CALITOO

Sun photometer

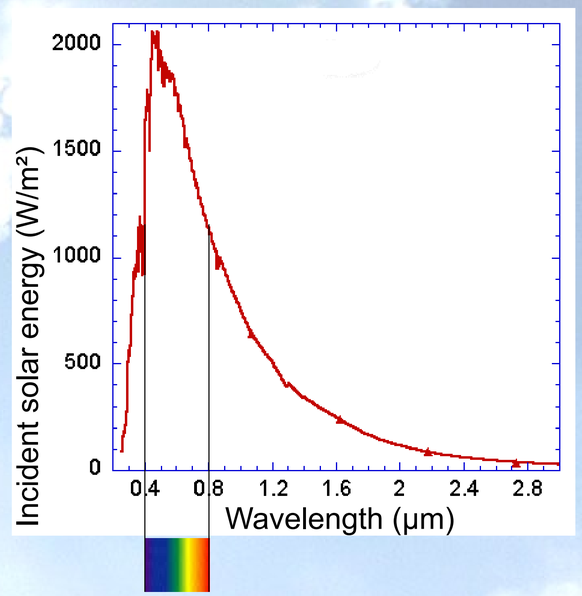
HOW THE CALITOO TAKES AEROSOLS MEASUREMENTS?

Tenum

Agencia Estatal de Meteorología

HOW TAKES AEROSOLS MEASURE ?

Energy source : the Sun

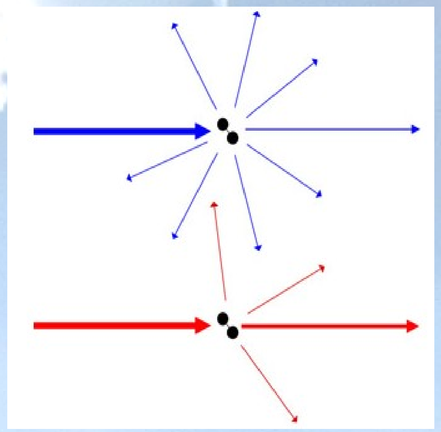


The measurement results the CN0, the calibration coefficient for each measured wavelength

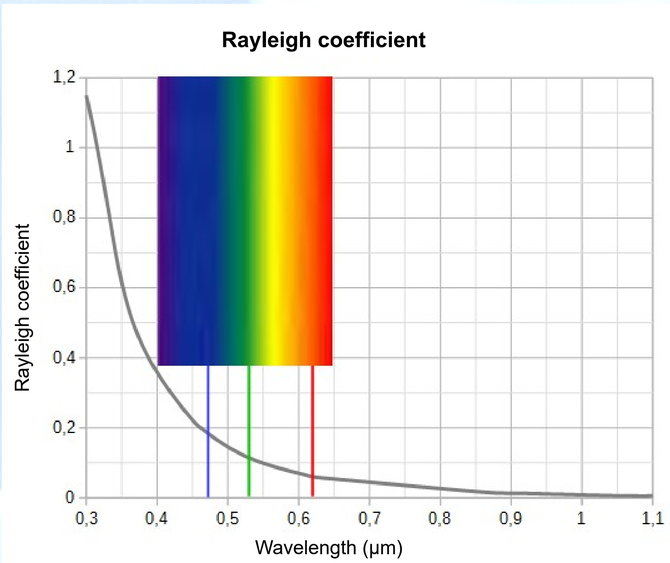
HOW TAKES AEROSOLS MEASURE ?

AOD $_{RAYLEIGH}$ (0.05 to 0.20)

Rayleigh scattering



Some of the sun's radiation is scattered in the atmosphere depending on its wavelength. Blue light is scattered more than red light.

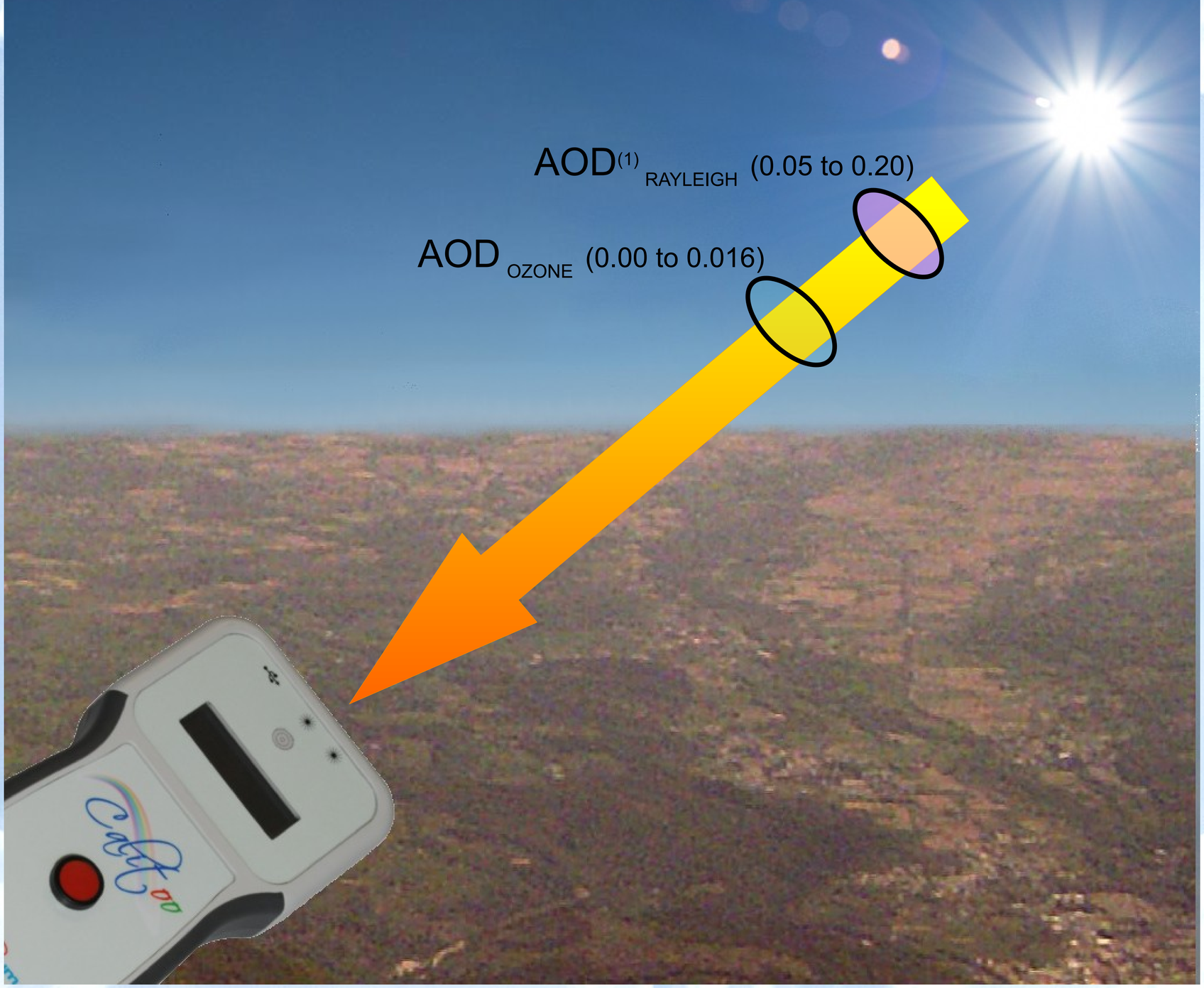


(1) AOD : Atmospheric Optical Depth

HOW TAKES AEROSOLS MEASURE ?

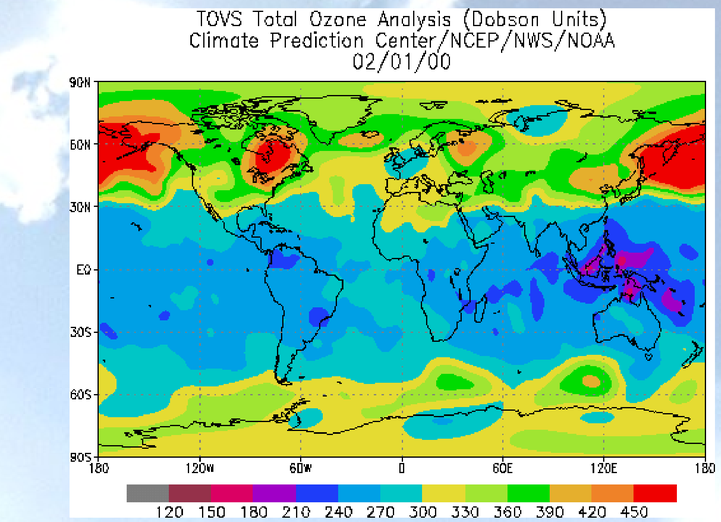
$AOD^{(1)}_{RAYLEIGH}$ (0.05 to 0.20)

AOD_{OZONE} (0.00 to 0.016)



(1) AOD : Atmospheric Optical Depth

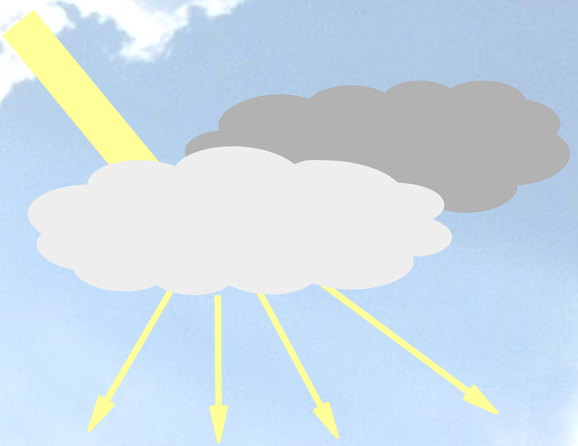
The ozone layer



Overall coefficients. Ozone slightly attenuates red and green colors but does not attenuate blue.

HOW TAKES AEROSOLS MEASURE ?

Clouds are hiding the Sun



Their ability to block sunlight varies greatly and is difficult to determine.

(1) AOD : Atmospheric Optical Depth

HOW TAKES AEROSOLS MEASURE ?

$AOD^{(1)}_{RAYLEIGH}$ (0.05 to 0.20)

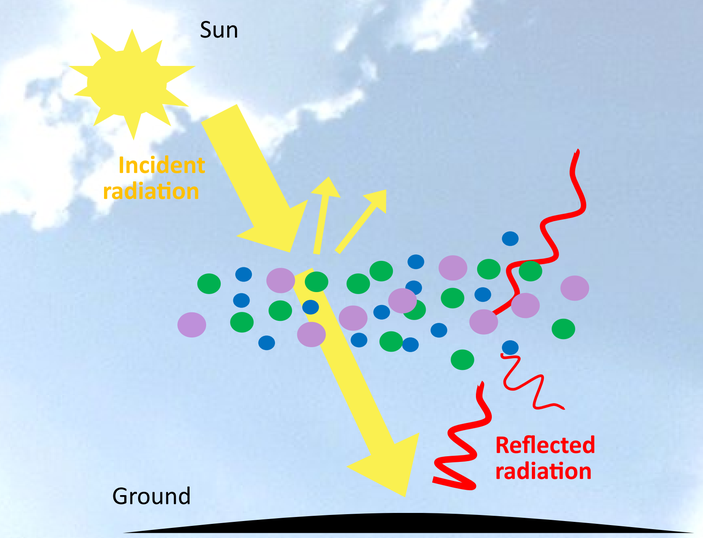
AOD_{OZONE} (0.00 to 0.016)

AOD_{NUAGE} (0.5 to 50)

$AOD_{AEROSOL}$ (0.01 to 5)

AOD_{TOTAL}

Energy source : the Sun



Aerosols reflect some of the sun's radiation. It is this attenuation that we will measure.

$$AOD_{TOTAL} = AOD_{AEROSOL} + AOD_{CLOUD} + AOD_{OZONE} + AOD_{RAYLEIGH}$$

Measured parameter
Measurements taken at three wavelengths to determine aerosol size.

Searched parameter
Depending on the quantity and the size of the aerosols.

Void parameter
Measurements are taken on a sunny, cloudless day.

Known parameter
Based on satellite data

Red = 0.0154
Green = 0.0128
Blue = 0.0

Known parameter
Depending on the wavelength

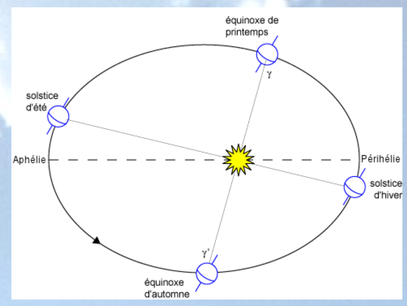
Red = 0,06281
Green = 0,10637
Blue = 0,19490

(1) AOD : Atmospheric Optical Depth

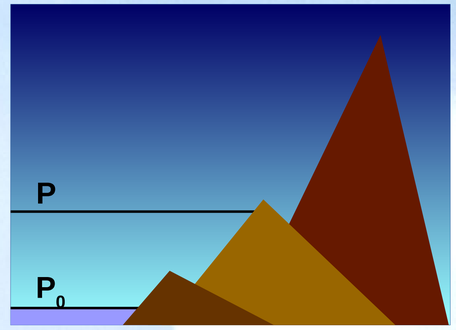
HOW TAKES AEROSOLS MEASURE ?

(1) AOD : Atmospheric Optical Depth

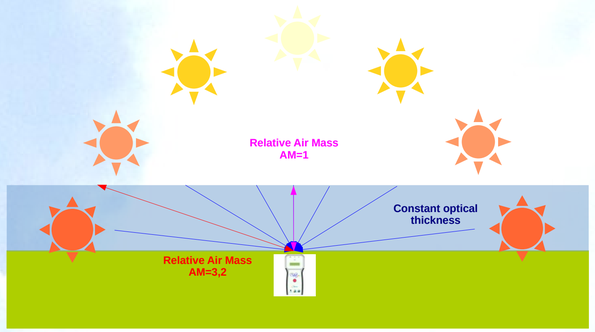
Other parameters



Distance between Earth and the Sun as a function of the measurement date.

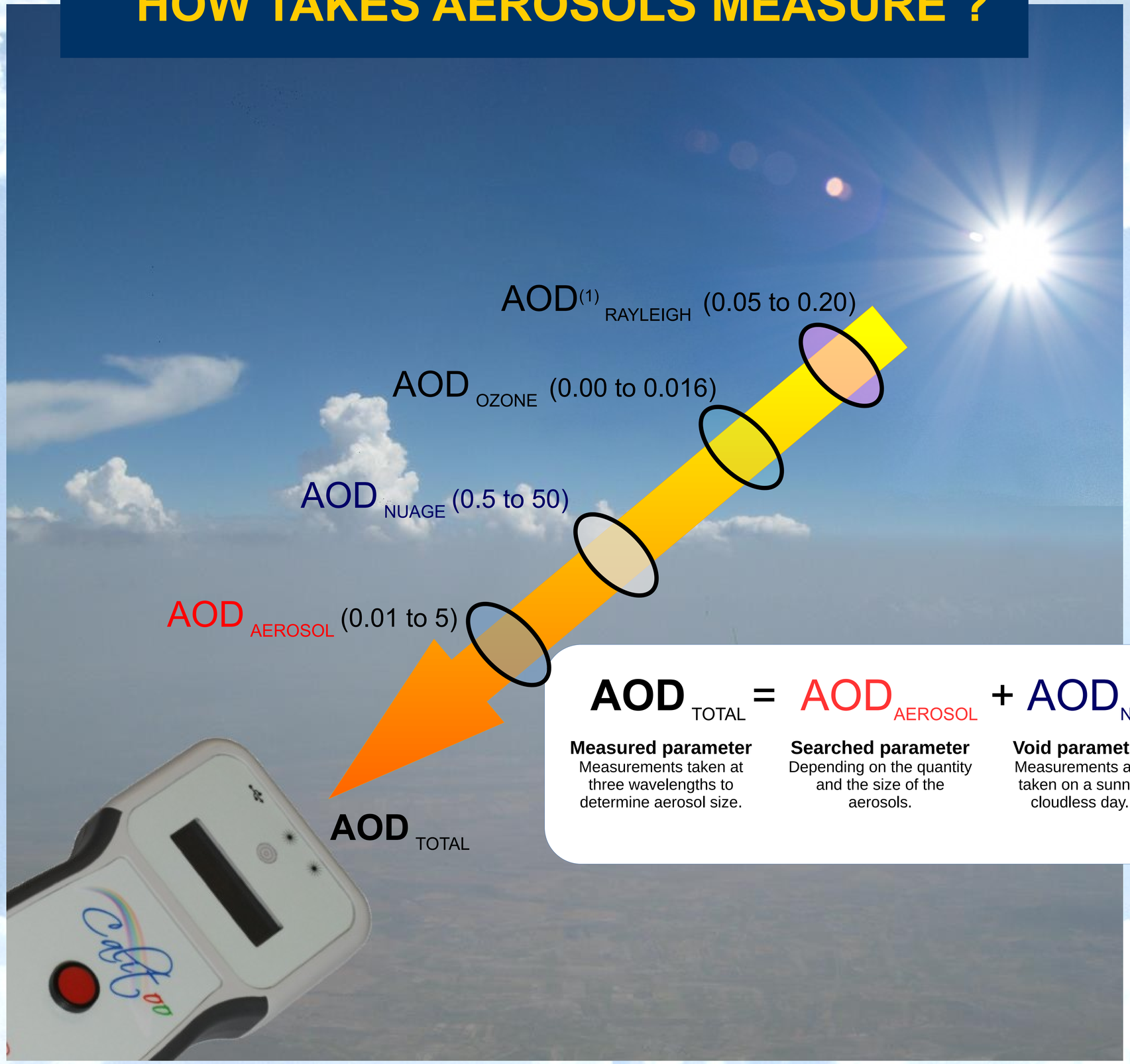


The measurement altitude affects all attenuation values. To correct for this, we use the ratio :
$P_{measure} / P_{sea\ level}$



The Sun's elevation above the horizon affects the length of the optical path through the atmosphere.
Air Mass = 1 / sin(Θ)

HOW TAKES AEROSOLS MEASURE ?



The formula !

$$M(\lambda) = M_0(\lambda) \cdot \exp\left(-\frac{1}{\sin\theta}(\tau_a + \tau_{O3} + \tau_r)\right)$$

The M-measurement is equal to the measurement without the atmosphere (calibration coefficient) multiplied by the exponential of negative the inverse of the sine of the angle of the sun's elevation above the horizon, multiplied by the sum of the optical depths of aerosols, ozone, and Rayleigh scattering.

AOD TOTAL = AOD AEROSOL + AOD NUAGE + AOD OZONE + AOD RAYLEIGH

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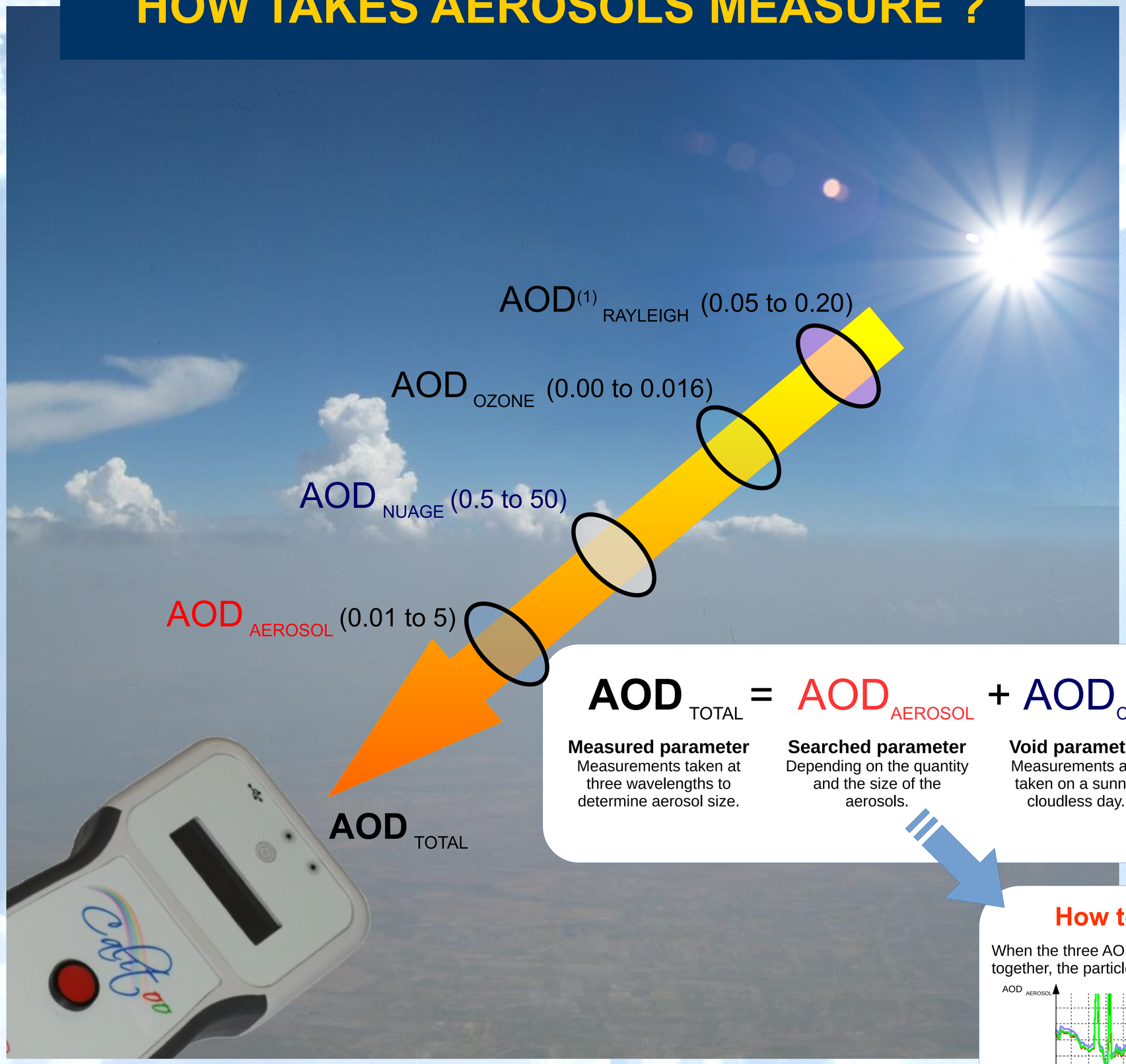
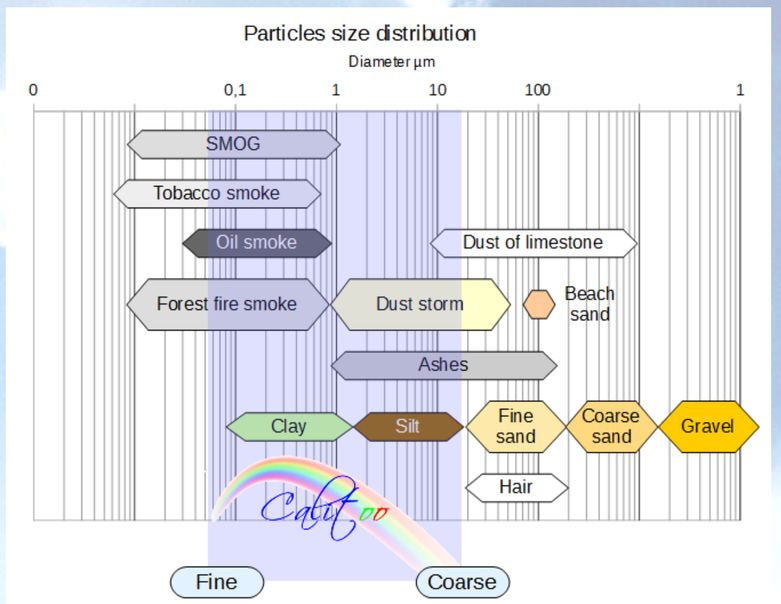


The size of the particles



The Calitoo can determine whether the aerosols being measured consist mainly of large particles (10 µm) or fine particles (0.1 µm)

$$\mathbf{AOD}_{TOTAL} = AOD_{AEROSOL} + AOD_{CLOUD} + AOD_{OZONE} + AOD_{RAYLEIGH}$$

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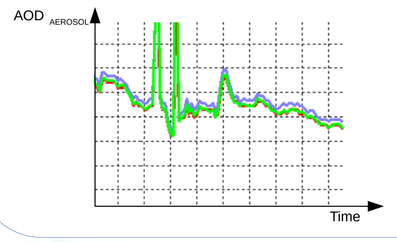
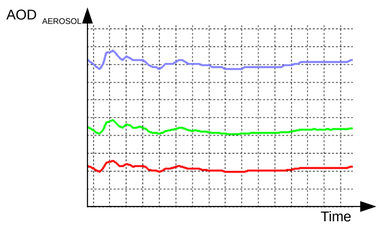
How to determine the size of aerosols?

When the three AOD curves are close together, the particles are coarse.



When the three AOD curves are widely spaced, these are fine particles.



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