Important Oceanography Formulas PDF

Formulas Examples with Units

List of 36 Important Oceanography Formulas

1) Dynamics of Ocean Currents Formulas

1.1) Angular Velocity given Pressure Gradient Normal to Current Formula

Evaluate Formula

Formula

$$\Omega_E = \frac{\left(\frac{1}{\rho_{water}}\right) \cdot \left(\delta p/\delta n\right)}{2 \cdot \sin(L) \cdot V}$$

Example with Units

$$7.3\text{E-}5\,\text{rad/s} = \frac{\left(\frac{1}{1000\,\text{kg/m}^3}\right) \cdot (4000)}{2 \cdot \sin(20°) \cdot 49.8\,\text{mi/s}}$$

1.2) Coriolis Acceleration Formula

Evaluate Formula

Formula

$$a_C = 2 \cdot \Omega_E \cdot \sin(L) \cdot V$$

Example with Units

$$3.9977 = 2 \cdot 7.2921159\text{E-}05\,\text{rad/s} \cdot \sin(20°) \cdot 49.8\,\text{mi/s}$$

1.3) Current Velocity given Coriolis Acceleration Formula

Evaluate Formula

Formula

$$V = \frac{a_C}{2 \cdot \Omega_E \cdot \sin(L)}$$

Example with Units

$$49.8283\,\text{mi/s} = \frac{4}{2 \cdot 7.2921159\text{E-}05\,\text{rad/s} \cdot \sin(20°)}$$

1.4) Current Velocity given Pressure Gradient Normal to Current Formula

Evaluate Formula

Formula

$$V = \frac{\left(\frac{1}{\rho_{water}}\right) \cdot \left(\delta p/\delta n\right)}{2 \cdot \Omega_E \cdot \sin(L)}$$

Example with Units

$$49.8283\,\text{mi/s} = \frac{\left(\frac{1}{1000\,\text{kg/m}^3}\right) \cdot (4000)}{2 \cdot 7.2921159\text{E-}05\,\text{rad/s} \cdot \sin(20°)}$$

1.5) Latitude given Coriolis Acceleration Formula

Evaluate Formula

Formula

$$L = asin\left(\frac{a_C}{2 \cdot \Omega_E \cdot V}\right)$$

Example with Units

$$20.0118° = asin\left(\frac{4}{2 \cdot 7.2921159\text{E-}05\,\text{rad/s} \cdot 49.8\,\text{mi/s}}\right)$$

1.6) Latitude given Pressure Gradient Normal to Current Formula

Evaluate Formula

Formula

$$L = asin\left(\frac{\left(\frac{1}{\rho_{water}}\right) \cdot \delta p_{/\delta n}}{2 \cdot \Omega_E \cdot V}\right)$$

Example with Units

$$20.0118° = asin\left(\frac{\left(\frac{1}{1000\,kg/m^3}\right) \cdot 4000}{2 \cdot 7.2921159E\text{-}05\,rad/s \cdot 49.8\,mi/s}\right)$$

1.7) Pressure Gradient Normal to Current Formula

Evaluate Formula

Formula

$$\delta p_{/\delta n} = 2 \cdot \Omega_E \cdot \sin(L) \cdot \frac{V}{\frac{1}{\rho_{water}}}$$

Example with Units

$$3997.7301 = 2 \cdot 7.2921159E\text{-}05\,rad/s \cdot \sin(20°) \cdot \frac{49.8\,mi/s}{\frac{1}{1000\,kg/m^3}}$$

2) Eckman Wind Drift Formulas

2.1) Angle between Wind and Current Direction Formula

Evaluate Formula

Formula

$$\theta = 45 + \left(\pi \cdot \frac{z}{D_F}\right)$$

Example with Units

$$49.1888 = 45 + \left(3.1416 \cdot \frac{160}{120\,m}\right)$$

2.2) Atmospheric Pressure as function of Salinity and Temperature Formula

Evaluate Formula

Formula

$$\sigma_t = 0.75 \cdot S$$

Example with Units

$$24.9975 = 0.75 \cdot 33.33\,mg/L$$

2.3) Density given Atmospheric Pressure whose value of Thousand is reduced from Density Value Formula

Evaluate Formula

Formula

$$\rho_S = \sigma_t + 1000$$

Example with Units

$$1025\,kg/m^3 = 25 + 1000$$

2.4) Depth given Angle between Wind and Current Direction Formula

Evaluate Formula

Formula

$$D_F = \pi \cdot \frac{z}{\theta - 45}$$

Example with Units

$$119.9654\,m = 3.1416 \cdot \frac{160}{49.19 - 45}$$

2.5) Depth given Volume Flow rate per unit of Ocean Width Formula

Evaluate Formula

Formula

$$D_F = \frac{q_x \cdot \pi \cdot \sqrt{2}}{V_s}$$

Example with Units

$$119.9578\,\text{m} = \frac{13.5\,\text{m}^3/\text{s} \cdot 3.1416 \cdot \sqrt{2}}{0.5\,\text{m/s}}$$

2.6) Depth of Frictional Influence by Eckman Formula

Evaluate Formula

Formula

$$D_{Eddy} = \pi \cdot \sqrt{\frac{\varepsilon_v}{\rho_{water} \cdot \Omega_E \cdot \sin(L)}}$$

Example with Units

$$15.4089\,\text{m} = 3.1416 \cdot \sqrt{\frac{0.6}{1000\,\text{kg/m}^3 \cdot 7.2921159\text{E-}05\,\text{rad/s} \cdot \sin(20°)}}$$

2.7) Latitude given Depth of Frictional Influence by Eckman Formula

Evaluate Formula

Formula

$$L = asin\left(\frac{\varepsilon_v}{\rho_{water} \cdot \Omega_E \cdot \left(\frac{D_{Eddy}}{\pi}\right)^2}\right)$$

Example with Units

$$21.1274° = asin\left(\frac{0.6}{1000\,\text{kg/m}^3 \cdot 7.2921159\text{E-}05\,\text{rad/s} \cdot \left(\frac{15.01\,\text{m}}{3.1416}\right)^2}\right)$$

2.8) Salinity given Atmospheric Pressure Formula

Evaluate Formula

Formula

$$S = \frac{\sigma_t}{0.75}$$

Example with Units

$$33.3333\,\text{mg/L} = \frac{25}{0.75}$$

2.9) Velocity at Surface given Velocity Component along Horizontal x Axis Formula

Evaluate Formula

Formula

$$V_s = \frac{u_x}{e^{\pi \cdot \frac{z}{D_F}} \cdot \cos\left(45 + \left(\pi \cdot \frac{z}{D_F}\right)\right)}$$

Example with Units

$$0.4796\,\mathrm{m/s} = \frac{15\,\mathrm{m/s}}{e^{3.1416 \cdot \frac{160}{120\,\mathrm{m}}} \cdot \cos\left(45 + \left(3.1416 \cdot \frac{160}{120\,\mathrm{m}}\right)\right)}$$

2.10) Velocity at Surface given Velocity detail of Current Profile in Three Dimensions Formula

Evaluate Formula

Formula

$$V_s = \frac{v}{e^{\pi \cdot \frac{z}{D_F}}}$$

Example with Units

$$0.9099\,\mathrm{m/s} = \frac{60\,\mathrm{m/s}}{e^{3.1416 \cdot \frac{160}{120\,\mathrm{m}}}}$$

2.11) Velocity Component along Horizontal x Axis Formula

Evaluate Formula

Formula

$$u_x = V_s \cdot e^{\pi \cdot \frac{z}{D_F}} \cdot \cos\left(45 + \left(\pi \cdot \frac{z}{D_F}\right)\right)$$

Example with Units

$$15.6365\,\mathrm{m/s} = 0.5\,\mathrm{m/s} \cdot e^{3.1416 \cdot \frac{160}{120\,\mathrm{m}}} \cdot \cos\left(45 + \left(3.1416 \cdot \frac{160}{120\,\mathrm{m}}\right)\right)$$

2.12) Velocity in Current Profile in Three Dimensions by introducing Polar Coordinates Formula

Evaluate Formula

Formula

$$V_{Current} = V_s \cdot e^{\pi \cdot \frac{z}{D_F}}$$

Example with Units

$$32.9715\,\mathrm{m/s} = 0.5\,\mathrm{m/s} \cdot e^{3.1416 \cdot \frac{160}{120\,\mathrm{m}}}$$

2.13) Vertical Coordinate from Ocean Surface given Angle between Wind and Current Direction Formula

Evaluate Formula

Formula

$$z = D_F \cdot \frac{\theta - 45}{\pi}$$

Example with Units

$$160.0462 = 120\,\mathrm{m} \cdot \frac{49.19 - 45}{3.1416}$$

2.14) Vertical Eddy Viscosity Coefficient given Depth of Frictional Influence by Eckman Formula

Evaluate Formula

Formula

$$\varepsilon_v = \frac{D_{Eddy}^2 \cdot \rho_{water} \cdot \Omega_E \cdot \sin(L)}{\pi^2}$$

Example with Units

$$0.5693 = \frac{15.01\,\text{m}^2 \cdot 1000\,\text{kg/m}^3 \cdot 7.2921159\text{E-}05\,\text{rad/s} \cdot \sin(20°)}{3.1416^2}$$

2.15) Volume Flow Rates per unit of Ocean Width Formula

Evaluate Formula

Formula

$$q_x = \frac{V_s \cdot D_F}{\pi \cdot \sqrt{2}}$$

Example with Units

$$13.5047\,\text{m}^3/\text{s} = \frac{0.5\,\text{m/s} \cdot 120\,\text{m}}{3.1416 \cdot \sqrt{2}}$$

3) Forces Driving Ocean Currents Formulas

3.1) Angular Speed of Earth for given Coriolis Frequency Formula

Evaluate Formula

Formula

$$\Omega_E = \frac{f}{2 \cdot \sin(\lambda_e)}$$

Example with Units

$$7.3\text{E-}5\,\text{rad/s} = \frac{0.0001}{2 \cdot \sin(43.29°)}$$

3.2) Coriolis Frequency Formula

Evaluate Formula

Formula

$$f = 2 \cdot \Omega_E \cdot \sin(\lambda_e)$$

Example with Units

$$0.0001 = 2 \cdot 7.2921159\text{E-}05\,\text{rad/s} \cdot \sin(43.29°)$$

3.3) Coriolis Frequency given Horizontal Component of Coriolis Acceleration Formula

Evaluate Formula

Formula

$$f = \frac{a_C}{U}$$

Example with Units

$$0.0001 = \frac{4}{24.85\,\text{mi/s}}$$

3.4) Drag Coefficient Formula

Evaluate Formula

Formula

$$C_D = 0.00075 + (0.000067 \cdot V_{10})$$

Example with Units

$$0.0022 = 0.00075 + (0.000067 \cdot 22\,\text{m/s})$$

3.5) Drag Coefficient given Wind Stress Formula

Evaluate Formula

Formula

$$C_D = \frac{\tau_o}{\rho \cdot V_{10}^2}$$

Example with Units

$$0.0024 = \frac{1.5\,\text{Pa}}{1.293\,\text{kg/m}^3 \cdot 22\,\text{m/s}^2}$$

3.6) Horizontal Component of Coriolis Acceleration Formula

Evaluate Formula

Formula

$$a_C = f \cdot U$$

Example with Units

$$3.9992 = 0.0001 \cdot 24.85\,\text{mi/s}$$

3.7) Horizontal Speed across Earth's Surface given Coriolis Frequency Formula

Evaluate Formula

Formula

$$U = \frac{a_C}{f}$$

Example with Units

$$24.8548\,\text{mi/s} = \frac{4}{0.0001}$$

3.8) Horizontal Speed across Earth's Surface given Horizontal Component of Coriolis Acceleration Formula

Evaluate Formula

Formula

$$U = \frac{a_C}{2 \cdot \Omega_E \cdot \sin(\lambda_e)}$$

Example with Units

$$24.8541\,\text{mi/s} = \frac{4}{2 \cdot 7.2921159\text{E-}05\,\text{rad/s} \cdot \sin(43.29°)}$$

3.9) Latitude given Coriolis Frequency Formula

Evaluate Formula

Formula

$$\lambda_e = asin\left(\frac{f}{2 \cdot \Omega_E}\right)$$

Example with Units

$$43.2885° = asin\left(\frac{0.0001}{2 \cdot 7.2921159\text{E-}05\,\text{rad/s}}\right)$$

3.10) Latitude given Magnitude of Horizontal Component of Coriolis Acceleration Formula

Evaluate Formula

Formula

$$\lambda_e = asin\left(\frac{a_C}{2 \cdot \Omega_E \cdot U}\right)$$

Example with Units

$$43.299° = asin\left(\frac{4}{2 \cdot 7.2921159\text{E-}05\,\text{rad/s} \cdot 24.85\,\text{mi/s}}\right)$$

3.11) Magnitude of Horizontal Component of Coriolis Acceleration Formula

Evaluate Formula

Formula

$$a_C = 2 \cdot \Omega_E \cdot \sin(\lambda_e) \cdot U$$

Example with Units

$$3.9993 = 2 \cdot 7.2921159\text{E-}05\,\text{rad/s} \cdot \sin(43.29°) \cdot 24.85\,\text{mi/s}$$

3.12) Wind Speed at Height 10 m for Drag Coefficient Formula

Evaluate Formula

Formula

$$V_{10} = \frac{C_D - 0.00075}{0.000067}$$

Example with Units

$$26.1194\,\text{m/s} = \frac{0.0025 - 0.00075}{0.000067}$$

3.13) Wind Speed at Height 10 m given Wind Stress Formula

Evaluate Formula

Formula

$$V_{10} = \sqrt{\frac{\tau_o}{C_D \cdot \rho}}$$

Example with Units

$$21.5415\,\text{m/s} = \sqrt{\frac{1.5\,\text{Pa}}{0.0025 \cdot 1.293\,\text{kg/m}^3}}$$

3.14) Wind Stress Formula

Evaluate Formula

Formula

$$\tau_o = C_D \cdot \rho \cdot V_{10}^{2}$$

Example with Units

$$1.5645\,\text{Pa} = 0.0025 \cdot 1.293\,\text{kg/m}^3 \cdot 22\,\text{m/s}^{2}$$

Variables used in list of Oceanography Formulas above

- a_C Horizontal Component of Coriolis Acceleration
- C_D Drag Coefficient
- D_{Eddy} Depth of Frictional Influence by Eckman *(Meter)*
- D_F Depth of Frictional Influence *(Meter)*
- **f** Coriolis Frequency
- **L** Latitude of a Position on Earth Surface *(Degree)*
- q_x Volume Flow Rates per unit of Ocean Width *(Cubic Meter per Second)*
- **S** Salinity of Water *(Milligram per Liter)*
- **U** Horizontal Speed across the Earth's Surface *(Mile per Second)*
- u_x Velocity Component along a Horizontal x Axis *(Meter per Second)*
- **v** Current Profile Velocity *(Meter per Second)*
- **V** Current Velocity *(Mile per Second)*
- V_{10} Wind Speed at Height of 10 m *(Meter per Second)*
- $V_{Current}$ Velocity in the Current Profile *(Meter per Second)*
- V_s Velocity at the Surface *(Meter per Second)*
- **z** Vertical Coordinate
- $\delta p_{/\delta n}$ Pressure Gradient
- ε_v Vertical Eddy Viscosity Coefficient
- **θ** Angle between the Wind and Current Direction
- λ_e Earth Station Latitude *(Degree)*
- **ρ** Density of Air *(Kilogram per Cubic Meter)*
- ρ_s Density of Salt Water *(Kilogram per Cubic Meter)*
- ρ_{water} Water Density *(Kilogram per Cubic Meter)*
- σ_t Difference of Density Values
- τ_o Wind Stress *(Pascal)*
- Ω_E Angular Speed of the Earth *(Radian per Second)*

Constants, Functions, Measurements used in list of Oceanography Formulas above

- constant(s): **pi**, 3.14159265358979323846264338327950288 *Archimedes' constant*
- constant(s): **e**, 2.71828182845904523536028747135266249 *Napier's constant*
- Functions: **asin**, asin(Number) *The inverse sine function, is a trigonometric function that takes a ratio of two sides of a right triangle and outputs the angle opposite the side with the given ratio.*
- Functions: **cos**, cos(Angle) *Cosine of an angle is the ratio of the side adjacent to the angle to the hypotenuse of the triangle.*
- Functions: **sin**, sin(Angle) *Sine is a trigonometric function that describes the ratio of the length of the opposite side of a right triangle to the length of the hypotenuse.*
- Functions: **sqrt**, sqrt(Number) *A square root function is a function that takes a non-negative number as an input and returns the square root of the given input number.*
- Measurement: **Length** in Meter (m) *Length Unit Conversion*
- Measurement: **Pressure** in Pascal (Pa) *Pressure Unit Conversion*
- Measurement: **Speed** in Mile per Second (mi/s), Meter per Second (m/s) *Speed Unit Conversion*
- Measurement: **Angle** in Degree (°) *Angle Unit Conversion*
- Measurement: **Volumetric Flow Rate** in Cubic Meter per Second (m^3/s) *Volumetric Flow Rate Unit Conversion*
- Measurement: **Angular Velocity** in Radian per Second (rad/s) *Angular Velocity Unit Conversion*
- Measurement: **Density** in Kilogram per Cubic Meter (kg/m^3), Milligram per Liter (mg/L) *Density Unit Conversion*

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