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Measurement of Atmospheric Turbidity in Firuzkuh by Sun photometer

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Abstract

The important of solar energy as a pure radiation free of pollutant, a multiple wavelength radiometer mainz designed for the purpose of measuring atmospheric turbidity collecting maximum radiation per unit area, & extinction coefficient of solar radiation by aerosol at discrete wavelengths through the visible region to near IR region is described in Global Atmospheric Watch station mountain. These techniques apply for conditions where the optical depth is either temporally variant or invariant during the course of day. The influence of the aerosol size distribution on optical is investigated. Method is presented for estimating the diurnal variation & the monthly variation of the mean atmospheric turbidity during 2007-2008 from multi wavelength depth measurements. However, for such site of clean air our measurements show there is fall of solar energy at the rate of 9×10^3 calories per day.

Keywords: Atmospheric turbidity, Optical depth, Atmospheric watch, Optical, Solar energy.

Introduction

The energy from the sun received by earth is the rate of 5.4×10^{24} cal. per year [Pandey. G.N., 1994].When light propagates through the atmosphere, particles in its path (whether gas molecules or aerosol particles abstract energy from it and partly radiate into total solid angle centered at the particles. The radiometer system has been developed at Firuzkuh mountain (52°34′, 45°34′) at height of 3000m above mean sea level, 20 km away from Tehran city during the period 2007-2008. The intensity of direct solar radiation shows diurnal and annual variation due to its dependence on the sun's elevation and it varies with time and place in a way which depends on the varying constitution of the atmosphere, particularly its content of dust, which has been termed turbidity.

Instrumentation

The instrument can be divided in two parts:
a) Optical system consisting of five interference filters, 368, 862, 778, and
b) 500 nm, and silicon photo detector UV-100 BQ, G xEG (Fig.1).

Electronics system, consisting of a special operational amplifier receiving the signal from silicon photo detector whose output signal digitized by a digital voltmeter. The instrument calibrated in the laboratory. The UV-enhanced silicon photo detector used has linearity over 7 decades smaller than 1% and a low dark current of 3nA (nano ampere). The device is battery – powered with an automatic shutdown after 10-12 minutes of non-use. By the fitting power supply 1226, the instrument can be driven at 110 V and 230 V from the net (fig.2). The radiometer Mainz (Model MSII 585-19), since 1995 by Iranian Meteorological Organization and WMO (World Meteorological Organization) stating to work and this results is first data of the station during the period December 2007 to December 2008.

Fig.1. Mainz Sunphotometer

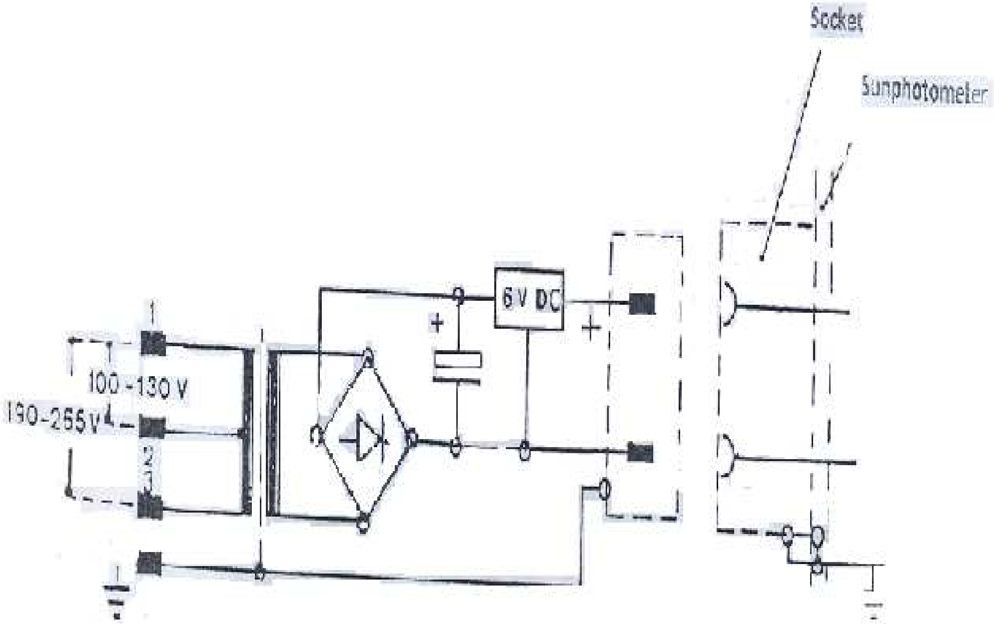

Fig. 2. Power supply Circuit

Experimental Results

Fig.1 illustrated a Langley plot [log v vs m(z), v and m(z) are voltage and air mass in respectively] of data points at five wavelengths at GAV station during very clear and stable condition. The data points are arrayed in linear fashion in accordance with functional from of the Lambert Beer's law [Mani. A, Chacko. O, 1968 & Science & Technology, 2005]

$$I = I_0 \exp [t_A + t_O + t_R)_m]$$

Where

I : The irradiance at wave length at the observing point,

I_0 : the extraterrestrial irradiance at wavelength at mean Sun Earth distance,

t_A : the extinction coefficient due to aerosol,

t_O : the absorption coefficient for ozone,

t_R : the Rayleigh scattering coefficient,

m : the absolute air mass,

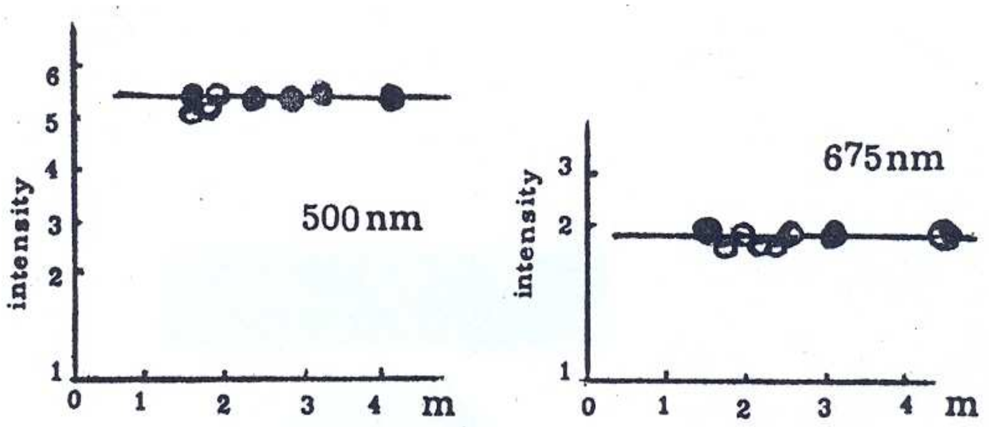

Fig. 3. Logley Plot of Solar Radiometer Data points

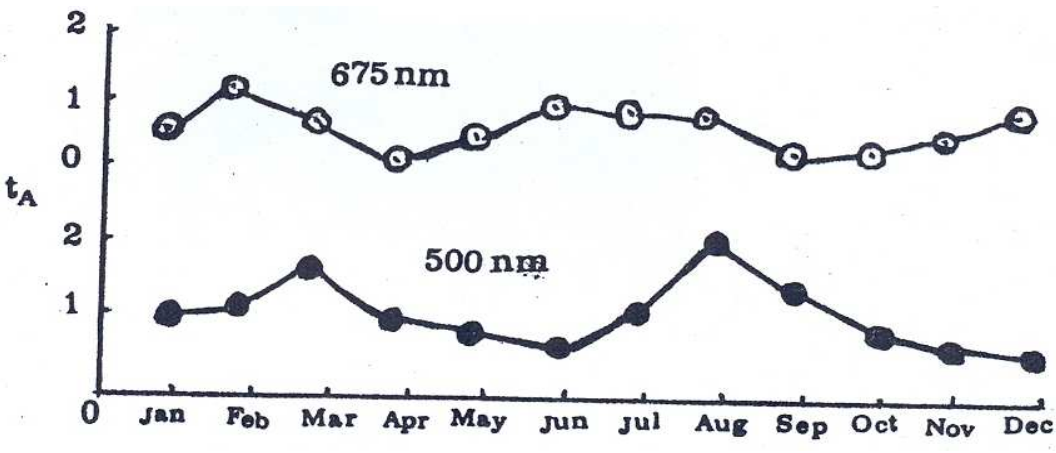

Fig.4. Monthly Variation of Mean Turbidity 2007-2008

Analysis

Intercepts corresponding to zero air mass found by extending the line draw through the data points to the ordinate proved to be quite constant from day to day [WMO, 1978 & World Wide Web, 2005].

Figure 2 shows the turbidity in month of July increased due to situation such as blowing dust and increased convection currents in the air columns increasing solar with day. Figure 3 shows the monthly mean turbidity during 2007-8 due to increasing solar intensity from March to July and this may be ascribed to increased convection effects and consequent disorderly mixing than from August to March [WMO, 1978], during winter season after the snowfalls because of the washing out of the atmospheric dust content by the snowfalls from September to December the particles of size 368 nm appear and then vanish .However, for such site of clean air also there is fall of solar energy receiving by earth is the rate of 9×10^3 calories per day due to aerosol, Rayleigh scattering and ozone..

Error Analysis

The error analysis can be found by the following formula [Payamara, J 1989 & National & International Patent data 2005].

$$\Delta t_A(\lambda)=\pm\frac{1}{m}\frac{\Delta I(\lambda)}{I(\lambda)}+\frac{1}{m}\frac{\Delta I_0(\lambda)}{I_0(\lambda)}+\Delta t_R+\Delta t_0(\lambda)$$

Table I summarizes these error at m=2

λ_{nm}	$\frac{\Delta I_0(\lambda)}{I_0(\lambda)}$	$\frac{\Delta I(\lambda)}{I(\lambda)}$	Δt_R *for* $\Delta\lambda = 13nm$	$\Delta t_0(\lambda)$ *Ozone* var.	$\Delta t_A(\lambda)$
	Langley plot	Reading error			
500	0.01	0.005	0.001	0.003	0.17
675	0.03	0.005	0.001	0.004	0.027
778	0.01	0.005	0.001	0.004	0.018
862	0.01	0.005	0.0013	0.005	0.0142
368	0.01	0.004	0.0011	0.002	0.015

Acknowledgement

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