

Development of surface-towed controlled source electromagnetics to detect offshore extensions of freshwater aquifers in complex coastal settings: Concepts, modeling and initial field trials from the Adriatic Sea

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SUMMARY

Offshore Freshened Groundwater (OFG) and Submarine Groundwater Discharge (SGD) play crucial roles in coastal hydrological systems. Despite their significance for both humans and ecosystems, the interaction between onshore and offshore freshwater systems worldwide remains poorly understood. A major challenge is the limited availability of appropriate geophysical technologies, which restricts our understanding of the spatial extents and connectivity of both onshore and offshore aquifers. Controlled-Source Electromagnetics (CSEM) is a promising noninvasive method for identifying and characterizing coastal freshwater aquifers and their potential connection to OFG and SGD. However, the use of CSEM systems in academic research is currently restricted to a few institutions, with applications focused on either the onshore or offshore component of coastal groundwater systems. The Institute of Geophysics and Planetology at University of Hawaii is committed to developing a suite of CSEM tools to address open questions in coastal groundwater research, both onshore and offshore. This presentation focuses on the development of offshore surface-towed CSEM and the essential components required for robust CSEM data acquisition. Field tests demonstrate the capabilities of surface-towed CSEM systems to image the shallow seafloor at water depths of up to approximately 100 meters. Recent studies highlight its ability to provide continuous measurements, achieving higher depth and spatial resolution, while operating at speeds of 2.5 to 3 knots. The presentation will address technological advancements, modeling studies, and field trials conducted in the Adriatic Sea.

Keywords: Controlled Source Electromagnetics, Inversion, Coastal Groundwater
