Towards understanding fine scale circulation and hydrodynamic connectivity between MPAs in the USVI and Eastern PR

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This study seeks to conduct model and data-based connectivity studies that will provide quantitative information in support of the management of the marine protected area (MPA) network in Federal waters off the US Virgin Islands and Eastern Puerto Rico. The work will focus on fish aggregation areas (Figure 1): Hind Bank and Lang Bank (both red hind sites); El Seco (tiger grouper), Grammanik (yellowfin grouper), and the Mutton Snapper Spawning Area south of St. Croix.

The connectivity simulations will be based on the CARICOOS FVCOM circulation model and will take into account 3D advection and limited larval behavior. The circulation model will be validated using Lagrangian drifters and two ADCPs. This study is supported by the Caribbean Fisheries Management Council.

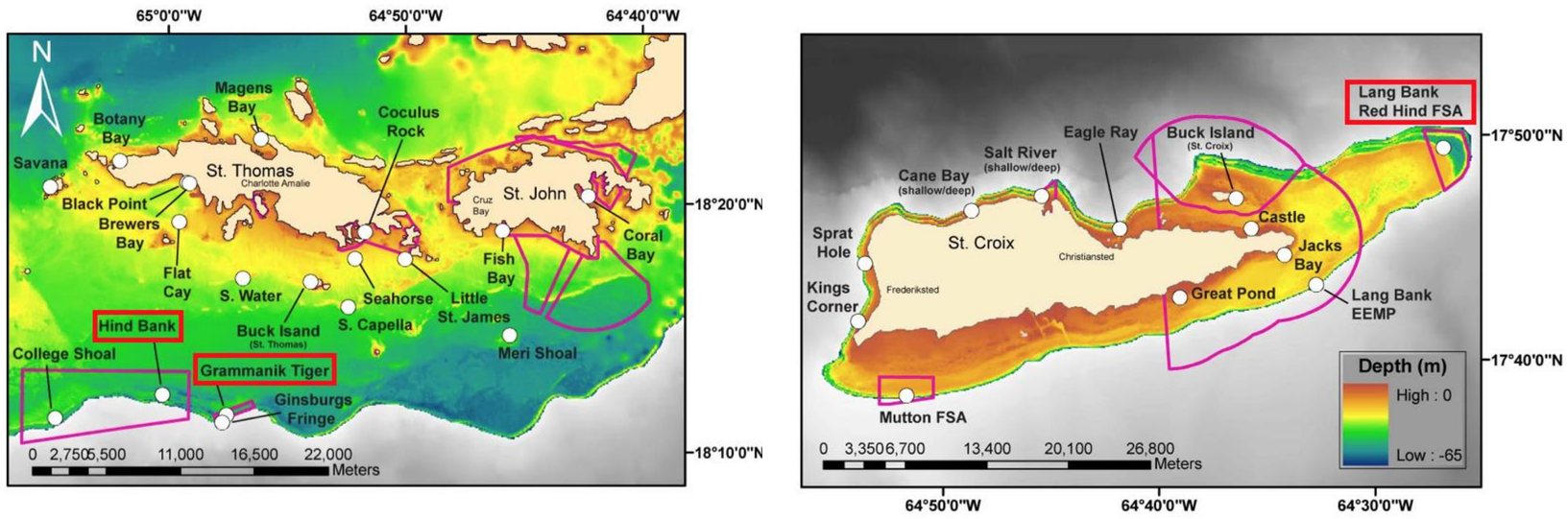

Figure 1. Marine protected areas in the US Virgin Islands (from NOAA: http://sero.nmfs.noaa.gov). The present study will focus on MPA's outlined by red rectangles: Hind Bank, Grammatik Tiger, and Lang Bank.

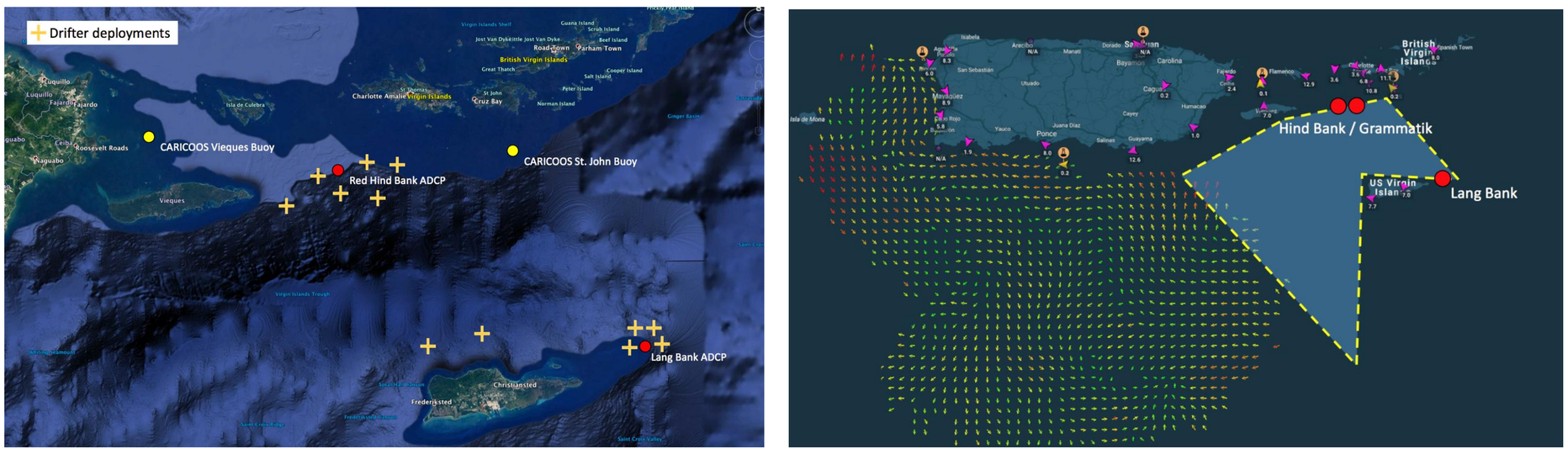

Figure 2. Left: Drifter and ADCP deployments. Right: Current and expected CARICOOS HFR coverage

CARICOOS FVCOM: Understanding fine-scale connectivity

The CARICOOS FVCOM circulation model (Figure 3) obtains subtidal baroclinic boundary conditions from the global mesoscale HYCOM + NCODA Global 1/12° Analysis, tida forcing from the Western North Atlantic, Caribbean and Gulf of Mexico ADCIRC Tidal Database (EC2015) (Szpilka et al., 2016), and spatially varying 10 m wind speed, sea level atmospheric pressure, 2 m relative humidity, 2 m air temperature, surface downward longwave radiation and surface net short wave radiation from CARICOOS WRF. Larval transport modeling will be conducted with the FVCOM Offline Particle Tracking Code. Preliminary simulations using an advection-only MATLAB code are shown below as an example. Connectivity simulations will begin June 2018.

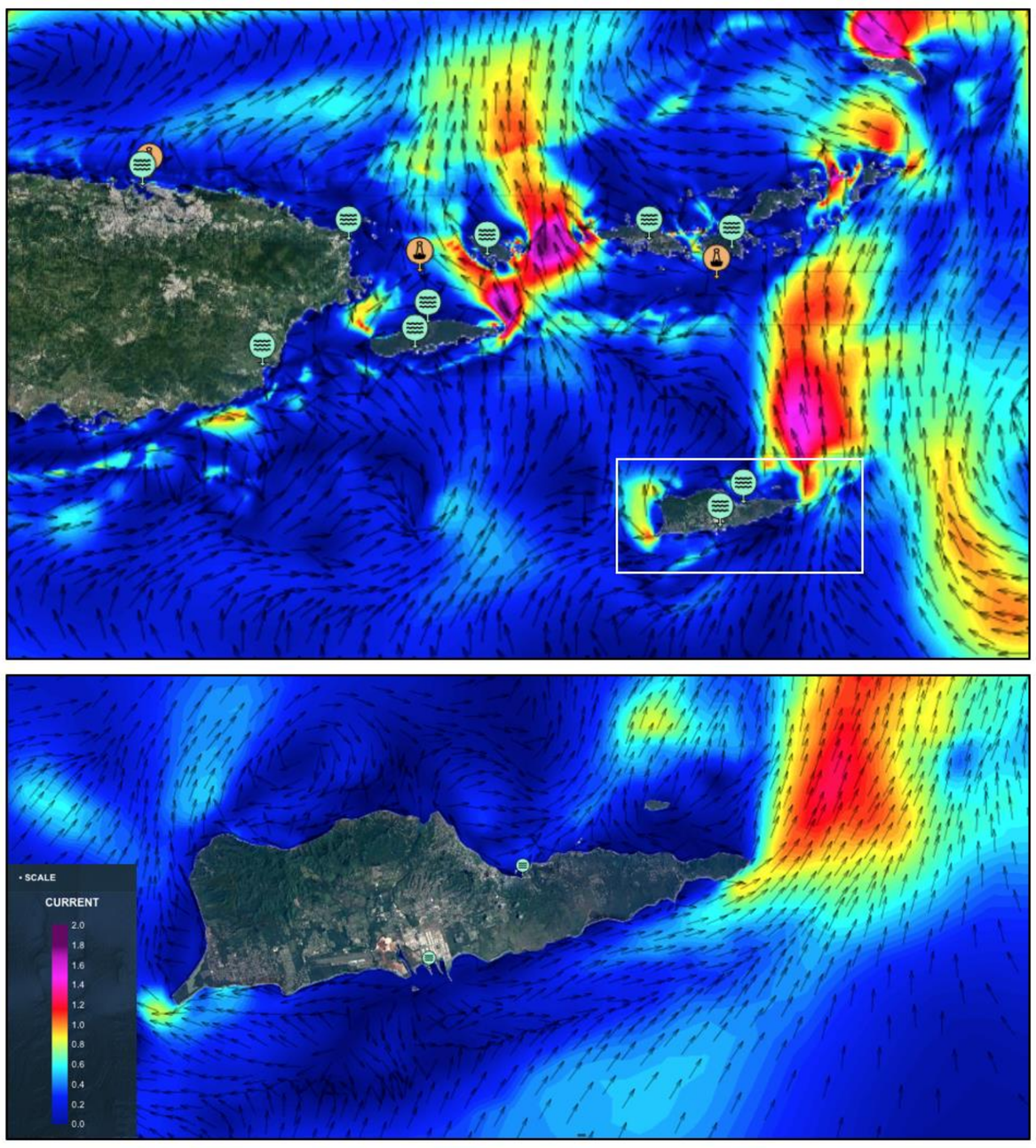

Figure 3. Example output from the very high-resolution CARICOOS FVCOM model for the study area.

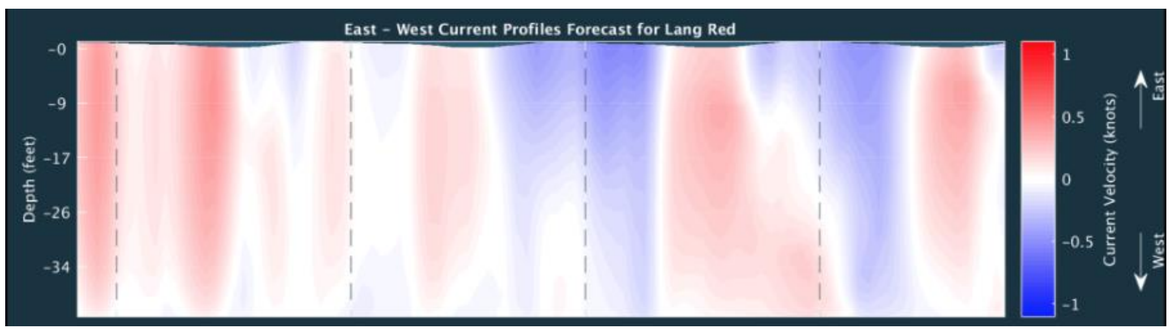

Figure 4. Example of FVCOM's capabilities in representing 3D circulation structure at the the shallow Lang Bank.

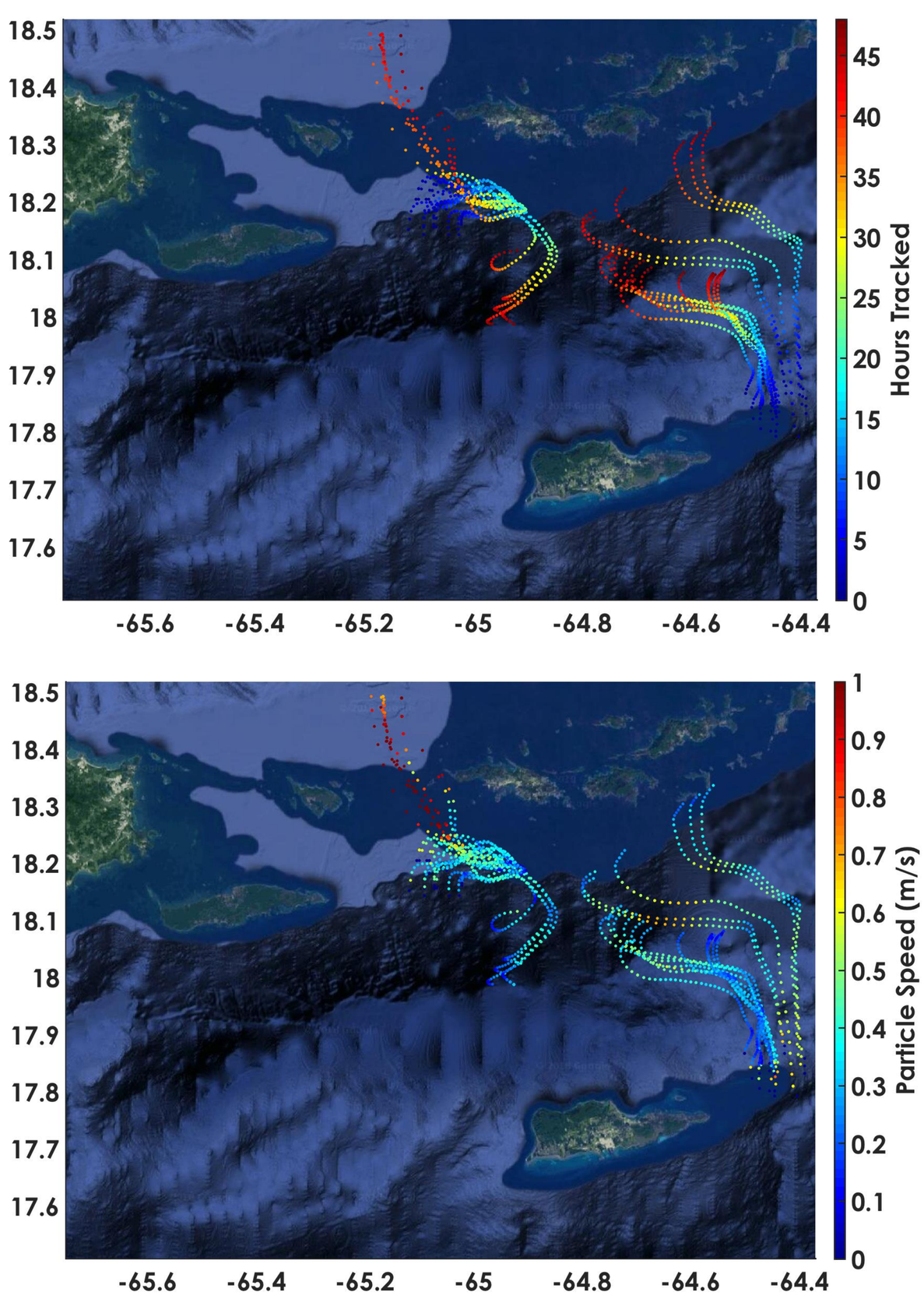

Figure 5. Example particle trajectories released from Red Hind Bank and Lang Bank using a simple advection model driven by FVCOM high-resolution velocity fields.