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Parametric Spectrum Models Formulas

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List of 16 Parametric Spectrum Models Formulas

Parametric Spectrum Models

1) Dimensionless Time

Open Calculator

fx $$t' = \frac{[g] \cdot t_d}{V_f}$$

ex $$111.142 = \frac{[g] \cdot 68s}{6m/s}$$

2) Fetch Length given Frequency at Spectral Peak

Open Calculator

fx $$F_l = \frac{(V_{10}^3) \cdot \left(\left(\frac{f_p}{3.5}\right)^{-\left(\frac{1}{0.33}\right)}\right)}{[g]^2}$$

ex $$2.000015m = \frac{\left((22m/s)^3\right) \cdot \left(\left(\frac{0.013162kHz}{3.5}\right)^{-\left(\frac{1}{0.33}\right)}\right)}{[g]^2}$$

3) Fetch Length given Scaling Parameter

Open Calculator

fx $$F_l = \frac{V_{10}^2 \cdot \left(\left(\frac{\alpha}{0.076}\right)^{-\left(\frac{1}{0.22}\right)}\right)}{[g]}$$

ex $$2.003396m = \frac{(22m/s)^2 \cdot \left(\left(\frac{0.1538}{0.076}\right)^{-\left(\frac{1}{0.22}\right)}\right)}{[g]}$$

4) Frequency at Spectral Peak

Open Calculator

fx $$f_p = 3.5 \cdot \left(\frac{[g]^2 \cdot F_l}{V_{10}^3} \right)^{-0.33}$$

ex $$0.013162\text{kHz} = 3.5 \cdot \left(\frac{[g]^2 \cdot 2\text{m}}{(22\text{m/s})^3} \right)^{-0.33}$$

5) JONSWAP Spectrum for Fetch-limited Seas

Open Calculator

fx $$E_f = \left(\frac{\alpha \cdot [g]^2}{(2 \cdot \pi)^4 \cdot f^5} \right) \cdot \left(\exp\left(-1.25 \cdot \left(\frac{f}{f_p} \right)^{-4} \right) \cdot \gamma \right)^{\exp\left(-\frac{\left(\left(\frac{f}{f_p} \right) - 1 \right)^2}{2 \cdot \sigma^2} \right)}$$

ex $$2.9\text{E}\hat{}\text{-}22 = \left(\frac{0.1538 \cdot [g]^2}{(2 \cdot \pi)^4 \cdot (8\text{kHz})^5} \right) \cdot \left(\exp\left(-1.25 \cdot \left(\frac{8\text{kHz}}{0.013162\text{kHz}} \right)^{-4} \right) \cdot 5 \right)^{\exp\left(-\frac{\left(\left(\frac{8\text{kHz}}{0.013162\text{kHz}} \right) - 1 \right)^2}{2 \cdot (1.33)^2} \right)}$$

6) Maximum Controlling Parameter for Angular Distribution

Open Calculator

fx $$s = 11.5 \cdot \left(\frac{2 \cdot \pi \cdot f_p \cdot V_{10}}{[g]} \right)^{-2.5}$$

ex $$2.5\text{E}\hat{}\text{-}5 = 11.5 \cdot \left(\frac{2 \cdot \pi \cdot 0.013162\text{kHz} \cdot 22\text{m/s}}{[g]} \right)^{-2.5}$$

7) Phillip's Equilibrium Range of Spectrum for Fully Developed Sea in Deep Water

Open Calculator

fx $$E_\omega = b \cdot [g]^2 \cdot \omega^{-5}$$

ex $$0.00105 = 0.1 \cdot [g]^2 \cdot (6.2\text{rad/s})^{-5}$$

8) Scaling Parameter

Open Calculator

fx $$\alpha = 0.076 \cdot \left(\frac{[g] \cdot F_l}{V_{10}^2} \right)^{-0.22}$$

ex $$0.153857 = 0.076 \cdot \left(\frac{[g] \cdot 2\text{m}}{(22\text{m/s})^2} \right)^{-0.22}$$

9) Shape Factor for Higher Frequency Component

Open Calculator

fx $$\lambda_2 = 1.82 \cdot \exp(-0.027 \cdot H_s)$$

ex $$0.314691 = 1.82 \cdot \exp(-0.027 \cdot 65\text{m})$$

10) Significant Wave Height given Significant Wave Height of Lower and Higher Frequency Components

Open Calculator

fx $$H_s = \sqrt{H_{s1}^2 + H_{s2}^2}$$

ex $$65.11528\text{m} = \sqrt{(48\text{m})^2 + (44\text{m})^2}$$

11) Significant Wave Height of Higher Frequency Component

Open Calculator

fx $$H_{s2} = \sqrt{H_s^2 - H_{s1}^2}$$

ex $$43.82921\text{m} = \sqrt{(65\text{m})^2 - (48\text{m})^2}$$

12) Significant Wave Height of Lower Frequency Component

Open Calculator

fx $$H_{s1} = \sqrt{H_s^2 - H_{s2}^2}$$

ex $$47.84349\text{m} = \sqrt{(65\text{m})^2 - (44\text{m})^2}$$

13) Weighing Factor for Angular Frequency Lesser than or Equal to One

Open Calculator

fx $\varphi = 0.5 \cdot \omega^2$

ex $19.22 = 0.5 \cdot (6.2\text{rad/s})^2$

14) Wind Speed at Elevation 10m above Sea Surface given Frequency at Spectral Peak

Open Calculator

fx $V = \left(\frac{F_l \cdot [g]^2}{\left(\frac{f_p}{3.5} \right)^{-\left(\frac{1}{0.33} \right)}} \right)^{\frac{1}{3}}$

ex $0.01879\text{m/s} = \left(\frac{2\text{m} \cdot [g]^2}{\left(\frac{0.013162\text{kHz}}{3.5} \right)^{-\left(\frac{1}{0.33} \right)}} \right)^{\frac{1}{3}}$

15) Wind Speed at Elevation 10m above Sea Surface given Scaling Parameter

Open Calculator

fx $V_{10} = \left(\frac{F_l \cdot [g]}{\left(\frac{\alpha}{0.076} \right)^{-\frac{1}{0.22}}} \right)^{0.5}$

ex $21.98135\text{m/s} = \left(\frac{2\text{m} \cdot [g]}{\left(\frac{0.1538}{0.076} \right)^{-\frac{1}{0.22}}} \right)^{0.5}$

16) Wind Speed given Maximum Controlling Parameter for Angular Distribution

Open Calculator

fx $V_{10} = [g] \cdot \frac{\left(\frac{s}{11.5} \right)^{-\frac{1}{2.5}}}{2 \cdot \pi \cdot f_p}$

ex $21.83343\text{m/s} = [g] \cdot \frac{\left(\frac{2.5\text{E}\hat{}\text{-}5}{11.5} \right)^{-\frac{1}{2.5}}}{2 \cdot \pi \cdot 0.013162\text{kHz}}$

Variables Used

- **b** Constant B
- E_f Frequency Energy Spectrum
- E_ω Phillip's Equilibrium Range of Spectrum
- **f** Wave Frequency *(Kilohertz)*
- F_l Fetch Length *(Meter)*
- f_p Frequency at Spectral Peak *(Kilohertz)*
- H_s Significant Wave Height *(Meter)*
- H_{s1} Significant Wave Height 1 *(Meter)*
- H_{s2} Significant Wave Height 2 *(Meter)*
- **s** Controlling Parameter for the Angular Distribution
- **t'** Dimensionless Time
- t_d Time for Dimensionless Parameter Calculation *(Second)*
- **V** Wind Speed *(Meter per Second)*
- V_{10} Wind Speed at Height of 10 m *(Meter per Second)*
- V_f Friction Velocity *(Meter per Second)*
- **α** Dimensionless Scaling Parameter
- **γ** Peak Enhancement Factor
- λ_2 Shape Factor for Higher Frequency Component
- **σ** Standard Deviation
- **φ** Weighing Factor
- **ω** Wave Angular Frequency *(Radian per Second)*

Constants, Functions, Measurements used

- Constant: **pi**, 3.14159265358979323846264338327950288
  Archimedes' constant
- Constant: **[g]**, 9.80665
  Gravitational acceleration on Earth
- Function: **exp**, exp(Number)
  n an exponential function, the value of the function changes by a constant factor for every unit change in the independent variable.
- 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: **Time** in Second (s)
  Time Unit Conversion
- Measurement: **Speed** in Meter per Second (m/s)
  Speed Unit Conversion
- Measurement: **Frequency** in Kilohertz (kHz)
  Frequency Unit Conversion
- Measurement: **Angular Frequency** in Radian per Second (rad/s)
  Angular Frequency Unit Conversion

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