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A simple method for calculating in-situ settling velocities of cohesive sediment without fractal dimensions

KEYWORDS:
DREDGE; SEDIMENT SETTLING; POROSITY; IN-SITU MEASUREMENT; DENSITY FUNCTION

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Deduction of settling velocity

Balance of forces

Expressions of forces based on porosity

Relationship between porosity and fractal dimension

$$F_g - F_b = F_v + F_i$$

$$F_g = V_f \rho_f g = a d_f{}^2 \rho_f g$$

$$F_b = V_f \rho_w g = a d_f{}^2 \rho_w g$$

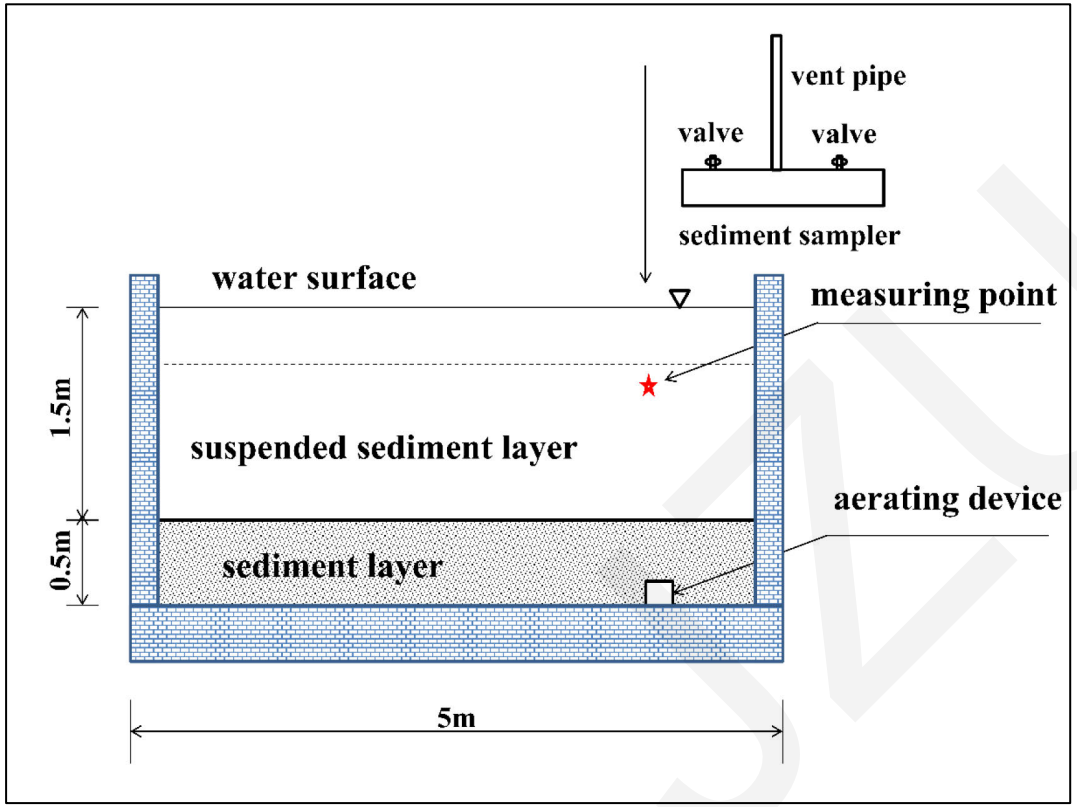
$$F_v = 4 P_f \mu \omega = c\left(b d_f{}^2\right)^{\left(\frac{9}{16D}+\frac{7}{16}\right)} \mu \omega$$

$$F_i = A_f \rho_f \omega^2 = b d_f{}^2 \rho_f \omega^2$$

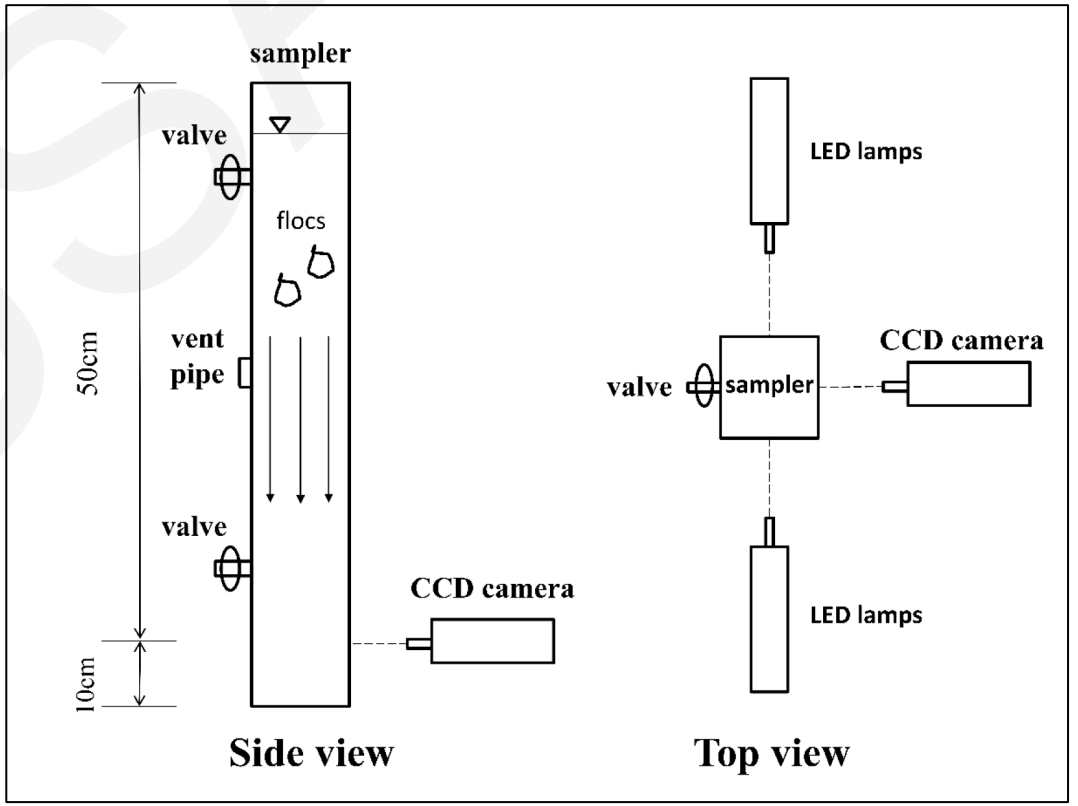
$$D = \log_l(1-e) + 3$$

$$\omega = \frac{-3\mu c\left(b d_f{}^2\right)^{\frac{E}{2}} \pm \sqrt{9\mu^4 c^2 \left(b d_f{}^2\right)^E + 4ab\rho_f g(\rho_f - \rho_w) d_f{}^5}}{2\rho_f b d_f{}^2}$$

Experiments on the settling of sediment flocs

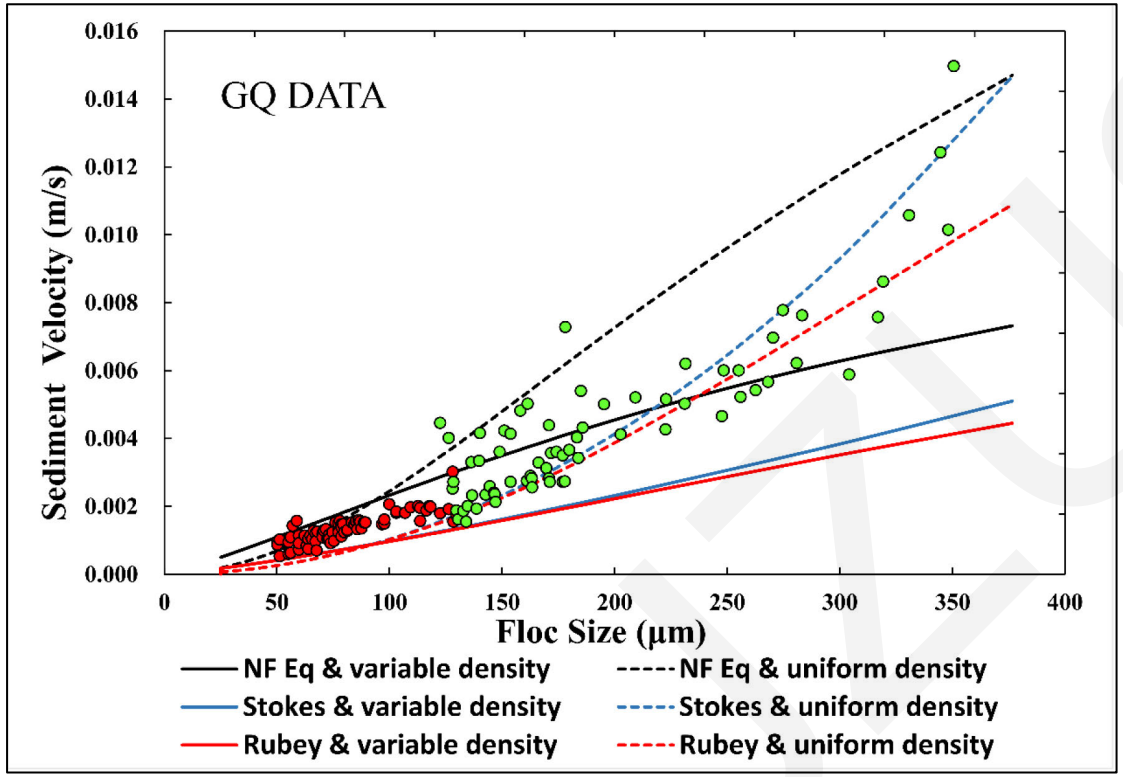


Experiment site

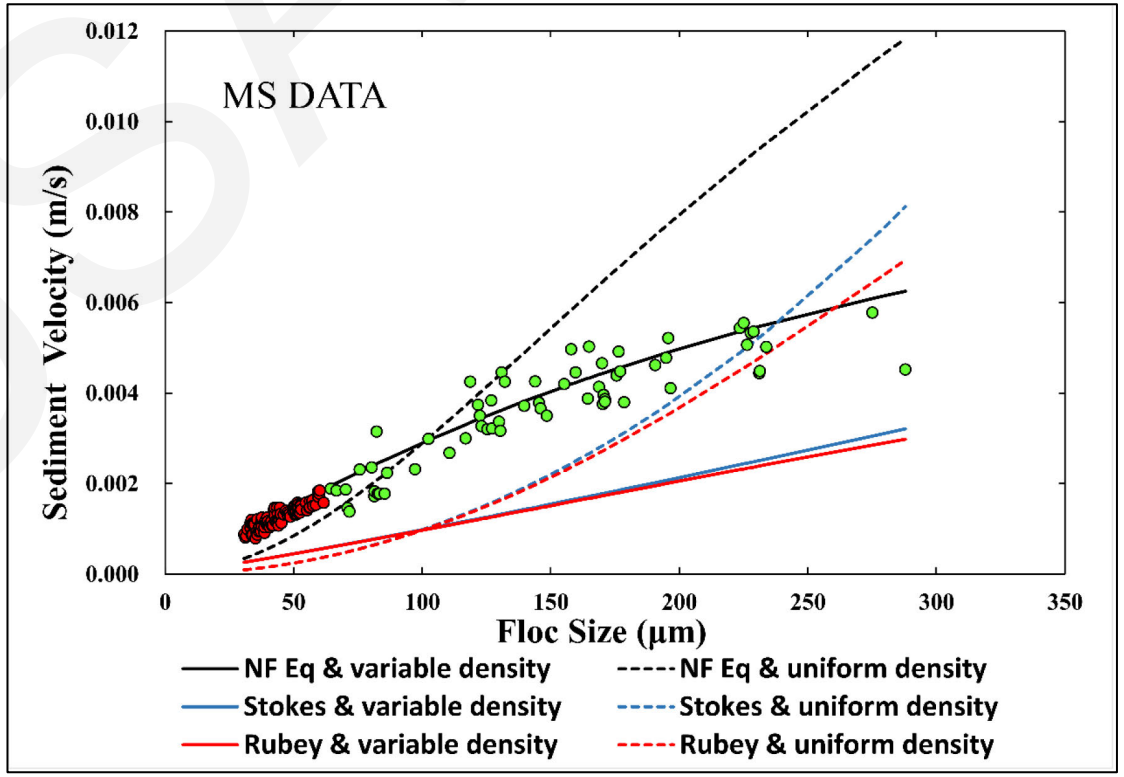


Settling volumes

Results of settling velocity



Guanqiao lake



Moshui lake

Conclusions

- The variable density function performed better than the uniform density function and was, therefore, recommended for calculating the settling velocities for both micro and macro flocs.
- The method presented in this paper, which is simpler in determining in-situ settling velocities than traditional methods, also allows for direct inter-comparisons between results derived from various studies.

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