CALCULATIONS FOR TWO-STATION METHOD

A = amount settled in array. Number of particles, d'less.

$$\frac{dA}{dt} = \frac{C' V_s}{h}(1-E_r')\,\phi\, \forall_A$$ ($\forall_A$: volume in the array) $\left[\frac{1}{TL}L^3\right]$

Primes denote calculations specific to array

$$\frac{dA}{dt} = \frac{C' V_s}{h}(1-E_r')\,\phi_0\, e^{-kt}\, \forall_A$$ (ϕ_0: instantaneous conc.)

k is measured from whole-experiment removal rate.

Let $k' = \phi_0 \frac{C' V_s}{h}(1-E_r')\forall_A$ $\left[\frac{1}{L^3}\frac{L}{TL}L^3\right] = \left[\frac{1}{T}\right]$

$$\frac{dA}{dt} = k' e^{-kt}$$ $u = -kt \quad du = -k\,dt$

$$A = \int_0^T k' e^{-kt}\,dt = -\frac{k'}{k} e^{-kt}\Big|_0^T = -\frac{k'}{k}e^{-kT} + \frac{k'}{k} = \frac{k'}{k}\left(1-e^{-kT}\right)$$

$$\boxed{k' = \frac{kA}{(1-e^{-kT})}}$$ $\left[\frac{1}{T}\right]$

k from LISST; A, T from sed traps, #

T = total time of experiment

At any given sampling time,

$$\left(\frac{d\phi}{dt}\right)_{\text{settling}} = \frac{-k'\bar{\phi}}{\phi_0 \forall_A},$$ where $\bar{\phi}$ is the number concentration averaged over 2 stations.

(change in # concentration)

Across the sample volume —

A_c = amount removed due to capture ($\frac{\#\text{ particles}}{\text{volume}}$) u = velocity

L = length (streamwise) of sample array $\forall_A$ = volume of array

$$\boxed{A_c = \phi_{upstream} - \frac{k'\phi_{upstream}}{\forall_A \phi_0}\,\frac{\text{length of Larray}}{\text{velocity}}\,\phi_{downstream}}$$ $\left[\frac{\#}{L^3}\right]$

$$\boxed{\eta \bar{\phi} \int_L d_c I_c^* = A_c}$$ (from Fauria) $\left[\frac{L}{L^3}\frac{L}{L^2}\right]$

ϕ = depth-avg particle concentration, uL/

* Based on volume of array (array = test section)

TWO-STATION METHOD, IN TERMS OF BULK MASS CONC.

A_m = Amount settled by mass

A = # particles

particle density

$$A_m = \frac{4}{3} A \rho_b \pi \left(\frac{d}{2}\right)^3 = \frac{1}{6} A \rho_b \pi d^3$$

d = mass-weighted mean sediment diameter (different from d_c collar/stem diameter)

$$k' = \frac{kA}{(1-e^{-kT})}$$

$$\boxed{k' = \frac{6 k A_m}{\rho_b \pi d^3 (1-e^{-kT})}}$$

How to calculate A?
- from LISST volume concentration?

Or use sed. traps to get A_m directly?

✱ Get A from settling traps

C = mass concentration

$\bar{\bar{C}}$ = concentration averaged @ two stations.

C_c = concentration removed due to capture

C_o = mass concentration @ time 0.

$$C_c = C_{upstream} - \underbrace{\frac{k' C_{upstream}}{\forall_A C_o}}_{\text{settling}} \frac{L}{u} - C_{downstream}$$

$$C_c = \eta \bar{\bar{C}} L d_c I_c^* \quad (\text{or } L_c)$$

✱ Based on volume of array

✓ Assuming this is capture efficiency?

total density (volume of test section)

HOW TO CALCULATE d FROM LISST DATA, ASSUMING NON-FLOCCULATED PARTICLES:

Mass of a particle = $\rho_b \cdot \frac{1}{6} \pi D^3$

D = size class-specific diameter

$$d = \frac{\sum_i^n C_{v_i} \rho_b d_i}{\sum_i^n C_{v_i} \rho_b}$$

C_{v_i} = volumetric concentration (vol sed / vol sample)

i = size class

n = total # size classes

SINGLE-STATION METHOD

$$\frac{d\bar{C}}{dt} = -\left[\underbrace{\frac{C v_s}{h}(1-t_r)}_{\text{Get this from no-dowel experiments}} + \eta' u d_c I_c\right] \bar{C} = -k \bar{C}$$