A new horizon for deep ocean seafloor geodesy

Harold T. "Bud" Vincent & Frederik J. Simons

DBV Technology | Princeton University

In 2023 we conducted a first-of-its-kind technology demonstration in seafloor geodesy, in the deepest part of the Atlantic Ocean where it meets the Caribbean Sea, a complex geologic area known as the Puerto Rico Trench. Specifically, the demonstration consisted of deploying a solar-powered SeaTrac SP-48 uncrewed surface vehicle (USV) equipped with a DBV Technology GNSS-Acoustic Surface System to execute survey transects in open ocean while communicating with novel Deep Ocean Geodetic sensors (DOGs) submerged in the trench at depths of up to 5,500 m. The USV operated autonomously while being monitored and controlled from shore by satellite at two remote locations. The DOGs and SP-48 were deployed from RV Blue Manta. SeaTrac demonstrated excellent seakeeping ability (+/- 3 m cross track error) over sustained survey legs exceeding 20 km. Additionally, the platform demonstrated the ability to provide enough power to operate the surface acoustic system with limited self noise. Acoustic testing consisted of bi-directional transmissions from shore, to the sea surface via satellite, down to the seafloor and back again at horizontal distances up to 11 km. Transmissions included signals for synchronization, survey, command and control, and data telemetry. The DOGs contain a Chip Scale Atomic Clock for precise synchronization with GPS to enable sub-centimeter level positioning of the sensors on the seafloor. DOGs use very low power, and are suitable for very long-term deployments, more accurately and economically than possible using present methods. T-DOGs are recoverable and intended for deployments up to 3 years. C-DOGs are designed to last 30-50 years and are not intended to be recovered.

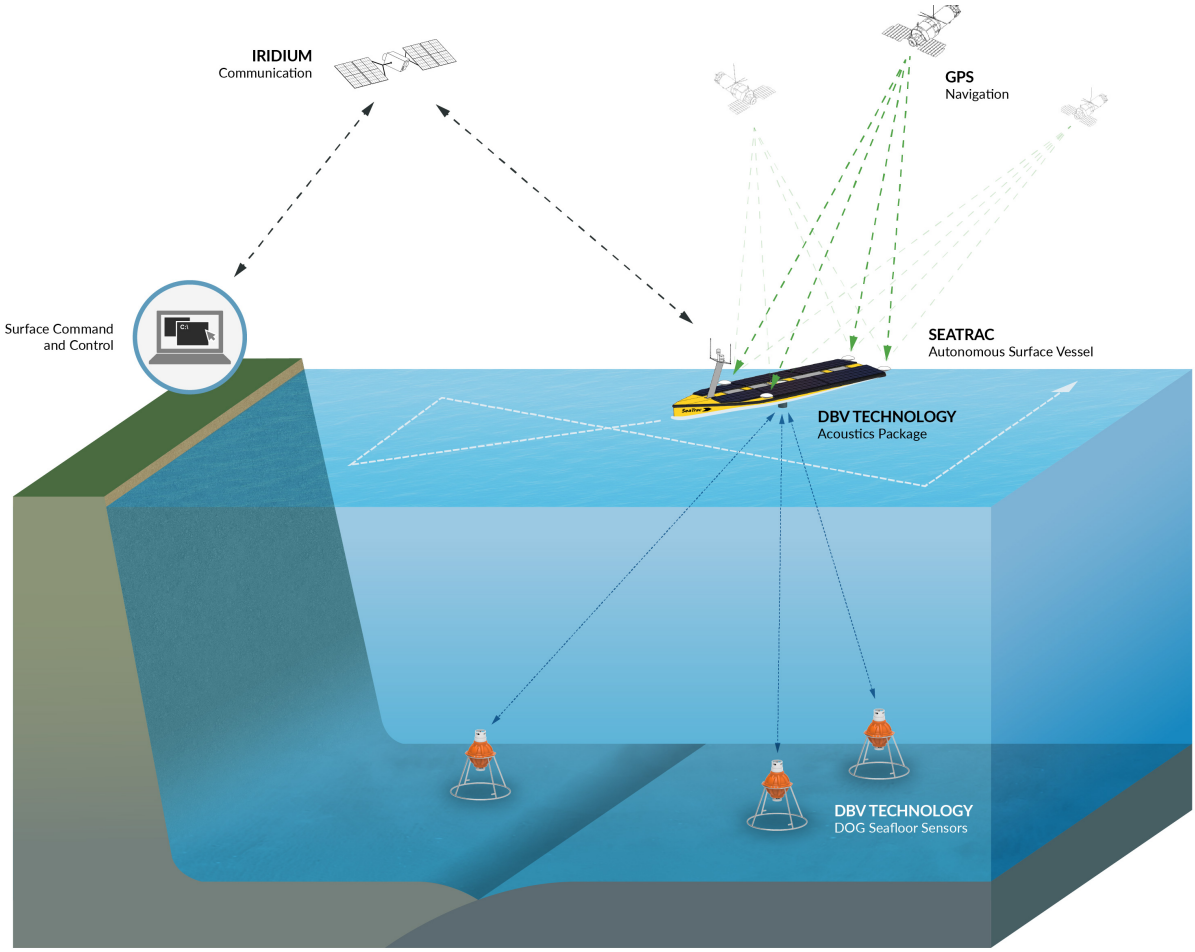

Figure 1: *Schematic of the successful test of the DBV/Princeton/SeaTrac system for deep ocean geodetic surveying in the Puerto Rican trench.* *Graphic by Mike Dunne,* `https://mikedunne.net`