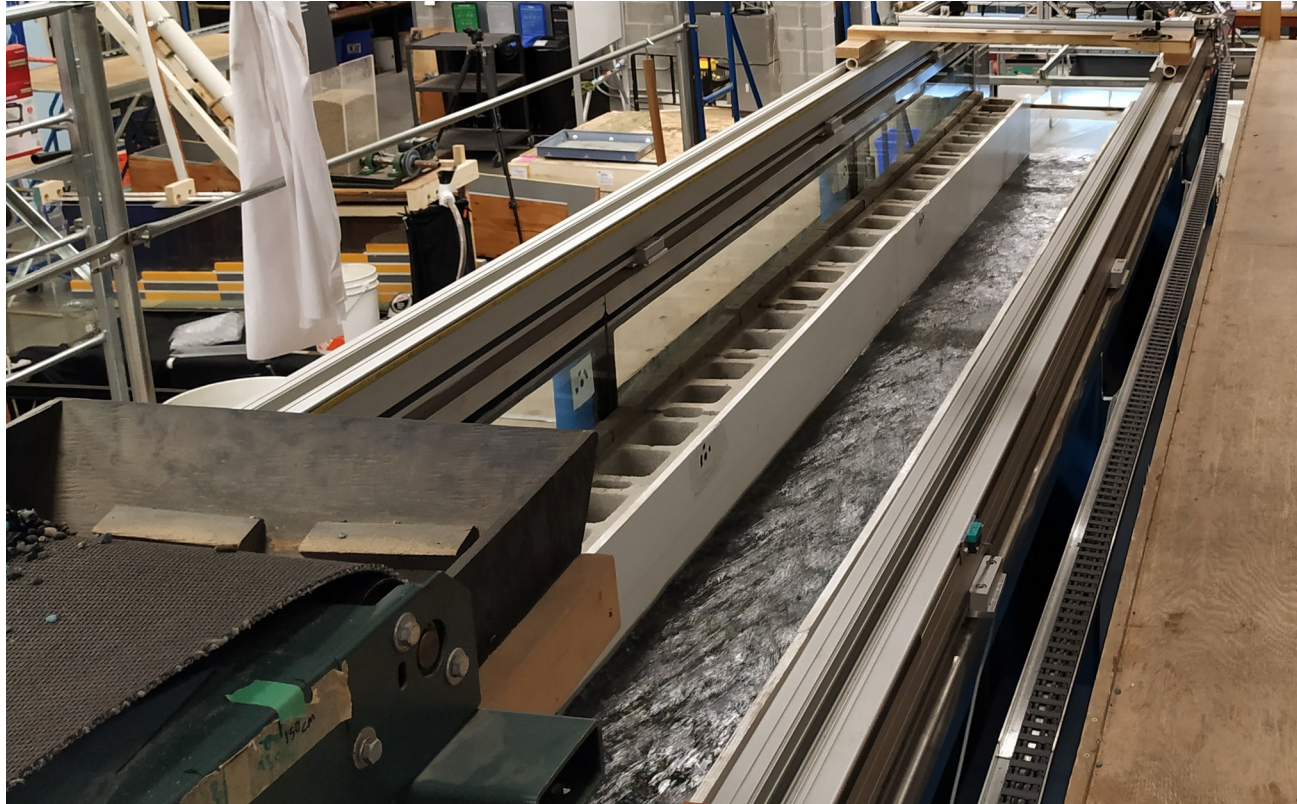# Mechanistic formulation of the bedload sediment flux

J. Kevin Pierce[1], Marwan A. Hassan[1], Rui M.L. Ferreira[2]
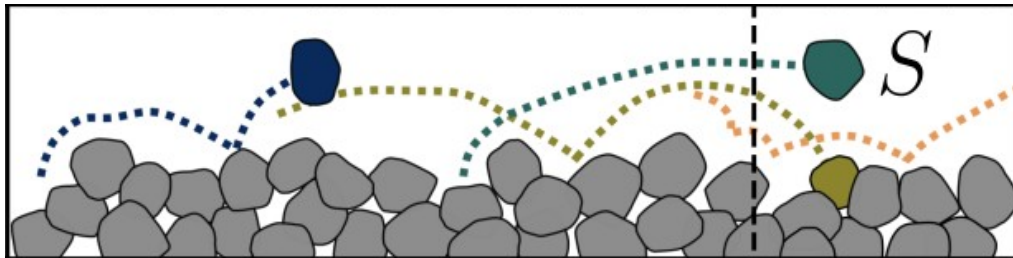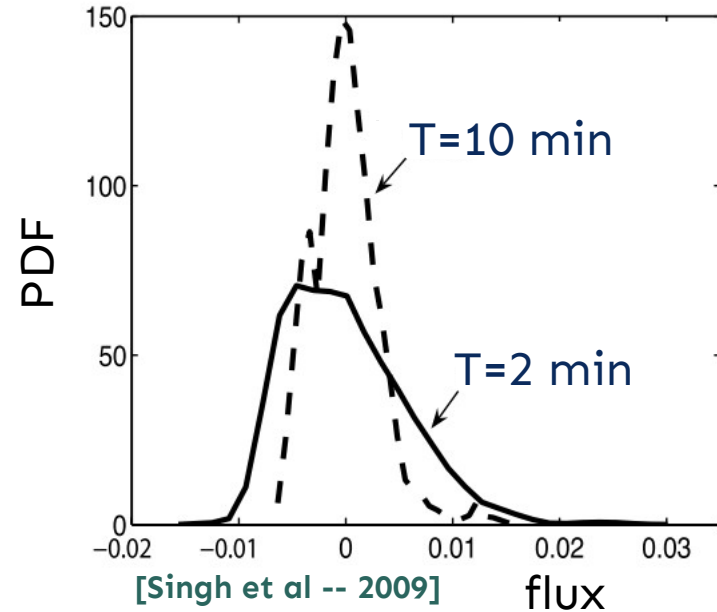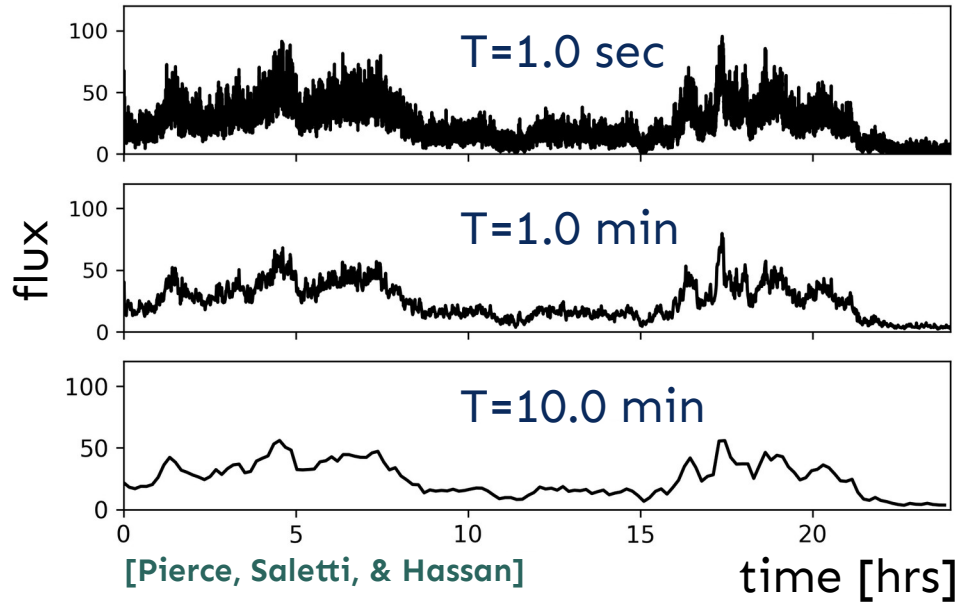
[1]University of British Columbia, [2]University of Lisbon

AGU, 2021

Unclear aspects of bedload transport

Sampling interval - T

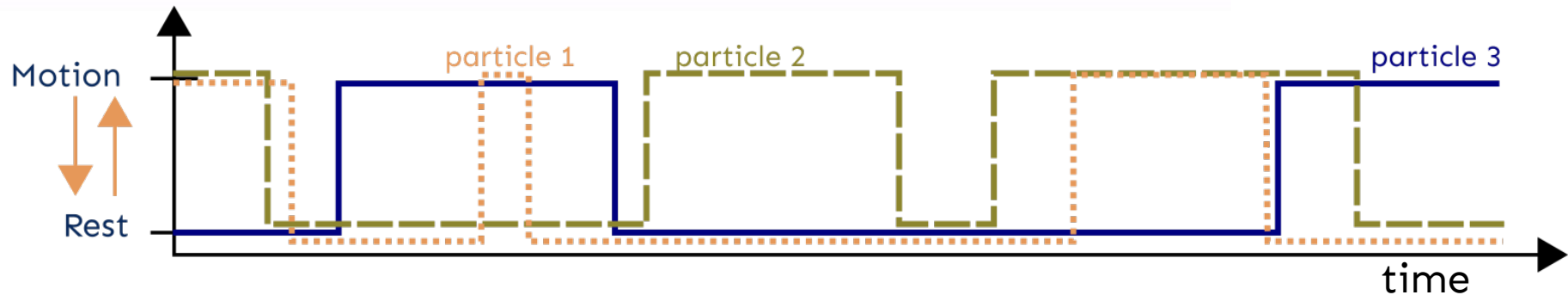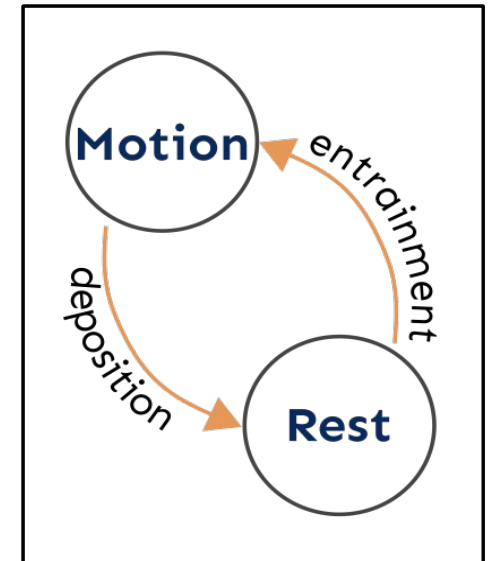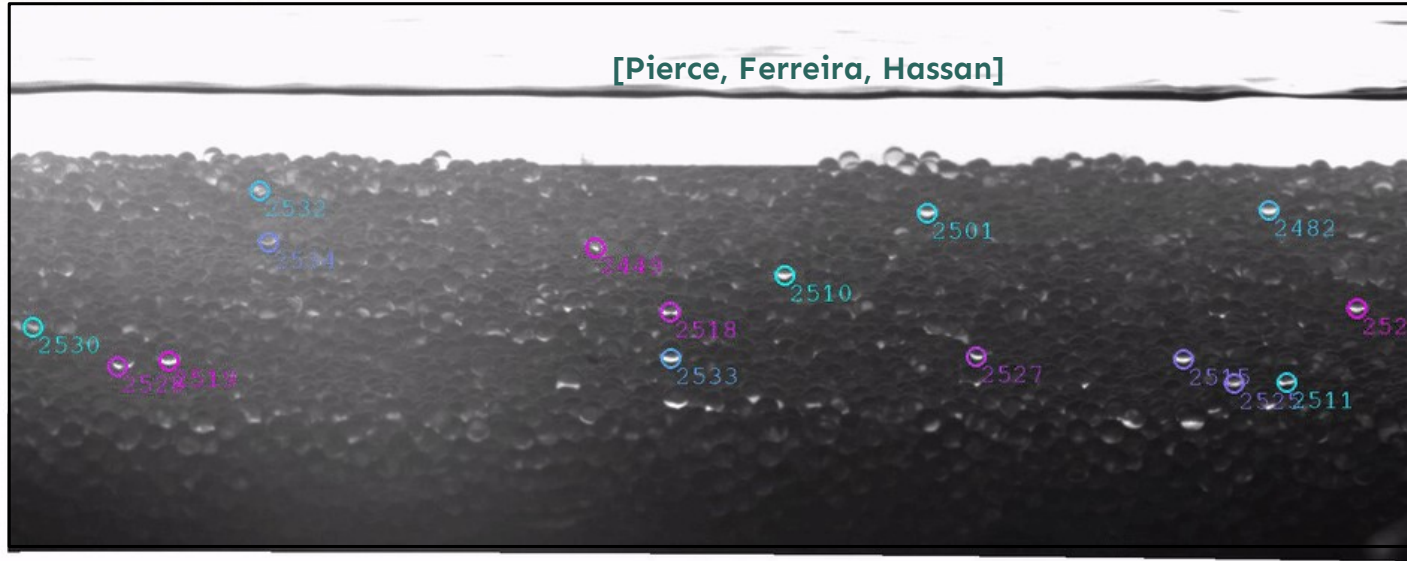[Pierce, Saletti, & Hassan]

[Singh et al -- 2009]

Research question:

How do we understand bedload transport **fluctuations** and **scale dependence**?

Particle-based concept of the sediment flux

The relationship between particle dynamics and the flux remains unclear
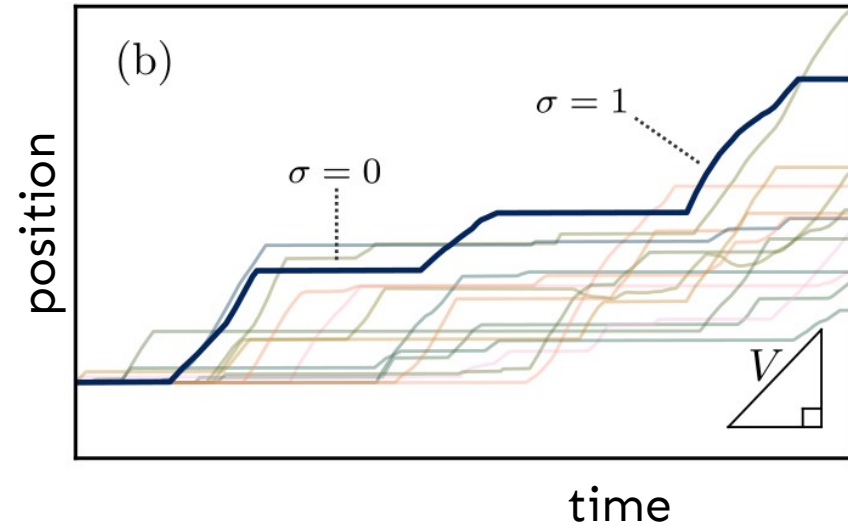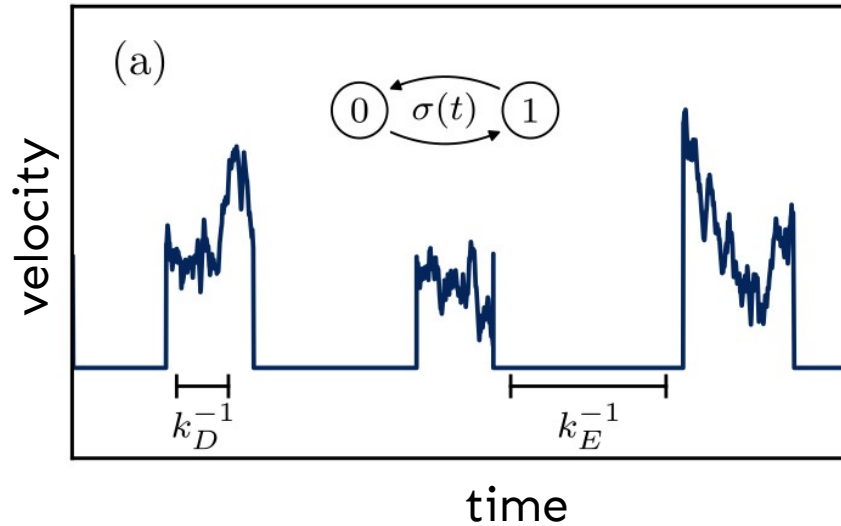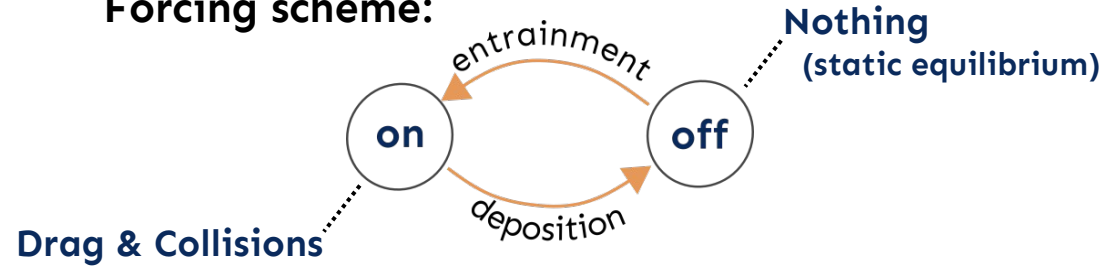
New formulation of particle dynamics

Newtonian dynamics *switched on and off*

Stochastic description:

$$\dot{x}(t) = v(t)\sigma(t)$$

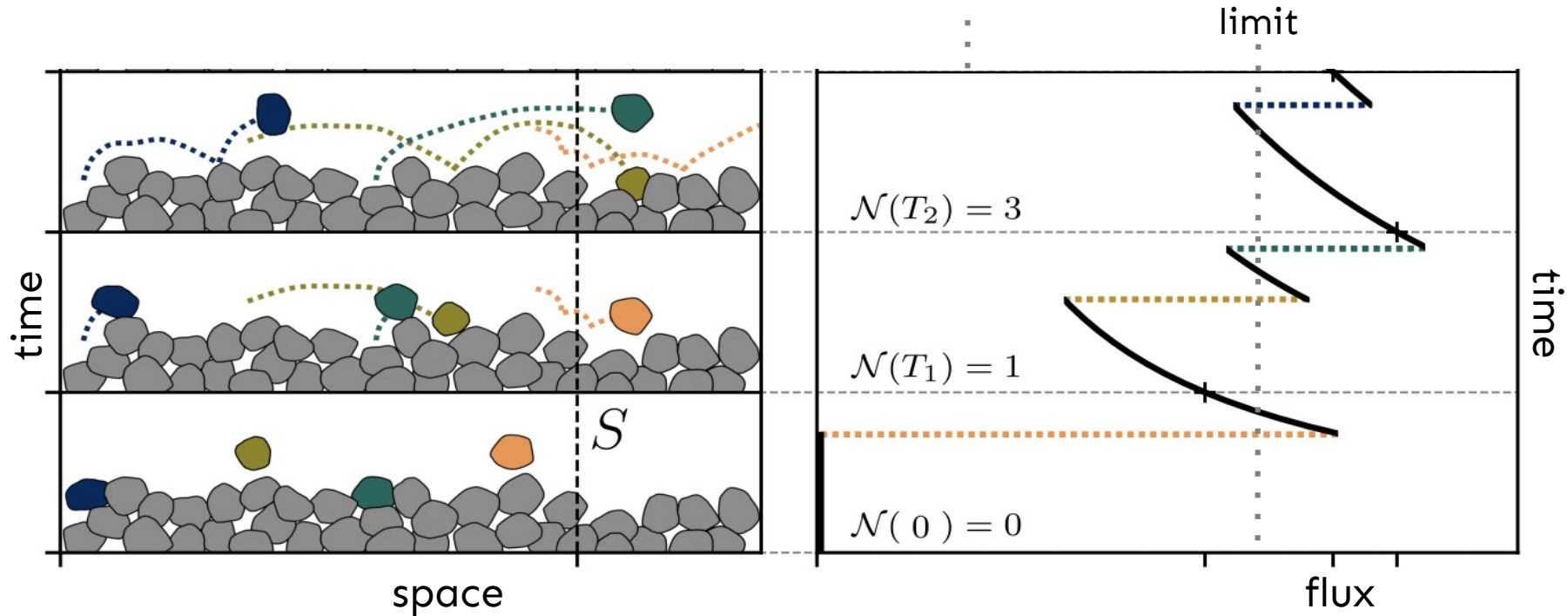$$\dot{v}(t) = [F(v) + \xi(t)]\sigma(t)$$

Forcing scheme:

Improved description of grain-scale transport

New formulation of the sediment flux

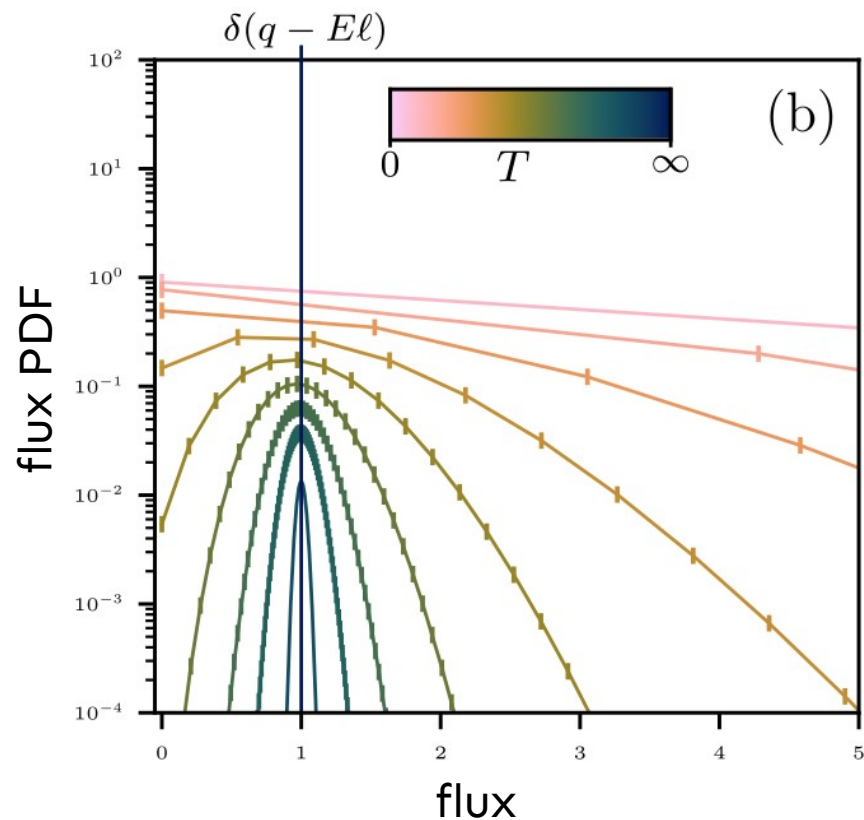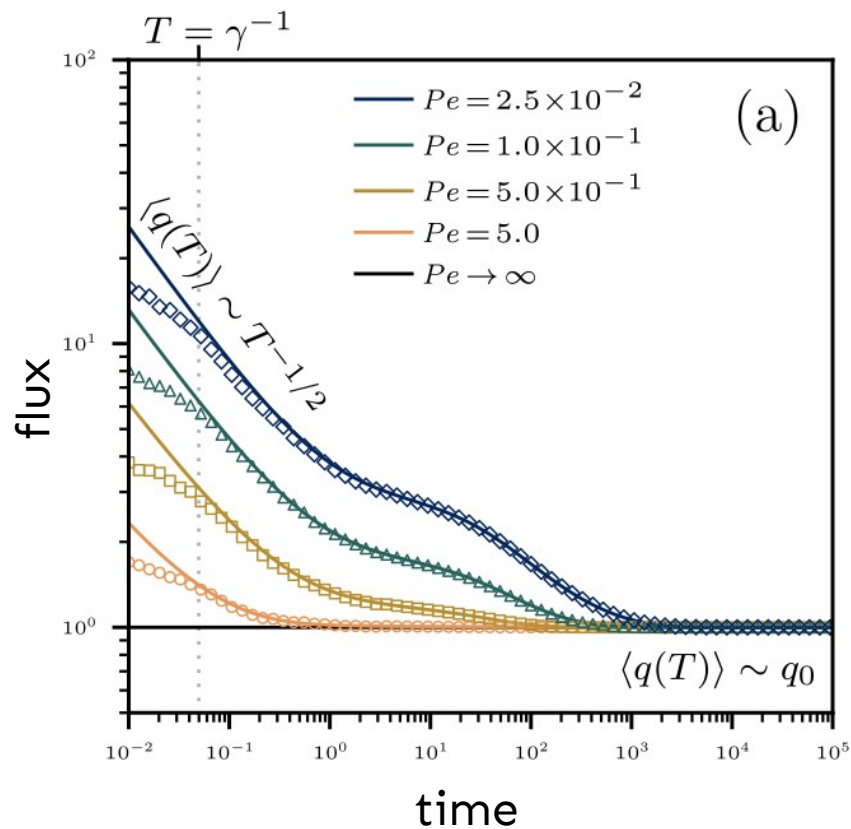## The rate of particles crossing a surface in T

Definition:

$$q(T) = \frac{\mathcal{N}(T)}{T} \cdots\cdots \textbf{Particle dynamics}$$

limit

$\mathcal{N}(T_2) = 3$

$\mathcal{N}(T_1) = 1$

S

$\mathcal{N}(0) = 0$

time

space

time

flux

Calculated transport rates **fluctuate** and depend on **observation scale**

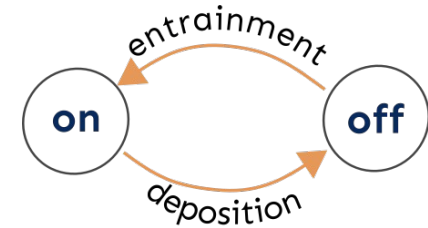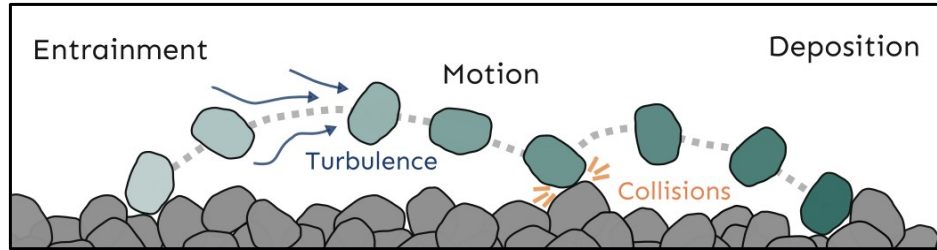# Bedload transport rate fluctuations and scale-dependence

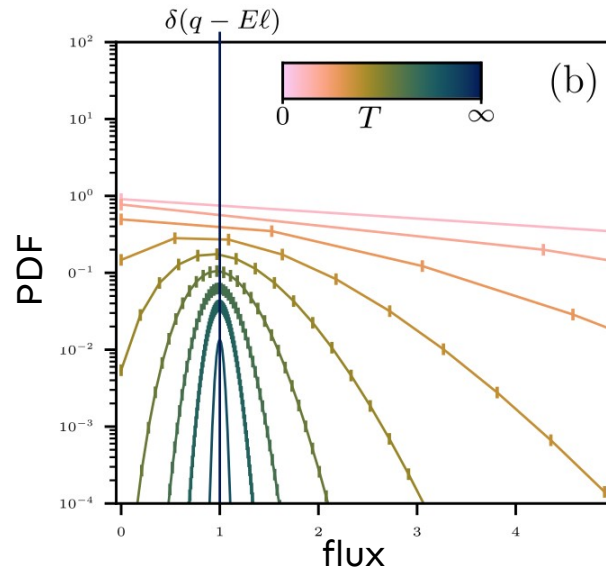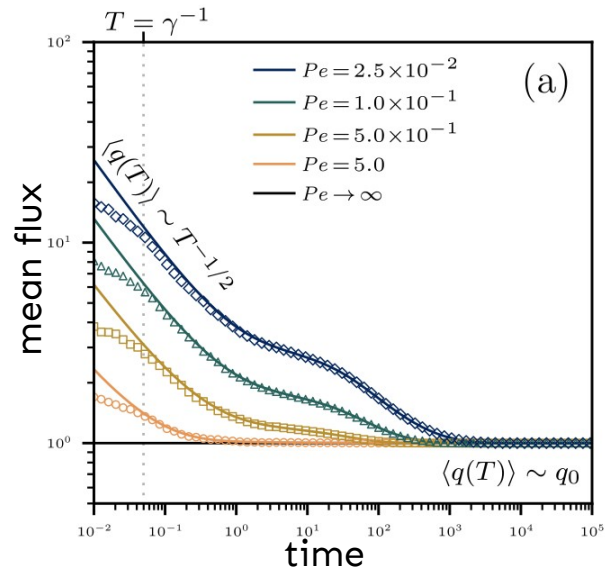## Dependence of flux on observation time T

Bedload transport rates are deterministic only when you measure **forever**

Summary

1. Formulated individual bedload motions as a stochastic process

2. Explained bedload transport fluctuations & scale dependence

Thank you!

🐦 @j_k_pierce

🌐 jkpierce.github.io