sea interaction, the water column, as well as the subsurface geology and groundwater hydrology of the seabed. Basically, taking the idea of Ocean Observatories Initiative coastal array (e.g. Coastal Pioneer) and expanding it to include the seafloor subsurface geology and atmosphere with a series of wells, moorings, and meteorological sensors.

Specifically, USC is proposing conducting a campaign for exploring the Charleston Bump region aimed at a complete atmosphere-to-lithosphere characterization of an ocean region of interest.

The Charleston Bump is a unique feature, deflecting the flow of the Gulf Stream and setting up the Charleston Gyre, bringing warmer Gulf Stream water close to shore to meet cooler shelf water potential application of "Horizontal Ocean Thermal Energy Conversion?) and causing upwelling of nutrient-rich water that supports the rich fishery in this region. Also, the Charleston Bump includes a series of steep scarps with rocky cliffs, ridges, overhangs and caves that support populations of deep reef fishes, the only known spawning site for wreckfish in the western North Atlantic, and spawning ground for swordfish. In the broader region this is an area expecting increased shipping traffic from Post/New PANAMAX deep draft ships, poorly known marine mineral reserves, and potential deep biological communities.

An example of a Charleston Bump R&D collaborative effort, according to the NOAA website "Increased research efforts are needed on the U.S. continental slope as fisheries expend into deeper water…The fauna of the Charleston Bump and the Blake Plateau has been poorly studied because of the difficulties in deploying nets and other traditional fish sampling gear in deep water under the Gulf Stream. Visual observations from submersible are needed to describe the deep water fish assemblages, their preferred habitats, and their ecological roles."

Our proposed initiative is aimed at measuring fluxes of water, nutrients, sediments and involves a multi-stage, multi-year effort. Fluxes, direct measurements of changes in volume or mass over time, have been difficult if not impossible to capture data for with present technology. Initial data from ship-based observations could constrain a set of numerical models. Such models could predict the best locations for infrastructure such as vertical profiler moorings, seabed wells, and meterological platforms. Autonomous technology would be employed to dynamically collect dense spatial data with UUV's, AUV's and wave gliders, and also UAV's doing atmosphere and surface ocean work. This autonomous network could be repositioned as needed based on near real-time feedback from the static sensors and data provided to run numerical models of oceanographic processes. Data from this area are essential toward to the smart growth of the rising Blue Economy in the U.S. Southeast EEZ, and addressing the need to more comprehensively understand the ocean dynamics and biology in the Southeast U.S. shelf.

Relevant Partnerships: NOAA's Office of Coastal Services, the National Ocean Service, NOAA NERRS SWMP and our NOAA IOOS.