Lecture 16: The Solar Resource

Black body (BB) radiation

Spectral power density emitted by BB at temperature T: $u(E)dE = \frac{2\pi}{h^3c^2}\frac{E^3 dE}{e^{E/kT}-1}$

Spectral photon flux density: $b(E)dE = \frac{2\pi}{h^3c^2}\frac{E^2 dE}{e^{E/kT}-1}$

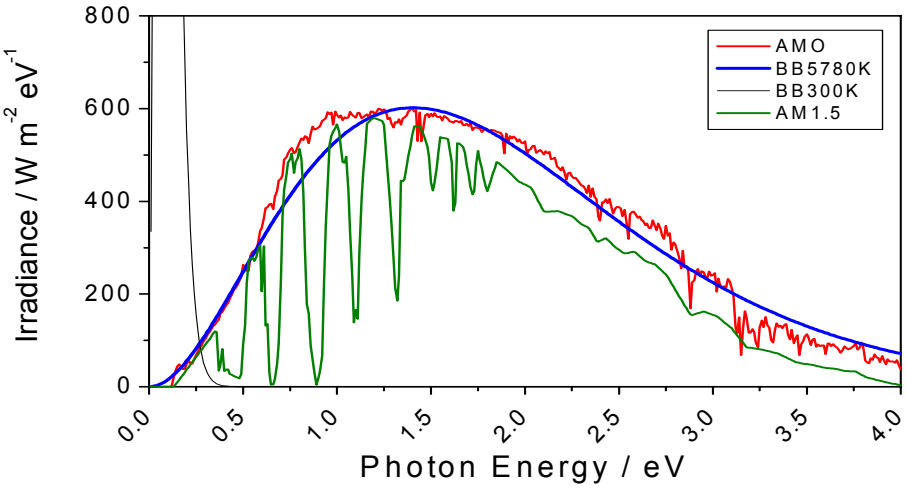
Stefan-Boltzmann Law : $I = \int_0^\infty u(E)dE = \sigma T^4$

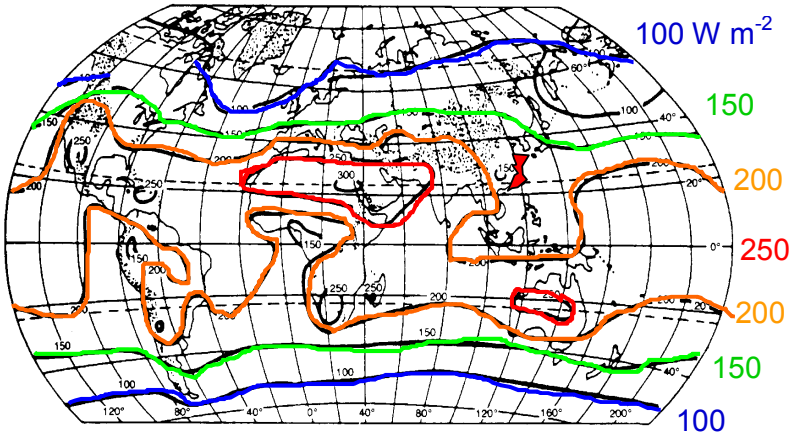
N.B. Energy of a photon. E / eV = 1240 / (λ/nm)

Solar radiation

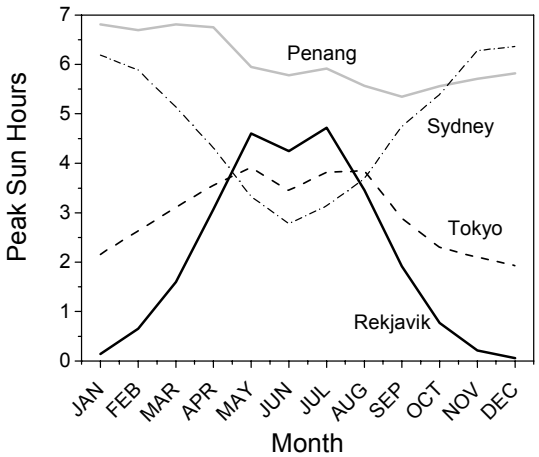
Sun radiates like BB at T_{sun} =5780K, diluted by $f_s = 2.16\times10^{-5}$ due to distance from Sun.
Solar constant (intensity outside Earth atmosphere) = 1368 Wm^{-2}

Solar radiation attenuated by the Earth's atmosphere through: absorption (by CO_2 and H_2O in IR), scattering (15% of radiation is "diffuse") and reflection (cloud and ice).
Standard solar spectrum is "Air Mass 1.5" normalised to 1000 W m^{-2}.
Irradiance depends on latitude, climate, seasonal and daily cycles.





Mean annual solar irradiance / W m^{-2}



1 Peak Sun Hour = 1kWh m^{-2} day^{-1}