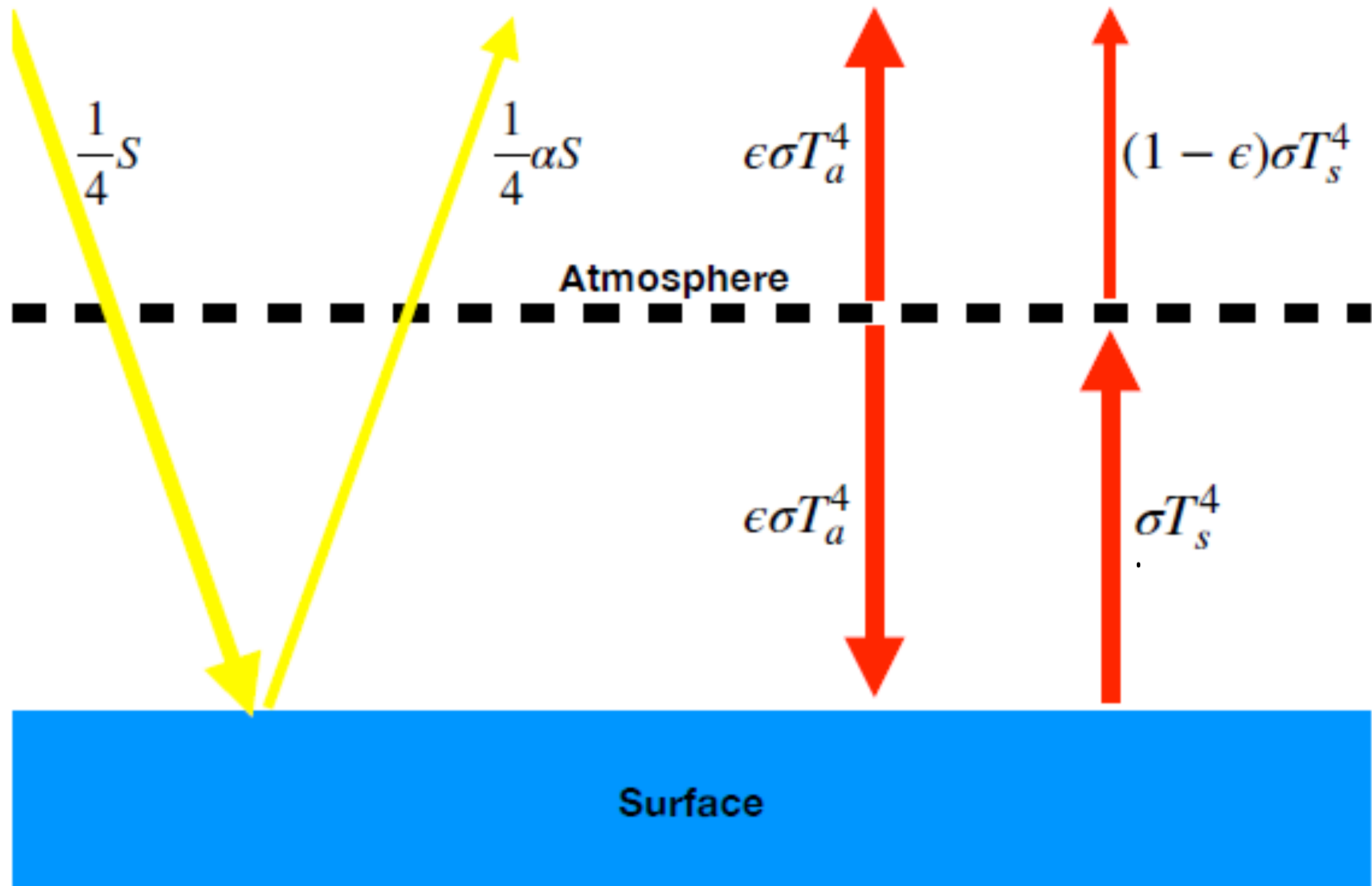
A bright sun with prominent rays is positioned in the upper center of the frame against a clear blue sky. Below the sun, a vast expanse of water is covered with numerous ice floes of various sizes. The scene is brightly lit, and a lens flare is visible in the lower center. The text is overlaid in the middle of the image.

Global Warming

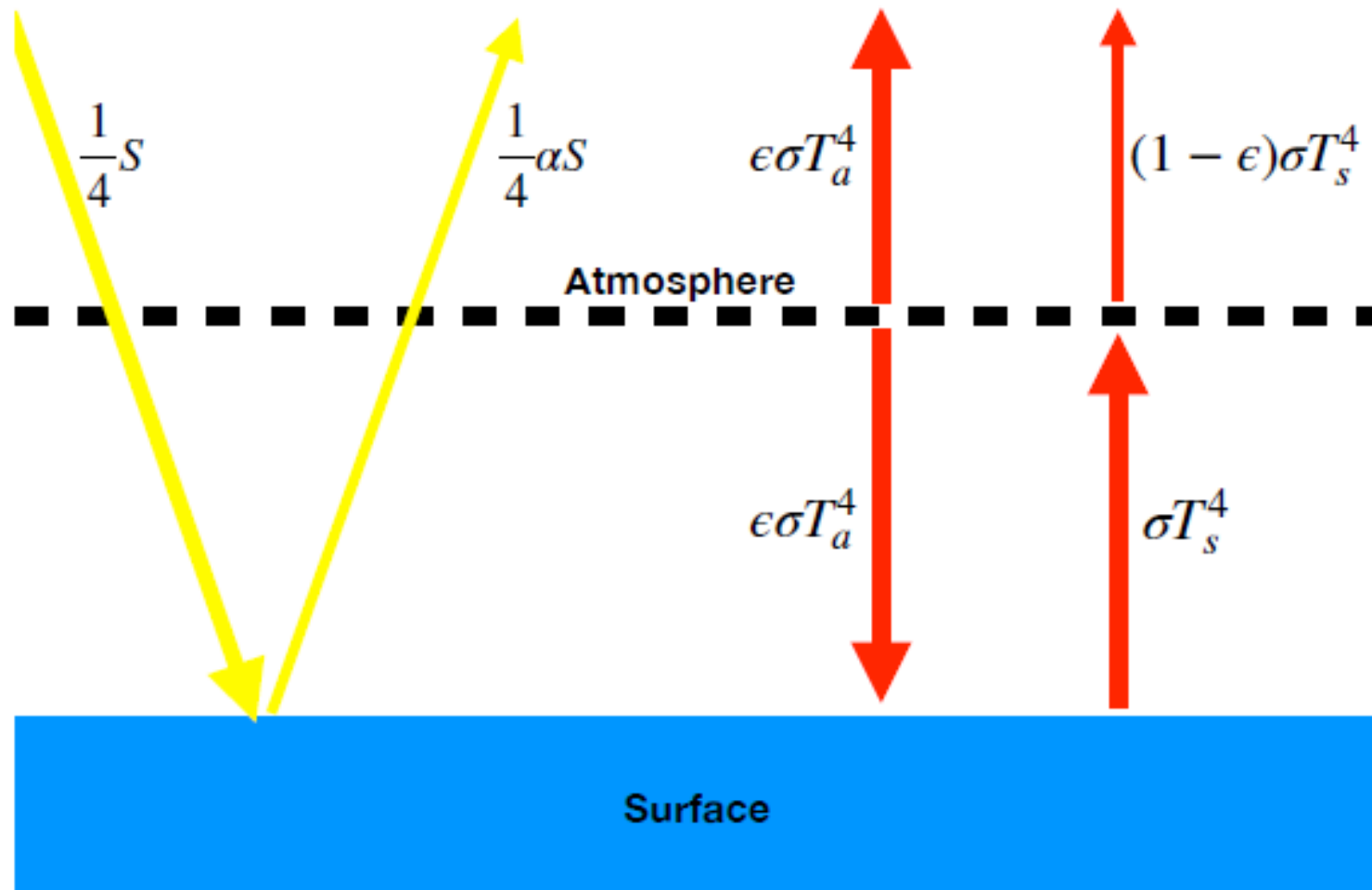
Lecture 4.2

One-Layer Model: Praxis

ONE-LAYER MODEL



ONE-LAYER MODEL

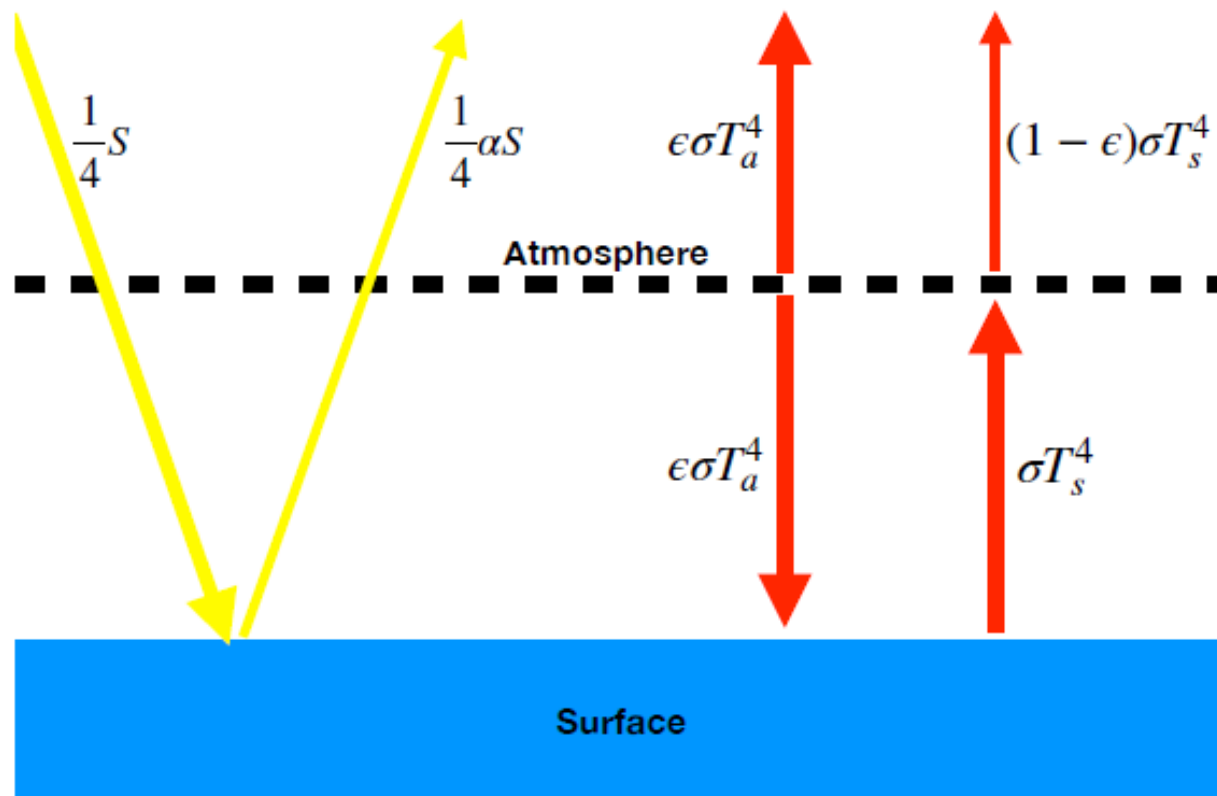


$$\frac{1}{4}(1 - \alpha)S + \frac{\epsilon}{2}\sigma T_s^4 = \sigma T_s^4$$

$$\frac{1}{4}(1 - \alpha)S = \left(1 - \frac{\epsilon}{2}\right)\sigma T_s^4$$

$$T_s = \left(\frac{(1 - \alpha)S}{4\left(1 - \frac{\epsilon}{2}\right)\sigma} \right)^{\frac{1}{4}}$$

ONE-LAYER MODEL



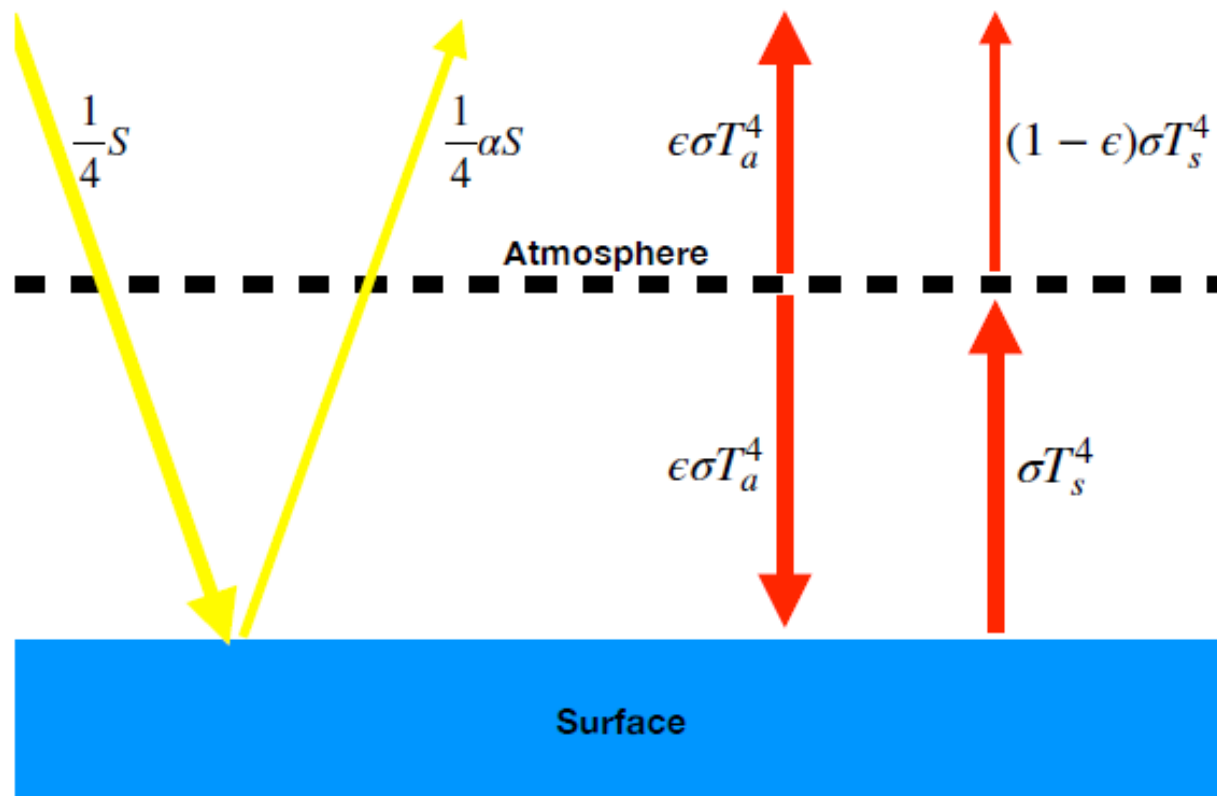
$$\frac{1}{4}(1 - \alpha)S + \frac{\epsilon}{2}\sigma T_s^4 = \sigma T_s^4$$

$$\frac{1}{4}(1 - \alpha)S = (1 - \frac{\epsilon}{2})\sigma T_s^4$$

$$T_s = \left(\frac{(1 - \alpha)S}{4(1 - \frac{\epsilon}{2})\sigma} \right)^{\frac{1}{4}}$$

1. Mars has an insolation of $S = 586 \text{ W m}^{-2}$ and an albedo of $\alpha = 0.25$. It has a very thin atmosphere, so we can approximate $\epsilon = 0$. Remember that $\sigma = 5.67 \times 10^{-8} \text{ W m}^{-2} \text{ K}^{-4}$. Use the one-layer model to estimate the surface temperature of Mars, and compare to the actual value of 210 K.

ONE-LAYER MODEL



$$\frac{1}{4}(1 - \alpha)S + \frac{\epsilon}{2}\sigma T_s^4 = \sigma T_s^4$$

$$\frac{1}{4}(1 - \alpha)S = (1 - \frac{\epsilon}{2})\sigma T_s^4$$

$$T_s = \left(\frac{(1 - \alpha)S}{4(1 - \frac{\epsilon}{2})\sigma} \right)^{\frac{1}{4}}$$

1. Mars has an insolation of $S = 586 \text{ W m}^{-2}$ and an albedo of $\alpha = 0.25$. It has a very thin atmosphere, so we can approximate $\epsilon = 0$. Remember that $\sigma = 5.67 \times 10^{-8} \text{ W m}^{-2} \text{ K}^{-4}$. Use the one-layer model to estimate the surface temperature of Mars, and compare to the actual value of 210 K.

$$T_s = \left(\frac{(1 - 0.25)586 \text{ W m}^{-2}}{4 \times 5.67 \times 10^{-8} \text{ W m}^{-2} \text{ K}^{-4}} \right)^{\frac{1}{4}} = 210 \text{ K}$$

This is actually a 0-layer model since we assume there is no atmosphere!