Aerosol optical characteristics at Ouarzazate, Morocco in 2012

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The desert aerosol has an important role in the atmospheric evolution as well as the climatic changes. In this study, we present the results of the Aerosol Optical Depth (AOD), the single scattering albedo (SSA) and radiative forcing (ARF) of desert aerosol measurements at Ouarzazate (30.92N, 06.91W, 1136 m). All these optical parameters are determined from sun-photometer recorded data through AERONET/PHOTONS network.

The aerosol optical Depth (τ_{Aer}) is defined by:

$$\tau_{Aer}(\lambda) = \frac{1}{m_{air}} \ln\left(\frac{I_0(\lambda)}{I(\lambda)}\right) - \tau_{Ray}(\lambda) - \tau_{gaz(\lambda)}(\lambda)$$

With τ_{gaz} : Optical depth of gaseous absorbers

τ_{Ray} : Optical depth of Rayleigh scattering.

I (λ): Solar flux measured by the sun photometer

I_0 (λ): Solar flux extra-terrestrial; m_{air} : Air mass

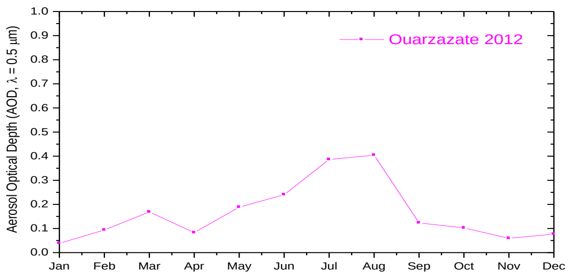

Figure 1 Monthly means of AOD at 0.5µm

The annual cycle of the AOD shows variable values due to the changeable weather and the Sahara source. The maximum values at 0.5µm were recorded in summer on July and August.

Aerosol radiative forcing is defined as the increase or decrease of the net radiation flux at the altitude z due to an instantaneous change of aerosol atmospheric content. The atmosphere free of aerosols is the reference case. Thus, the ARF values can be derived from the following expression:

$$ARF(z) = (F^{\downarrow} - F^{\uparrow})(z) - (F^{\downarrow}_0 - F^{\uparrow}_0)(z)$$

F and F_0 denote respectively the global irradiances with and without aerosol. The arrows indicate the direction of the global irradiances, ↓ indicating downward irradiance and ↑ indicating upward irradiance.

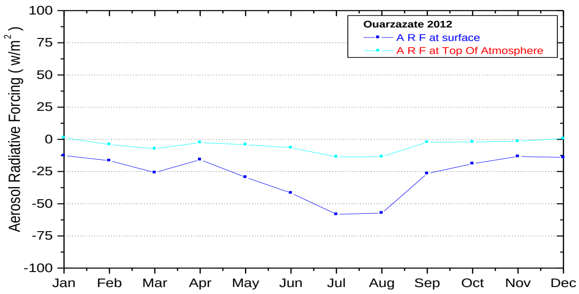

Figure 2 Monthly means of ARF at ground surface and at Top of the atmosphere

The ARF values at surface ranged from -12.61 to -58.24 W/m^2 and being larger in July. The negative value at surface reveals that the desert dust aerosol reduced significantly the solar radiation reaching the ground level producing thus a cooling tendency. The ARF at top of the atmosphere changed from -13.61 to +0.62 W/m^2, the negative values indicate that desert dust aerosol caused an increase of light scattered back to space inducing thus cooling of the Earth-atmosphere system, while the positive values indicate the influence of a greater amount of radiative energy reflected by cirrus.

The Single Scattering Albedo is the ratio of the scattering coefficient σ_d and the extinction coefficient σ_e It is defined by:

$$\omega_{SSA} = \frac{\sigma_d(\lambda)}{\sigma_e(\lambda)} = \frac{\sigma_d(\lambda)}{\sigma_d(\lambda) + \sigma_a(\lambda)}$$

σ_a Aerosol absorption coefficient.

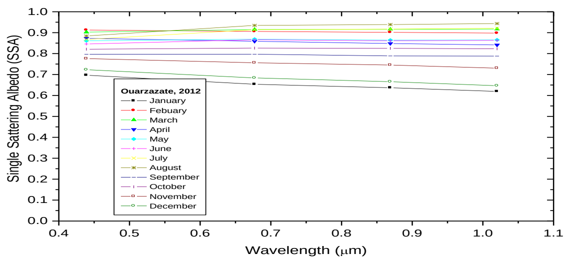

Figure 3 Monthly averages of aerosol SSA.

The single scattering albedo ranges from 0.61 to 0.94 shows the importance of light scattered. It is changing with wavelength. The lowest values close to 0.65 are recorded for the channel 1.02 µm.

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