3D time-lapse reverse-time migration of DAS-VSP data: Snowflake data from Carbon Management Canada Newell County Facility

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Abstract

Reverse-time migration (RTM) is a potent technique for visualizing geological structures. We've implemented high-efficiency RTM leveraging GPU processing. Our approach involves several key steps: Firstly, we employ an optimal least-squares-based finite-difference (FD) method to solve the acoustic wave equation. Secondly, we suppress artifact boundary reflections using a hybrid absorbing boundary condition (ABC). Thirdly, we introduce a combinatorial strategy for handling large-scale data that focuses on optimal checkpointing and efficient boundary storage. This strategy strikes a balance between memory usage and recomputation requirements. Additionally, to streamline communication and reduce time between the host and disk, we utilize portable operating system interface (POSIX) threads to create additional CPU cores at the checkpoints. Finally, applying the RTM method on 3D time-lapse DAS-VSP Snowflake data showcases the efficiency and effectiveness of RTM as an imaging tool for visualizing geological structures.

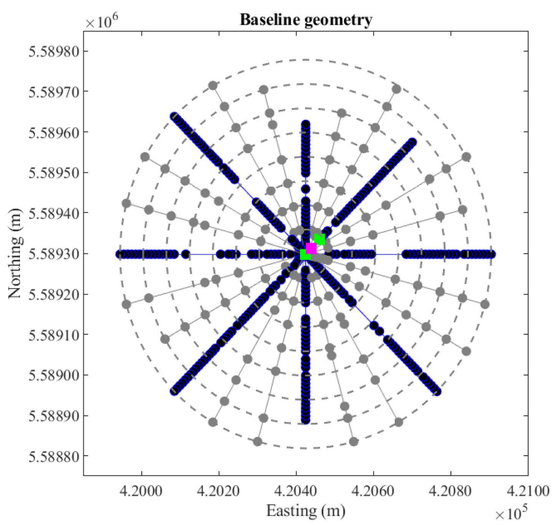

Figure 1: Baseline shots geometry.

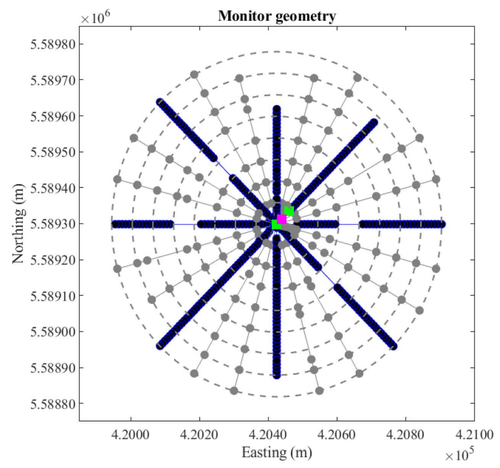

Figure 2: Monitoring shots geometry.

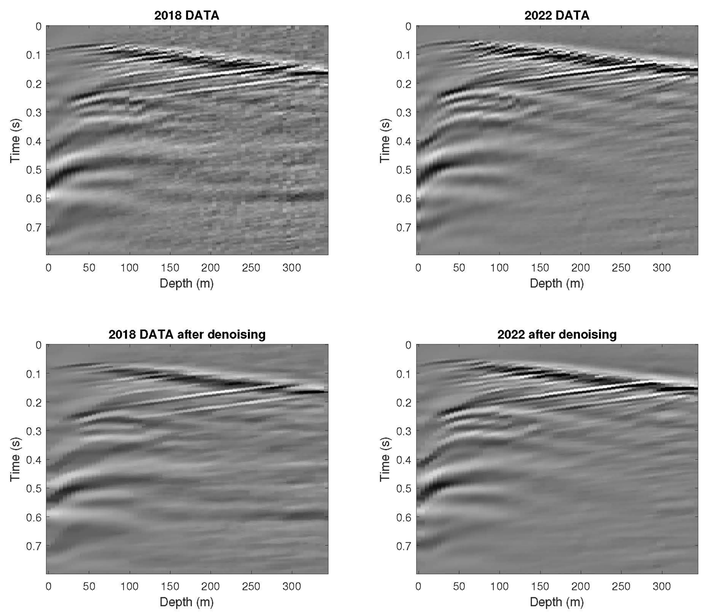

Figure 3: The processed baseline data with good SNR and monitoring data before and after denoising.

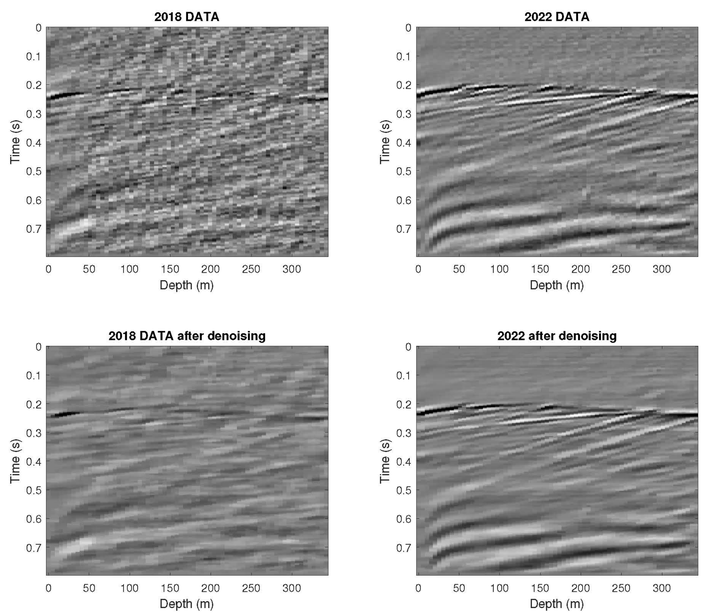

Figure 4: The processed baseline data with relatively bad SNR and monitoring data

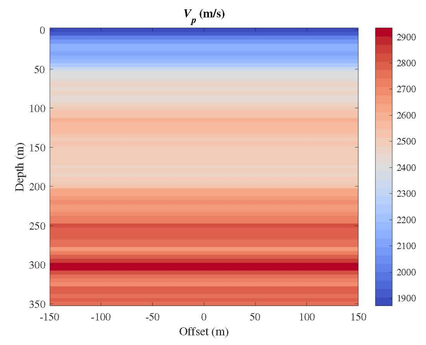

Figure 5: The initial model for vertical slice.

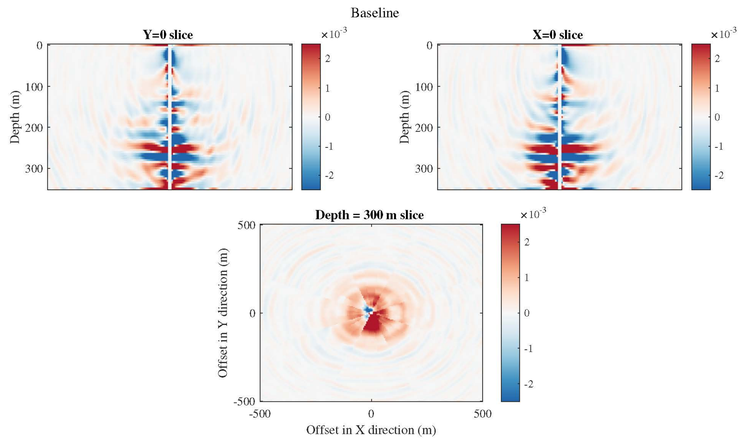

Figure 6: The baseline RTM images for x = 0, y=0 and z = 300 m slices.

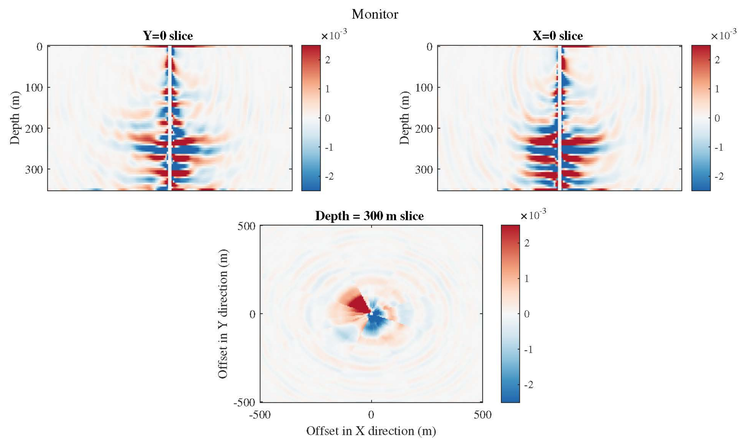

Figure 7: The monitoring RTM images for x = 0, y=0 and z = 300 m slices.

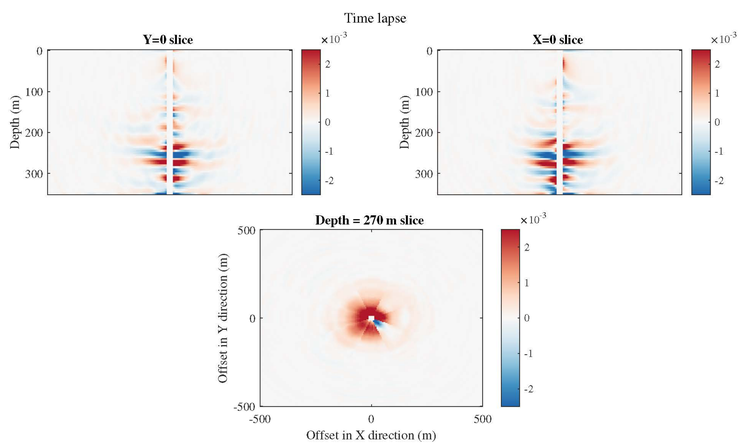

Figure 8: The time lapse RTM images for x = 0, y=0 and z = 300 m slices.

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