Estimating field volatility of soil fumigants using CHAIN_2D: Mitigation methods and comparison against chloropicrin and 1,3-dichloropropene field observations

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Academic, government and industrial field researchers have generated a significant database of field studies of the volatility of soil applied fumigants. However, limited work exists in validating physical models against field volatility data sets and fully exploring the volatility parametric response surface. Field studies quantifying atmospheric flux for soil fumigants 1,3-dichloropropene and chloropicrin are validated against the United States Department of Agriculture (USDA Salinity Laboratory) soil physics model CHAIN_2D that was modified specifically for agronomic uses of soil fumigants. Comparison between model predictions and field observations for 6 unique field trials in 5 different states indicate that CHAIN_2D effectively captures the magnitude and duration of fumigant emission from soil observed experimentally with r^2 ~0.14 – 0.96 (avg. 0.66) for peak emission, and r^2 ~0.76 – 1.0 (avg. 0.91) for cumulative emissions. Correct prediction magnitudes suggest that CHAIN_2D is a useful tool for extrapolating flux predictions to diverse scenarios not addressed by field trials. Examples of mitigation strategies such as the use of agricultural films (tarps), increased soil injection depth, and management of soil water content, under near semi-infinite parameter combinations of soil, meteorological, and agronomic properties are discussed.