Technical Note Daily Extraterrestrial Radiation:

\[ H_o = \frac{24}{\pi} I_{sc} \left( 1 + 0.033 \cos \frac{360n}{365} \right) (\omega_s \sin \phi \sin \delta + \cos \phi \cos \delta \sin \omega_s) \]  \hspace{1cm} (3.6.4)

**How do the units work again?**

1. From the very beginning, you could write the daily extraterrestrial irradiation as

\[ H_o = \int_{\text{sunrise}}^{\text{sunset}} I_{sc} \ ' dt , \]

where \( I_{sc} \) is in W/m\(^2\) and \( t \) is in hr. So \( H_o \) has units of W-h/m\(^2\).

2. If we integrate over the hour angle instead of time, we would have

\[ H_o = \int_{\omega_s}^{\omega_s} I_{sc} \ ' d \omega , \]

which would have units of W-rad/m\(^2\). This integral yields

\[ H_o = 2 I_{sc} \left( 1 + 0.033 \cos \frac{360n}{365} \right) (\omega_s \sin \phi \sin \delta + \cos \phi \cos \delta \sin \omega_s) \text{ W-rad/m}^2 . \]

(Don't forget: the first instance of \( \omega_s \) in the above equation must be converted to radians!)

3. Now, to convert the result above from W-rad/m\(^2\) to W-h/m\(^2\), we multiply the above by

\[ \frac{W \cdot \text{rad}}{m^2} \left( \frac{360^\circ}{2\pi \text{rad}} \right) \left( \frac{1 h}{15^\circ} \right) \]

to yield

\[ H_o = \frac{24}{\pi} I_{sc} \left( 1 + 0.033 \cos \frac{360n}{365} \right) (\omega_s \sin \phi \sin \delta + \cos \phi \cos \delta \sin \omega_s) . \]  \hspace{1cm} (3.6.4)

**Bottom line:**

1. The units on (3.6.4) are W-h/m\(^2\).

2. If you want units of J/m\(^2\), you need to multiply the result by (3600 s/h).