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Impacts of changes of building conditions on vapor intrusion

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It is well-known that vapor intrusion (VI) is difficult to characterize, and most VI researchers have focused more on the subsurface processes, because the aboveground processes have more temporal and spatial variability in different building conditions, which causes the greater uncertainty than subsurface processes in VI. Therefore, there is a need to understand the role of aboveground processes, especially building conditions, in the assessment of VI exposure risks. The building conditions contain the weather conditions (i.e. wind speed, wind direction, temperature difference, etc.) and building structures (i.e. ventilation, building volume, building interval, etc.). In this study we present the spatial and temporal variations of these selected factors in Chinese buildings from a potential VI site in Hubei province. Then a multi-zone airflow and contaminant transport analysis software is employed to illuminate the variation of the indoor air contaminant concentrations in response to the changes of building conditions. The developed model is partially validated by the site data. The simulation results show that the indoor air contaminant concentrations can vary more than one order of magnitude due to the changes of building conditions, and the ventilation has the greatest impact, the temperature difference also has significant impact on simulation results of the indoor air contaminant concentrations. Furthermore, the VI exposure risk is calculated based on the simulation results, and compares with the assessment result by Johnson-Ettinger model which is widely used in the assessment of VI exposure risks. With these results we are able to quantitatively understand the variations in potential VI scenario, reduce uncertainty of the aboveground process, and make better decisions at VI sites.