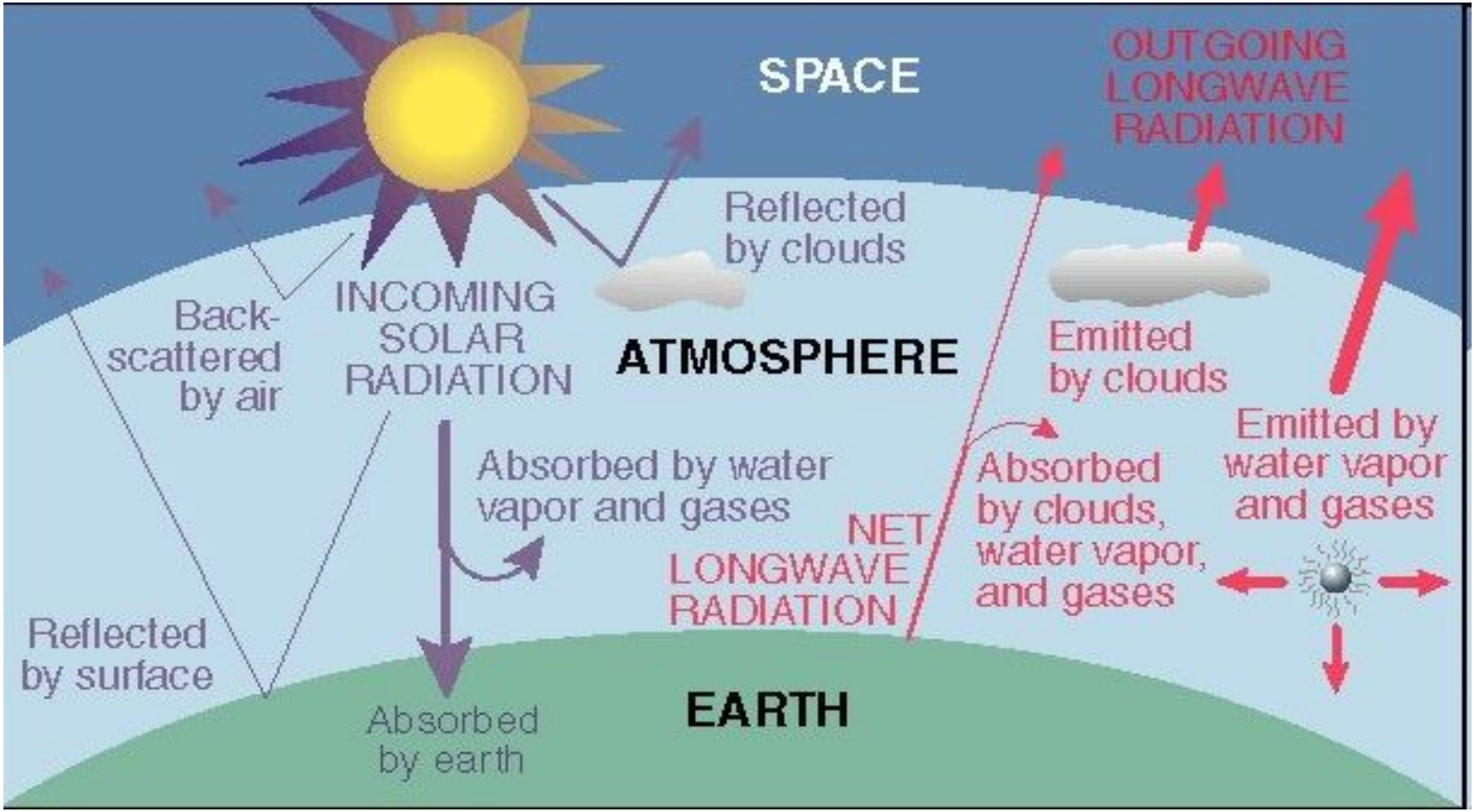
Net radiation (NR)

The sum of the direct (*I'*) *and* scattered (*i*) solar radiation coming on the horizontal surface is called

NET RADIATION FLUX

http://www.uwsp.edu/geo/faculty/ritter/images/atmosphere/energy/radiation_balance_usgs_large.jpg



http://www.uwsp.edu/geo/faculty/ritter/images/atmosphere/energy/radiation_balance_usgs_large.jpg

$$Q_0 = \frac{I_0 \cdot SINh_o}{1 + \varepsilon\tau \cdot COSECh_o}$$

Kondratiev's formula

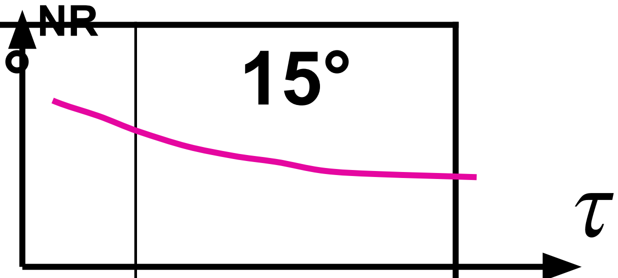
τ represents the optical depth of the atmosphere for the total radiation flux.

$$\tau = \tau_{0,55}$$

$\tau_{0,55}$ **denotes *optical depth* for homogeneous radiation flux** $\lambda = 0{,}55\mu$

ε is a coefficient depending on the Sun altitude.

h_o	60°	30°	15°
ε	0,14	0,20	0,24



NR depends only slightly on optical depth of the atmosphere

That is why we can adopt τ value as a constant

Normal values of the NR

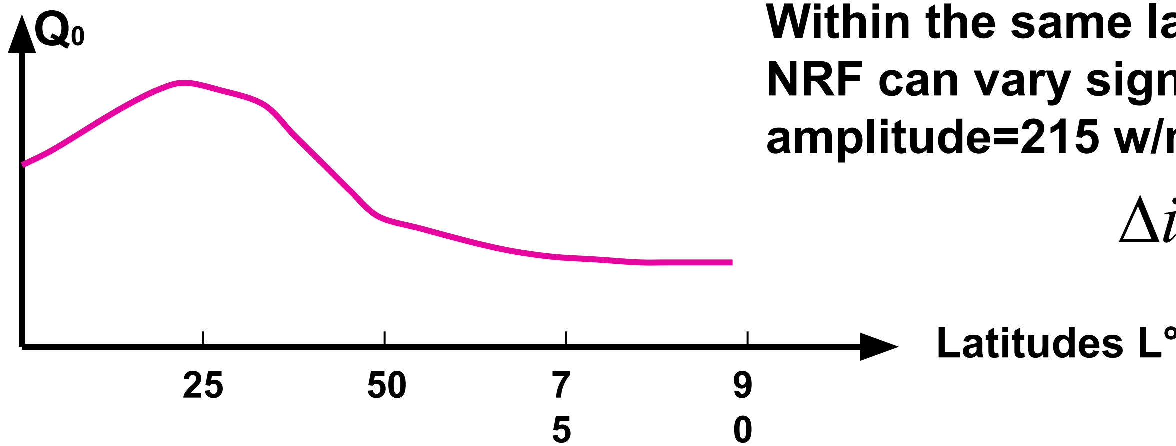
These values greatly depends on the sun altitude (h_o) and atmospheric transparency (we'll denote it be the letter "c").

C=0,27 corresponds to the highest transparency; c=0,91 – to the lowest one.

$$NR \; {kW}/{m^2}$$

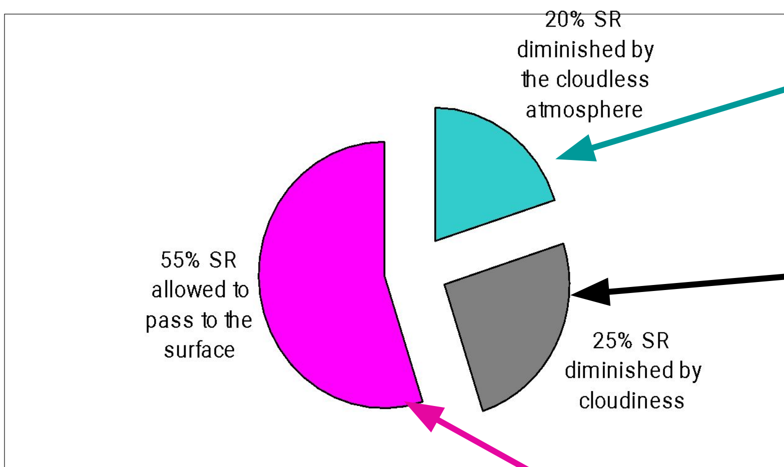
c	h_o						
	7	15	30	45	60	75	90
0,91	0,05	0,15	0,38	0,61	0,80	0,90	0,95
0,67	0,06	0,18	0,41	0,66	0,84	0,95	0,98
0,54	0,07	0,20	0,44	0,52	0,87	0,98	1,03
0,43	0,08	0,22	0,48	0,56	0,91	1,02	1,07
0,34	0,08	0,22	0,50	0,59	0,96	1,06	1,11
0,27	0,10	0,24	0,54	0,62	0,99	1,10	1,14

NR flux depends also on latitude.



Within the same latitudinal zone NRF can vary significantly. Global amplitude=215 w/m².

$$\Delta i = 25 - 50W / m^2$$



Cloudless atmosphere absorbs and diffuses 20% incoming SR.

Cloudiness further diminishes about 25% of SR

The rest 55% reaches the ground surface

Cloudiness impact on net radiation can be described with following formulas:

$$Q = Q_0(1 - fn) \quad \text{or} \quad Q = Q_0[1 - (a + bn)n]$$

Q_0 **is the net radiation flux in cloudless atmosphere,**

n **is cloud amount in decimal fractions,**

"f", *"a"*, *"b"* **are empirical coefficients.** $b \approx 0{,}38$

These coefficients depend on latitudes and type of underlying surface (land or sea).

For the land surface the coefficients are presented in the table on the page 1 of the Lecture Note #5.

Transmission function for sea surface

$$a_1 = 1 - 0{,}11\sqrt{e} \qquad P = \frac{Q_n}{Q^0} = 0{,}8 - 0{,}7 \cdot \exp(-a_1 \cdot x) \qquad x = (1{,}1 - n)d$$

n **is cloud amount in decimal fractions,** ***e*** **is water vapor partial pressure in hPa,** ***d*** **is deficit of the water vapor pressure in hPa.**

Q_n **is net radiation at the ground surface,** Q° **is the solar radiation flux at the top of the atmosphere.**

$$n = \frac{n_t + n_l}{2}$$

n_t is amount of the total cloudiness, n_l is low cloudiness amount.

In case of no information on humidity

$$P = \frac{Q_n}{Q^0} = 0{,}8 - 0{,}6n^2$$

The net radiation determines whether the surface temperature rises, falls, or remains the same:

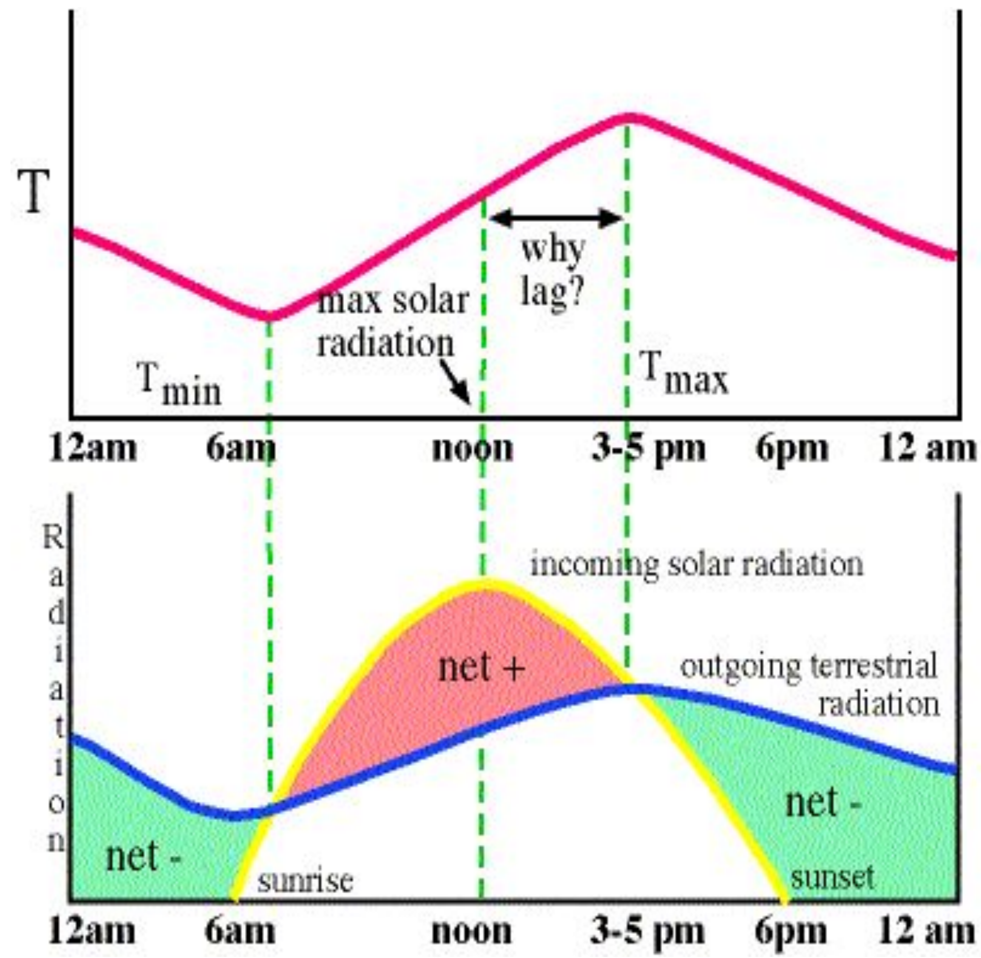
http://apollo.lsc.vsc.edu/classes/met130/notes/chapter3/daily_trend5.html

net radiation = incoming solar - outgoing IR

If the net radiation > 0, surface warms (6 AM - 3-5 PM)

if the net radiation < 0, surface cools (3-5 PM - 6 AM)

This also explains why the warmest part of the year is in July/August, not on 21 June during the summer solstice.



http://apollo.lsc.vsc.edu/classes/met130/notes/chapter3/daily_trend5.html