Equilibrium Temperature

For a star-planet system, the planet intercepts the amount of starlight,

Sun's emitting power

$$\frac{(\sigma T_\odot^4)\,(4\pi R_\odot^2)}{4\pi d^2}(\pi R_p^2)(1-A) = (\sigma T_p^4)\,(4\pi R_p^2)$$

Planet's cross section

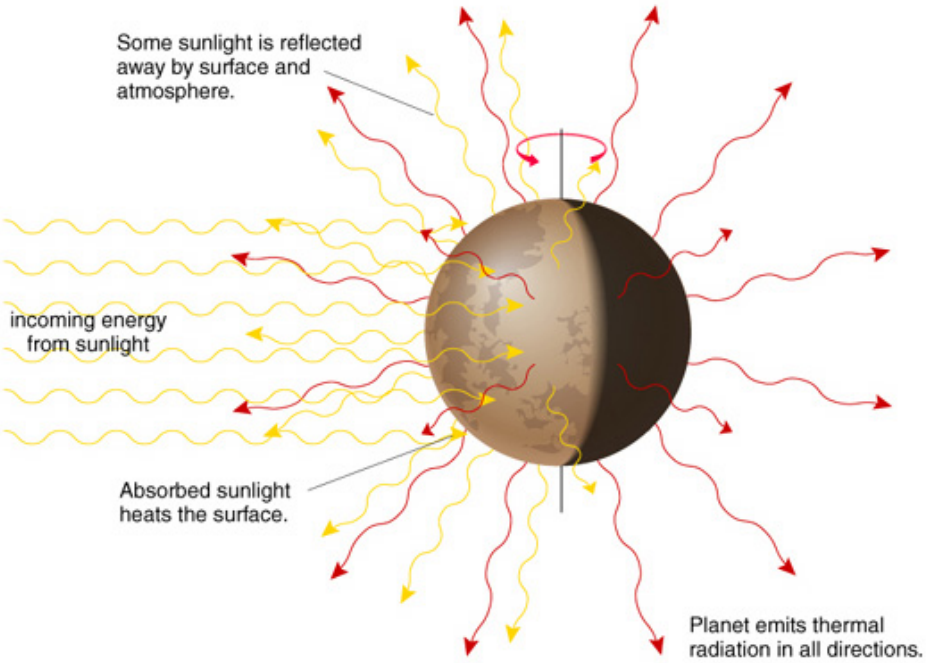
Albedo 反光率

Flux at the planet's distance

The planet itself radiates like a blackbody,

$$t_p \propto d^{1/2}$$

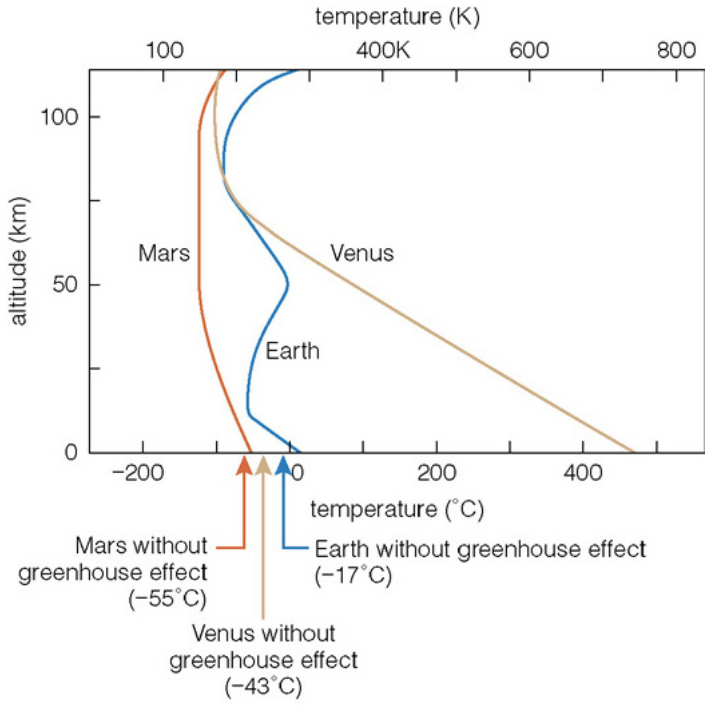
- 這是行星的平衡溫度
- 與行星與太陽距離平方根成反比
- 與大小無關
- 實際尚須考慮是否有大氣、自轉快慢等



http://lasp.colorado.edu/~bagenal/3720/CLASS6/EquilTemp.jpg

簡單理論估計

$$T_p = 280\,(\frac{1-A}{d^2})^{1/4}$$



實際測量

The atmosphere really makes the difference!

World	Average Distance from Sun (AU)	Reflectivity	"No Greenhouse" Average Surface Temperature*	Actual Average Surface Temperature	Greenhouse Warming (actual temperature minus "no greenhouse" temperature)
Mercury	0.387	11%	164°C	425°C (day), −175°C (night)	—
Venus	0.723	72%	−43°C	470°C	513°C
Earth	1.00	36%	−17°C	15°C	32°C
Moon	1.00	7%	0°C	125°C (day), −175°C (night)	—
Mars	1.52	25%	−55°C	−50°C	5°C

可參考

http://lasp.colorado.edu/~bagenal/3720/CLASS6/6EquilibriumTemp.html