هواشناسی فیزیکی 1

درس ششم

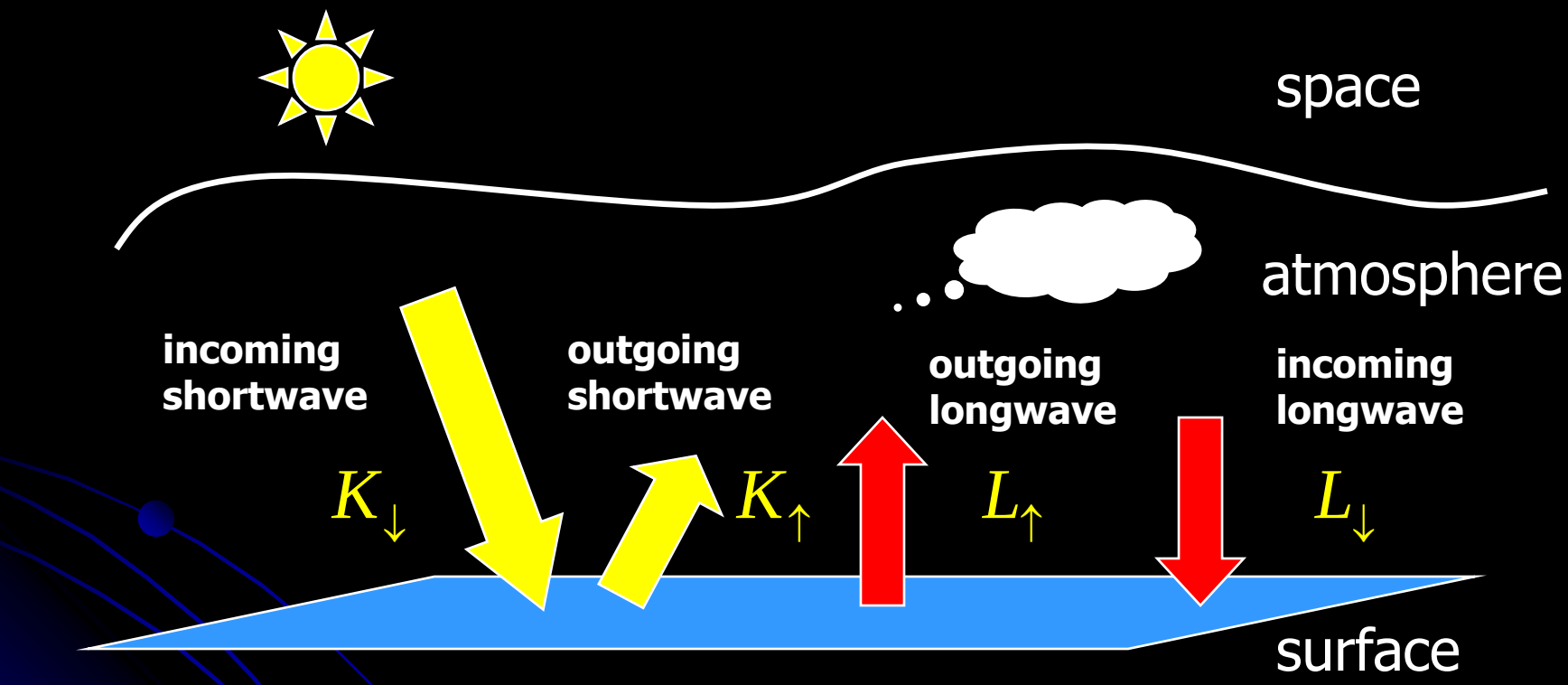
صحرایی

گروه فیزیک دانشگاه رازی

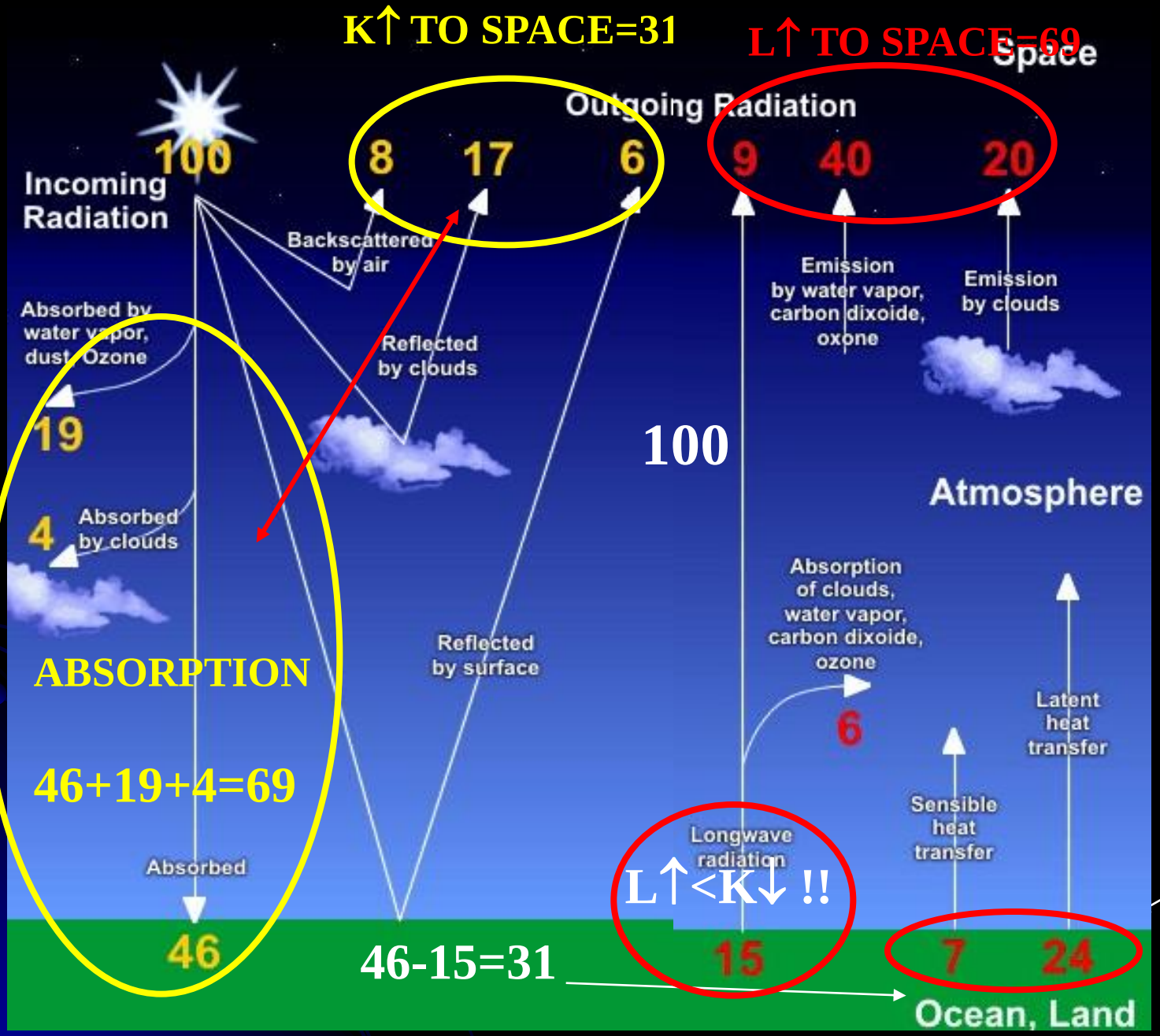
http://www.razi.ac.ir/sahraei

Net Radiation at the Surface

net all wave radiation



$$Q^* = K^* + L^* = \left(K_{\downarrow} - K_{\uparrow}\right) + \left(L_{\downarrow} - L_{\uparrow}\right)$$



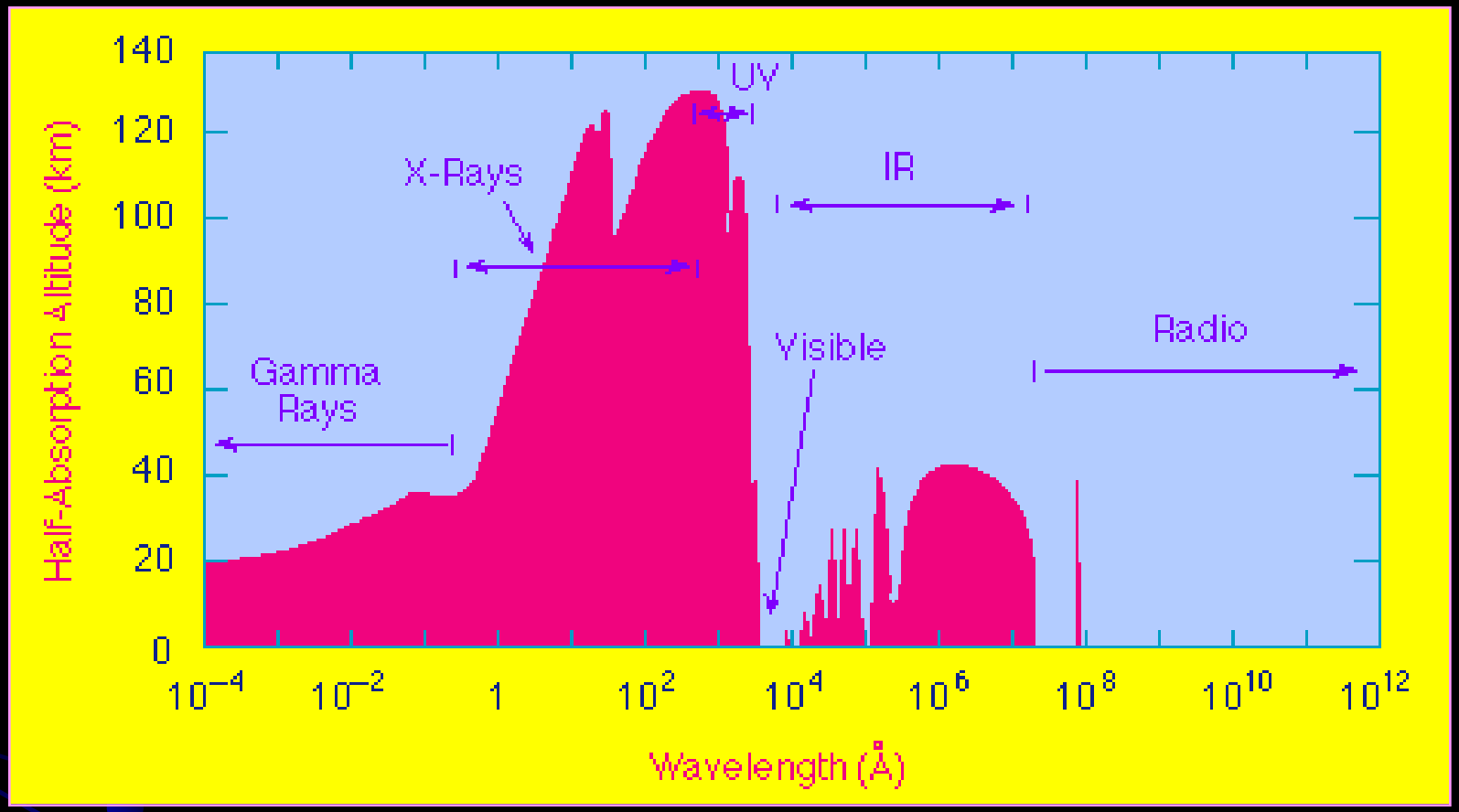
Heat transfer 7+24=31 ! Compensates for radiation imbalance at surface

Atmospheric Windows

The radiation emitted upward by the surface of the earth travels through the atmosphere where some of it is entirely absorbed by the gases making up the atmosphere and some of it travels through the atmosphere almost unaffected.

One important practical consequence of the interaction of electromagnetic radiation with matter and of the detailed composition of our atmosphere is that only light in certain wavelength regions can penetrate the atmosphere well. These regions are called *atmospheric windows*.

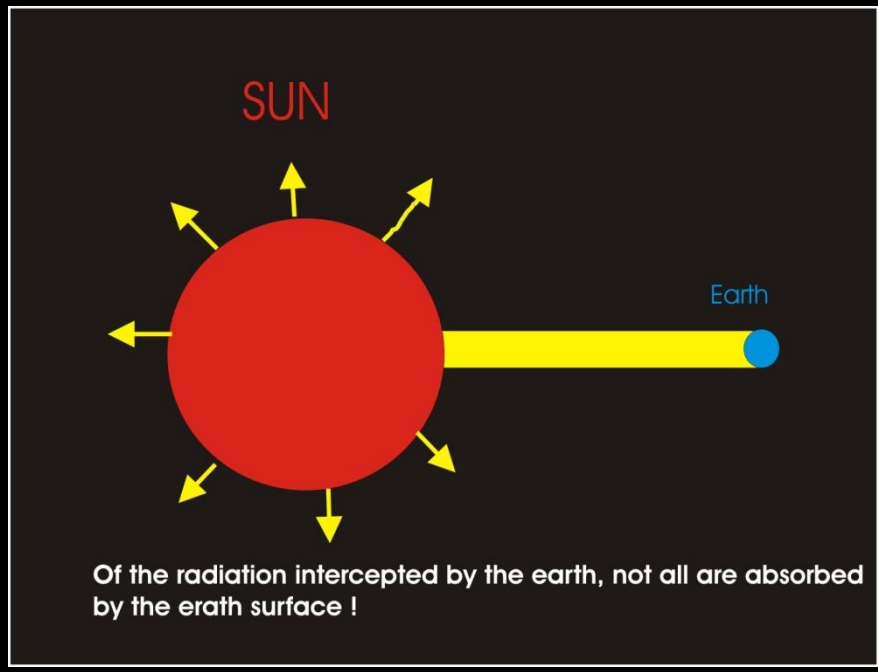
The following figure shows the amount of absorption at different wavelengths in the atmosphere. It is presented in terms of the *half-absorption altitude*, which is defined to be the altitude in the atmosphere (measured from the Earth's surface) where 1/2 of the radiation of a given wavelength incident on the upper atmosphere has been absorbed. Windows correspond to those regions where the half-absorption altitude is very small.



The dominant windows in the atmosphere are seen to be in the visible and radio frequency regions, while X-Rays and UV are seen to be very strongly absorbed and Gamma Rays and IR are somewhat less strongly absorbed.

Terrestrial Radiation تابش زمینی

When the earth surface absorbs the solar radiation, it gets heated up.
But any body that has a non-zero temperature will radiate at its characteristic temperature.
This radiation is called the terrestrial radiation.



انرژی خورشیدی جذب شده از جانب سطح زمین و جو ابتدا به انرژی درونی تبدیل می شود و ممکن است بعدا به انرژی پتانسیل - گرمای نهان و انرژی جنبشی تغییر شکل یابد.

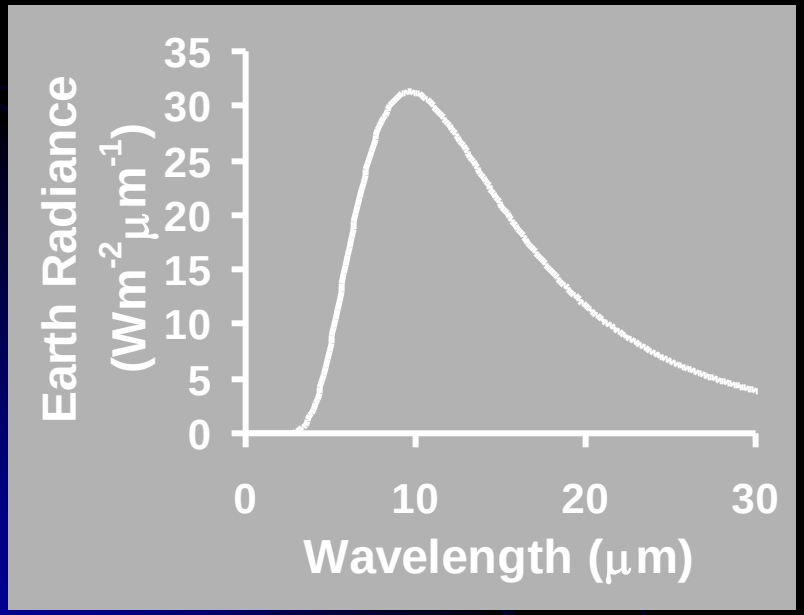
ویژگیهای تابش زمینی

$$T_e \approx 5800\ K$$

$$\lambda_{\max} = \frac{2897}{T} \approx 0.5\mu m$$

$$T_{av.} \approx 288\ K$$

$$\lambda_{\max} = \frac{2897}{T} \approx 10\mu m$$



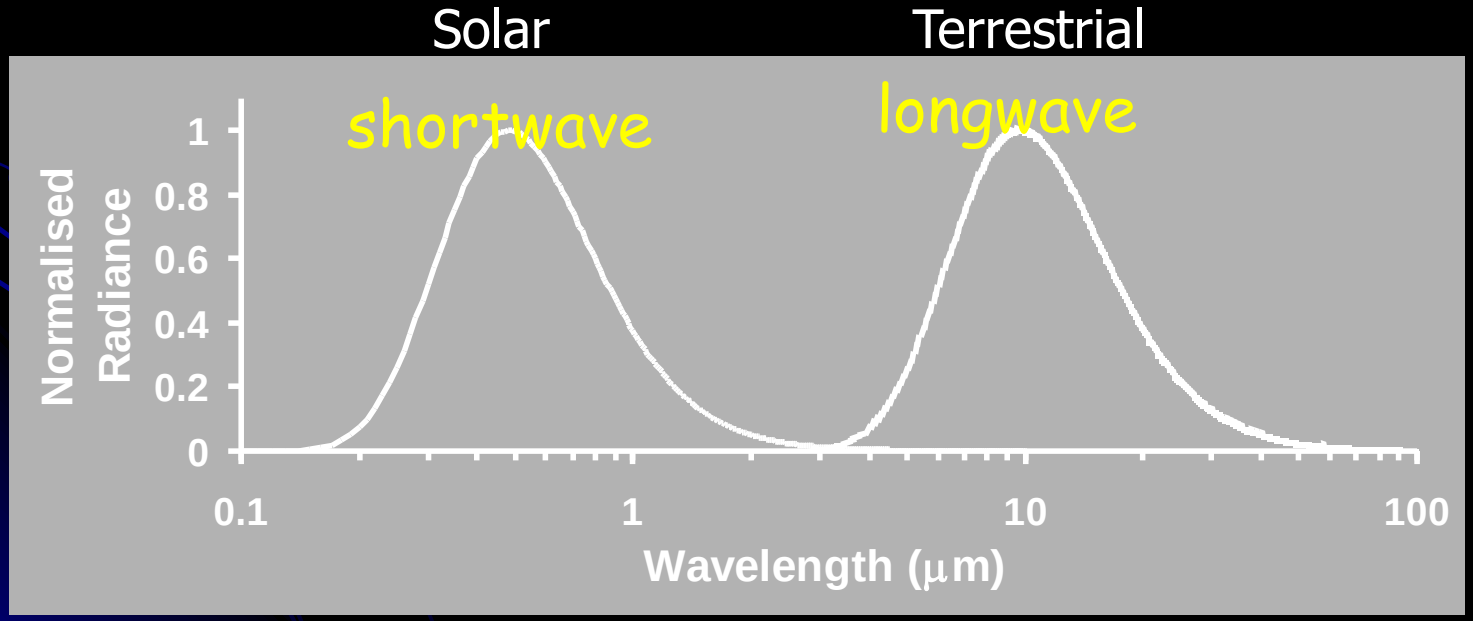
terrestrial spectrum
most energy between 4 and 30 μm

تابش زمینی : تابشی که توسط زمین و جو آن انجام می گیرد.

تابشی که از جانب سیاره زمین (یعنی سیستم زمین – جو) تابش می شود مشتمل بر:

الف) تابش سطح زمین ب) تابش جوی

Radiation from the Sun and Earth

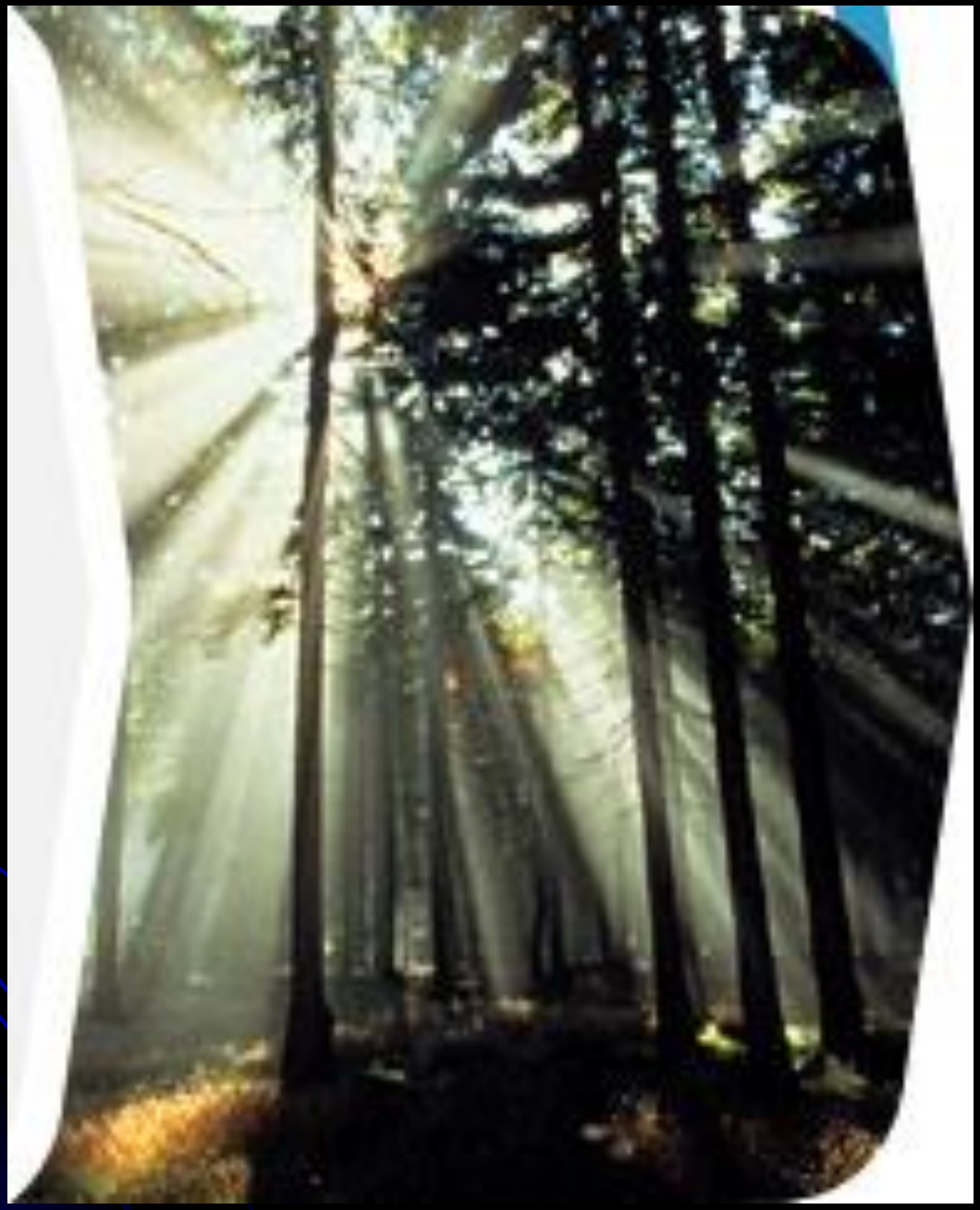


Ways to label radiation

- **By its source**
  - **Solar radiation - originating from the Sun**
  - **Terrestrial radiation - originating from the Earth**
- **By its proper name**
  - **ultra violet, visible, near infrared, infrared, microwave, etc….**
- **By its wavelength**

  short wave radiation $\lambda \leq 4$ micrometers

  long wave radiation $\lambda > 4$ micrometers



Greenhouse Effect

- **Visible light (short wavelength)**
  - Not absorbed by glass
  - Passes thru unchanged
  - Contacts surfaces
    - Some reflected
    - Some degraded (IR)
- **Infrared light (long wavelength) Heat**
  - Absorbed by glass
  - Re-emitted to space and back into greenhouse

Greenhouse Effect اثر گلخانه ای

اثر گلخانه ای یک پدیده طبیعی است که باعث افزایش دمای سطح زمین می گردد.

غلظت گازهای گلخانه ای در اثر فعالیتهای انسان باعث دمای سطح زمین و بروز مشکلات ویژه می گردد.

تغییر آب و هوای کره زمین حاصل اثر گلخانه ای است.

گازهای مهم گلخانه ای عبارتند از:

دی اکسید کربن (سوختهای فسیلی و آتش سوزی جنگلها).

کلروفلوروکربن ها (فومها- ایروسلها- یخچالها و حلالها).

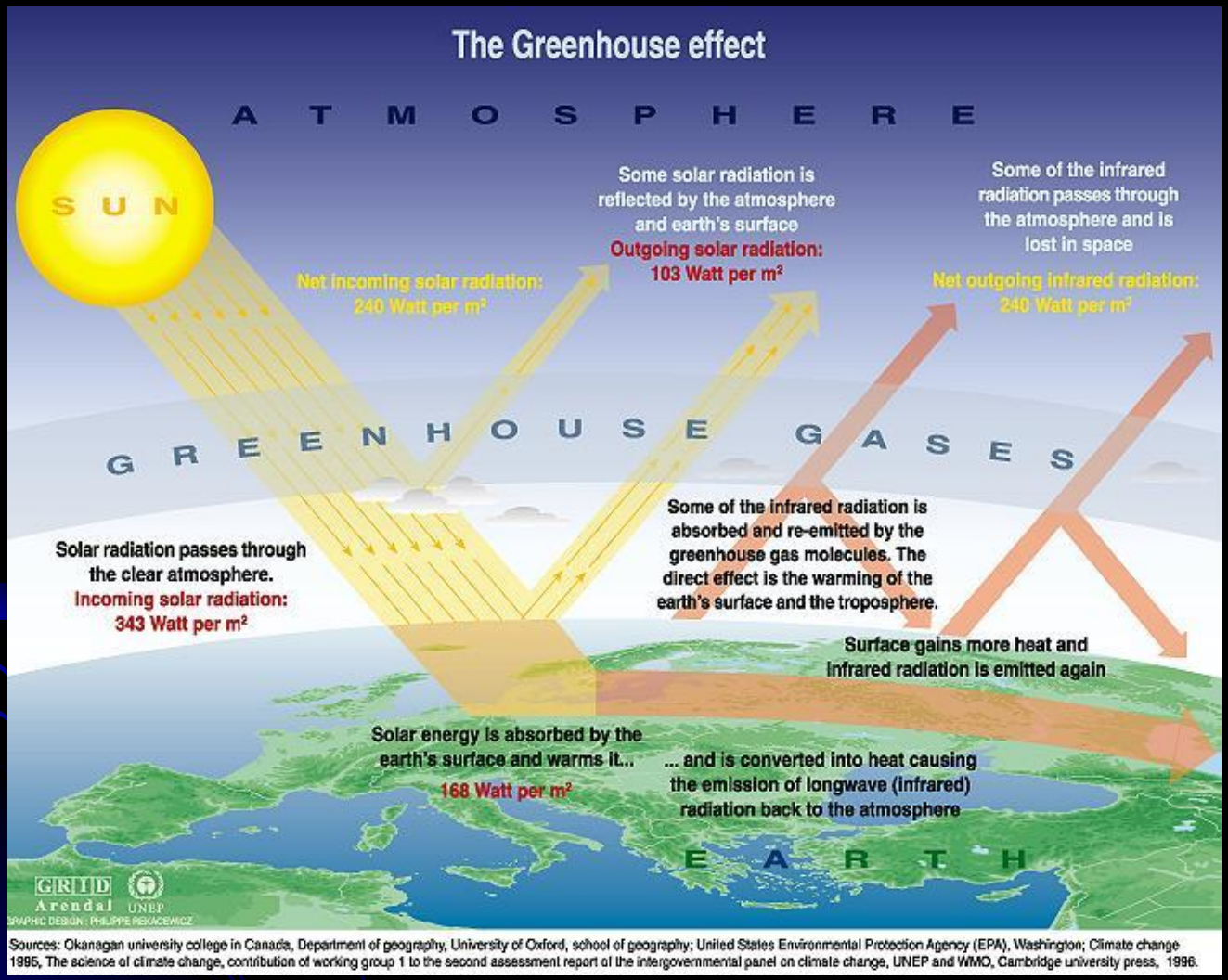
متان (اراضی باتلاقی- دامپروریها و سوختهای فسیلی).

نیتروس اکسید.

THE GREENHOUSE EFFECT

- The **greenhouse effect** is a naturally occurring process that aids in heating the Earth's surface and atmosphere. It results from the fact that certain atmospheric gases, such as **carbon dioxide *water vapor***, and **methane**, are able to change the energy balance of the planet by absorbing **longwave radiation** emitted from the Earth's surface.
- Without the greenhouse effect life on this planet would probably not exist, as the average temperature of the Earth would be a chilly -18° Celsius, rather than the present 15° Celsius.

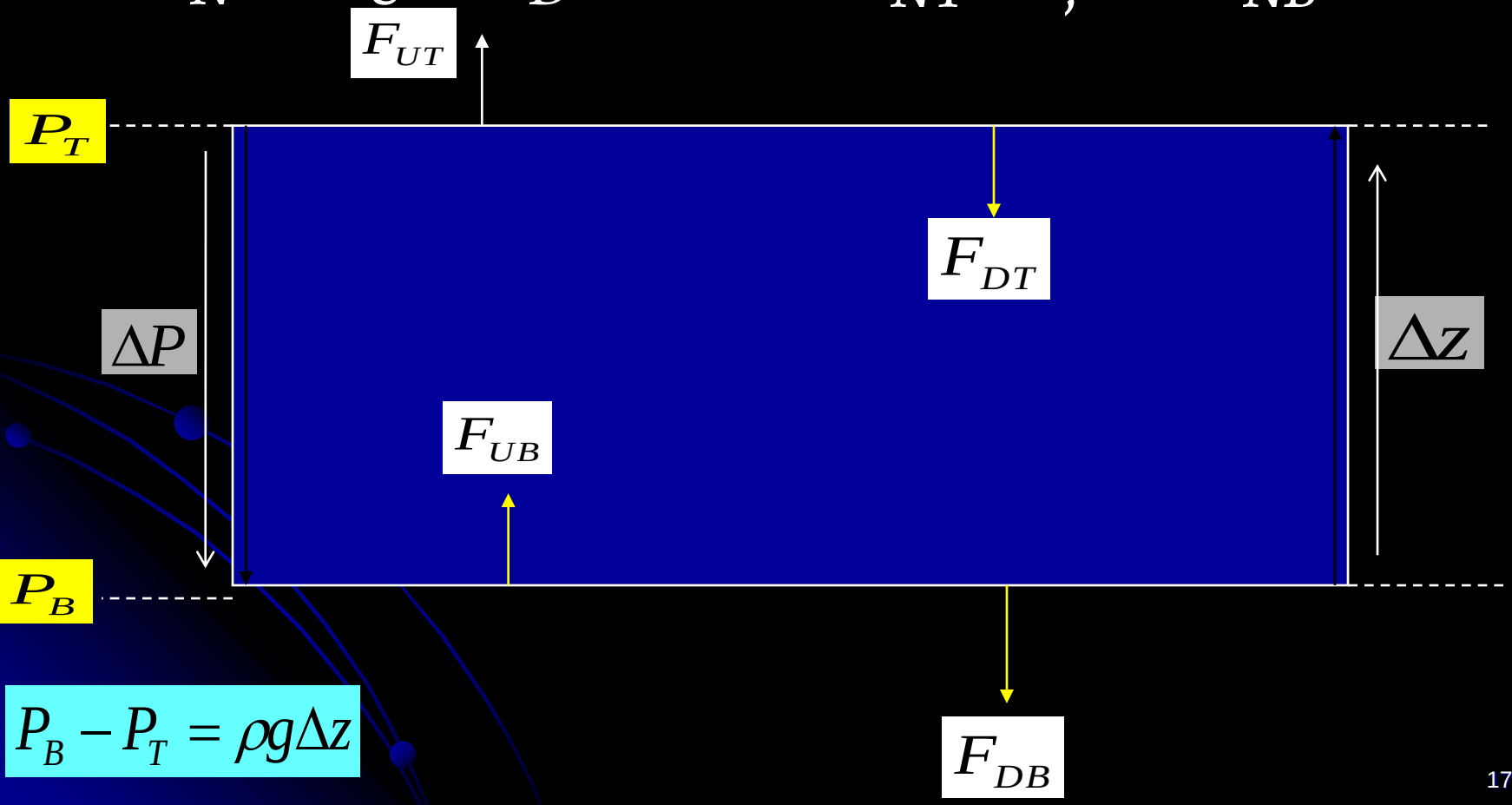
Atmospheric Greenhouse Effect



Sources: Okanagan university college in Canada, Department of geography, University of Oxford, school of geography; United States Environmental Protection Agency (EPA), Washington; Climate change 1995, The science of climate change, contribution of working group 1 to the second assessment report of the intergovernmental panel on climate change, UNEP and WMO, Cambridge university press, 1996.

Radiant Heating and Cooling

$$F_N = F_U - F_D \qquad F_{NT} \quad , \quad F_{NB}$$



$$P_B - P_T = \rho g \Delta z$$

$$\frac{\Delta Q}{\Delta t} = F_{NB} - F_{NT}$$

$$\Delta Q = \Delta M c_p \Delta T$$

$$\Delta M = \rho \Delta Z$$

$$\Delta Q = \frac{P_B - P_T}{g} c_p \Delta T$$

$$\frac{\Delta T}{\Delta t} = \frac{g}{c_p} \frac{F_{NB} - F_{NT}}{P_B - P_T}$$

$$\frac{\Delta T}{\Delta t} = \frac{g}{c_p} \frac{F_{NB} - F_{NT}}{P_B - P_T}$$

$$if \quad F_{NT} > F_{NB} \qquad \Rightarrow \frac{\Delta T}{\Delta t} < 0$$

$$if \quad F_{NB} > F_{NT} \qquad \Rightarrow \frac{\Delta T}{\Delta t} > 0$$

Thanks for your attention