Supplementary information to the paper:

Tracking CO_2 and seismicity during offshore carbon capture and storage operations with fiber-optic sensors

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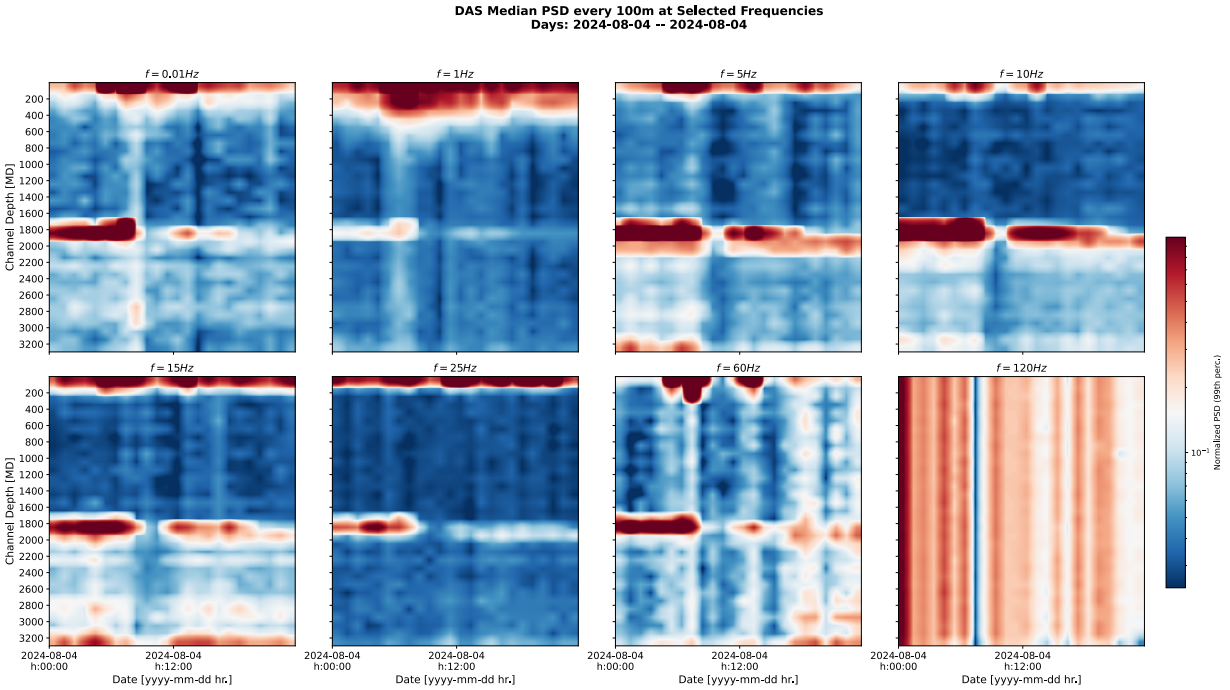
This PDF includes:

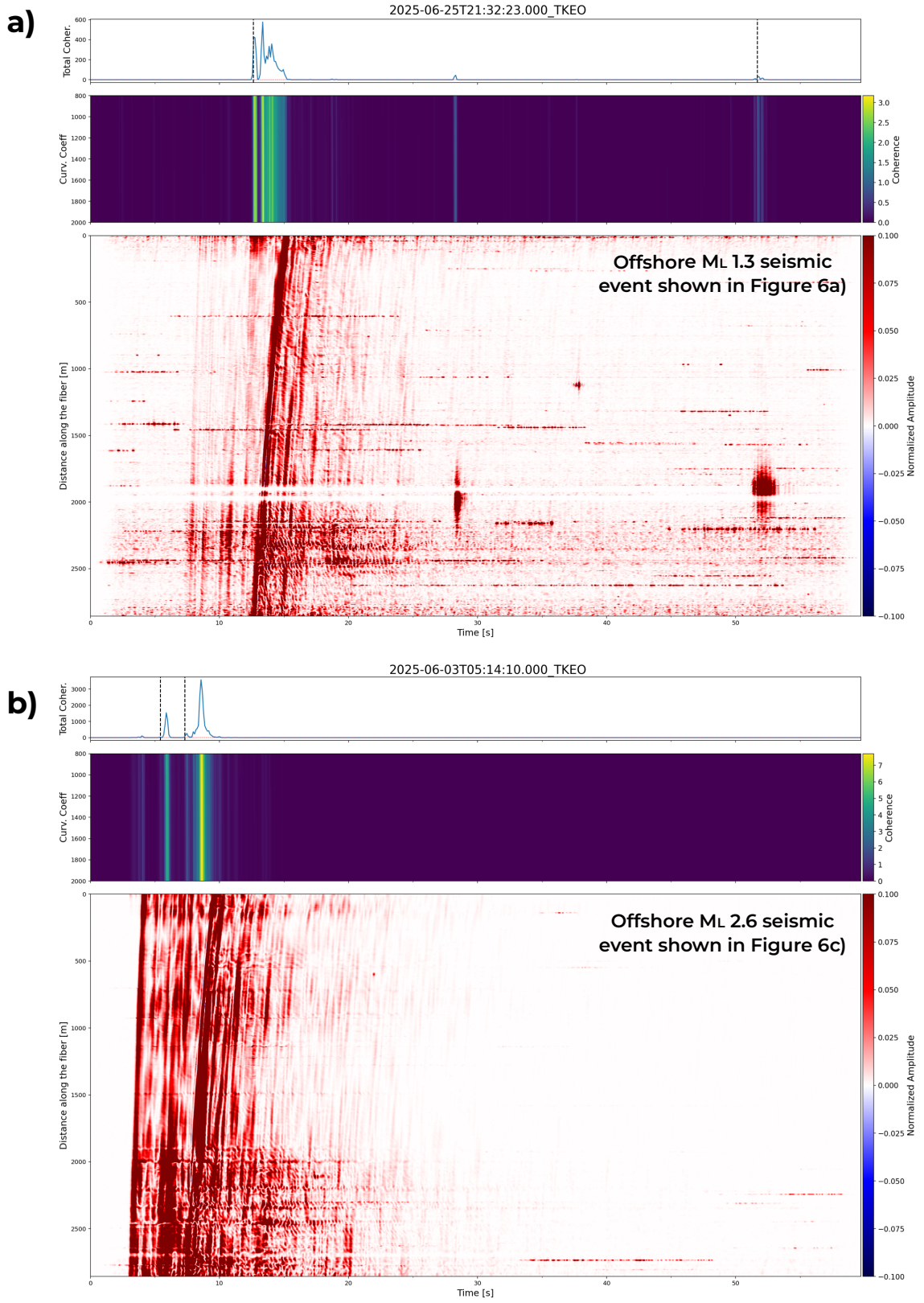
Supporting figures (Figures S1 to S4)

Supporting Figures

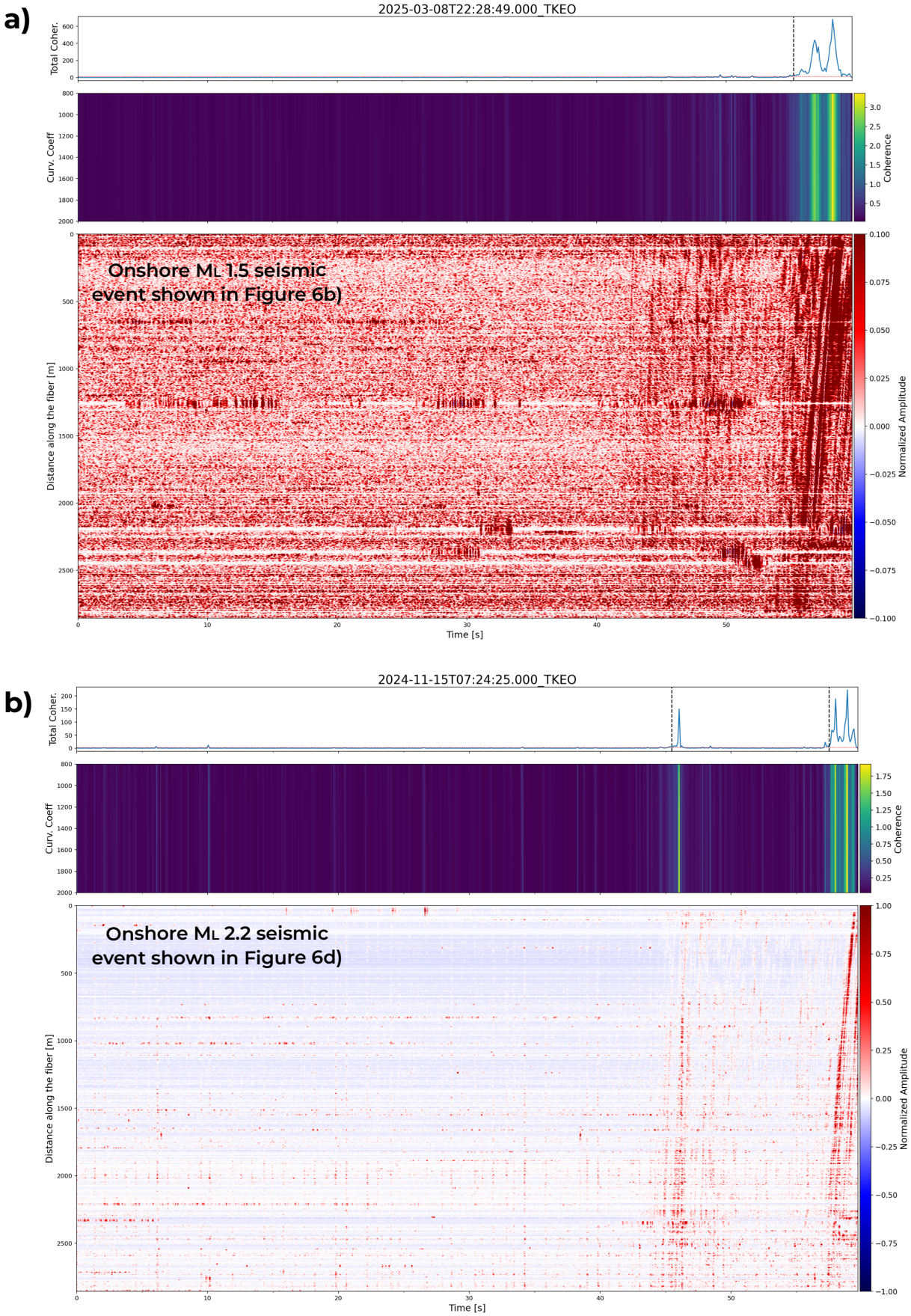
The following document includes supplementary figures cited in the main manuscript.



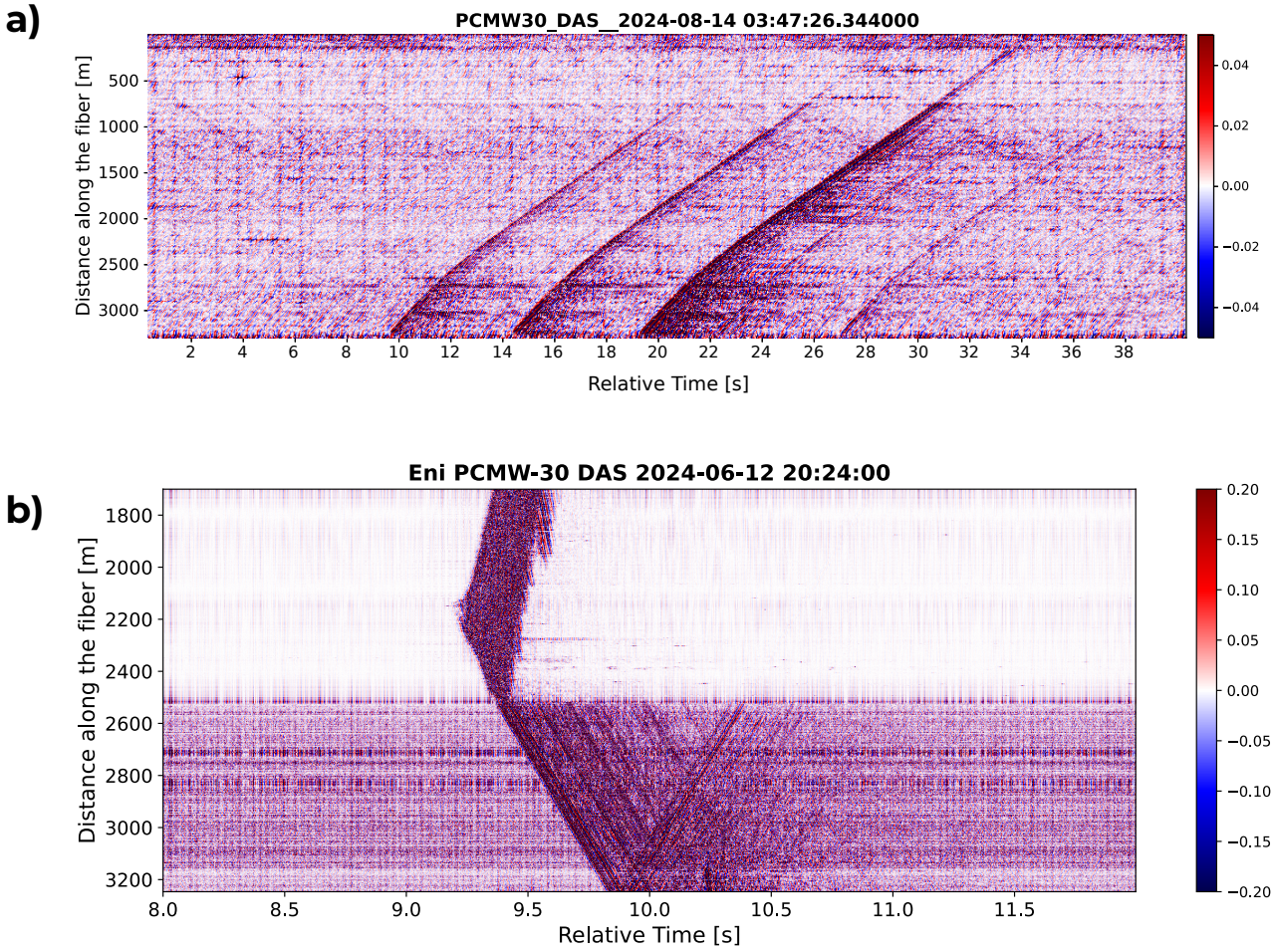
Supplementary figure S1: spatio-temporal changes in the PSD values over selected frequencies (0.01 hz to 120 hz). The f=10Hz band exhibits the highest energy in the brine-CO2 borehole contact, in the proximity of channel depth 1800 m (measured depth, MD).



Supplementary figure S2: Offshore ML 1.3 (a) and ML 2.6 (b) events shown in figures 6a) and 6c) in the main manuscript, detected by the semblance based detector described in the methodology section. The upper panel represent the total coherence time-series for the detected events. Dashed lines represent the detection time of the seismic event. The middle panel shows the coherence matrix calculated by the detector, while the bottom panel shows the DAS data after applying the TKEO characteristic function to enhance the signal.



Supplementary figure S3: Offshore ML 1.5 (a) and ML 2.2 (b) events shown in figures 6b) and 6d) in the main manuscript, detected by the semblance based detector described in the methodology section. The upper panel represent the total coherence time-series for the detected events. Dashed lines represent the detection time of the seismic event. The middle panel shows the coherence matrix calculated by the detector, while the bottom panel shows the DAS data after applying the TKEO characteristic function to enhance the signal.



Supplementary figure S4: Examples of transients detected by the DAS system, as explained in the main manuscript. a) example of transients originating below the deepest active DAS channel, characterized by a low apparent velocity of ≈200 m/s , with a marked repetitiveness suggesting a non-natural source. b) example of a class of high-frequency transients (>100 Hz) localized between 1.8 and 2.4 km depth along the fiber.

Supplementary figure captions

- **Figure S1:** spatio-temporal changes in the PSD values over selected frequencies (0.01 hz to 120 hz). The f=10Hz band exhibits the highest energy in the brine-CO2 borehole contact, in the proximity of channel depth 1800 m (measured depth, MD).

- **Figure S2:** Offshore ML 1.3 (a) and ML 2.6 (b) events shown in figures 6a) and 6c) in the main manuscript, detected by the semblance based detector described in the methodology section. The upper panel represent the total coherence time-series for the detected events. Dashed lines represent the detection time of the seismic event. The middle panel shows the coherence matrix calculated by the detector, while the bottom panel shows the DAS data after applying the TKEO characteristic function to enhance the signal.

- **Figure S3:** Offshore ML 1.5 (a) and ML 2.2 (b) events shown in figures 6b) and 6d) in the main manuscript, detected by the semblance based detector described in the methodology section. The upper panel represent the total coherence time-series for the detected events. Dashed lines represent the detection time of the seismic event. The middle panel shows the coherence matrix calculated by the detector, while the bottom panel shows the DAS data after applying the TKEO characteristic function to enhance the signal.

- **Figure S4:** Examples of transients detected by the DAS system, as explained in the main manuscript. a) example of transients originating below the deepest active DAS channel, characterized by a low apparent velocity of ≈200 m/s , with a marked repetitiveness suggesting a non-natural source. b) example of a class of high-frequency transients (>100 Hz) localized between 1.8 and 2.4 km depth along the fiber.