Supplementary Information for

Barometric Pumping as a Driver of Subsurface CO_2 Emissions: A Comparative Study of Vadose Zone vs. Groundwater Wells

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1. Data analysis process

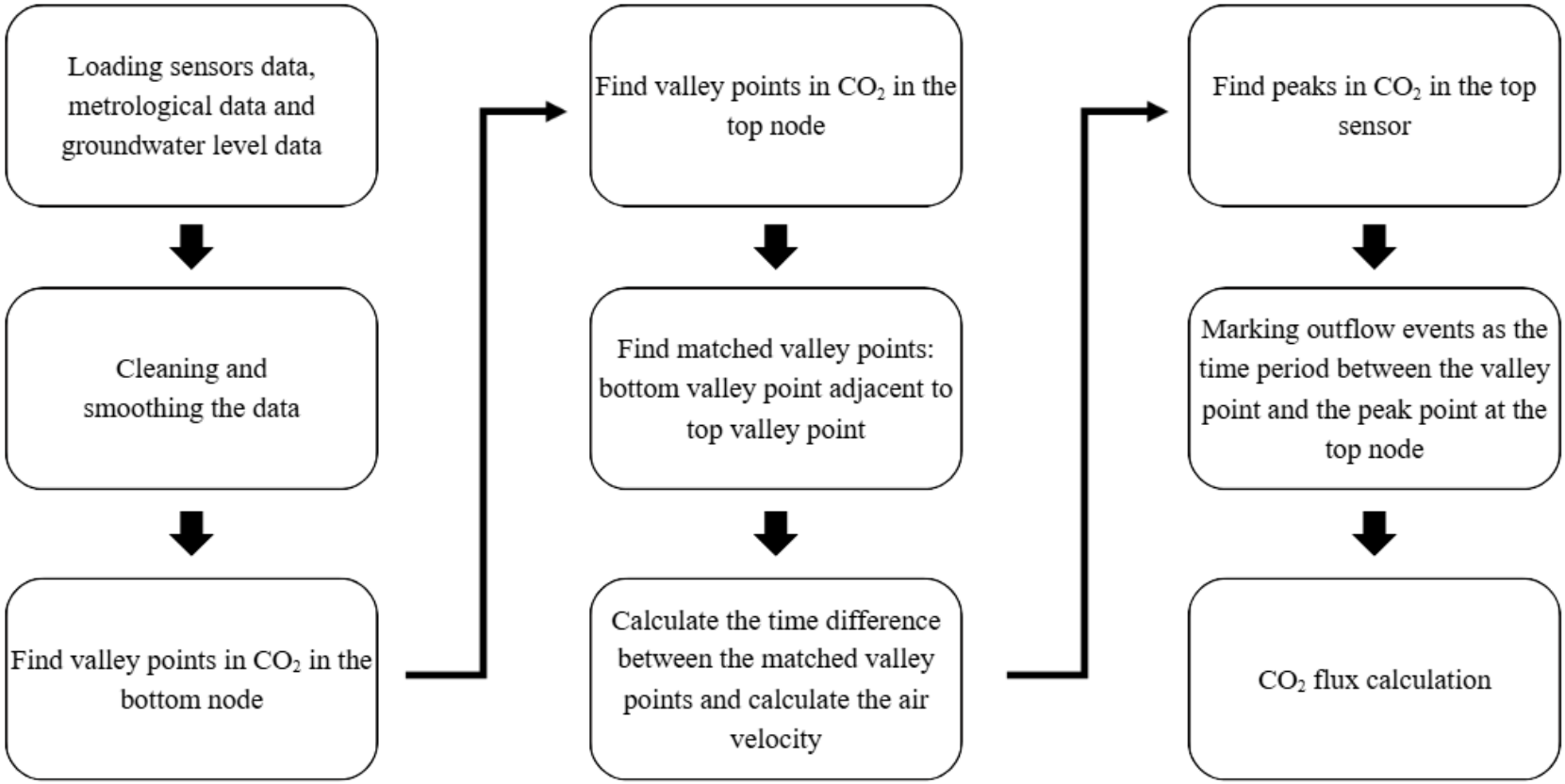

Fig. S1. Flowchart of the data analysis.

2. *Outflow* event

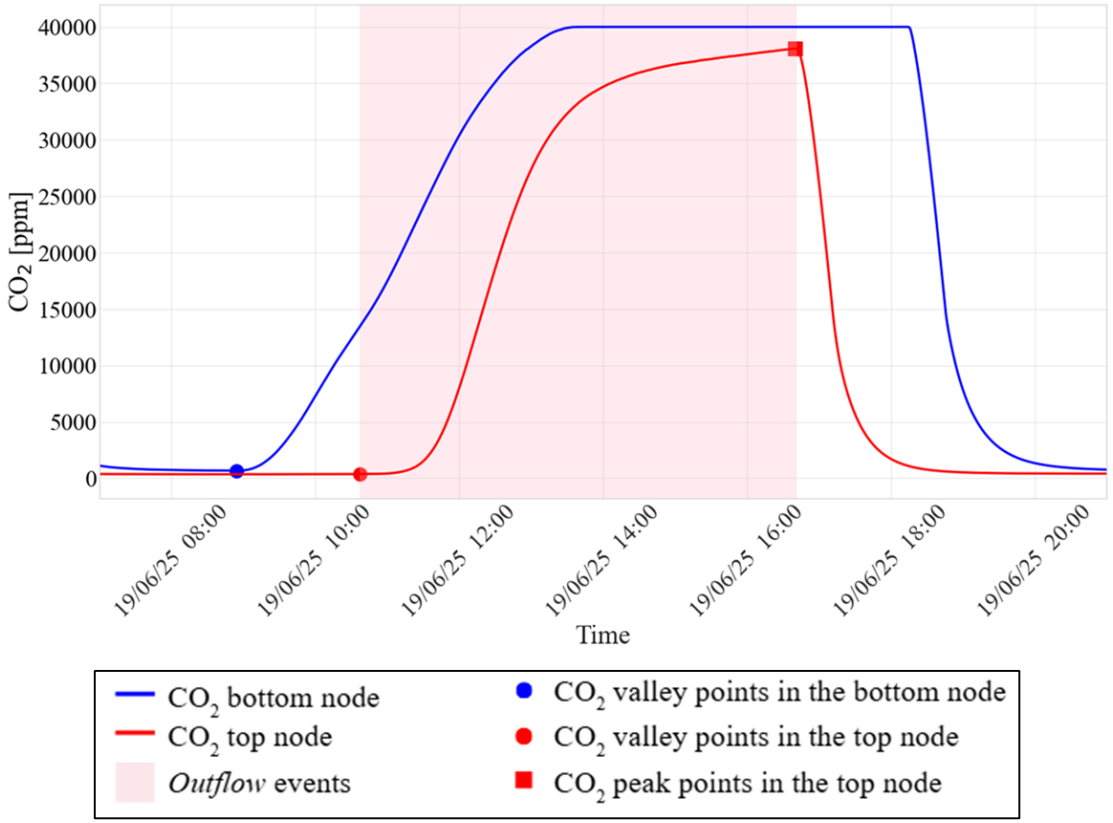

Fig. S2. Example of *outflow* event in the dry well. CO_2 valley point is the onset of increasing CO_2 concentrations, and CO_2 peak point is the onset of decreasing CO_2 concentrations.

3. One-year time series of the dry well

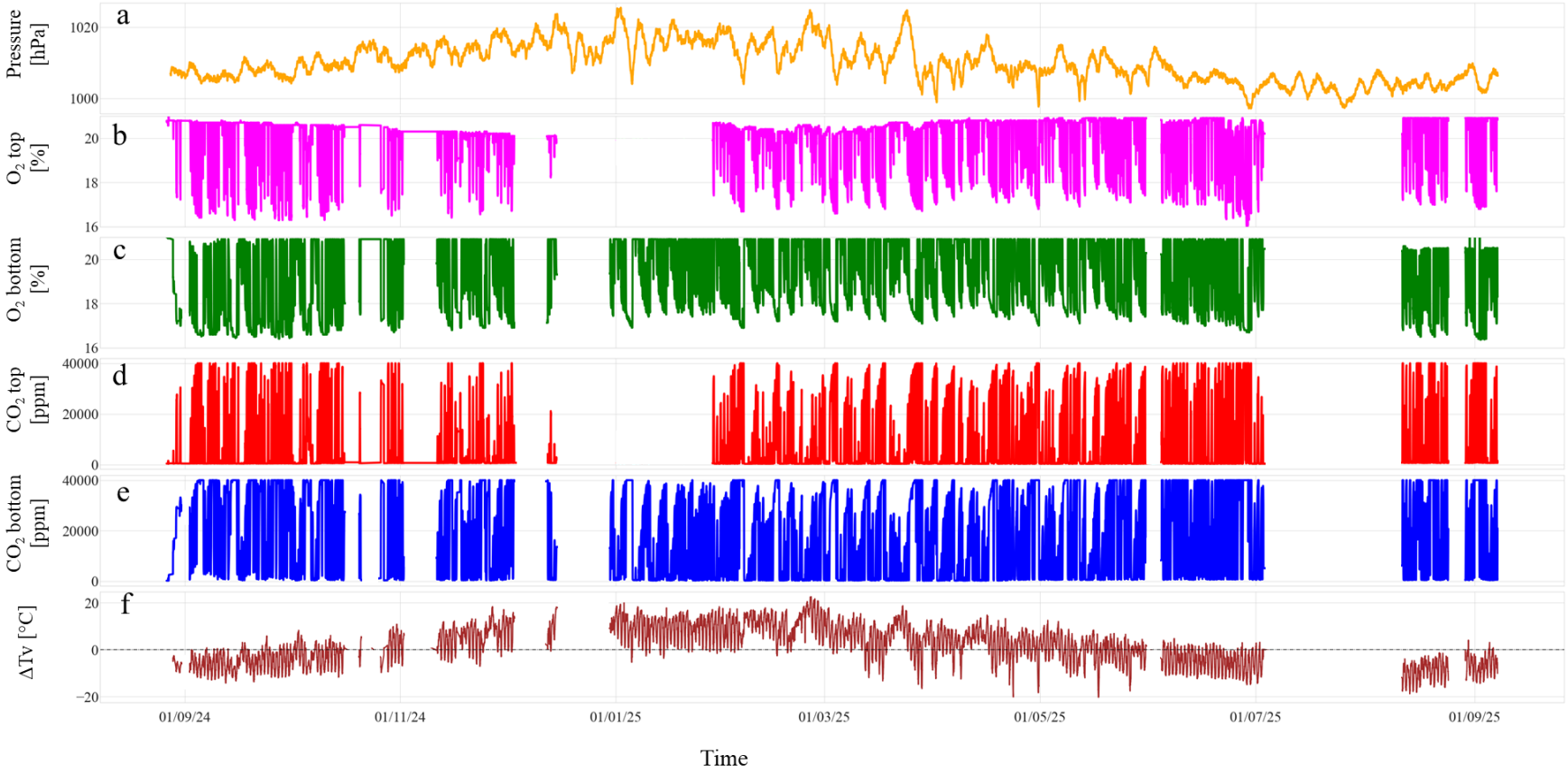

Fig. S3. One-year time series data (September 2024 - August 2025) in the dry well. (a) Barometric pressure; (b) O_2 concentrations in the top node; (c) O_2 concentrations in the bottom node; (d) CO_2 concentrations in the top node; (e) CO_2 concentrations in the bottom node; (f) ΔT_V between the bottom node and the atmosphere ($T_{V(bottom)} - T_{V(atm)}$); positive values indicates thermal instability conditions. Blank areas indicate missing data due to system malfunctions.

4. **Time lags between barometric pressure's peak and the start of *outflow* event**

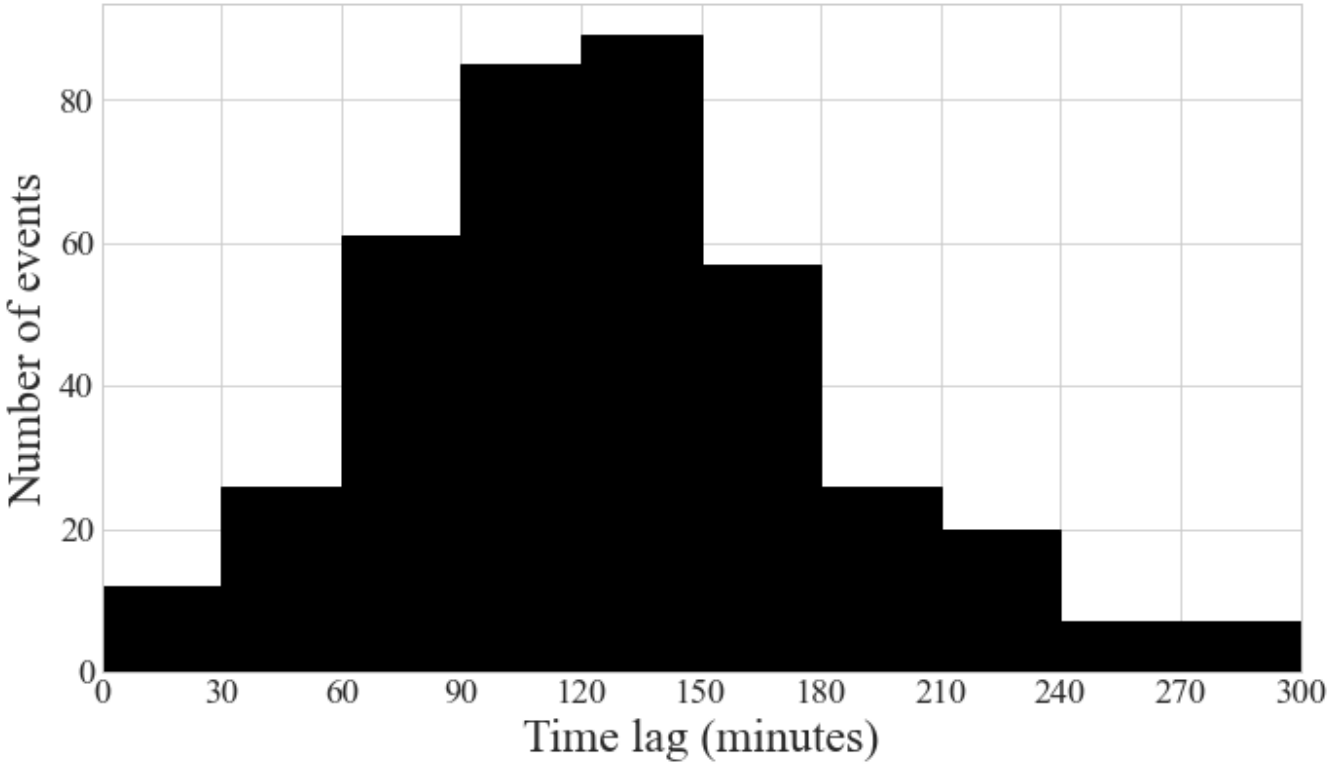

Fig. S4. Histogram of the time lags between the barometric pressure's peaks and the start of *outflow* events.