water

Biased Estimation of Groundwater Velocity from a Push-Pull Tracer Test Due to Plume Density and Pumping Rate

Hong-Hyun Kim, Eun-Hee Koh, Seong-Sun Lee and Kang-Kun Lee

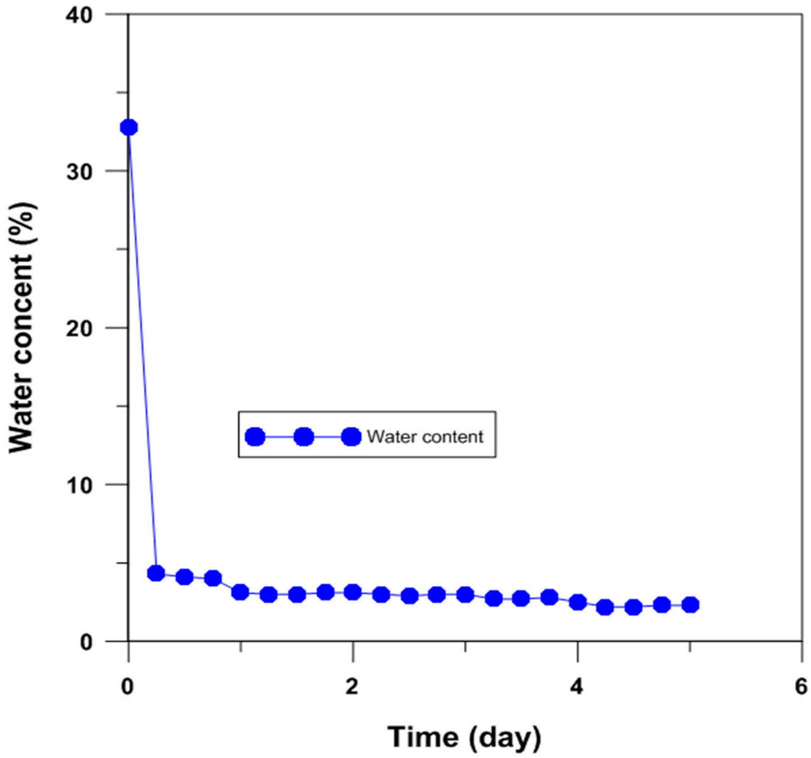

Figure S1. Comparison Water content (%) measured for 5 days by 5TE sensor.

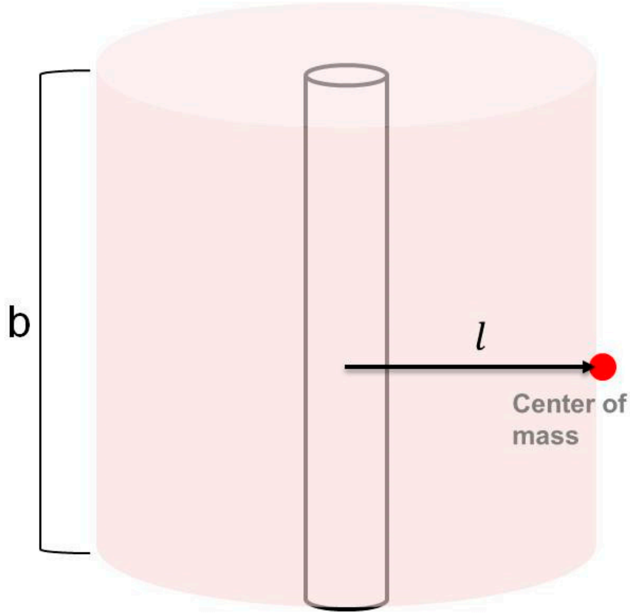

Figure S2. Schematic diagram of push-pull test.

Formulae

Darcy's law (including an effective porosity term) can be written

$$V = KI/n \tag{1}$$

where V is the average linear groundwater velocity; K is the horizontal hydraulic conductivity; I is the horizontal hydraulic gradient; and n is the effective porosity.

From Darcy's law, the tracer travel distance during drift time can be written

$$l = KIt_{total}/n \tag{2}$$

where l is the tracer travel distance during drift time; t_{total} is the time elapsed from the injection of the tracer until the center of mass of the tracer.

If the injected tracer is spread through a well screen, the amount of water pumped during t in the pumping phase will be equal to the volume of the cylinder in which the tracer's travel distance l is the radius and the thickness of the aquifer is b.

$$Qt_{com} = \pi K^2 I^2 {t_{total}}^2 bn/n^2 \tag{3}$$

where Q is the pumping rate; t_{com} is the time elapsed from the start of pumping until one-half of the injected tracer is recovered.

Therefore, by summarizing the velocity V using equations (1) and (3),

$$V = Qt_{com}/\pi bKI{t_{total}}^2 \tag{4}$$

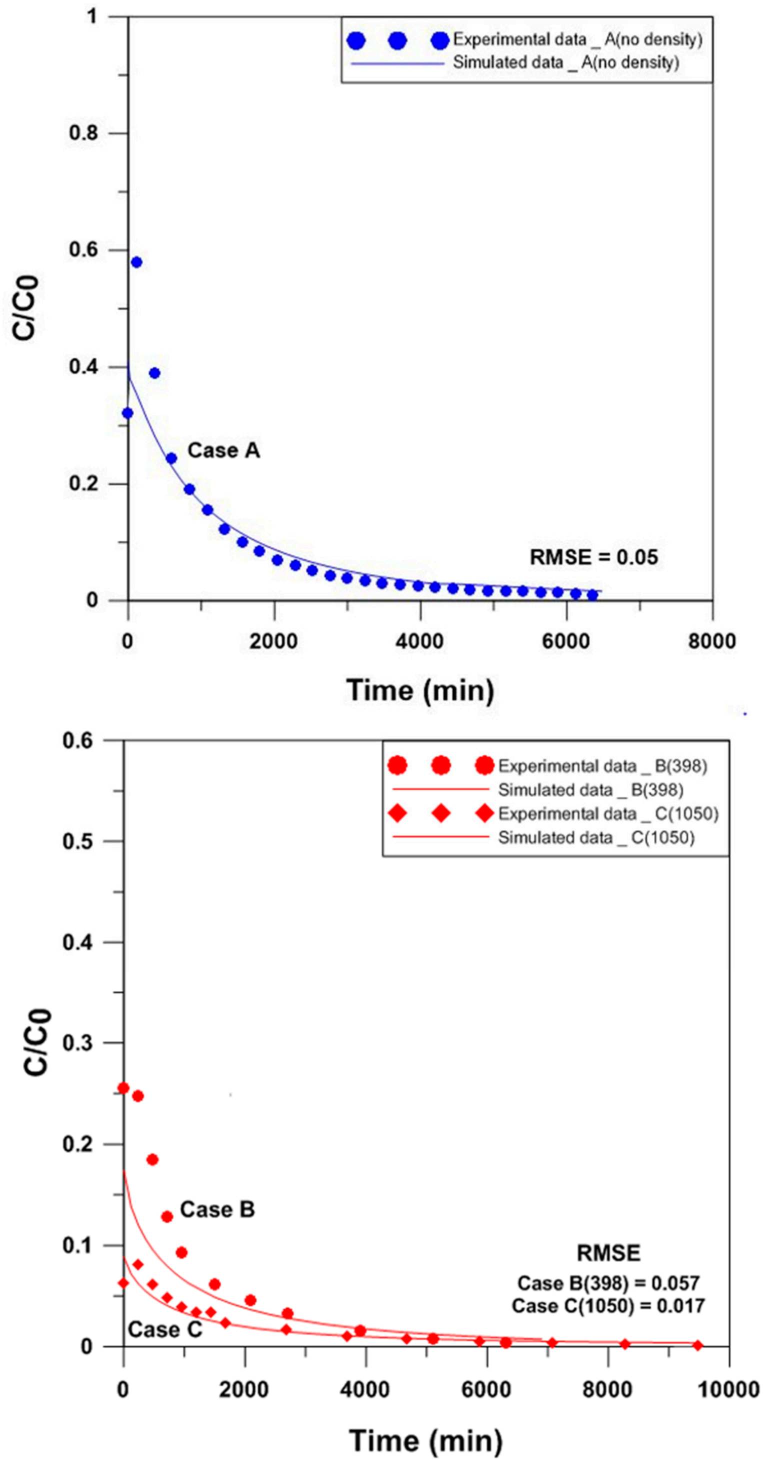

Figure S3. Comparison of the C/C_0 value obtained from the numerical simulation (in full line) with that from the experiments (in dot) with 3 density conditions: (**A**) 168 mg/L, (**B**) 398 mg/L, (**C**) 1050 mg/L.

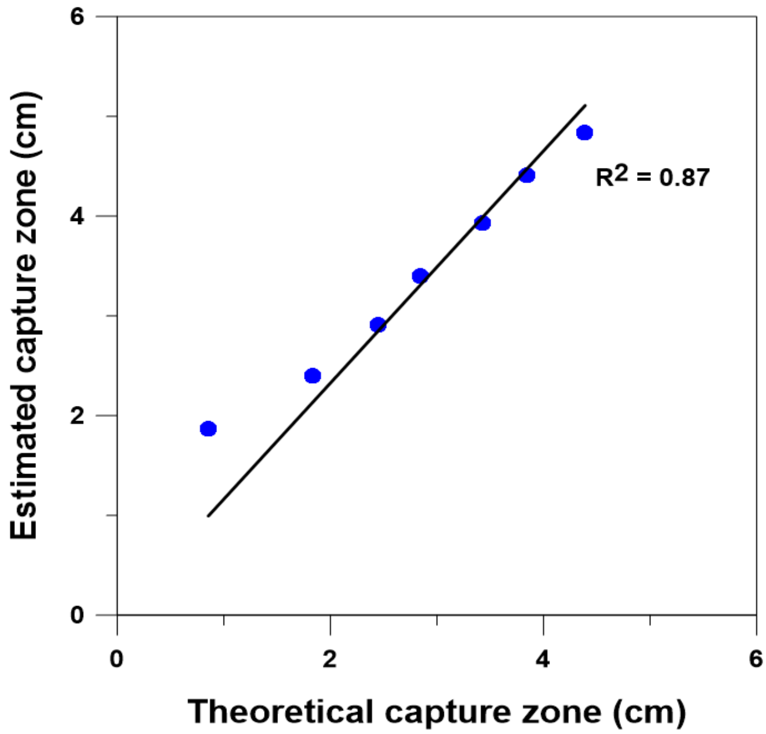

Figure S4. The comparison between the theoretical capture zone and estimated capture zone by numerical simulations ($R^2 = 0.87$).

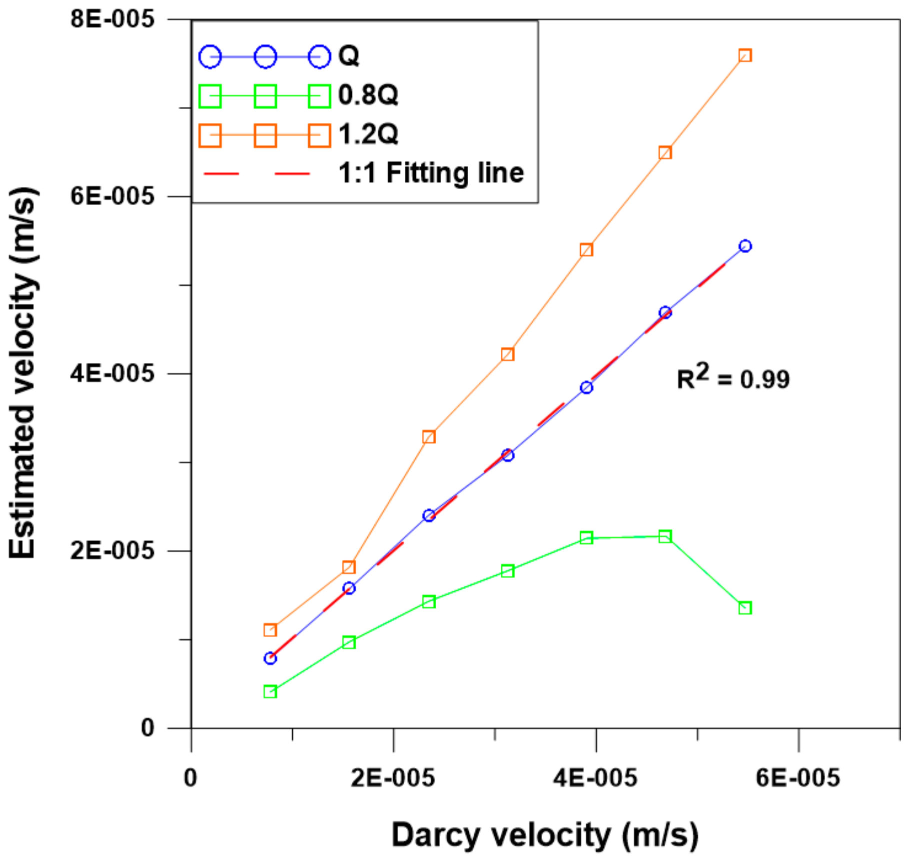

Figure S5. The comparison of estimated velocity and Darcy velocity as applying higher (1.2 Q) and lower (0.8 Q) pumping rate.