



Impact of Reynolds number on tracer spreading in porous media

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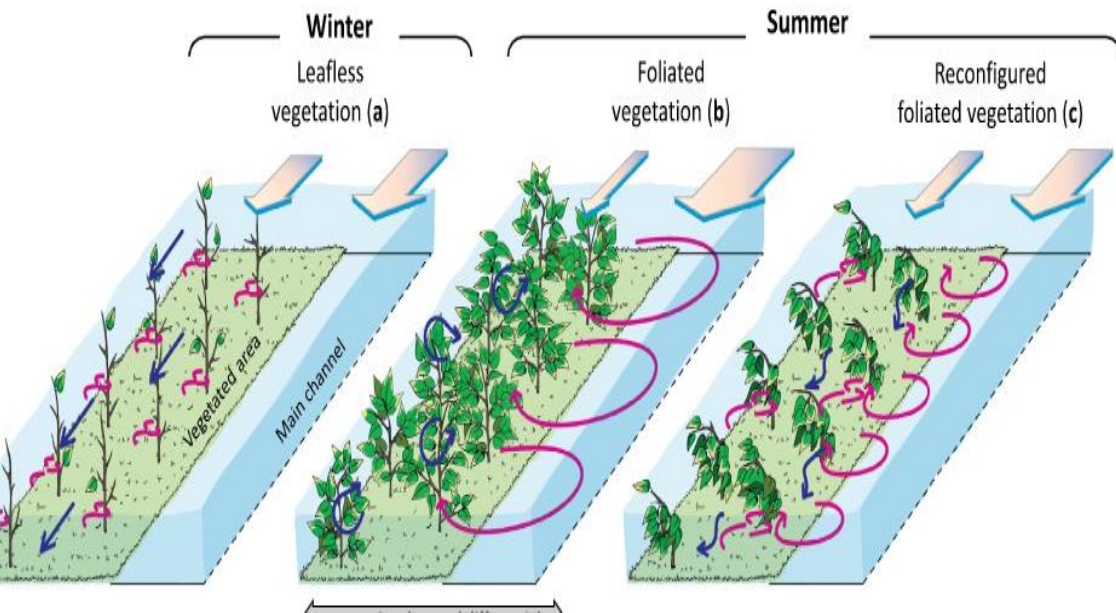
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Interfacial transport



Image by Manish Shukla



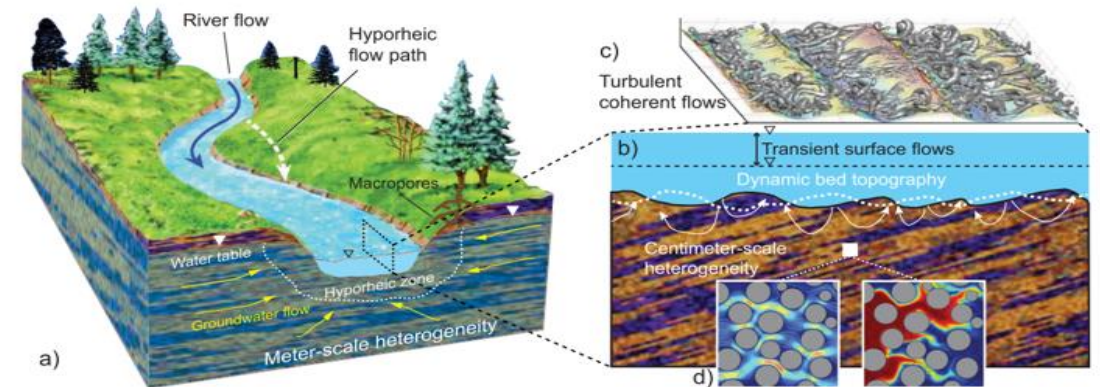
Caroppi et al., 2019

Water Resources Research

COMMENTARY

The importance and challenge of hyporheic mixing

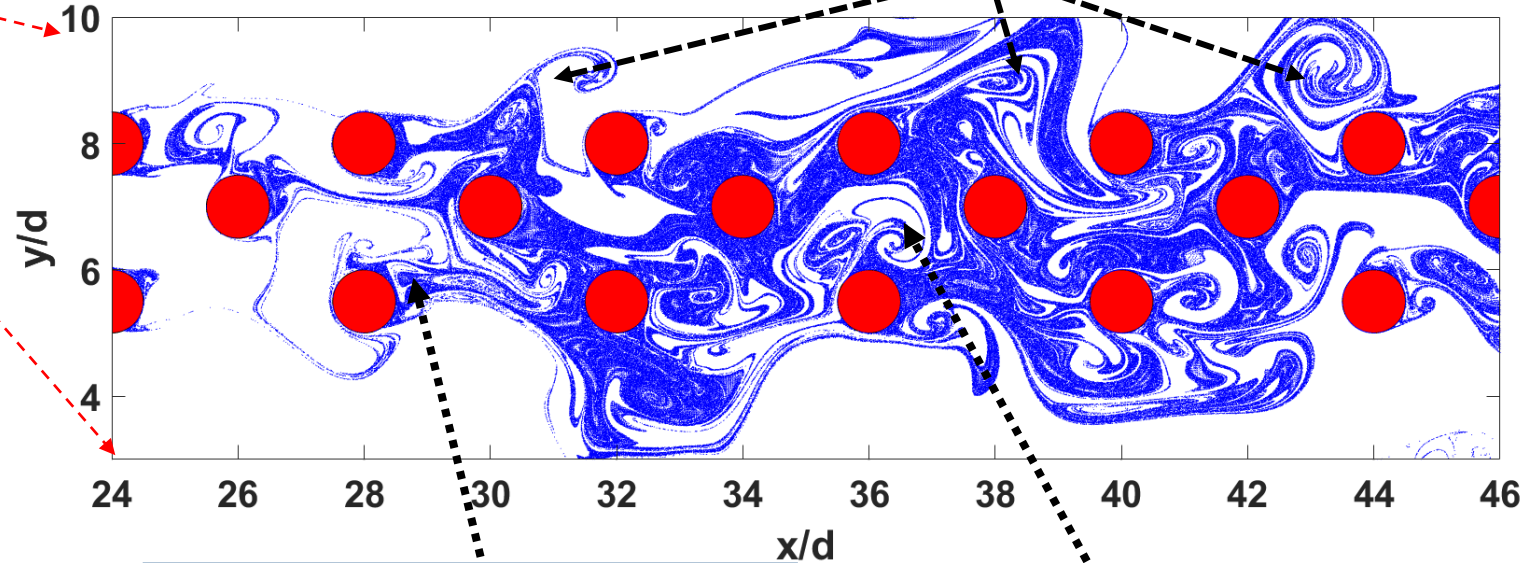
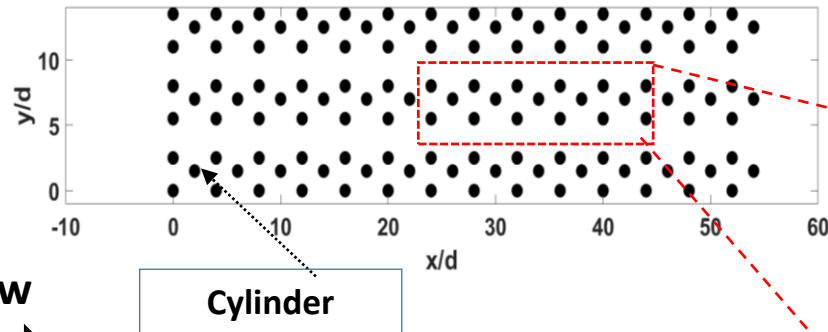
Erich T. Hester¹, M. Bayani Cardenas², Roy Haggerty³, and Sourabh V. Apte⁴



Hester et al., 2017

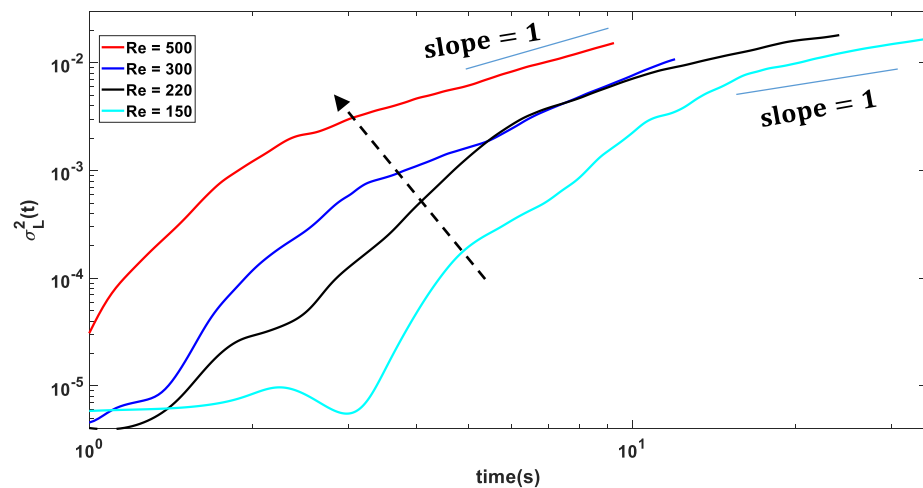
Tracer (blue) deformation at Reynolds number $Re = 500$ in an array of circular cylinder

Train of Large shear layer vortices at the cylinder – channel interface. These coherent rollers are popularly known as Kelvin Helmholtz billows

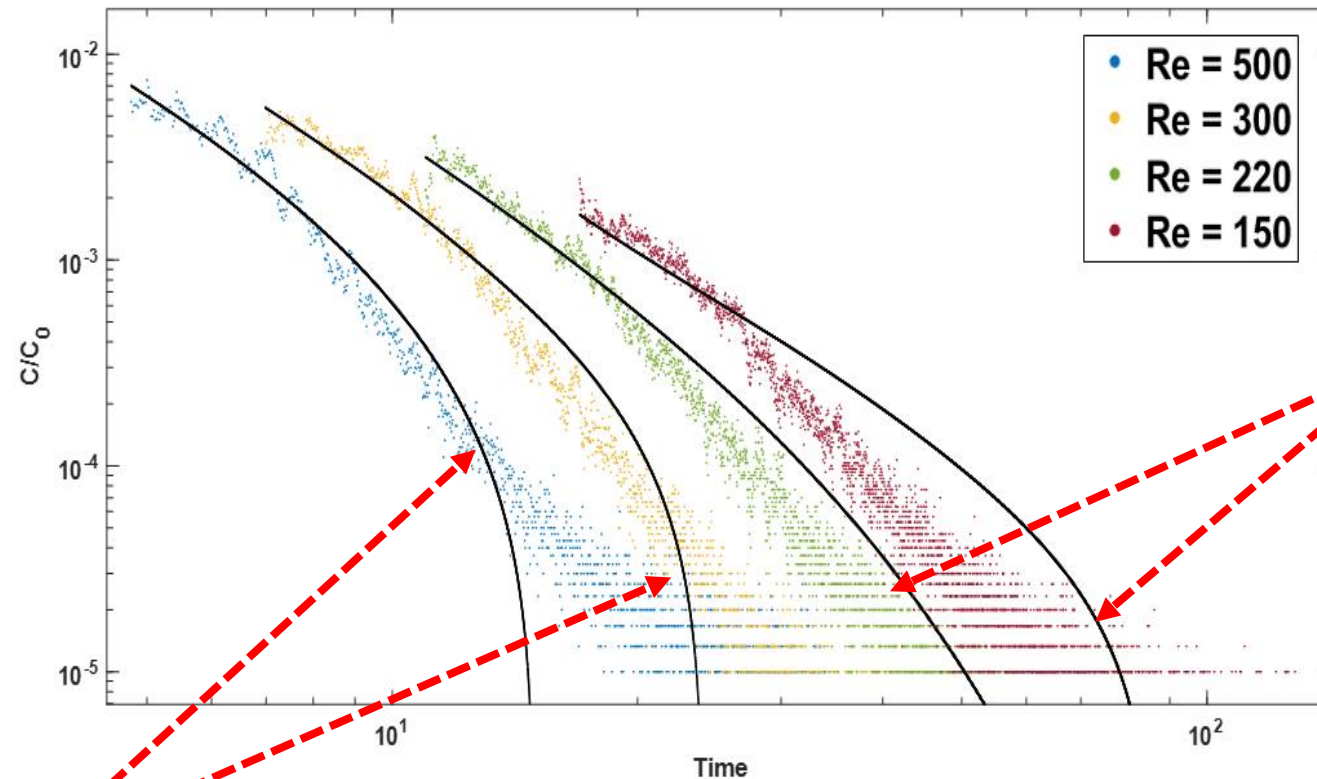


Small vortices in the cylinder wake

Leapfrogging Passing vortices across the array



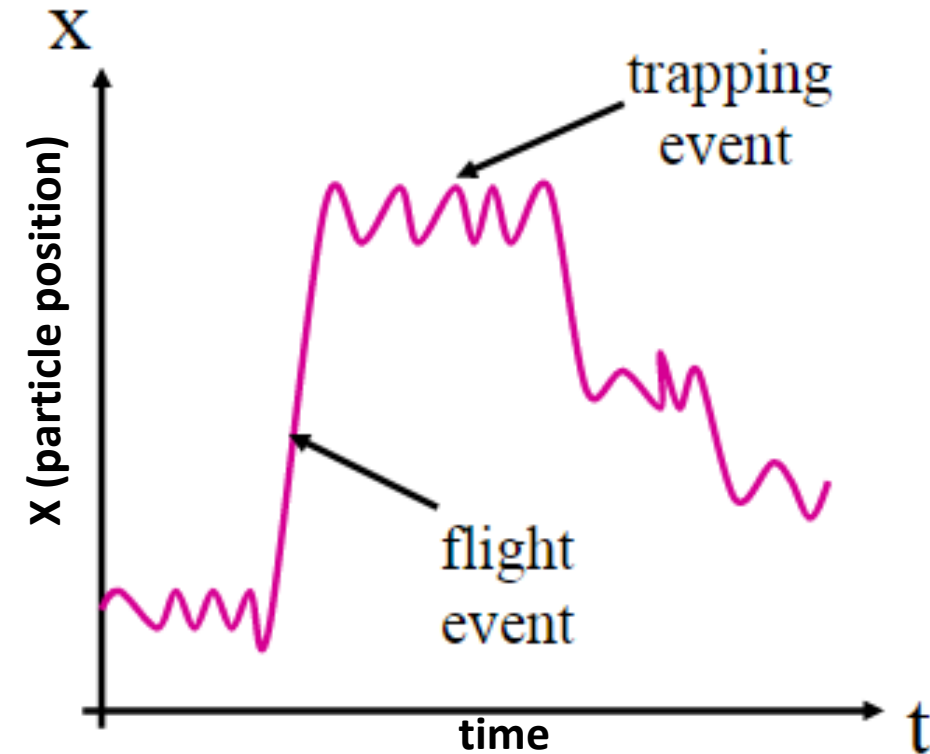
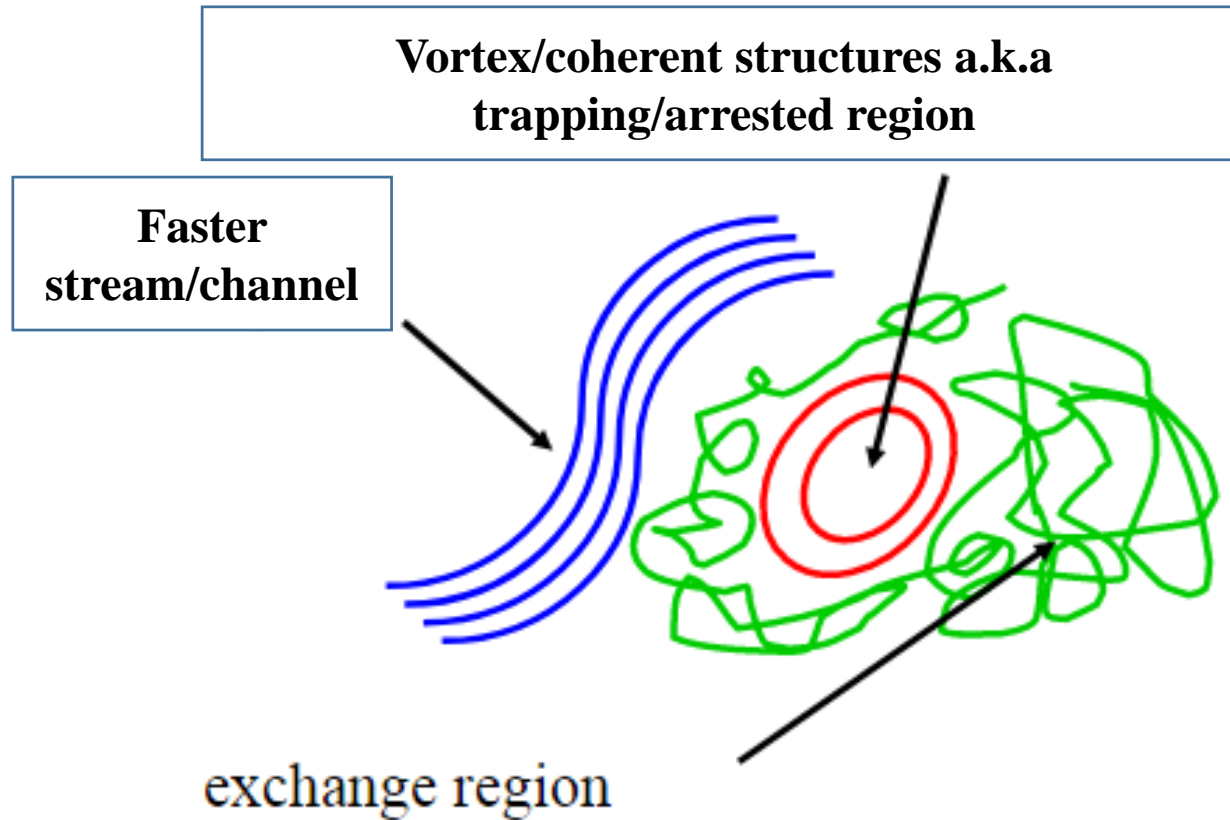
Breakthrough curve and CTRW best fits at the mid-point of the domain.



At $Re = 150$ and 220 ,
streamwise advection
dominates the transport.

At $Re = 300$ and 500 , lateral transport
rather than the longitudinal advection
control residence time.

Coherent structures can give rise to anomalous transport



Typical particle trajectory with respect to time showing jumps (due to faster stream) and long pause (vortex trapping).

References

- Caroppi, G., Västilä, K., Järvelä, J., Rowiński, P. M., & Giugni, M. (2019). Turbulence at water-vegetation interface in open channel flow: Experiments with natural-like plants. *Advances in Water Resources*, 127, 180-191.
- Hester, E. T., Cardenas, M. B., Haggerty, R., & Apte, S. V. (2017). The importance and challenge of hyporheic mixing. *Water Resources Research*, 53(5), 3565-3575.