Supplementary file

Field-scale investigation of CO_2 plume dynamics under spatial wettability variations: Implications for geological CO_2 storage

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Zhang, H., Mahmoud, M., Iglauer, S., Arif, M. Field-scale investigation of CO_2 plume dynamics under spatial wettability variations: Implications for geological CO_2 storage. Advances in Geo-Energy Research, 2025, 15(3): 230-244.

The link to this file is: https://doi.org/10.46690/ager.2025.03.06

Impact of gird resolution

The impact of parameters in Eq. (3), such as gridblock numbers as well as the CO_2-occupied volume, in the implementation of random wettability distribution, was investigated. Three different grid resolutions were considered, including the original gridblock, dividing each gridblock into 2 × 2 × 1, and dividing each gridblock into 3 × 3 × 1. Note that the grid resolution of 3 × 3 × 1 was used in this study. Only two wells were considered to change the CO_2-occupied volume. The CO_2 saturation distribution of different cases and the corresponding residual trapping are presented in Fig. S1. The results showed the random wettability assignment influences the local CO_2 saturation distribution across all resolutions, yet its influence on the overall plume shape is minimal. In addition, the variations in the residual trapping capacity among three random wettability assignment realizations diminish when the number of gridblocks increases. This implies that sufficiently high grid resolution and large CO_2-occupied volume may mitigate the uncertainties in residual trapping potential estimations due to the randomness in wettability distribution patterns.

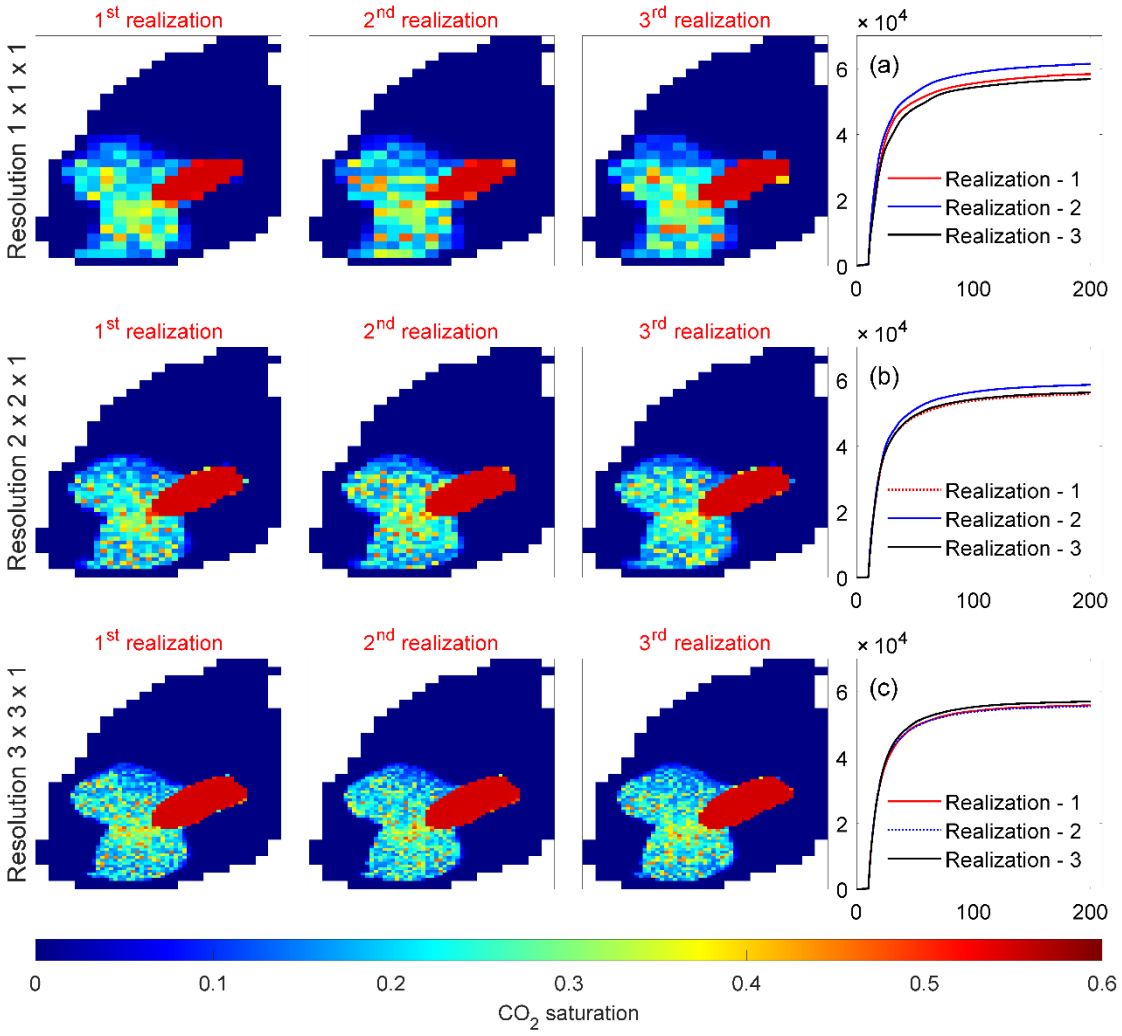

Fig. S1. CO_2 saturation distribution of three different random wettability assignments in different resolution strategies. The corresponding residual trapping as a function of simulation time is also presented in (a) (b) (c). Note that the capillary pressure curves are not considered for simplicity.