

Effect of varying injection rates and absolute permeability on plume shape

Table 1: Case setups. K_h [m^2] is absolute horizontal permeability, MASS_INJ [$\frac{kg}{s}$] is injected CO_2 mass rate and Gr [-] is gravitational number.

Cases	K_h	MASS_INJ	Gr
1	10^{-13}	0.001	27
2	10^{-12}	0.001	272
3	10^{-14}	0.001	2.7
4	10^{-13}	0.01	2.7
5	10^{-13}	0.0001	272
6	10^{-12}	0.01	27
7	10^{-14}	0.0001	27

The Gravitational Number (Gr) is defined as

$$Gr = \frac{(\varrho_w - \varrho_{CO_2}) \cdot \mathbf{g} \cdot \mathbf{K}_h}{\mu_{CO_2} \cdot v_{cr}} = \frac{\text{gravitational forces}}{\text{viscous forces}}, \quad (1)$$

where ϱ_w [$\frac{kg}{m^3}$] is water phase density, ϱ_{CO_2} [$\frac{kg}{m^3}$] is CO_2 phase density, \mathbf{g} is gravitational acceleration vector [$\frac{m}{s^2}$], μ_{CO_2} is CO_2 phase dynamic viscosity [$Pa \cdot s = \frac{N}{m^2} \cdot s = \frac{kg}{s \cdot m}$] and v_{cr} is characteristic velocity [$\frac{m}{s}$], which can be estimated by

$$v_{cr} = \frac{MASS_INJ}{\phi \cdot \varrho_{CO_2} \cdot A}. \quad (2)$$

where ϕ [-] is porosity, A is injection well surface (here 30 m^2 (since only the bottom 30 m are used for injection and 2-D model *depth* is 1 m)).

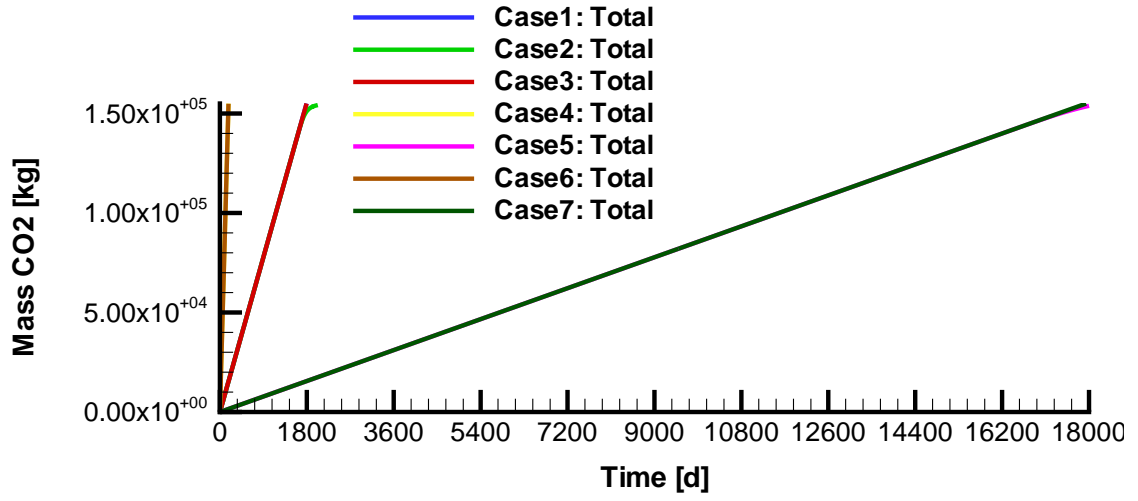


Figure 1: CO₂ mass in the model-domain versus time.

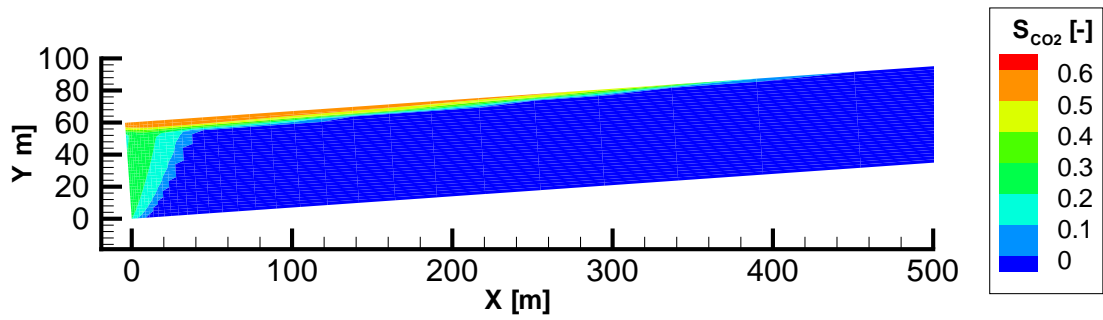


Figure 2: Case 1 plume shape after 1800 Days, i.e. $1.55 \cdot 10^5$ kg CO₂ injected.

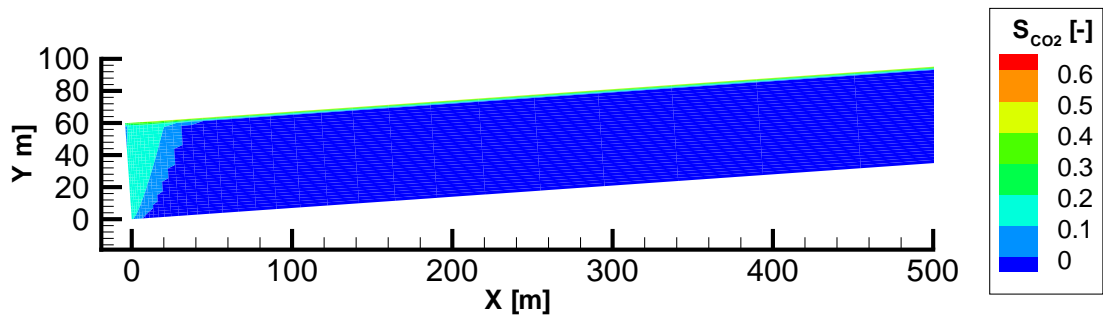


Figure 3: Case 2 plume shape after 1800 Days, i.e. $1.55 \cdot 10^5$ kg CO₂ injected.

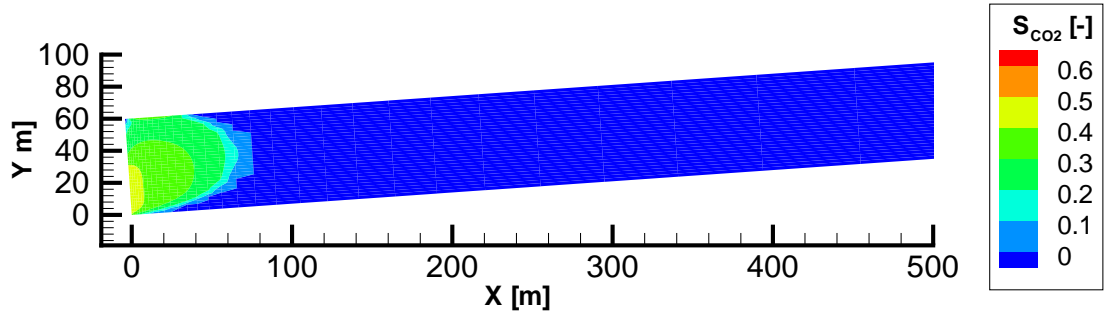


Figure 4: Case 3 plume shape after 1800 Days, i.e. $1.55 \cdot 10^5$ kg CO₂ injected.

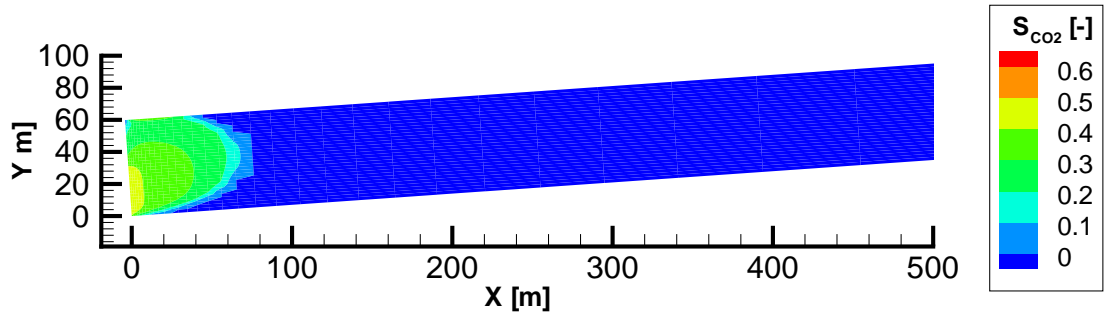


Figure 5: Case 4 plume shape after 180 Days, i.e. $1.55 \cdot 10^5$ kg CO₂ injected.

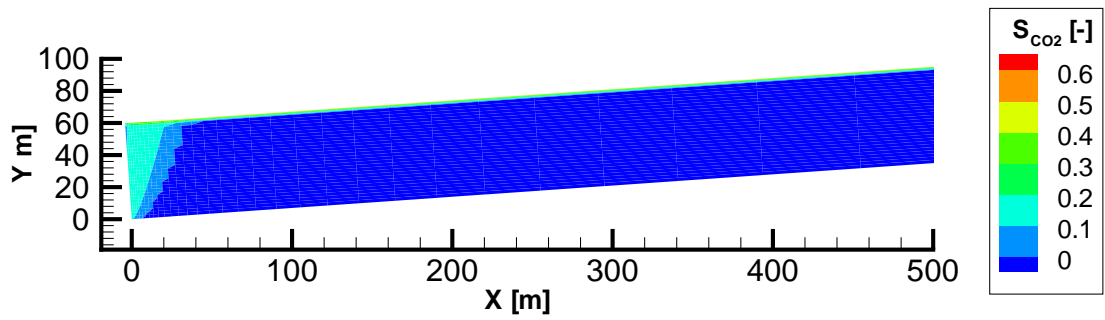


Figure 6: Case 5 plume shape after 18000 Days, i.e. $1.55 \cdot 10^5$ kg CO₂ injected.

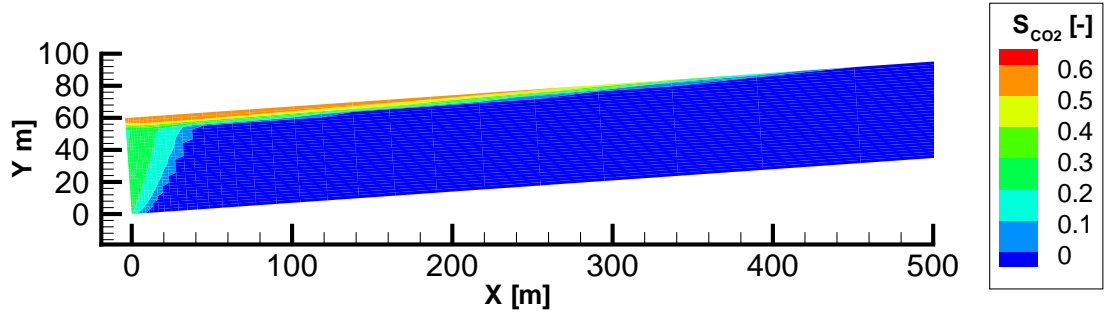


Figure 7: Case 6 plume shape after 180 Days, i.e. $1.55 \cdot 10^5$ kg CO₂ injected.

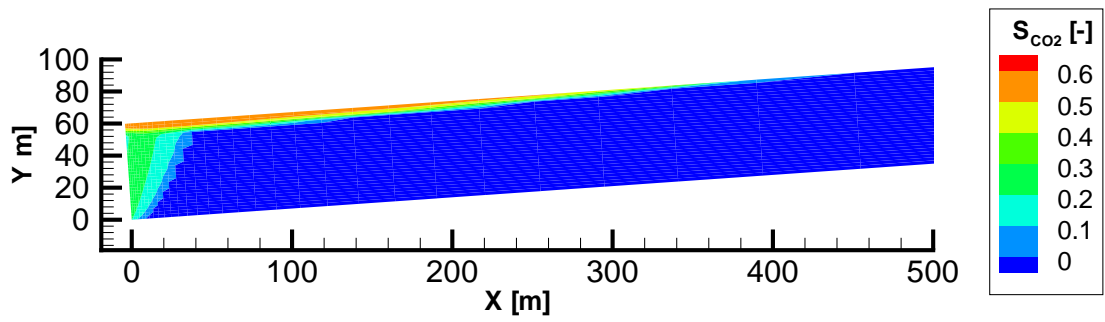


Figure 8: Case 7 plume shape after 18000 Days, i.e. $1.55 \cdot 10^5$ kg CO₂ injected.