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Investigating seabed fluid activities using historical single-beam echo sounder data in the offshore southwestern Taiwan

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Seabed fluid activity involves the transport and migration processes of liquids, gases, and seawater beneath the seafloor which is primarily controlled by factors such as fault activity, sediment overpressure, seismic events, sea level changes, tidal activity, and submarine landslides. Based on different formation mechanisms, the sources of fluids include such as thermal, biological, and natural gas hydrate decomposition. The southwestern offshore Taiwan experiences compressional stress, leading to the formation of numerous folds and thrust faults that establish conduits for fluid migration. The presence of a series of mud volcanoes and mounds of natural gas hydrates points to a substantial methane flux in this region. While previous studies have used single-beam echo sonar (SBES) data to detect seabed gas discharge phenomena, analyses relied on 2D sonar images, making results susceptible to the influence of single survey lines and temporal variations. We aim to develop processing programs for SBES data to obtain 3D sonar image distribution and intensity analysis, providing a more precise analysis of fluid and gas-related activities in southwestern offshore Taiwan. Three research vessels' SBES data from the past decade have been reexamined. The possible flare signals are transformed into a 3D point cloud distribution by computing the receiving angle of the data. The near-surface point cloud effectively illustrates the precise discharge area. Comparing changes at the same location over different times may provide insights into the correlation between geological structural activities and gas emissions. However, due to the significant period and differing equipment configurations on each vessel, consolidating the data to a uniform standard poses certain challenges. The complex changes in seafloor bathymetry also increase the difficulty of discerning gas emission signals.