A Concise Perspective on Wind, Ocean Waves, Wave Breaking, and Marine Aerosols.

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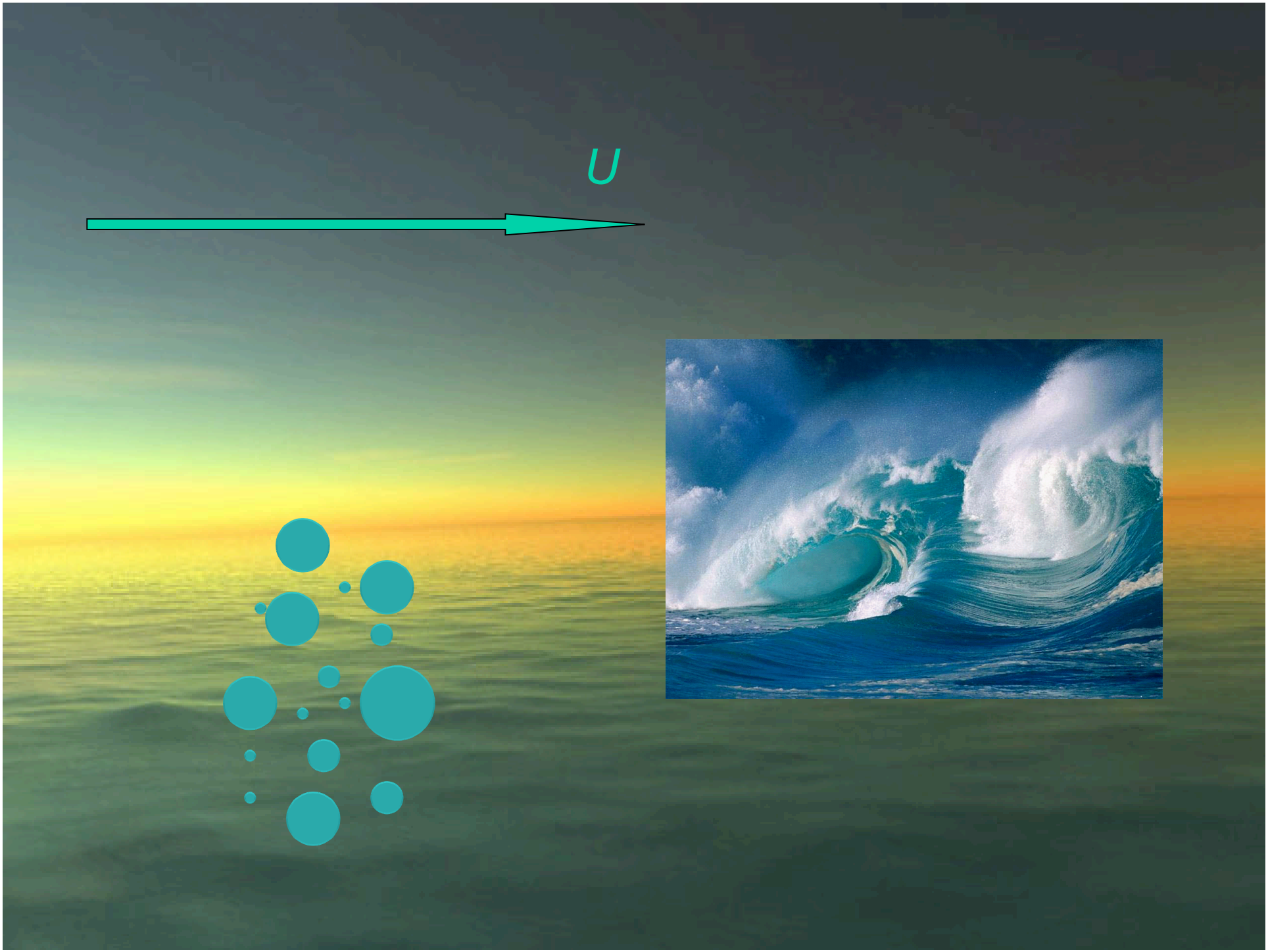
Mentor: Dave Erickson (Oak Ridge National Lab)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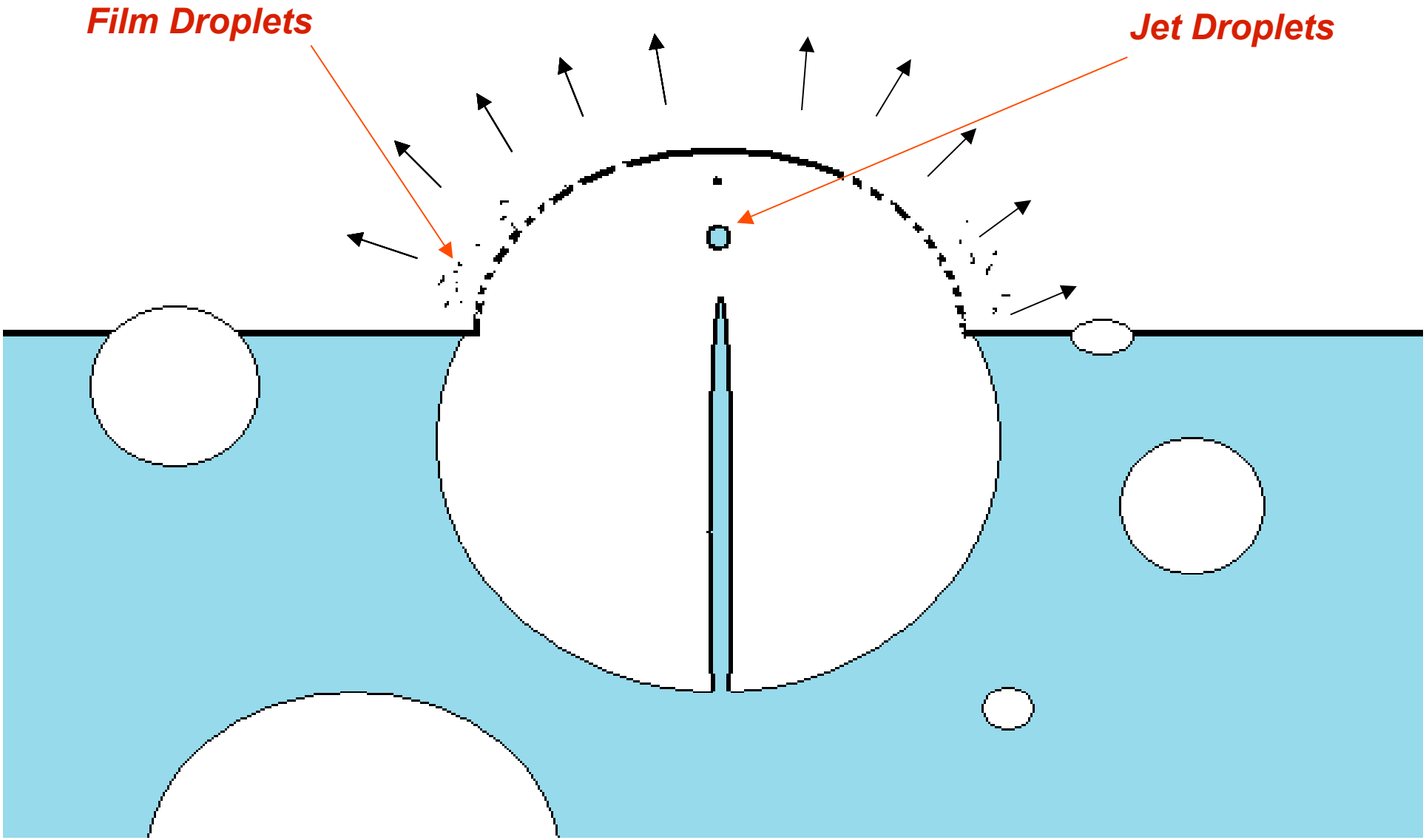
Bubble bursting



‘Whitecap’ Method

$$N_T = F_p \times W$$

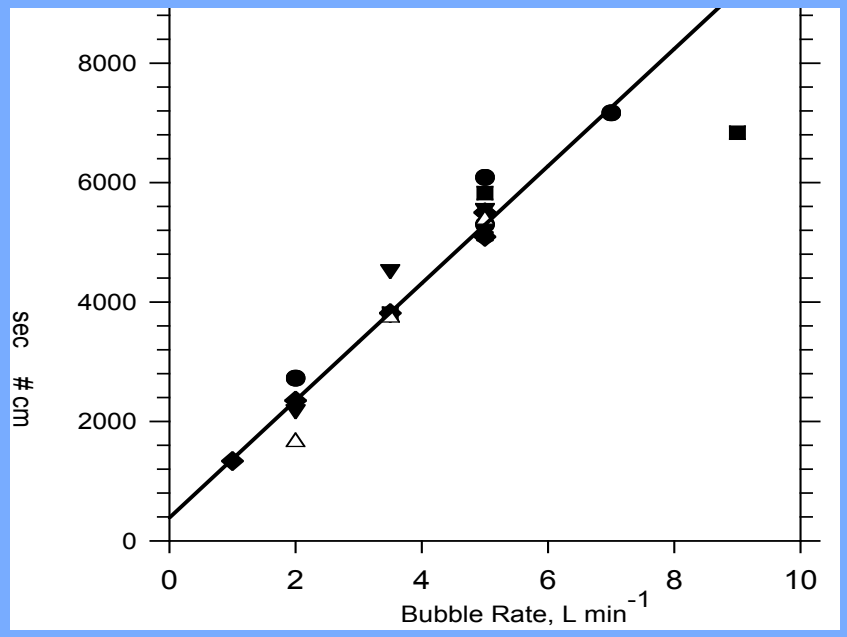
- N_T → *Total particle flux* from ocean surface
- F_p → *Particle productivity* per area of whitecap.
- W → *Whitecap fraction* per area of ocean surface.

Constant. (e.g. all whitecaps are uniformly productive)

Treated as some function of **10m wind speed** (***U_{10}***)

‘Whitecap’ Method

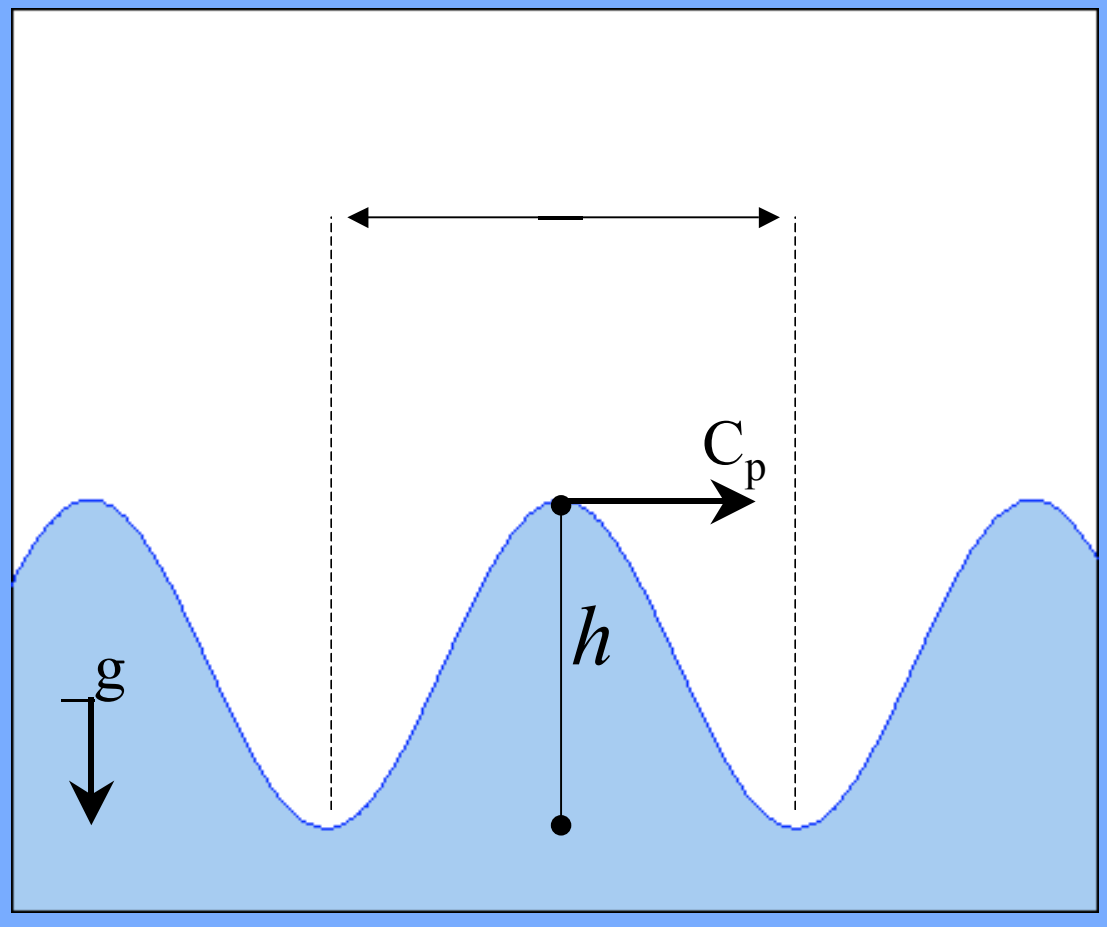
$$F_p = f\left(\frac{dV}{dt}\right)$$



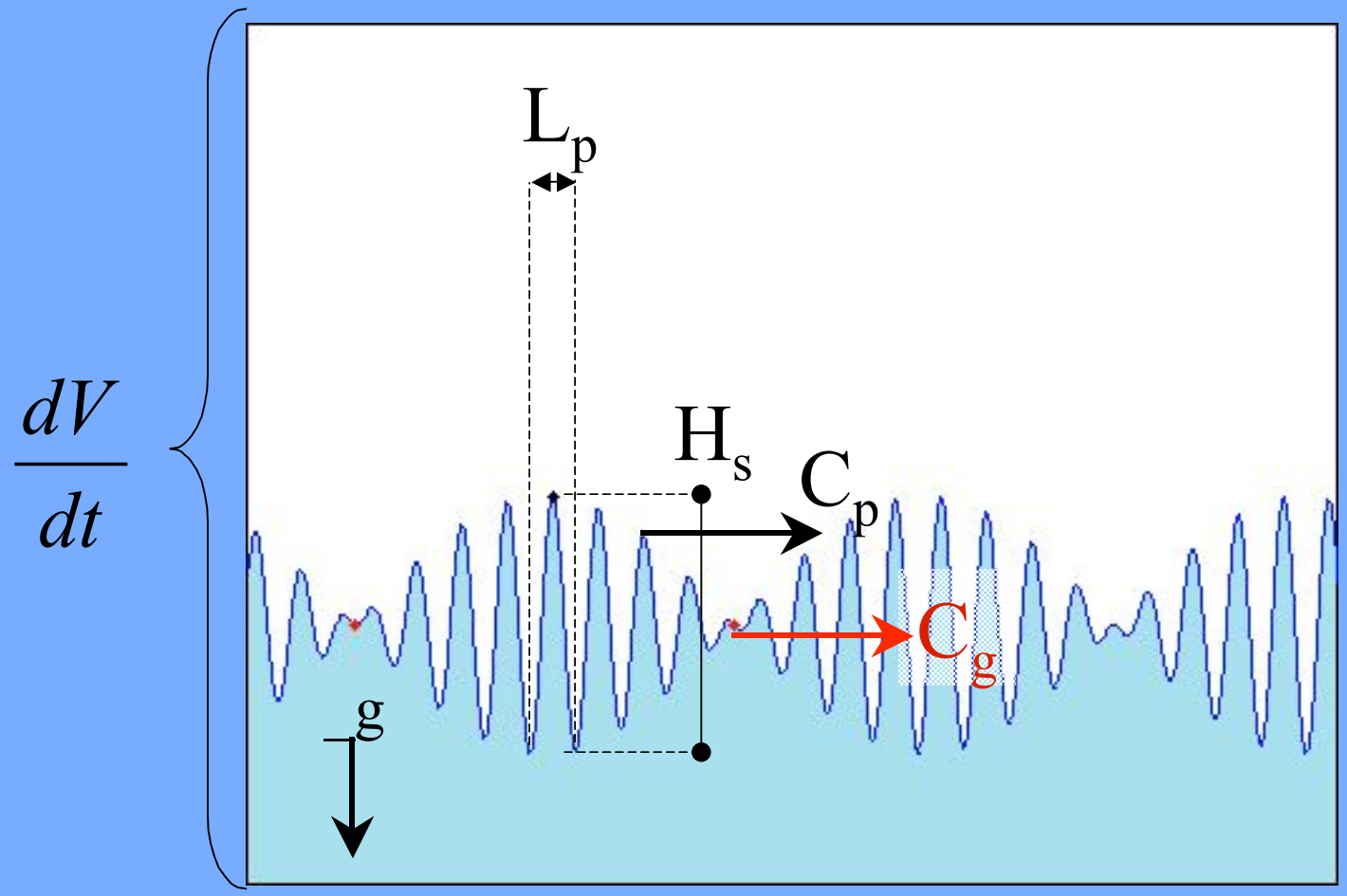
Keene et al. (2007)

Parameterization

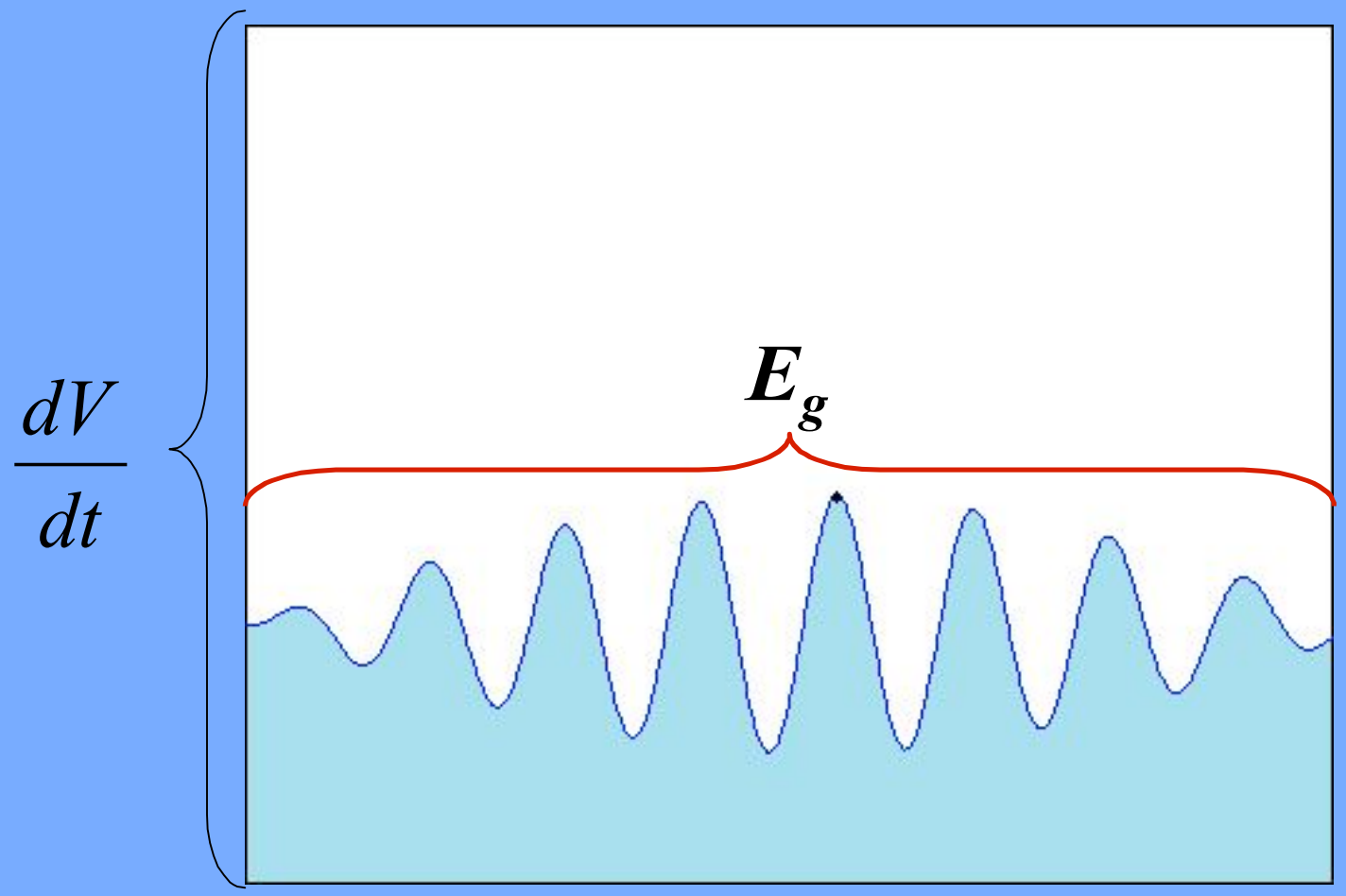
$$F_p = f\left(\frac{dV}{dt}\right)$$



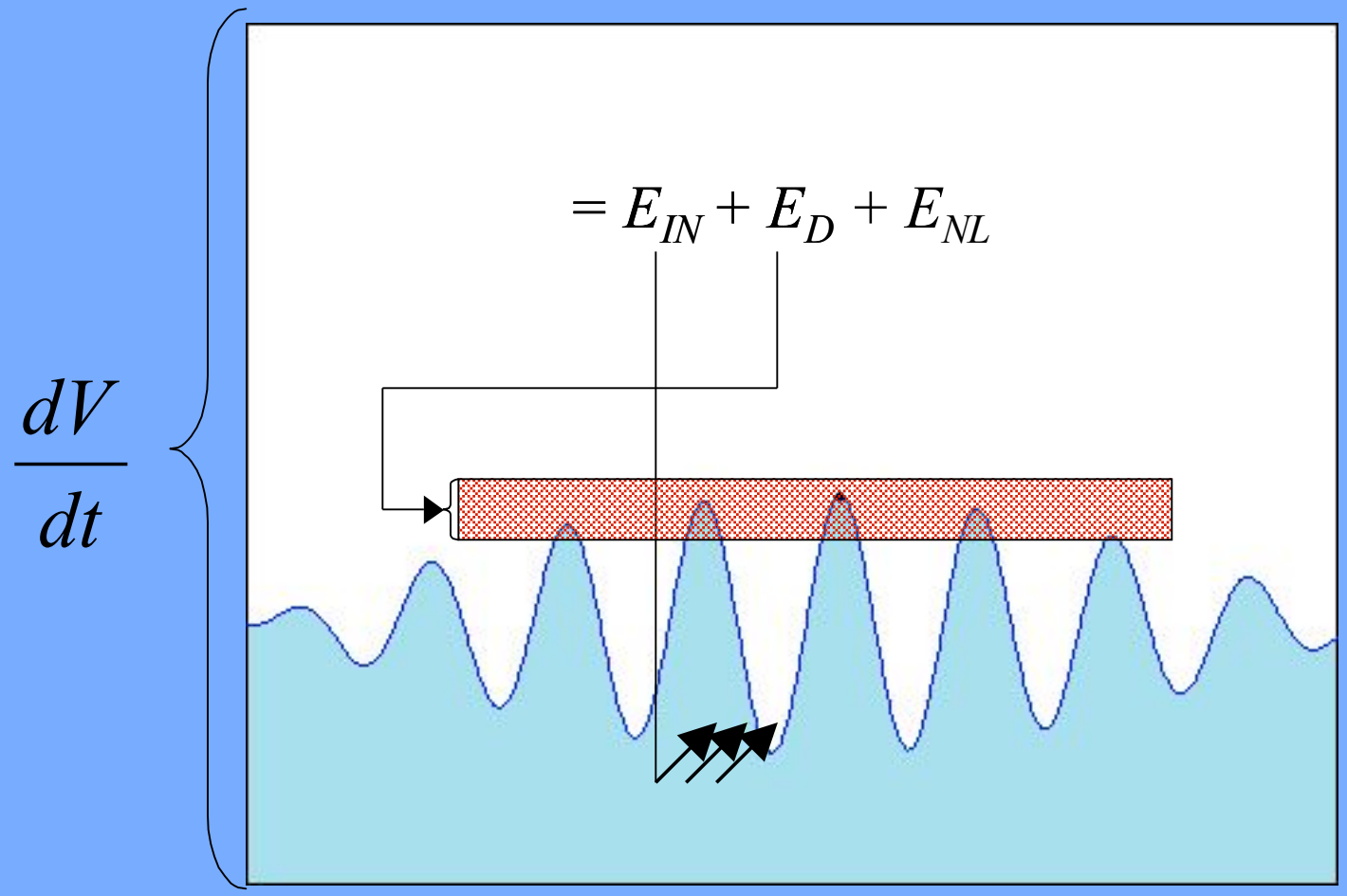
‘Whitecap’ Method



‘Whitecap’ Method



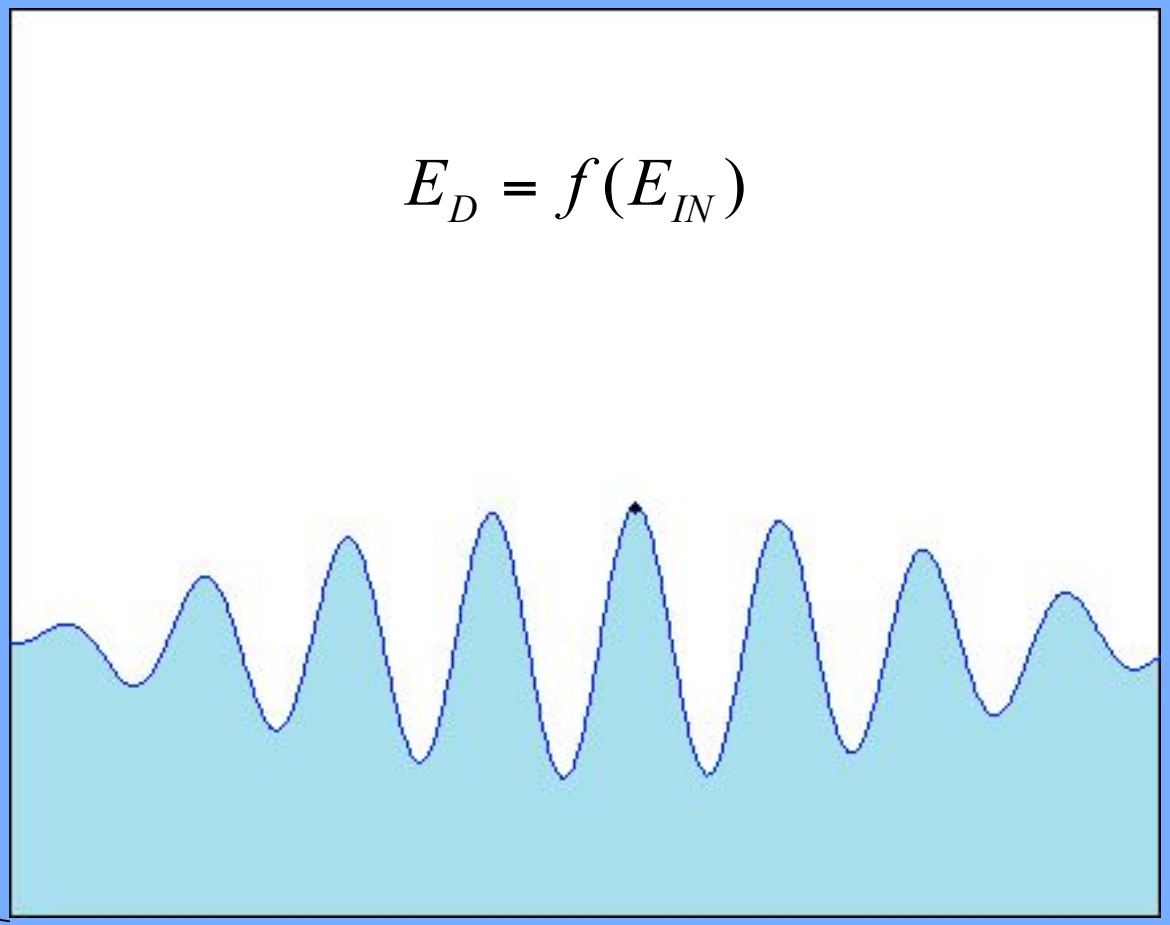
‘Whitecap’ Method



‘Whitecap’ Method

$$E_D = f(E_{IN})$$

$$\frac{dV}{dt}$$



‘Whitecap’ Method Parameters

$$f\left[\frac{dV}{dt}, _, g, H_s, L_P, C_g, C_P, E_{IN}, E_D\right]$$

$$\frac{H_S}{L_P} = Const.$$

‘Whitecap’ Method Parameters

$$f\left[\frac{dV}{dt}, _, g, H_s, \quad C_g, C_P, E_{IN}, E_D\right]$$

$$C_p = \sqrt{2\pi g L_P}$$

$$C_g = \frac{c_p}{2}$$

‘Whitecap’ Method Parameters

$$f\left[\frac{dV}{dt}, _, g, H_s, \qquad E_{IN}, E_D\right]$$

$$E_D = f(E_{IN})$$

‘Whitecap’ Method Parameters

$$f\left[\frac{dV}{dt}, _, g, H_s, E_D\right] \longrightarrow \frac{E_D}{\rho g\left(\frac{dV}{dt}\right)H_s}$$

‘Whitecap’ Method

$$N_T = F_p \, x \, W$$

$$N_T = f\left(\frac{dV}{dt}\right) \times W$$

$$N_T = C\left(\frac{E_D}{\rho g H_S}\right) \times W$$

‘Whitecap’ Method

$$N_T = C\left(\frac{E_D}{\rho g H_S}\right) \times W$$

$$N_T = C'\left(\frac{E_D}{H_S}\right) \times W$$

‘Whitecap’ Method

$$N_T = C'\left(\frac{E_D}{H_S}\right) \times W$$

$$N_T = f\left(U_{10}^{\delta}\right) \propto \left(\frac{U_{10}^{\alpha}}{U_{10}^{\beta}}\right) \times U_{10}^{\gamma}$$

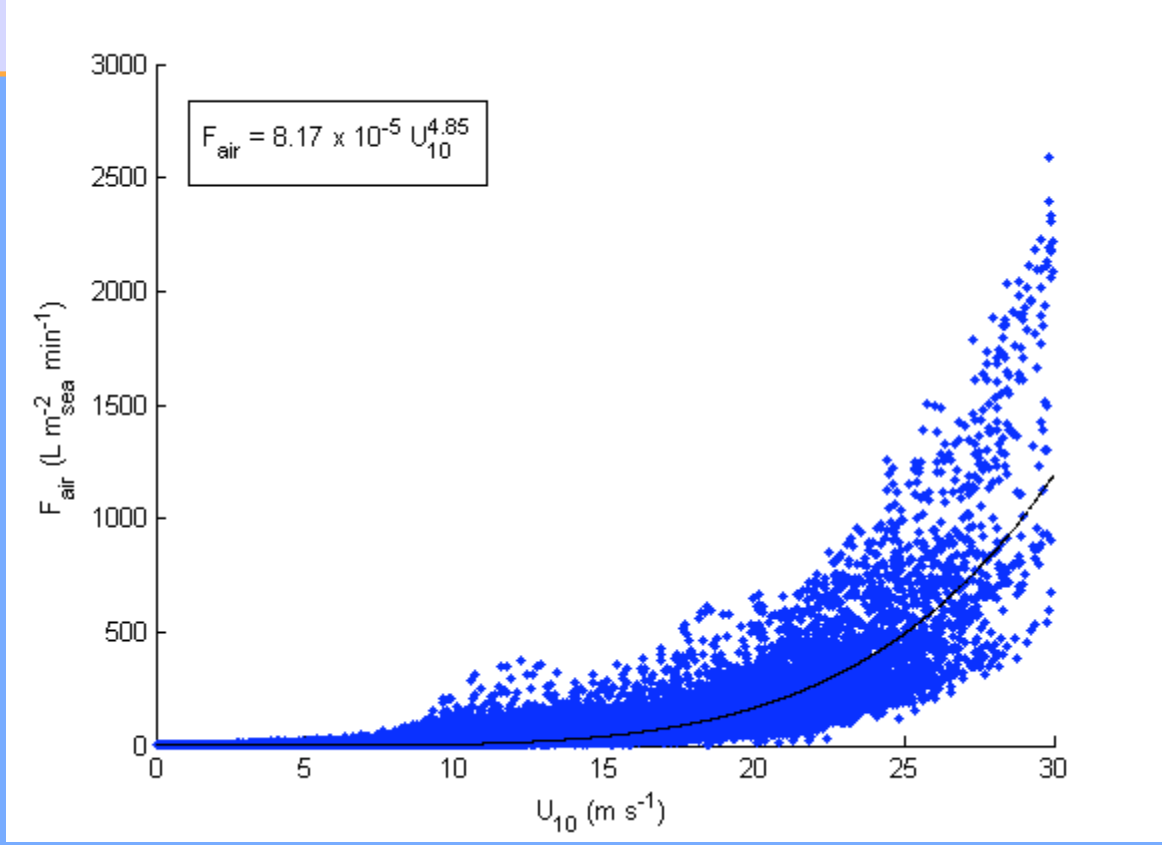
‘Whitecap’ Method

$$N_T = f\left(U_{10}^{\delta}\right) \propto \left(\frac{U_{10}^{\alpha}}{U_{10}^{\beta}}\right) \times U_{10}^{\gamma}$$

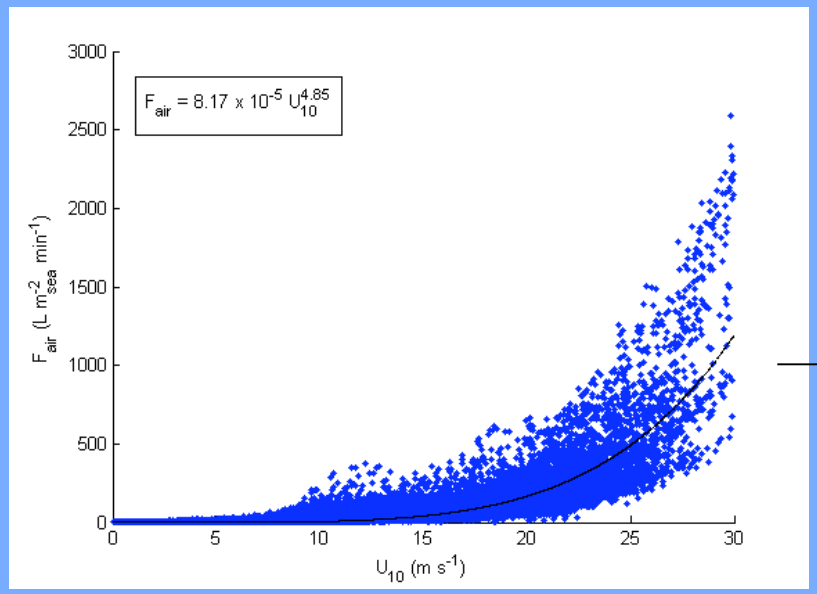
	$_(E_D)$	$_(H_S)$	$_(W)$	$_(N_T)$
Maximum	3.74 (Hanson & Phillips, 1999)	2 (Andreas & Wang, 2006)	5.61 (Hanson & Phillips, 1999)	7.35
Minimum	3.00 (Several sources…)	2	3.41 (O’Muirchearteigh & Monahan, 1981)	4.41

‘Whitecap’ Method

$$N_T = C'\left(\frac{E_D}{H_S}\right) \times W$$



‘Whitecap’ Method



4.85

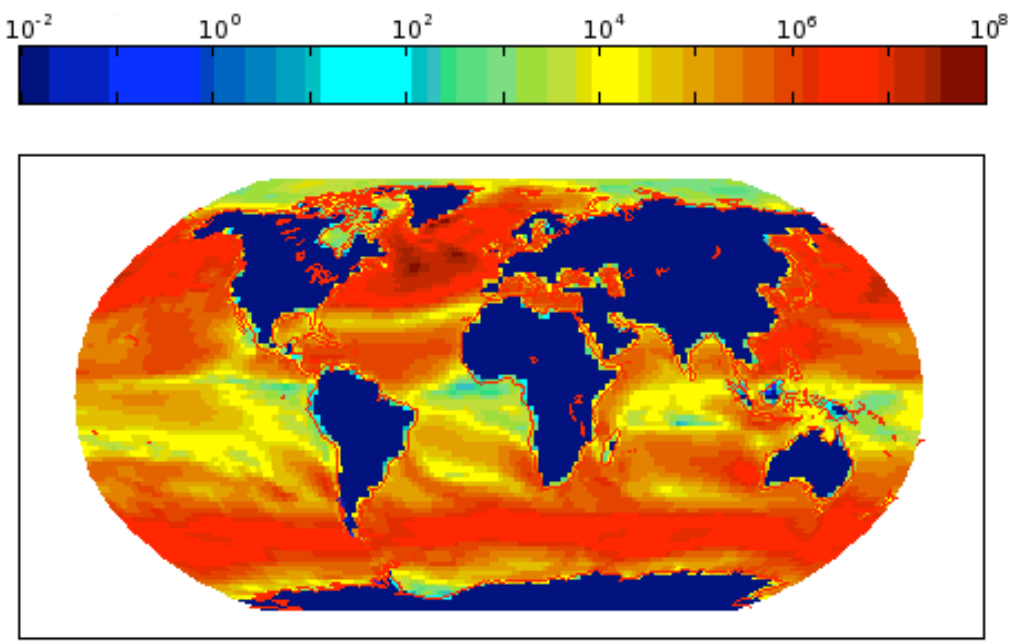
$$\mathbf{4.41} < N_T(\mathbf{V'}, \mathrm{W}) < \mathbf{7.35}$$

$$N_T = F_p \times W$$

$$\mathbf{3.41} < N_T(\mathbf{C}, \mathrm{W}) < \mathbf{5.61}$$

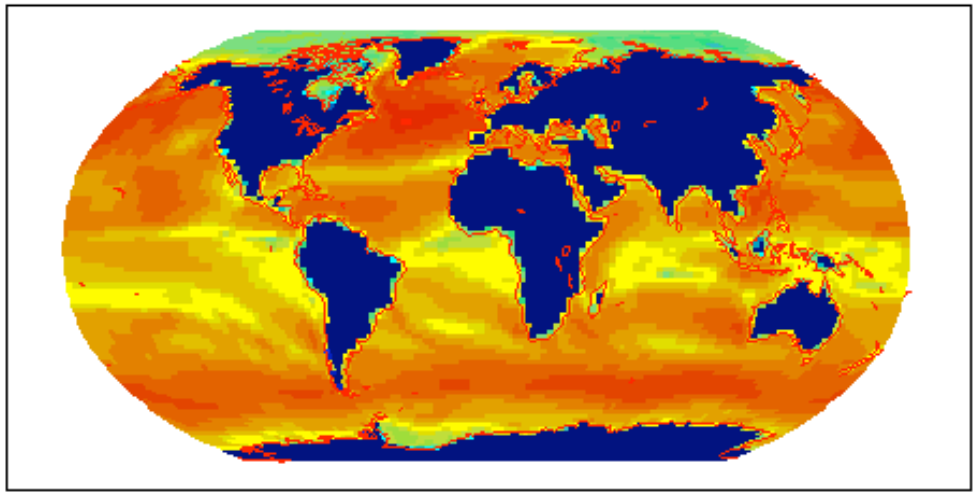
$F_P = constant$

$N_T = f(U_{10}^{4.85})$ ⟹



Long [2008] (# m^{-2} s^{-1})

$N_T = f(U_{10}^{3.41})$ ⟹



Gong [2003] (# m^{-2} s^{-1})

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