Bulk Aerodynamic Method

Another approach to parameterizing the vertical eddy flux of zonal momentum is to assume that both the vertical and horizontal eddy momentums are the same order of magnitude as the mean wind speed at anemometer level, $|\vec{v}_A|$. Then,

$$\boxed{\rho \overline{u_A' w_A'} = C_D \rho |\vec{v}_A|^2} \quad ,$$

where the constant of proportionality, C_D , is the **drag coefficient**.

The drag coefficient can be related to the friction velocity. At the anemometer level,

$$C_D \rho |\vec{v}_A|^2 = \rho \overline{u_A' w_A'} = \rho u_*^2 .$$

Then,

$$C_D |\vec{v}_A|^2 = u_*^2 .$$

The drag coefficient can also be related to the roughness parameter, since,

$$u_*^2 = \left(\frac{k \bar{u}_A}{\ln \frac{z_A}{z_o}} \right)^2 .$$

The result is,

$$C_D = \left(\frac{k}{\ln \frac{z_A}{z_o}} \right)^2 .$$

For k = .38 and z_A = 10 m, a few values are,

z_o (m)	C_D
.001	1.702×10^{-3}
.01	3.026×10^{-3}
.10	6.809×10^{-3}
1.00	27.236×10^{-3}