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Effects of the mixing degree upstream of the diverging area on the pollutant allocation characteristics of a braided river

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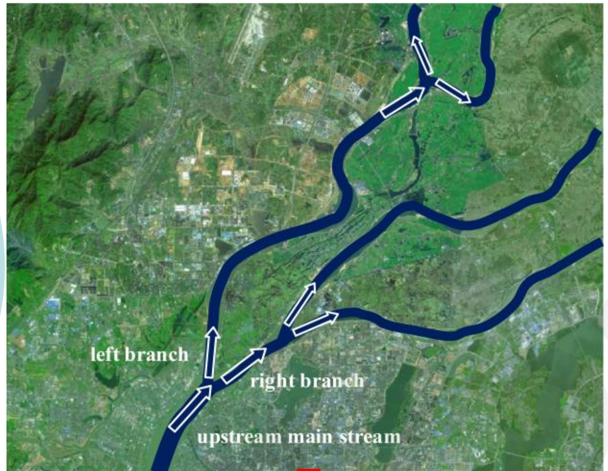
braided rivers and simulation

Rivers with branching structure

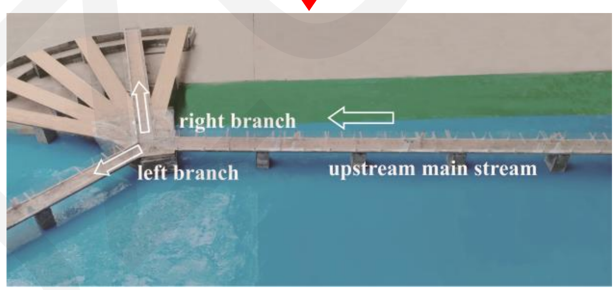
three-dimensional turbulence characteristics

Physical model of braided rivers

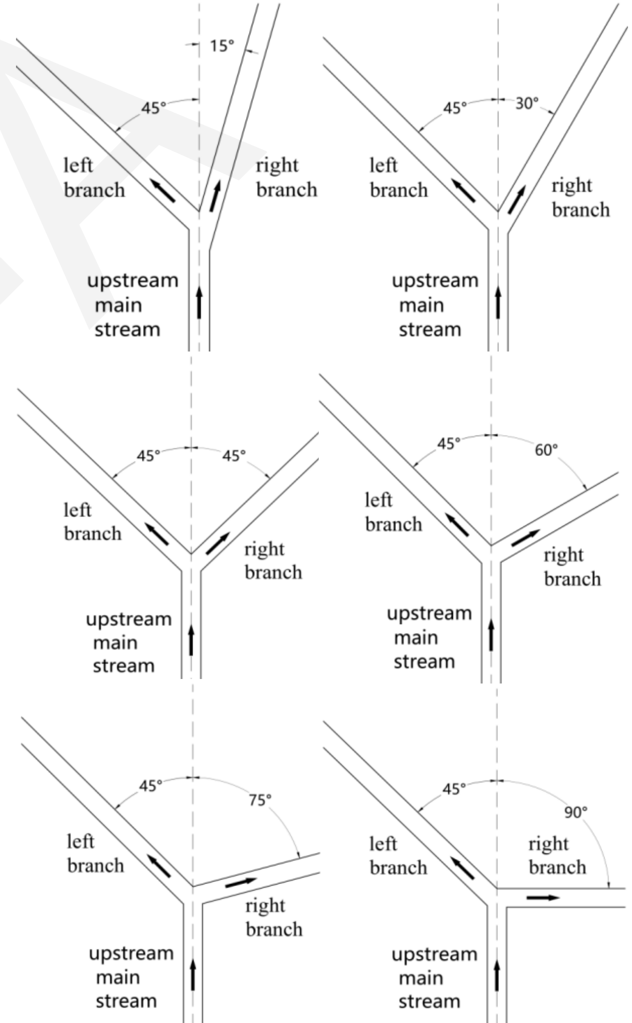
Pollutant diffusion and allocation



simulation



ranged from 15° ~90°



six branching forms

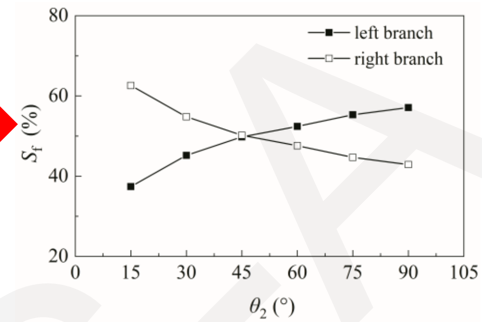
the discharge ratio and the pollutant flux ratio

The discharge ratio: ***Q*** **denotes the total flow rate, q_1 denotes the flow rate in the left branch, and q_2 denotes the flow rate in the right branch.**

$$S_{f1} = \frac{q_1}{Q}$$

$$S_{f2} = \frac{q_2}{Q}$$

$$Q = q_1 + q_2$$

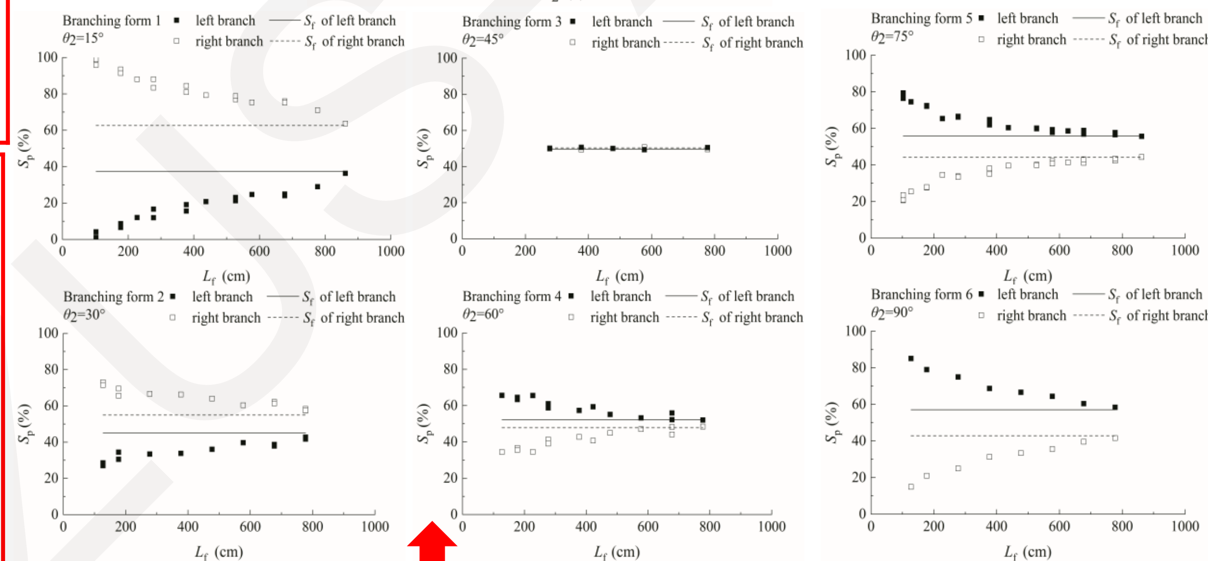


The pollutant flux ratio: ***P*** **denotes the total tracer discharge amount, p_1 denotes the tracer amount in the left branch, and p_2 denotes the tracer amount in the right branch.**

$$S_{p1} = \frac{p_1}{P}$$

$$S_{p2} = \frac{p_2}{P}$$

$$P = p_1 + p_2$$



the discharge ratio → **the pollutant flux ratio** → **deviation of the pollutant flux ratio from the discharge ratio**

The mixing degree

The mixing degree upstream of the diverging area σ:

- **Gaussian distribution fitting was carried out to determine the concentration distribution in the representative section upstream of the diverging area.**
- **A width of one standard deviation of the fitting curve was obtained for σ**
- **Equation 1 is the basic Gaussian distribution function. Based on this function.**
- **Equation 2 was applied to obtain the concentration spatial curve by fitting, where C0, A, PP, σ are fitting parameters.**

$$f(x)=\frac{1}{\sqrt{2\pi}\sigma}e^{-\frac{(x-\mu)^2}{2\sigma^2}} \quad (1)$$

$$C=C_0+A\times e^{-\frac{(y-pp)^2}{2\sigma^2}} \quad (2)$$

It is obvious that the mixing degree of the discharge point 1 is lower than that of the discharge point 2, and σ_1 is less than σ_2.

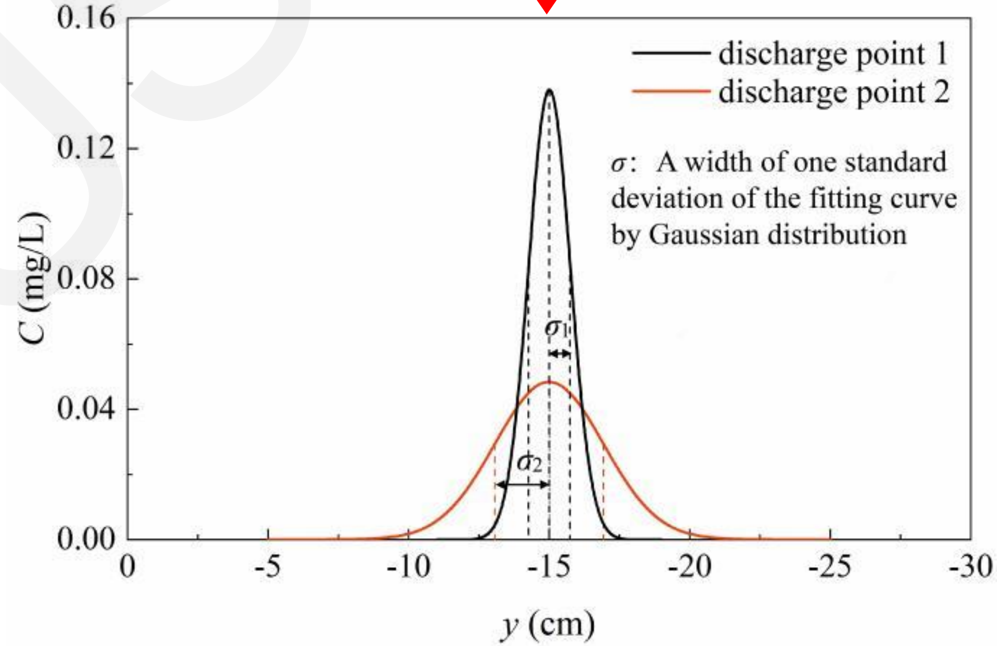
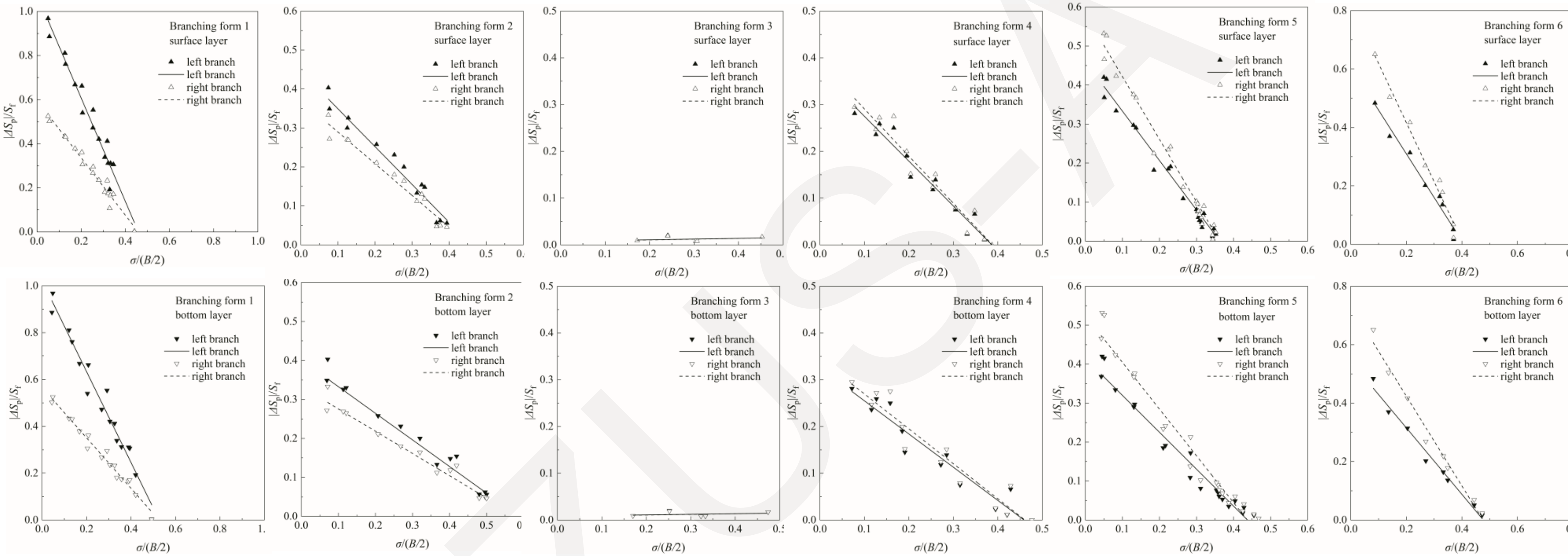


Fig. 3. Sketch of the mixing degree σ

Relationship between the mixing degree and the pollutant flux ratio

dimensionless treatment



Under asymmetric branching, when the pollutant diffusion process upstream of the diverging area occurred at the first or second stage, there existed an approximately linear relationship.

$$\frac{\left|\Delta S_{\mathrm{p}}\right|}{S_{\mathrm{f}}}=a+b\times\frac{\sigma}{B/2}$$

Conclusions

- Under asymmetric branching, when the pollutant diffusion process upstream of the diverging area occurred at the first or second stage, the pollutant flux ratio exhibited a **trend of deviating** from the corresponding discharge ratio.
- The mixing degree upstream of the diverging area, affected the pollutant flux ratio. **Gaussian distribution** fitting was carried out to determine the concentration distribution in the representative section upstream of the diverging area. **A width of one standard deviation** of the fitting curve was obtained for the mixing degree.
- The lower the mixing degree, the larger was the deviation of the pollutant flux ratio from the discharge ratio. A **linear relationship** was attained between the dimensionless mixing degree and the dimensionless deviation of the pollutant flux ratio from the discharge ratio .
- The intercept and slope of the linear relationship varied with the **branching angle**.