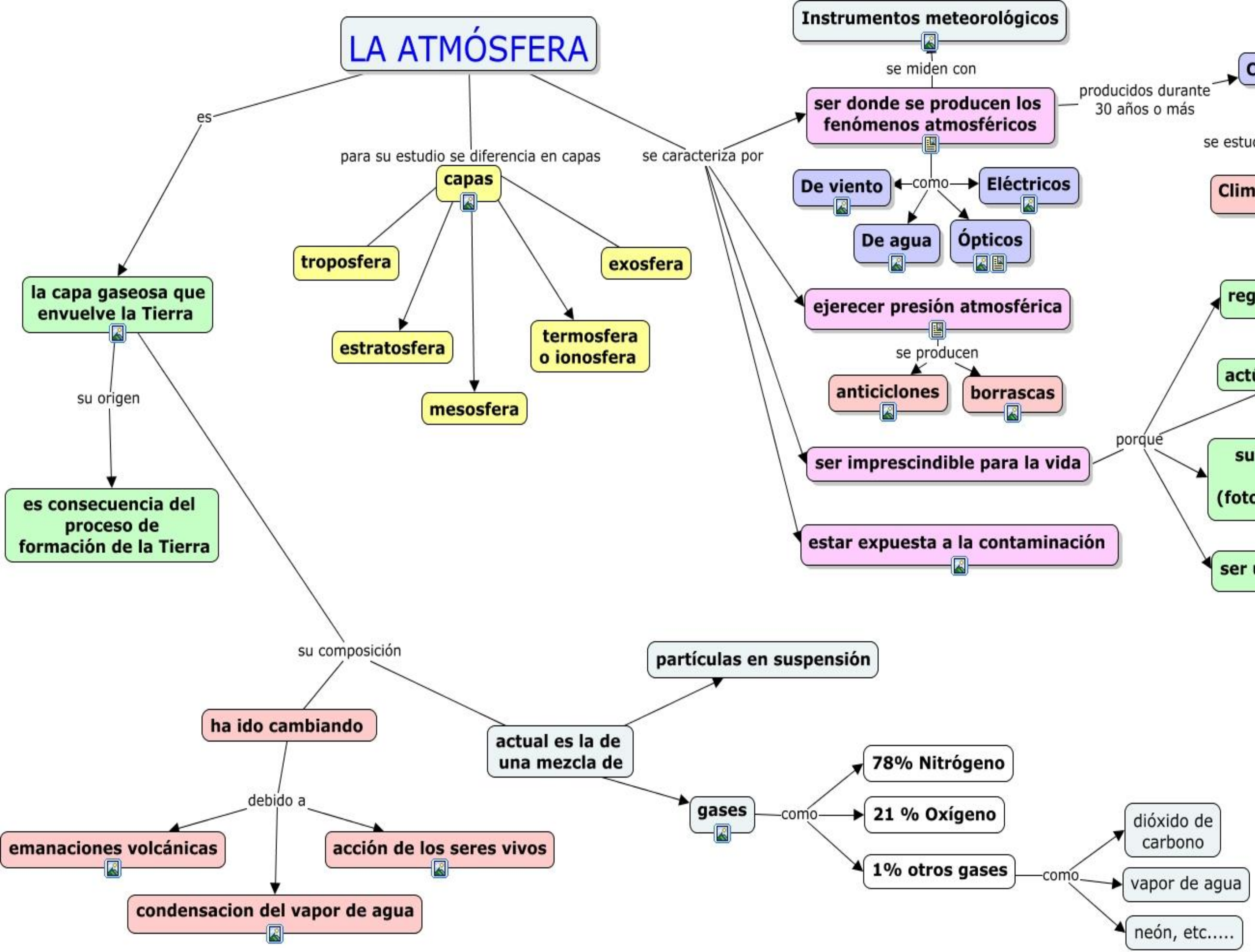
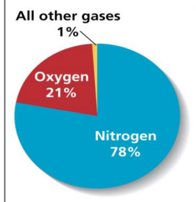
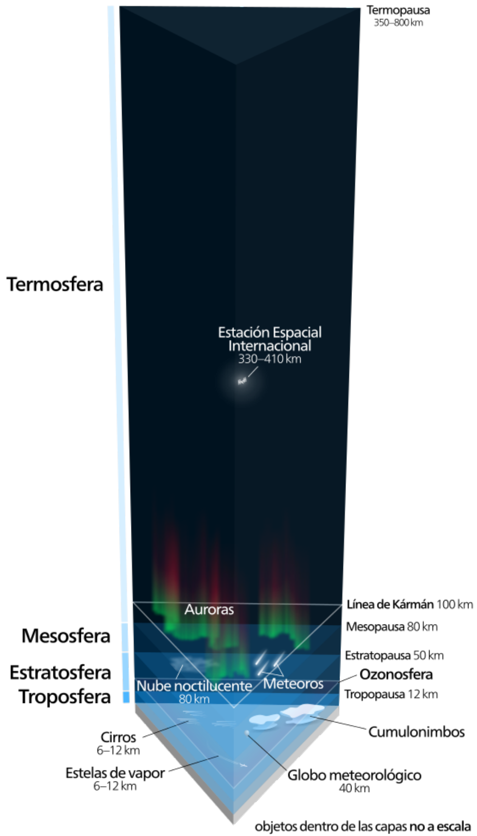


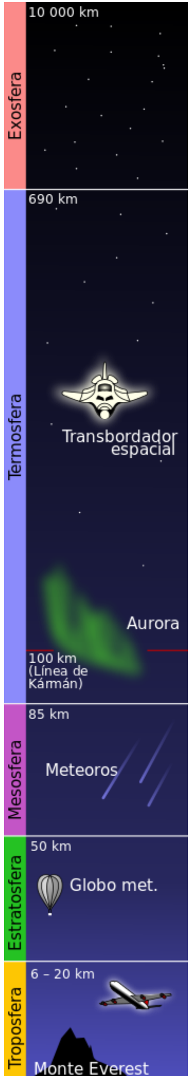
Composition of the Atmosphere

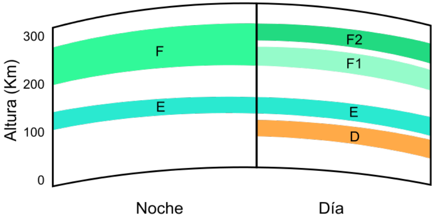


Gas	Percentage by Volume
Nitrogen (N_2)	78.084
Oxygen (O_2)	20.946
Argon (Ar)	0.934
Carbon dioxide (CO_2)	0.037
Neon (Ne)	0.00182
Helium (He)	0.00052
Methane (CH_4)	0.00015
Krypton (Kr)	0.00011

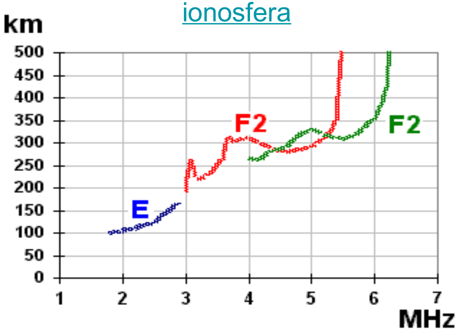
Capas de la atmósfera







Capas E y F de la [ionosfera]



[Ionograma], mostrando la altura a la que se reflejan ondas según las distintas frecuencias.

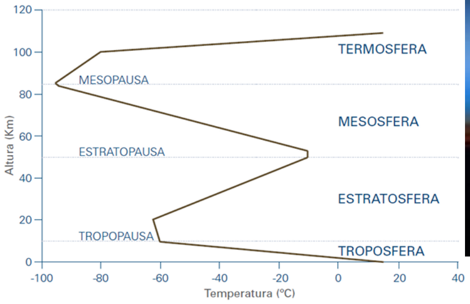


Figura 2.1. Perfil térmico de la atmósfera.

Atmósfera [wiki]

Troposfera: Es la capa más baja, en la que se desarrolla la vida y la mayoría de los fenómenos meteorológicos. Se extiende hasta una altura aproximada de 10 km en los polos y 18 km en el ecuador. En la troposfera la temperatura disminuye paulatinamente con la altura hasta alcanzar los -70º C. Su límite superior es la tropopausa.

Estratosfera: En esta capa, la temperatura se incrementa hasta alcanzar aproximadamente los -10ºC a unos 50 km de altitud. Es en esta capa donde se localiza la máxima concentración de ozono, "capa de ozono", gas que al absorber parte de la radiación ultravioleta e infrarroja del Sol posibilita la existencia de condiciones adecuadas para la vida en la superficie de la Tierra. El tope de esta capa se denomina estratopausa.

Mesosfera: En ella, la temperatura vuelve a disminuir con la altura hasta los -140 ºC. Llega a una altitud de 80 km, al final de los cuales se encuentra la mesopausa.

Termosfera: Es la última capa, que se extiende hasta varios cientos de kilómetros de altitud, presentando temperaturas crecientes hasta los 1000 ºC. Aquí los gases presentan una densidad muy baja y se encuentran ionizados.

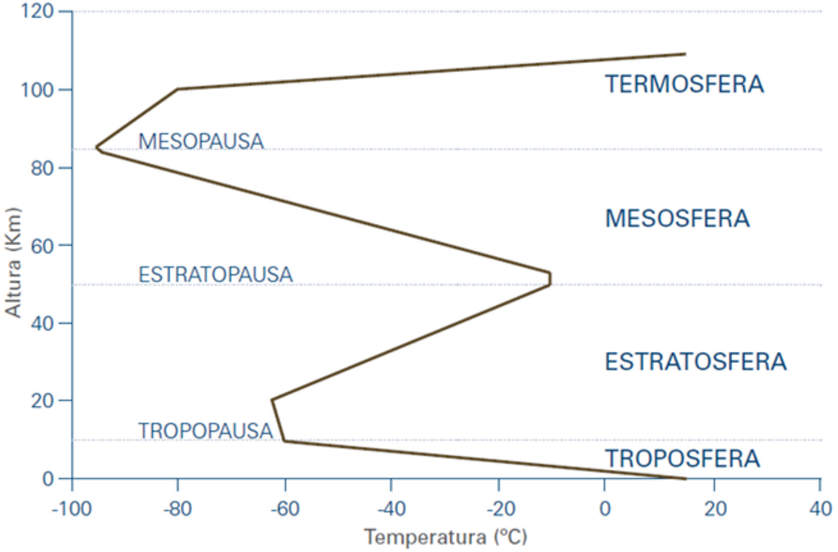
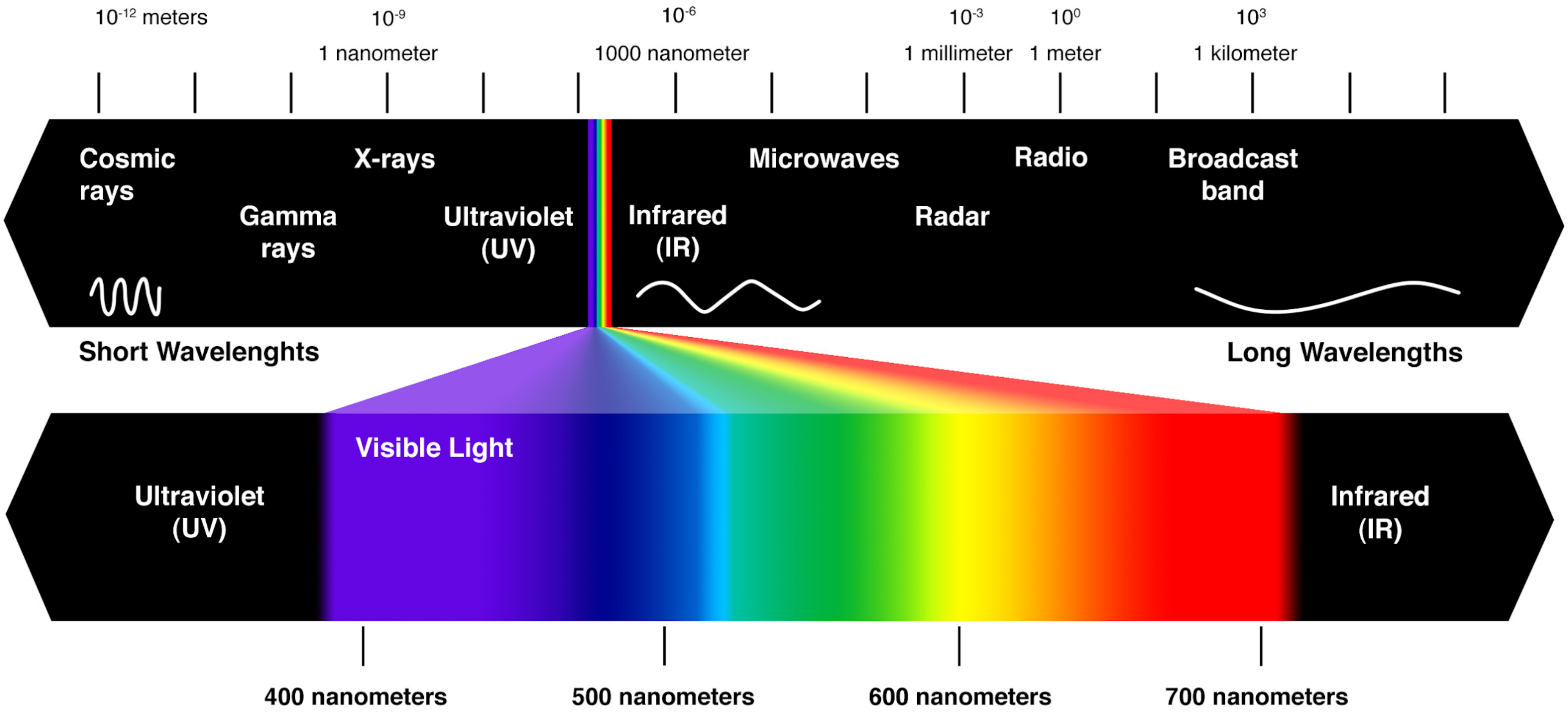
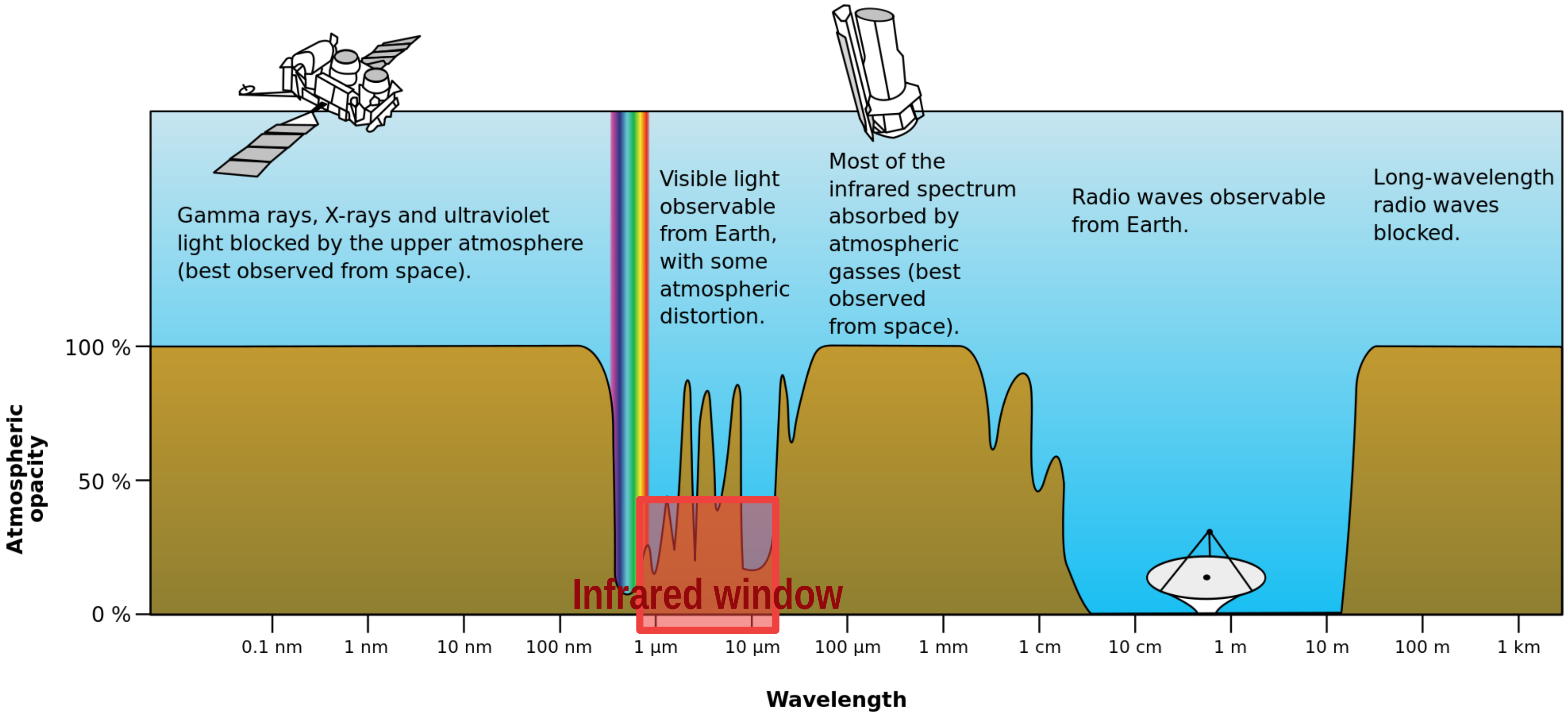


Figura 2.1. Perfil térmico de la atmósfera.

Espectro electromagnético

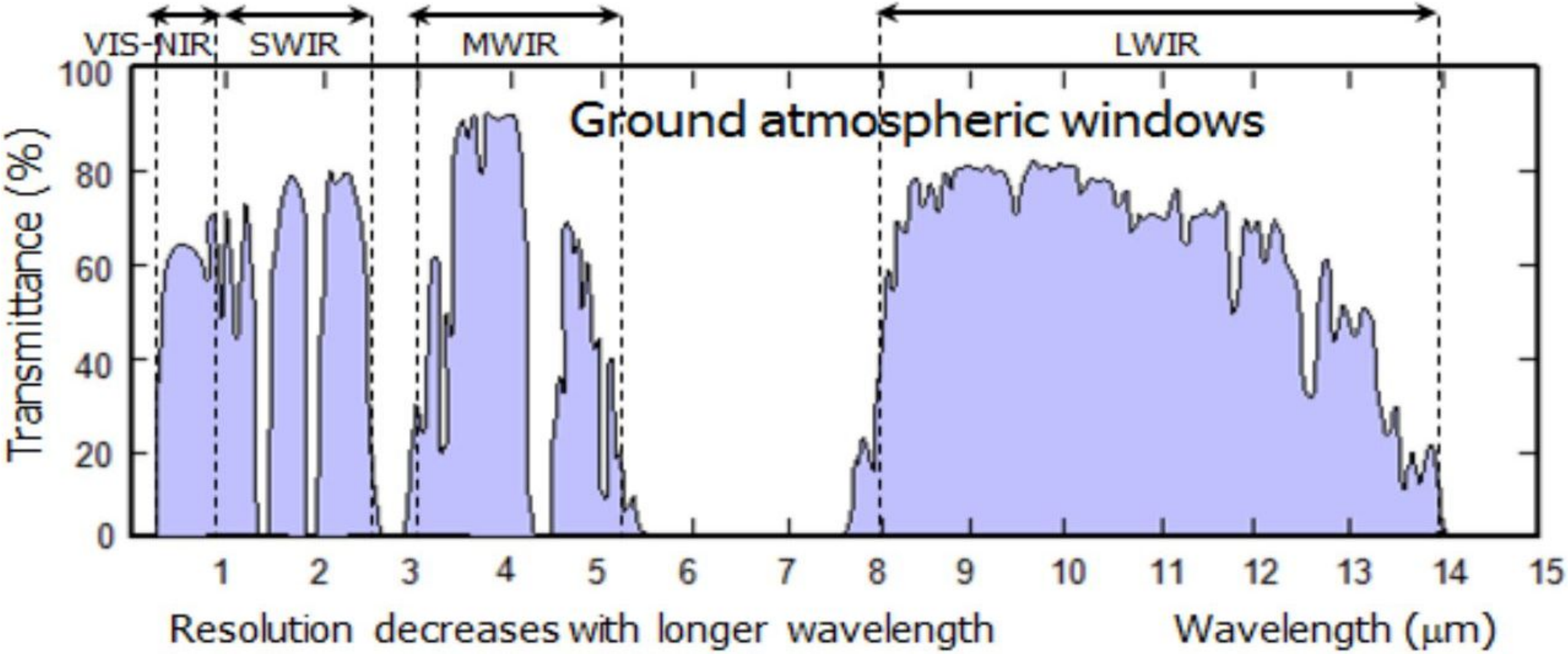


Espectro electromagnético



Plot of Earth's atmospheric **opacity** (somehow the inverse of **transmittance**) to various wavelengths of electromagnetic radiation.

Ventana de Infrarrojo



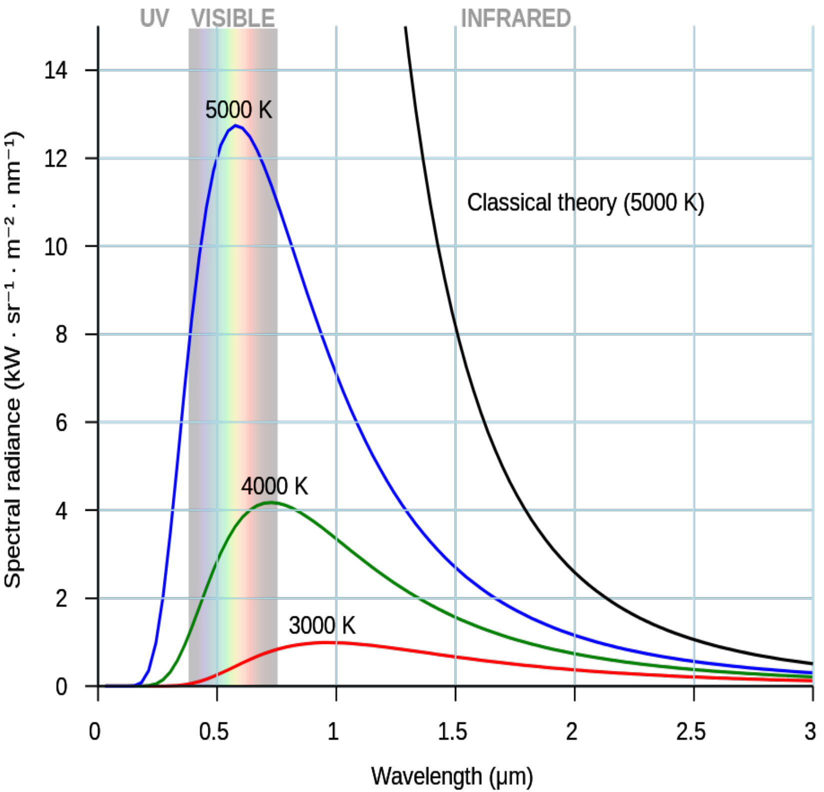
The **infrared atmospheric window** is the overall dynamic property of the earth's atmosphere, taken as a whole at each place and occasion of interest, that lets some infrared radiation from the cloud tops and land-sea surface pass directly to space without intermediate absorption and re-emission, and thus without heating the atmosphere.

Ley de Planck

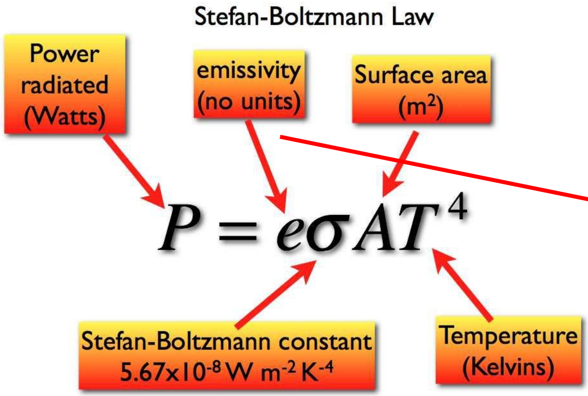
Planck's law describes the unique and characteristic spectral distribution for electromagnetic radiation in thermodynamic equilibrium, when there is no net flow of matter or energy. Its physics is most easily understood by considering the radiation in a cavity with rigid opaque walls. Motion of the walls can affect the radiation. If the walls are not opaque, then the thermodynamic equilibrium is not isolated. It is of interest to explain how the thermodynamic equilibrium is attained. There are two main cases: (a) when the approach to thermodynamic equilibrium is in the presence of matter, when the walls of the cavity are imperfectly reflective for every wavelength or when the walls are perfectly reflective while the cavity contains a small black body (this was the main case considered by Planck); or (b) when the approach to equilibrium is in the absence of matter, when the walls are perfectly reflective for all wavelengths and the cavity contains no matter. For matter not enclosed in such a cavity, thermal radiation can be approximately explained by appropriate use of Planck's law.

Classical physics led, via the Equipartition theorem, to the Ultraviolet catastrophe, a prediction that the total blackbody radiation intensity was infinite. If supplemented by the classically unjustifiable assumption that for some reason the radiation is finite, classical thermodynamics provides an account of some aspects of the Planck distribution, such as the Stefan–Boltzmann law, and the Wien displacement law. For the case of the presence of matter, quantum mechanics provides a good account, as found below in the section headed Einstein coefficients. This was the case considered by Einstein, and is nowadays used for quantum optics. For the case of the absence of matter, quantum field theory is necessary, because non-relativistic quantum mechanics with fixed particle numbers does not provide a sufficient account.

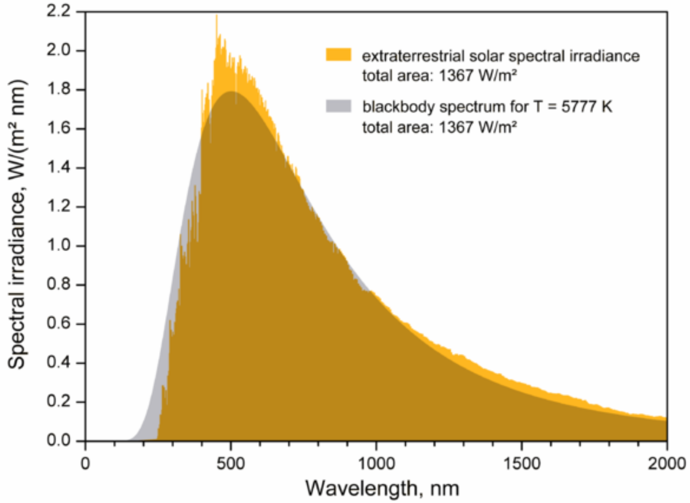
with h		with $\hbar$	
variable	**distribution**	**variable**	**distribution**
Frequency ν	$B_\nu(\nu,T)=\frac{2h\nu^3}{c^2}\frac{1}{e^{h\nu/(k_\mathrm{B}T)}-1}$	**Angular frequency** ω	$B_\omega(\omega,T)=\frac{\hbar\omega^3}{4\pi^3c^2}\frac{1}{e^{\hbar\omega/(k_\mathrm{B}T)}-1}$
Wavelength λ	$B_\lambda(\lambda,T)=\frac{2hc^2}{\lambda^5}\frac{1}{e^{hc/(\lambda k_\mathrm{B}T)}-1}$	**Angular wavelength** y	$B_y(y,T)=\frac{\hbar c^2}{4\pi^3y^5}\frac{1}{e^{\hbar c/(yk_\mathrm{B}T)}-1}$
Wavenumber $\tilde{\nu}$	$B_{\tilde{\nu}}(\tilde{\nu},T)=2hc^2\tilde{\nu}^3\frac{1}{e^{hc\tilde{\nu}/(k_\mathrm{B}T)}-1}$	**Angular wavenumber** k	$B_k(k,T)=\frac{\hbar c^2k^3}{4\pi^3}\frac{1}{e^{\hbar ck/(k_\mathrm{B}T)}-1}$



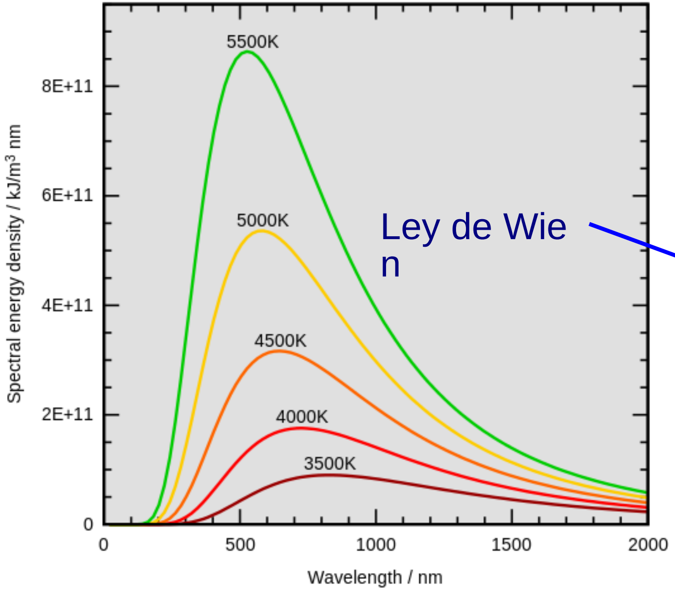
Black body curves of Planck for various temperatures and comparison with classical theory of Rayleigh-Jeans. See also ultraviolet catastrophe.



e = 1 para el cuerpo negro



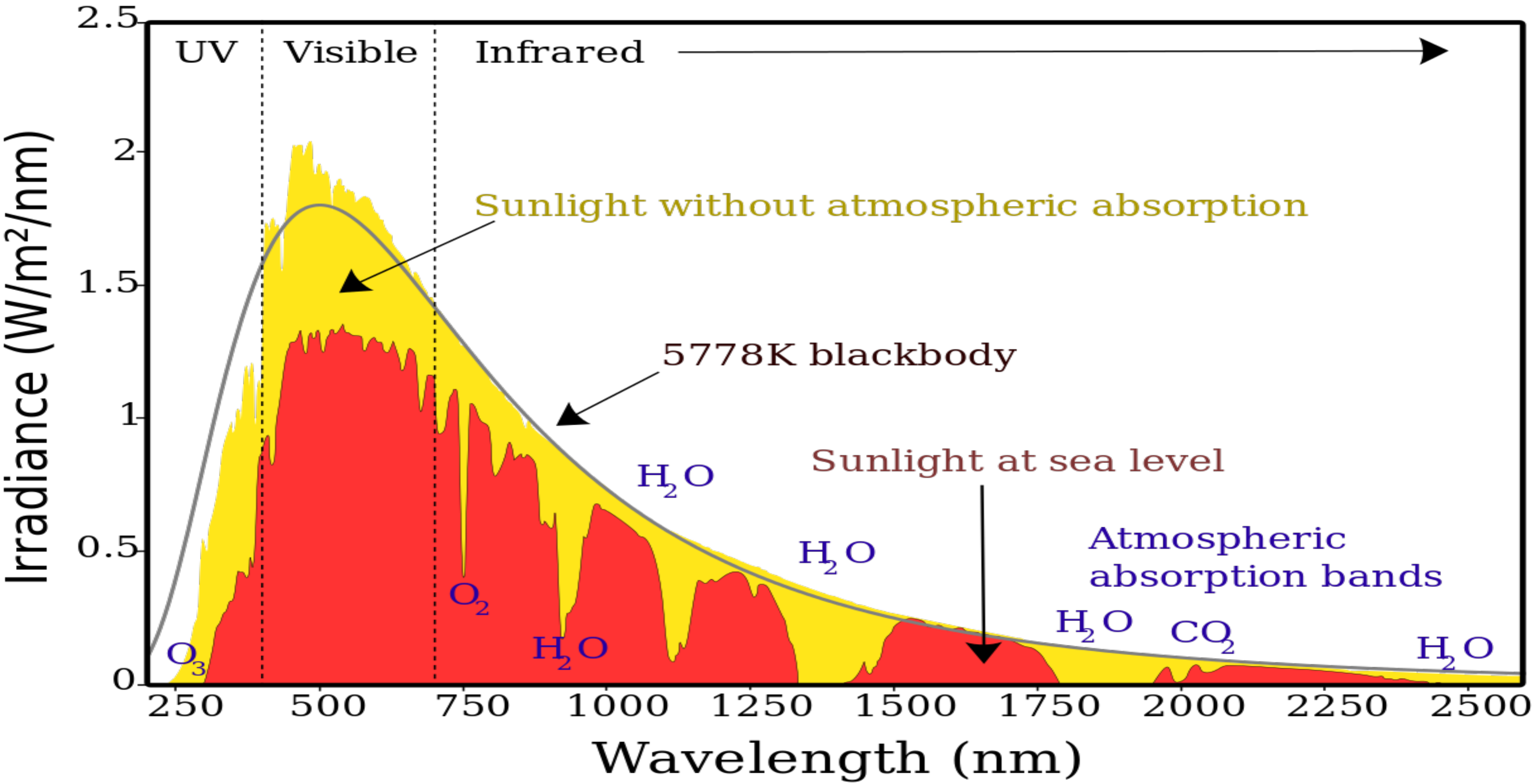
Comparación entre la irradiación de la fotosfera solar (amarillo) y la curva teórica de emisión de un cuerpo negro (en gris) a 5777 K, la temperatura estimada para la fotosfera solar.



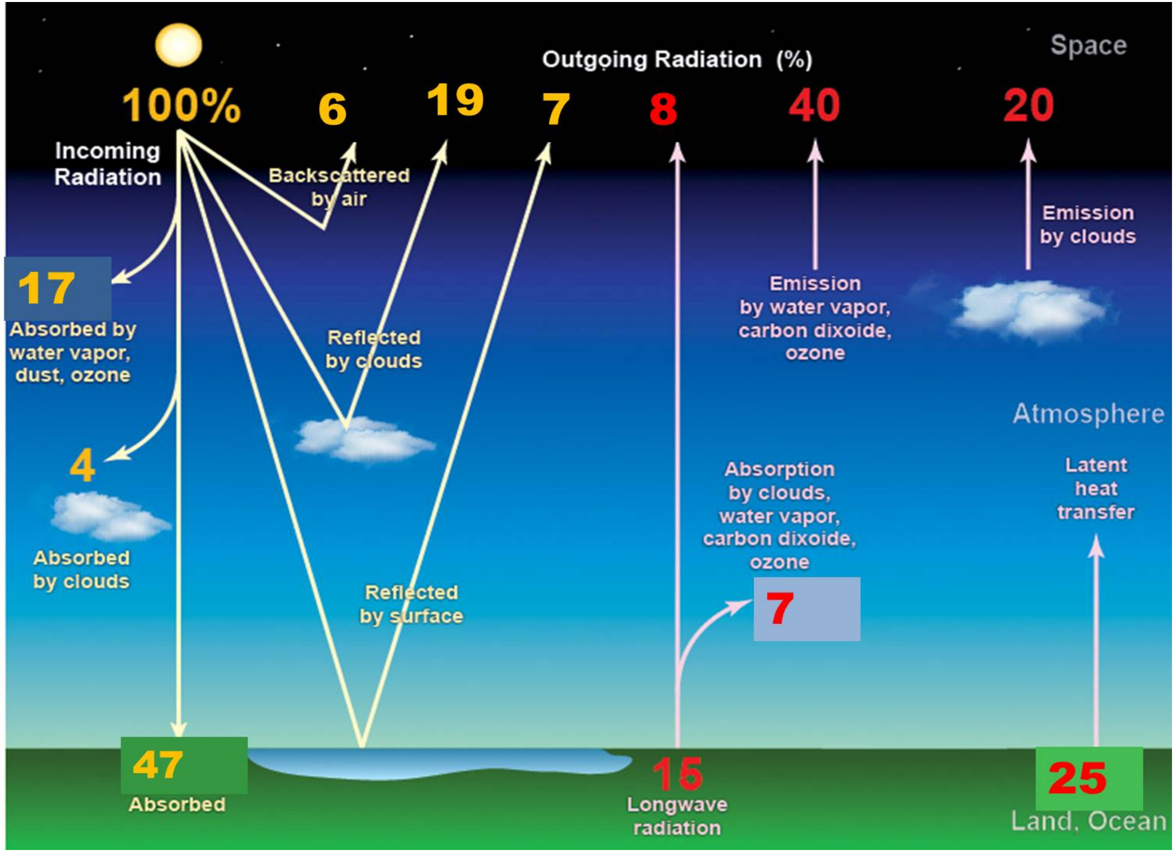
Ley de Wien

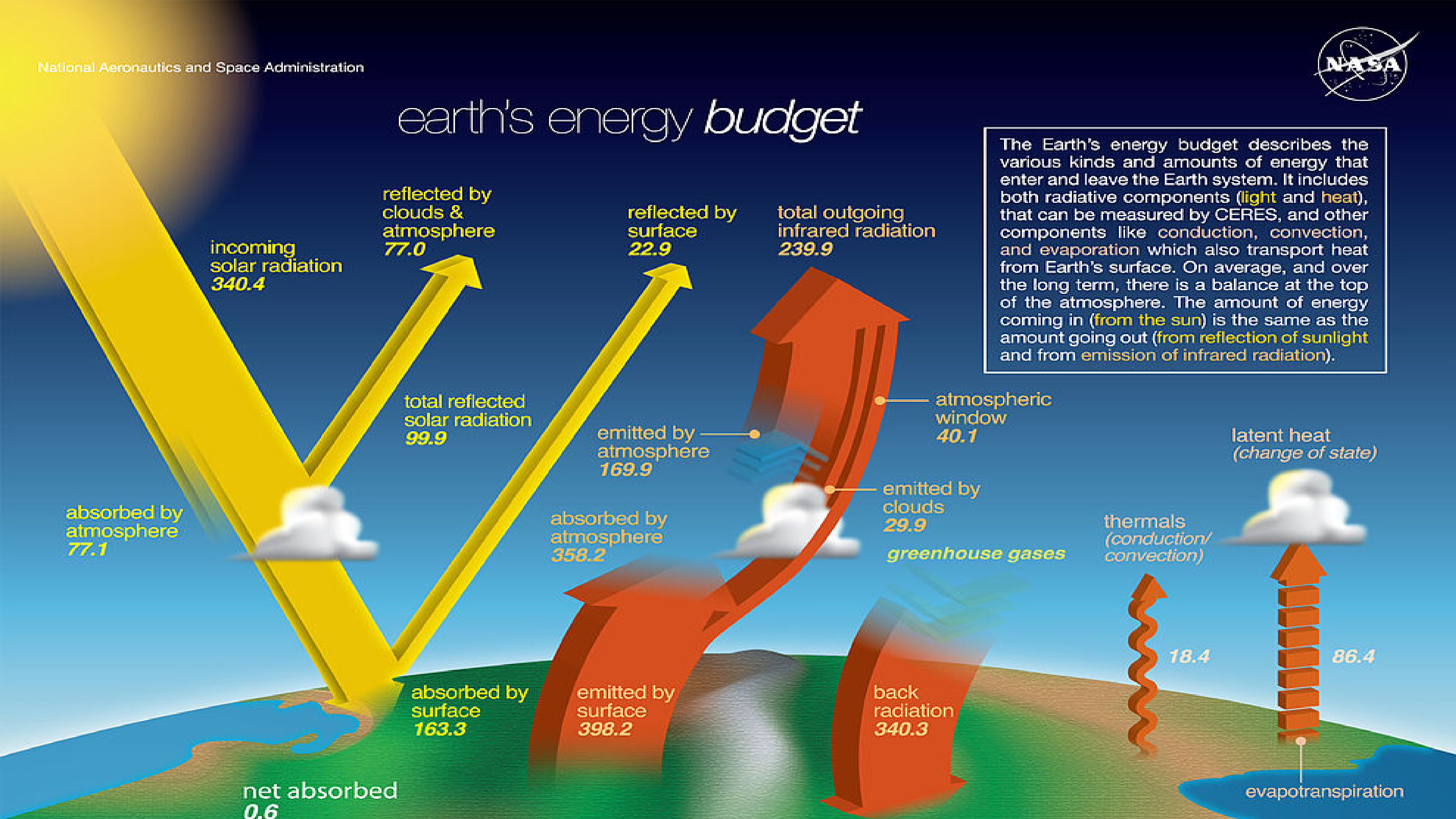
$$\lambda_{\max} = \frac{hc}{x}\frac{1}{kT} = \frac{2.89776829 \times 10^6\ \mathrm{nm \cdot K}}{T}$$

Spectrum of Solar Radiation (Earth)



Balance radiativo




National Aeronautics and Space Administration
NASA
earth's energy budget
The Earth's energy budget describes the various kinds and amounts of energy that enter and leave the Earth system. It includes both radiative components (light and heat), that can be measured by CERES, and other components like conduction, convection, and evaporation which also transport heat from Earth's surface. On average, and over the long term, there is a balance at the top of the atmosphere. The amount of energy coming in (from the sun) is the same as the amount going out (from reflection of sunlight and from emission of infrared radiation).
incoming solar radiation 340.4
reflected by clouds & atmosphere 77.0
reflected by surface 22.9
total outgoing infrared radiation 239.9
total reflected solar radiation 99.9
atmospheric window 40.1
emitted by atmosphere 169.9
latent heat (change of state)
absorbed by atmosphere 77.1
emitted by clouds 29.9
absorbed by atmosphere 358.2
thermals (conduction/ convection)
greenhouse gases
18.4
86.4
absorbed by surface 163.3
emitted by surface 398.2
back radiation 340.3
net absorbed 0.6
evapotranspiration

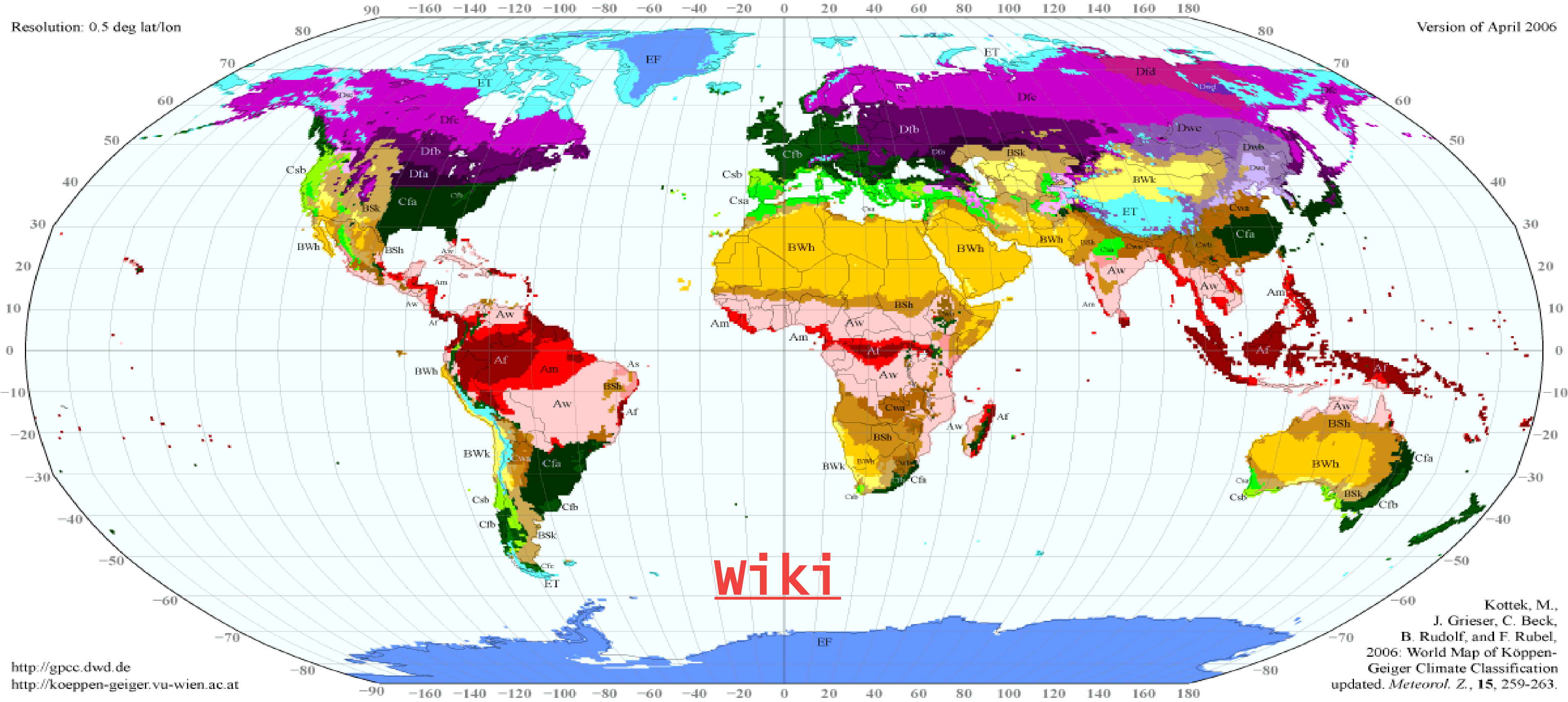
World Map of Köppen−Geiger Climate Classification

updated with CRU TS 2.1 temperature and VASClimO v1.1 precipitation data 1951 to 2000

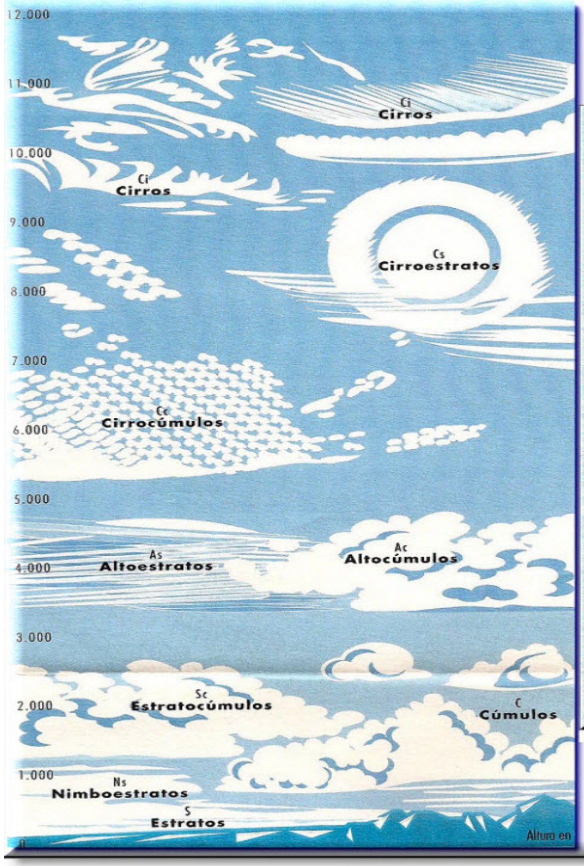
Af Am As Aw BWk BWh BSk BSh Cfa Cfb Cfc Csa Csb Csc Cwa

Cwb Cwc Dfa Dfb Dfc Dfd Dsa Dsb Dsc Dsd Dwa Dwb Dwc Dwd EF ET

Main climates	Precipitation	Temperature	
A: equatorial	W: desert	h: hot arid	F: polar frost
B: arid	S: steppe	k: cold arid	T: polar tundra
C: warm temperate	f: fully humid	a: hot summer	
D: snow	s: summer dry	b: warm summer	
E: polar	w: winter dry	c: cool summer	
	m: monsoonal	d: extremely continental	



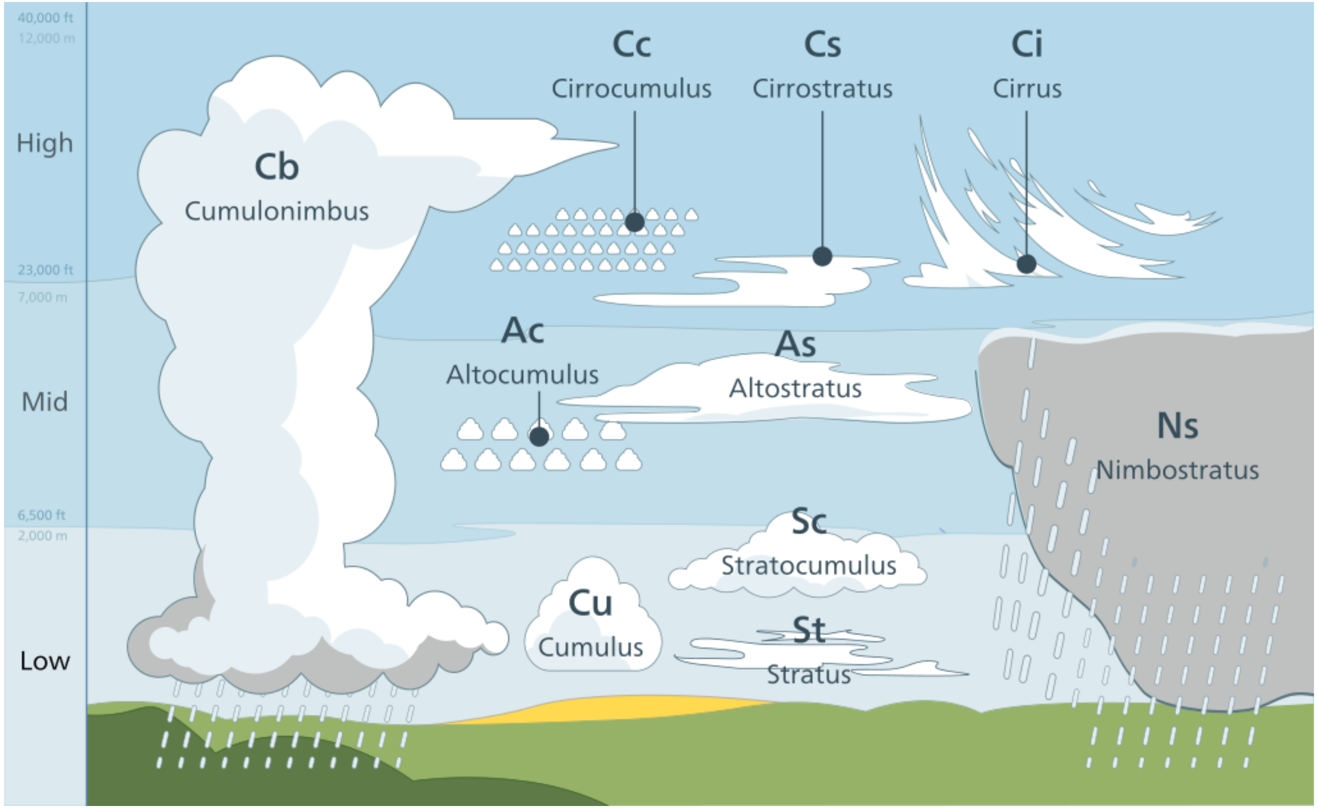
Clasificación de nubes



Género	Constitución física más común	Dimensión vertical/ Extensión horizontal	Meteoros más comunes
Cirros	Cristales de hielo	-	-
Cirroestratos	Cristales de hielo	Estratiforme	Halos
Cirrocúmulos	Cristales de hielo	Cumuliforme Estratiforme	-
Altoestratos	Mixta	Estratiforme	Lluvia (débil)
Altocúmulos	Liquida	Cumuliforme Estratiforme	Coronas
Nimboestratos	Líquida Cristales de hielo Mixta	Estratiforme	Lluvia Nieve
Estratocúmulos	Líquida	Cumuliforme Estratiforme	Lluvia,rara
Estratos	Líquida	Estratiforme	Llovizna
Cúmulos	Líquida	Cumuliforme	Chubasco
Cumulonimbos	Mixta	Cumuliforme	Chubascos Tormenta Granizo

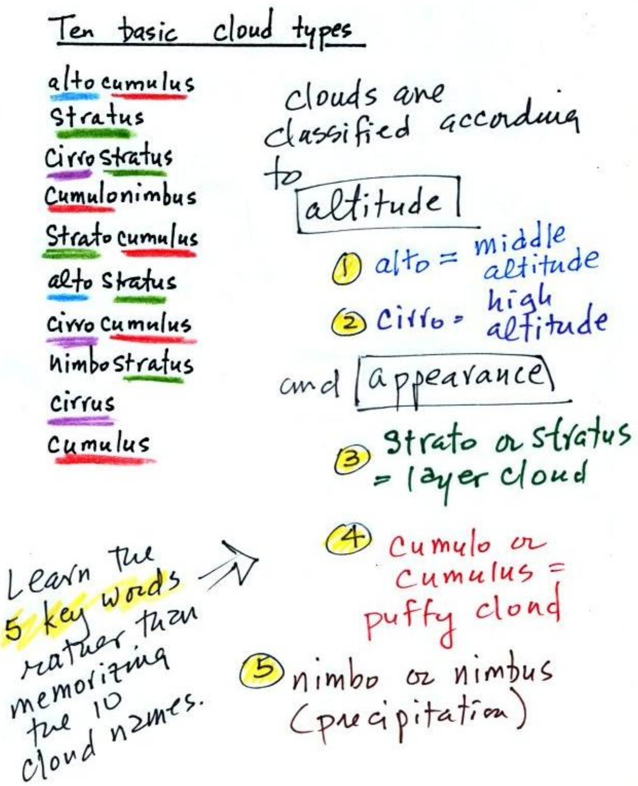
Atlas de nubes

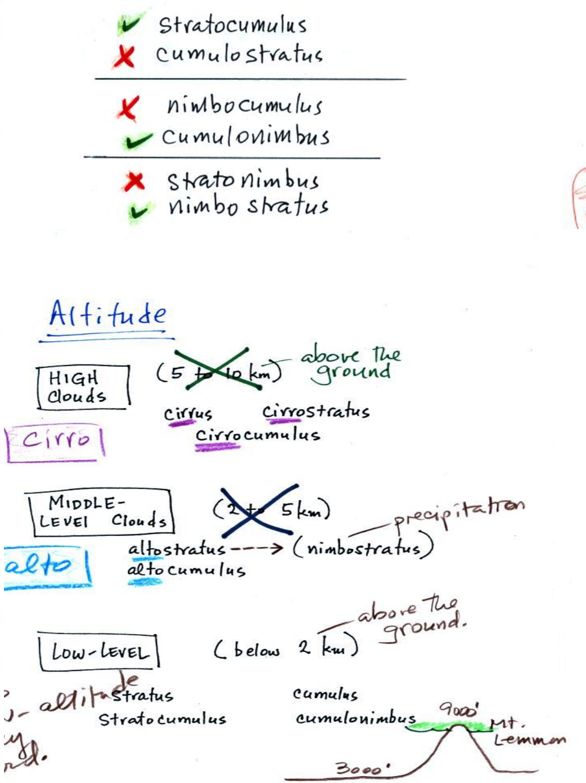
Clasificación de nubes

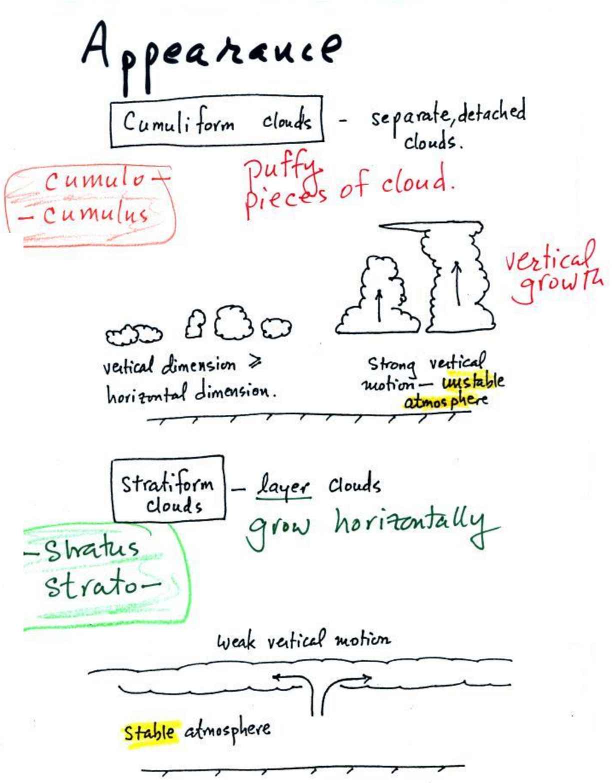


Nubes (wiki)

How to identify and name clouds



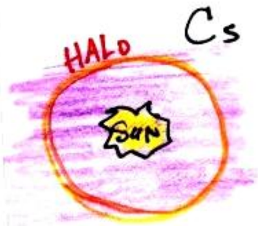




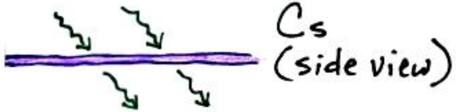
How to identify and name clouds

High altitude clouds

Cirrus (Ci) thin, white, filamentary appearance.
Form in cold air - not much water vapor.
Ice crystals. "Mare's tails"



Cirrostratus (Cs) white layer clouds. Thin enough to be pretty transparent. Can see the sun or moon clearly. Enough direct sunlight reaches the ground that objects on the ground cast shadows.



Haloes (caused by ice crystals) usually indicate Cs. Cs clouds may sometimes arrive 1 or 2 days ahead of an approaching storm (warm front).

Cirrocumulus (Cc) very small patches or ripples of cloud. Uniform white color, not thick enough to have grey shading. Not as common as two other cirrus type clouds.

At sunset, Cc clouds may resemble the scales on a fish - "mackerel sky"

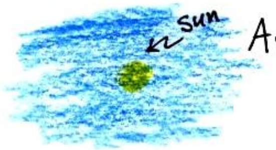
How to identify and name clouds

middle altitude clouds

Cc

Ac

Altocumulus (Ac) separate cloud elements about the size of your thumbnail when you hand is held at arm's length. May have grey shading.



As

Altostratus (As) gray cloud layer (thicker than Cs). Sun may be visible through thin As but will appear blurred or fuzzy.
Diffuse light, not much direct sunlight - objects on the ground do not cast shadows.

As

Nimbostratus (Ns) gray cloud layer producing precipitation. Precipitation usually fairly light, continuous, and may cover large area.

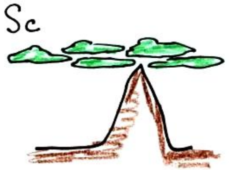
Thick As may resemble and eventually become Ns.

Fragments of cloud sometimes seen below Ns are called stratus fractus or "scud."

Ns

How to identify and name clouds

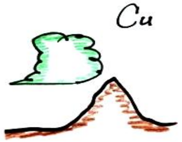
low altitude clouds



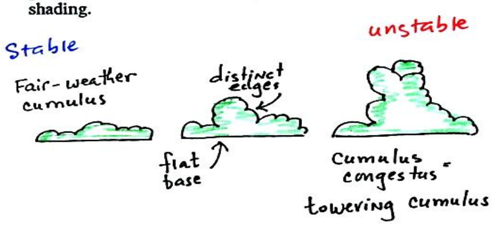
Stratocumulus (Sc) separate patches of cloud or waves of cloud with widths about the size of your fist.

Common low cloud type - "catch-all" category.

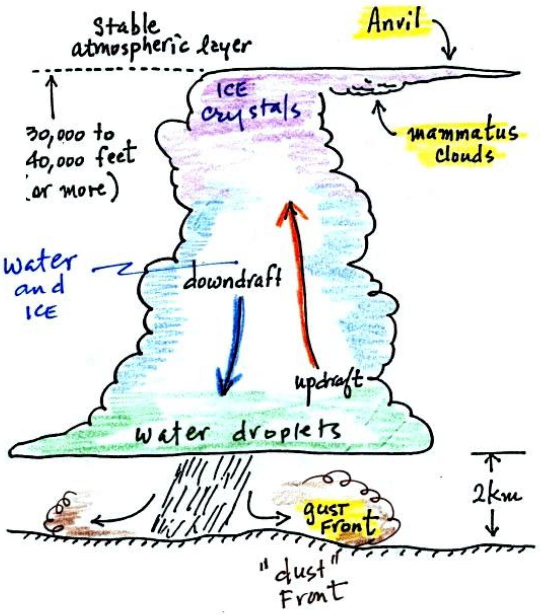
Stratus (St) gray layer cloud. Thick enough to completely hide the sun from view.



Cumulus (Cu) separate clouds resemble balls of cotton. Low enough and close enough to the ground to have a clear 3-D appearance and grey shading.



Cumulonimbus (Cb) thunderstorm cloud



How to identify and name clouds

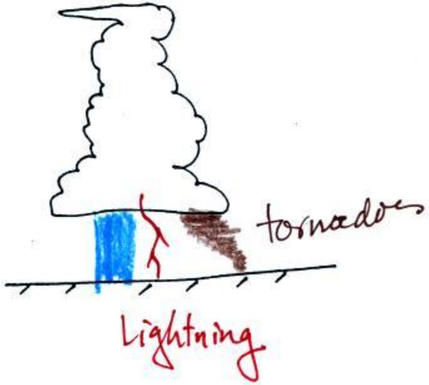
recap

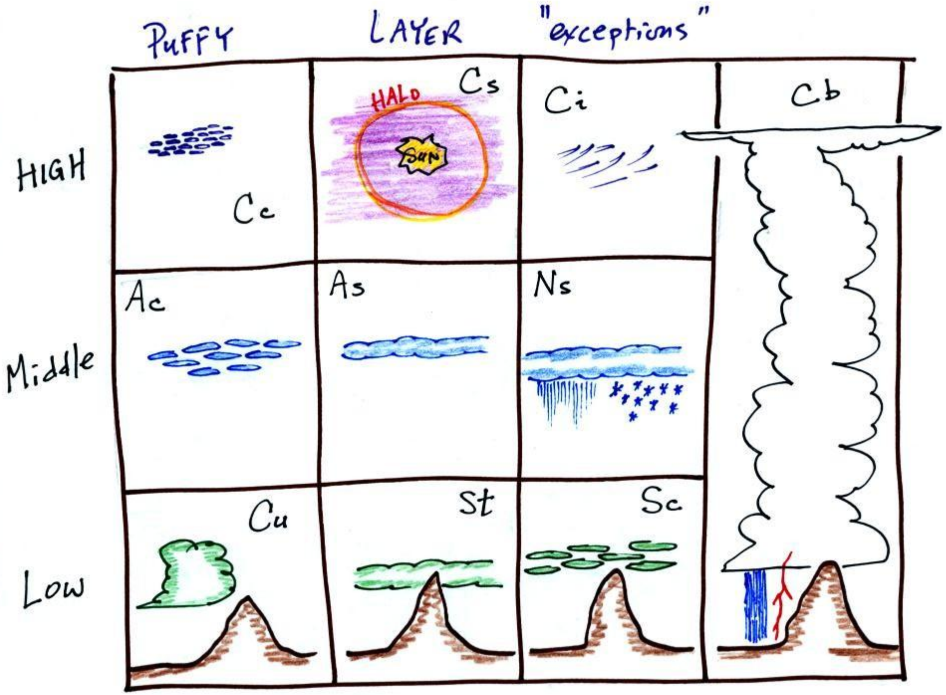
nimbo- or -nimbus means precipitation.

✓ nimbostratus
✗ stratonimbus

2 of the 10 cloud types can produce precipitation.

✗ nimbocumulus
✓ Cumulonimbus
(thunderstorm)
heavy rain, snow, hail showers.





Hidrometeoros o meteoros acuosos

Lluvia, Llovizna, Chubasco, Nieve, Granizo, Helada, Rocío, Escarcha y Niebla.

Litometeoros o meteoros de polvo

Calima, Calima de polvo, Humo, Ventisca, Tempestad de polvo y Remolino de polvo.

Eólicos o meteoros de viento

Tromba, Tornado, Turbonada, Ciclones tropicales.

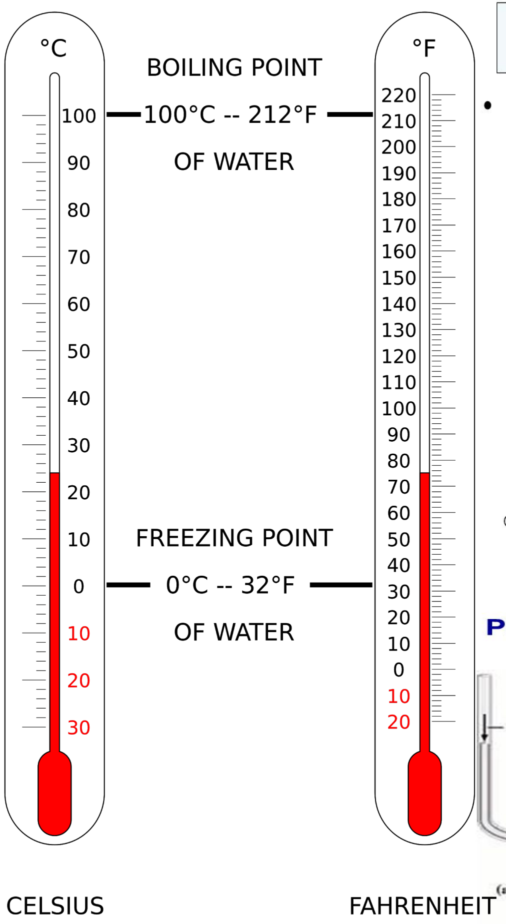
Electrometeoros o meteoros eléctricos

Tormentas (Relámpago y Trueno), Fuego de San Telmo, Aurora polar.

Fotometeoros o meteoros ópticos o luminosos

Fenómeno de halo (Solar y Lunar), Arco iris, Irisación en nubes, Gloria o Corona de Ulloa, Espejismo.

Fuente: Clasificación de los meteoros de la AEMET (PDF), wiki



Units of Pressure

- Standard pressure is the atmospheric pressure at sea level, 760 mm of mercury.
  - Here is standard pressure expressed in other units:

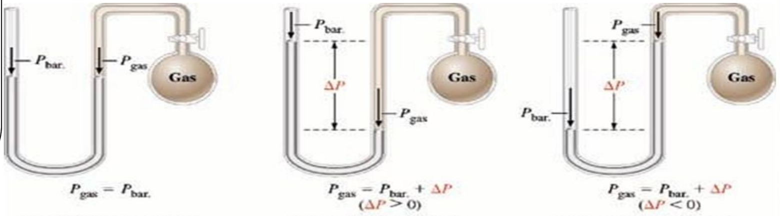
Unit	Abbreviation	Unit Equivalent to 1 atm
Atmosphere	atm	1 atm (exact)
Millimeters of Hg	mm Hg	760 mm Hg
Torr	torr	760 torr
Inches of Hg	in. Hg	29.9 in. Hg
Pounds per square inch	lb/in.^{2} (psi)	14.7 lb/in.^{2}
Pascal	Pa	101,325 Pa
Kilopascal	kPa	101.325 kPa

Tipos de Presión

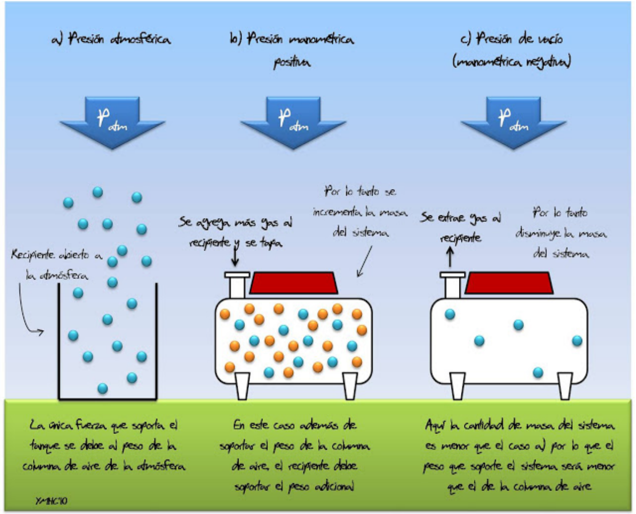
Presión absoluta	se mide con al cero absoluto de presión
Presión atmosférica	es la presión ejercida por la atmósfera terrestre medida mediante un barómetro
Presión relativa	es la determinada por un elemento que mide la diferencia entre la presión absoluta y la atmosférica del lugar donde se efectúa la medición
Presión diferencial	es la diferencia entre dos presiones
Vacío	es la diferencia de presiones entre la presión atmosférica existente y la presión absoluta, es decir, es la presión ,medida por debajo de la atmosférica

Presión y Temperatura

Presión Manométrica:



(a) Presión del gas igual a presión barométrica
(b) Presión del gas mayor que presión barométrica
(c) Presión del gas menor que presión barométrica



Six's thermometer (termómetro de máximas y mínimas)

Punto de rocío

El punto de rocío o temperatura de rocío es la temperatura a la que empieza a condensarse el vapor de agua contenido en el aire, produciendo rocío, neblina, cualquier tipo de nube o, en caso de que la temperatura sea lo suficientemente baja, escarcha. Wiki.