HOMEWORK 1

ECIV 767, Fall 2024

Due not later than Thursday September 5, 2024

Develop your own settling velocity relation $R_f = R_f(Re_p)$

In class we define the non-dimensional settling velocity as

$$R_f = \frac{v_s}{\sqrt{RgD}} = \left(\frac{4}{3c_D}\right)^{1/2}$$

where v_s is settling velocity, R submerged specific gravity of sediment, g acceleration of gravity, D the particle diameter and c_D d Re_{vp} and c_D rag coefficient, function of Re_{vp}, particle velocity Reynolds number

$$c_D = f(Re_{vp}) \qquad\qquad Re_{vp} = \frac{v_s D}{\nu}$$

with ν denoting the kinematic viscosity of the fluid.

To obtain the relation $R_f = R_f(Re_p)$ you need to express R_f as a function of Re_p (not Re_{vp}), with

$$Re_p = \frac{\sqrt{RgD}D}{\nu} = \frac{Re_{vp}}{R_f}$$

If we knew the relation between Re_{vp} and c_D, we could compute many values of R_f corresponding to values of Re_{vp} and then estimate the value of Re_p from the equation above.

Use Plot digitizer https://plotdigitizer.com/app to determine the empirical relation linking Re_{vp} and C_D for a sphere and formulate your relation $R_f = R_f(Re_p)$

- How does your relation compare to the Dietrich (1982) relation for quartz particles with grain size of 65 microns, 100 microns, 250 microns, 500 microns, 1 mm, 2 mm and 16 mm?
- How would you use it with clay particles (grain size smaller than 2 microns)?

Do the calculation on Earth and assume that the water temperature is 20 degrees Celsius

R = 1.65

g = 9.81 m/s^2

ν = 0.000001 m^2/s