

# Physical Geography: Quantitative Principles

Elite Reference Sheet for Earth and Atmospheric Sciences

## 1. Climatology Meteorology

**Geostrophic Wind Speed ( $V_g$ ):**

$$V_g = \frac{1}{2\Omega \sin \phi} \frac{1}{\rho} \frac{\partial p}{\partial n}$$

where  $\Omega$  is Earth's angular velocity ( $7.29 \times 10^{-5}$  rad/s),  $\phi$  is latitude,  $\rho$  is air density, and  $\partial p / \partial n$  is the pressure gradient.

**Coriolis Acceleration ( $a_c$ ):**

$$a_c = 2\Omega v \sin \phi$$

where  $v$  is the velocity of the object.

**Adiabatic Lapse Rate (Dry):**

$$\Gamma_d = \frac{g}{C_p} \approx 9.8^\circ\text{C/km}$$

where  $g$  is gravity and  $C_p$  is specific heat of air at constant pressure.

## 2. Hydrology Fluvial Geomorphology

**Discharge (Continuity Equation):**

$$Q = A \cdot V \quad (Q = \text{Width} \times \text{Depth} \times \text{Velocity})$$

**Mannings Equation for Open Channel Flow:**

$$V = \frac{1}{n} R^{2/3} S^{1/2}$$

where  $n$  is Manning's roughness coefficient,  $R$  is hydraulic radius, and  $S$  is channel slope.

**Stream Ordering (Horton-Strahler):** Hierarchical ordering where two streams of order  $u$  combine to form order  $u + 1$ .

## 3. Geomorphology Tectonics

**Stokes' Law (Sediment Settling Velocity):**

$$w = \frac{2}{9} \frac{(\rho_s - \rho_f)gr^2}{\mu}$$

where  $\rho_s, \rho_f$  are particle and fluid densities,  $r$  is particle radius, and  $\mu$  is dynamic viscosity.

**Isostatic Equilibrium (Airy Model):**

$$H_r = b + \left( \frac{\rho_c r}{\rho_m} \right)$$

where crustal root depth depends on crustal density ( $\rho_c$ ) and mantle density ( $\rho_m$ ).

## 4. Biogeography Energy Balance

**Net Radiation ( $R_n$ ):**

$$R_n = SW \downarrow (1 - \alpha) + LW \downarrow - LW \uparrow$$

where  $\alpha$  is surface albedo,  $SW$  is shortwave, and  $LW$  is longwave radiation.

**Bowen Ratio ( $\beta$ ):**

$$\beta = \frac{H}{LE}$$

where  $H$  is sensible heat flux and  $LE$  is latent heat flux.