Oceanography Formulas

List of 36 Oceanography Formulas

Oceanography

Dynamics of Ocean Currents

1) Angular Velocity given Pressure Gradient Normal to Current

Open Calculator

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

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

2) Coriolis Acceleration

Open Calculator

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

ex $$3.99773 = 2 \cdot 7.2921159E\hat{}\text{-}05\text{rad/s} \cdot \sin(20°) \cdot 49.8\text{mi/s}$$

3) Current Velocity given Coriolis Acceleration

Open Calculator

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

ex $$49.82828\text{mi/s} = \frac{4}{2 \cdot 7.2921159E\hat{}\text{-}05\text{rad/s} \cdot \sin(20°)}$$

4) Current Velocity given Pressure Gradient Normal to Current

Open Calculator

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

$$ex\quad 49.82828\text{mi/s} = \frac{\left(\frac{1}{1000\text{kg/m}^3}\right) \cdot (4000)}{2 \cdot 7.2921159\text{E\^{}-05rad/s} \cdot \sin(20°)}$$

5) Latitude given Coriolis Acceleration

Open Calculator

$$fx\quad L = a\sin\left(\frac{a_C}{2 \cdot \Omega_E \cdot V}\right)$$

$$ex\quad 20.01184° = a\sin\left(\frac{4}{2 \cdot 7.2921159\text{E\^{}-05rad/s} \cdot 49.8\text{mi/s}}\right)$$

6) Latitude given Pressure Gradient Normal to Current

Open Calculator

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

$$ex\quad 20.01184° = a\sin\left(\frac{\left(\frac{1}{1000\text{kg/m}^3}\right) \cdot 4000}{2 \cdot 7.2921159\text{E\^{}-05rad/s} \cdot 49.8\text{mi/s}}\right)$$

7) Pressure Gradient Normal to Current

Open Calculator

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

ex $$3997.73 = 2 \cdot 7.2921159\text{E\^{}-05rad/s} \cdot \sin(20°) \cdot \frac{49.8\text{mi/s}}{\frac{1}{1000\text{kg/m}^3}}$$

Eckman Wind Drift

8) Angle between Wind and Current Direction

Open Calculator

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

ex $$49.18879 = 45 + \left(\pi \cdot \frac{160}{120\text{m}}\right)$$

9) Atmospheric Pressure as function of Salinity and Temperature

Open Calculator

fx $$\sigma_t = 0.75 \cdot S$$

ex $$24.9975 = 0.75 \cdot 33.33\text{mg/L}$$

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

Open Calculator

fx $$\rho_s = \sigma_t + 1000$$

ex $$1025\text{kg/m}^3 = 25 + 1000$$

11) Depth given Angle between Wind and Current Direction

Open Calculator

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

ex $$119.9654\text{m} = \pi \cdot \frac{160}{49.19 - 45}$$

12) Depth given Volume Flow rate per unit of Ocean Width

Open Calculator

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

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

13) Depth of Frictional Influence by Eckman

Open Calculator

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

ex $$15.40894\text{m} = \pi \cdot \sqrt{\frac{0.6}{1000\text{kg}/\text{m}^3 \cdot 7.2921159\text{E}\hat{}\text{-}05\text{rad}/\text{s} \cdot \sin(20°)}}$$

14) Latitude given Depth of Frictional Influence by Eckman

Open Calculator

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

ex $$21.12738° = a\sin\left(\frac{0.6}{1000\text{kg/m}^3 \cdot 7.2921159\text{E\^{}-05rad/s} \cdot \left(\frac{15.01\text{m}}{\pi}\right)^2}\right)$$

15) Salinity given Atmospheric Pressure

Open Calculator

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

ex $$33.33333\text{mg/L} = \frac{25}{0.75}$$

16) Velocity at Surface given Velocity Component along Horizontal x Axis

Open Calculator

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

ex $$0.479647\text{m/s} = \frac{15\text{m/s}}{e^{\pi \cdot \frac{160}{120\text{m}}} \cdot \cos\left(45 + \left(\pi \cdot \frac{160}{120\text{m}}\right)\right)}$$

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

Open Calculator

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

ex $$0.909877\text{m/s} = \frac{60\text{m/s}}{e^{\pi \cdot \frac{160}{120\text{m}}}}$$

18) Velocity Component along Horizontal x Axis

Open Calculator

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

ex $$15.6365\text{m/s} = 0.5\text{m/s} \cdot e^{\pi \cdot \frac{160}{120\text{m}}} \cdot \cos\left(45 + \left(\pi \cdot \frac{160}{120\text{m}}\right)\right)$$

19) Velocity in Current Profile in Three Dimensions by introducing Polar Coordinates

Open Calculator

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

ex $$32.97148\text{m/s} = 0.5\text{m/s} \cdot e^{\pi \cdot \frac{160}{120\text{m}}}$$

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

Open Calculator

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

ex $$160.0462 = 120\text{m} \cdot \frac{49.19 - 45}{\pi}$$

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

Open Calculator

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

ex $$0.569334 = \frac{(15.01\text{m})^2 \cdot 1000\text{kg/m}^3 \cdot 7.2921159\text{E\^{}-05rad/s} \cdot \sin(20°)}{\pi^2}$$

22) Volume Flow Rates per unit of Ocean Width

Open Calculator

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

ex $$13.50474\text{m}^3/\text{s} = \frac{0.5\text{m/s} \cdot 120\text{m}}{\pi \cdot \sqrt{2}}$$

Forces Driving Ocean Currents

23) Angular Speed of Earth for given Coriolis Frequency

Open Calculator

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

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

24) Coriolis Frequency

Open Calculator

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

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

25) Coriolis Frequency given Horizontal Component of Coriolis Acceleration

Open Calculator

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

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

26) Drag Coefficient

Open Calculator

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

$$0.002224 = 0.00075 + (0.000067 \cdot 22\text{m/s})$$

27) Drag Coefficient given Wind Stress

Open Calculator

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

$$0.002397 = \frac{1.5\text{Pa}}{1.293\text{kg/m}^3 \cdot (22\text{m/s})^2}$$

28) Horizontal Component of Coriolis Acceleration

Open Calculator

$$a_C = f \cdot U$$

$$3.99922 = 0.0001 \cdot 24.85 \mathrm{mi/s}$$

29) Horizontal Speed across Earth's Surface given Coriolis Frequency

Open Calculator

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

$$24.85485 \mathrm{mi/s} = \frac{4}{0.0001}$$

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

Open Calculator

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

$$24.85415 \mathrm{mi/s} = \frac{4}{2 \cdot 7.2921159\mathrm{E\hat{}{-05}rad/s} \cdot \sin(43.29°)}$$

31) Latitude given Coriolis Frequency

Open Calculator

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

$$43.28848° = a\sin\left(\frac{0.0001}{2 \cdot 7.2921159\mathrm{E\hat{}{-05}rad/s}}\right)$$

32) Latitude given Magnitude of Horizontal Component of Coriolis Acceleration

Open Calculator

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

$$43.29901° = a\sin\left(\frac{4}{2 \cdot 7.2921159E\hat{}\text{-}05\text{rad/s} \cdot 24.85\text{mi/s}}\right)$$

33) Magnitude of Horizontal Component of Coriolis Acceleration

Open Calculator

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

$$3.999332 = 2 \cdot 7.2921159E\hat{}\text{-}05\text{rad/s} \cdot \sin(43.29°) \cdot 24.85\text{mi/s}$$

34) Wind Speed at Height 10 m for Drag Coefficient

Open Calculator

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

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

35) Wind Speed at Height 10 m given Wind Stress

Open Calculator

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

$$21.54152\text{m/s} = \sqrt{\frac{1.5\text{Pa}}{0.0025 \cdot 1.293\text{kg/m}^3}}$$

36) Wind Stress

Open Calculator

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

$$1.56453\text{Pa} = 0.0025 \cdot 1.293\text{kg/m}^3 \cdot (22\text{m/s})^2$$

Variables Used

- 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

- Constant: **pi**, 3.14159265358979323846264338327950288
  Archimedes' constant
- Constant: **e**, 2.71828182845904523536028747135266249
  Napier's constant
- Function: **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.
- Function: **cos**, cos(Angle)
  Cosine of an angle is the ratio of the side adjacent to the angle to the hypotenuse of the triangle.
- Function: **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.
- Function: **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/m³), Milligram per Liter (mg/L)
  Density Unit Conversion

Check other formula lists

- Calculation of Forces on Ocean Structures Formulas
- Density Currents in Harbors Formulas
- Density Currents in Rivers Formulas
- Dredging Equipment Formulas
- Estimating Marine and Coastal Winds Formulas
- Hydrodynamics of Tidal Inlets-2 Formulas
- Meteorology and Wave Climate Formulas
- Oceanography Formulas
- Shore Protection Formulas
- Wave Prediction Formulas

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