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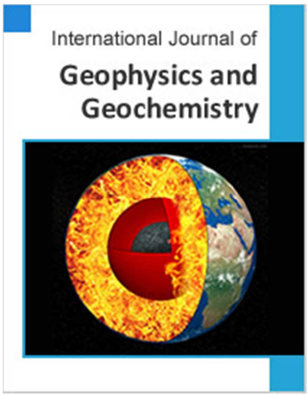

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A Study of Stratospheric Aerosols Using Twilight Method at Firuzku

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Abstract

Since 1990, color of twilight photometer in Iran, near Tehran of stratospheric turbidity to normal conditions. The twilight photometer includes four filters in the channel in IR region in which four filters are mounted in a filter wheel where each filter can be changed every few seconds. Thus, the average dust maximum layer accumulation is measured about 33km and lower layer is measured 14km. However, rather, strongly twilight was recorded on 13, 21, 23 March, and 18 May 2012, and coarse, irregular striations were observed.

1. Introduction

It was observed an unusual behavior in the near IR region associated with volcanic dust from the Agung in Bail (Castleman's 1974) [1]. Very large increases have occurred, following the eruption of Fuego in Guatemala beginning of October 10, 1974, as indicated by LIDAR monitoring (Fegley and Ellis, 1975) [2].

Figure 1. *The last volcano eruption in Iceland April 2010.*

Although Castleman (1974) believed that his data revealed increases in the concentrations of stratospheric sulfate following eruption of Taal in 1965, Awn in 1966, and Fernandina in 1968. the volcanic dust from the EI Chinchan eruption in Mexico 1981, (Science News, 1982) [3], and Mt. Pinatubo volcanic eruption in Philippines in 1991 [4].

The present author applied twilight method for the study of stratospheric aerosols from last volcano eruption, smoke and steam hangs over the volcano under the Eyjaf Jalllajokull glacier in Iceland, Wednesday April 14-18, 2010, (Xinhua /Reuters, File Photo) figure 1.

The history to 2010 of knowledge concerning stratospheric particle matter was thoroughly reviewed by this paper and therefore highlights only will be described here. Some of the earliest scientific studies, the investigation by twilight effects believed to be produced by the presence of dust in the stratosphere. More recent twilight sky measurements, which were interpreted as indicating the presence of dust layer in the lower stratosphere, beside observed colorful twilight glows.

The intensity of direct solar radiation shows a diurnal and annual variation due to its dependence on the sun's elevation. In addition, it varies with time and place in way which depends on the varying constitution of the atmosphere, particularly its content of water vapor, haze and dust, which has been termed its turbidity. Measurements of solar intensity enable us to analyze to some extent, the instantaneous composition of the atmosphere and open up the possibility of synoptic and climatic surveys of atmospheric aerosol.

An aerosol. is defined in its simplest form as solid or liquid particles suspended in a gas. Aerosols are two Phase systems, comprising both the particles and the gas in which they are suspended, and include a wide range of phenomena such as dust, Fumes, smoke, mist, fog, haze and smog. The world aerosol was coined about 1920 as an analog to the term hydrosol, a stable liquid.

Suspension of solid particles. Aerosols are usually stable for at least a few seconds and in some cases, may last a year or more. Sources of natural background aerosol, the aerosol that would exist in the absence of human, and man-made aerosols. The majority of the mass of soil dust volcano emissions, and man- made direct emission are likely to be large particles that fall out near the source.

Spectacular optical effects, especially sunsets and unusual colors imparted to the sun and the moon, have been observed following many violent volcanic eruptions. Various colors of the sun, such as pink, red, and green, were observed worldwide after the eruptions, these effects result from scattering and absorption of light by particles in atmosphere especially in the stratosphere, which are introduced directly and indirectly by the eruptions.

2. Experimental Set – up

The photometer mainly consists of a photometer, a filter sector, an amplifier, digital millimeter and power supply units [5, 11], figure 2. The photometer consists essentially of a large converging lens, three monochromatic filters and a photomultiplier tube. An optical section of the photometer collects sky light within a field of view of 5° half angle of the cone. The filters are symmetrically mounted on a circular disc which can be rotated with a stepper motor and a micro switch used to bring the filter in turn in the desired position above the lens.

The rapid filter change photometer is a single-channel photon-counting photometer, it was designed to do simultaneous measurement of two zero baseline colors, but it would be suitable for UV by photometry as well. The work has been carried out at Firuzku mountain (52° 342, 45° 342) at a height of 3000m above mean sea level, 20 km away from Tehran city. Associated with each one of four filters is one channel in a four-channel scaler used to record the pulses due to photons arriving through the filter. The four filters are mounted in a filter wheel so that the filter can be changed every few seconds.

Figure 3 shows the operation of the photometer. Pulses from the photo tube are pre-amplified, divided by two and gated into the control unit. This unit controls the position of the filter wheel & sends the pulses to the appropriate scaler channel.

Approximately every three seconds the control unit inhibits counting for about 0.25sec., advances the counting address, and initiates a train of pulses which drives the stepping motor, bringing the next filter into place. The dead time of about 8% could be reduced to less than 3% by building an acceleration circuit for the pulse-train generator, but at a change time of three seconds such additional complexity does not seem justified. For efficient operation at one second, however, such a circuit would be necessary. The scaler provides five columns of BCD storage. This provides sufficient accuracy as long as the range in counting rates through the four filters is less than about a factor of 100. After each filter has been in place ten times, the control unit goes into the off state.

A print sequence which steps through the memory channels and activates the printer is manually started. To avoid possible data loss due to a printer, malfunction the memory is manually erased. Instead of using longer integration times for fainter situation, a larger number of standard length integrations are used. Although this reduces operating efficiency somewhat, it avoids the possibility of a chance disturbance destroying a large amount of data. Pre-amplification is done with the circuit described by Taylor, 1972 Masheshwari, 2006 and Crecraft, 2000.

The circuit was chosen because it needs only at 15 volt power supply, a voltage which is also used by the STM 1800. Pulse resolution is as good as or better than that obtained by Taylor, while the output pulses are slightly less than +3 volts. Extensive use is made of an integrated circuit, 74121, which is a mono-stable oscillator. The operation of this circuit is symbolically depicted. This device will trigger on either a positive-going or negative-going edge if the other trigger input is in the appropriate state. The pulse width is adjusted by means of a timing capacitor and resistor. The width shows a slight variation with the operating temperature but is stable otherwise. Operation of control unit is shown in; SW allows the photometer to be used on a conventional time scale; it is shown in the suitable position. The incoming start pulse sets the ON signal to the high state; the rising edge of the ON signal start the loop of three 74121 oscillating with a period of three seconds. The output pulses of the third 74121 are used to advance the channel address and step the motor. The channel is selected by a pair of J-K flip-flops used in the toggle mode. When the ON signal at the flip-flops is low, Q is held low; when the ON signal is high, each negative going edge at the CP input causes Q and Q to invert state the outputs of two flip-flop are read by four NOR gates which in turn activate one of the NAND gates allowing the photo counts to pass on to the appropriate channel [5, 14].

Figure 2. *Experimental arrangement.*

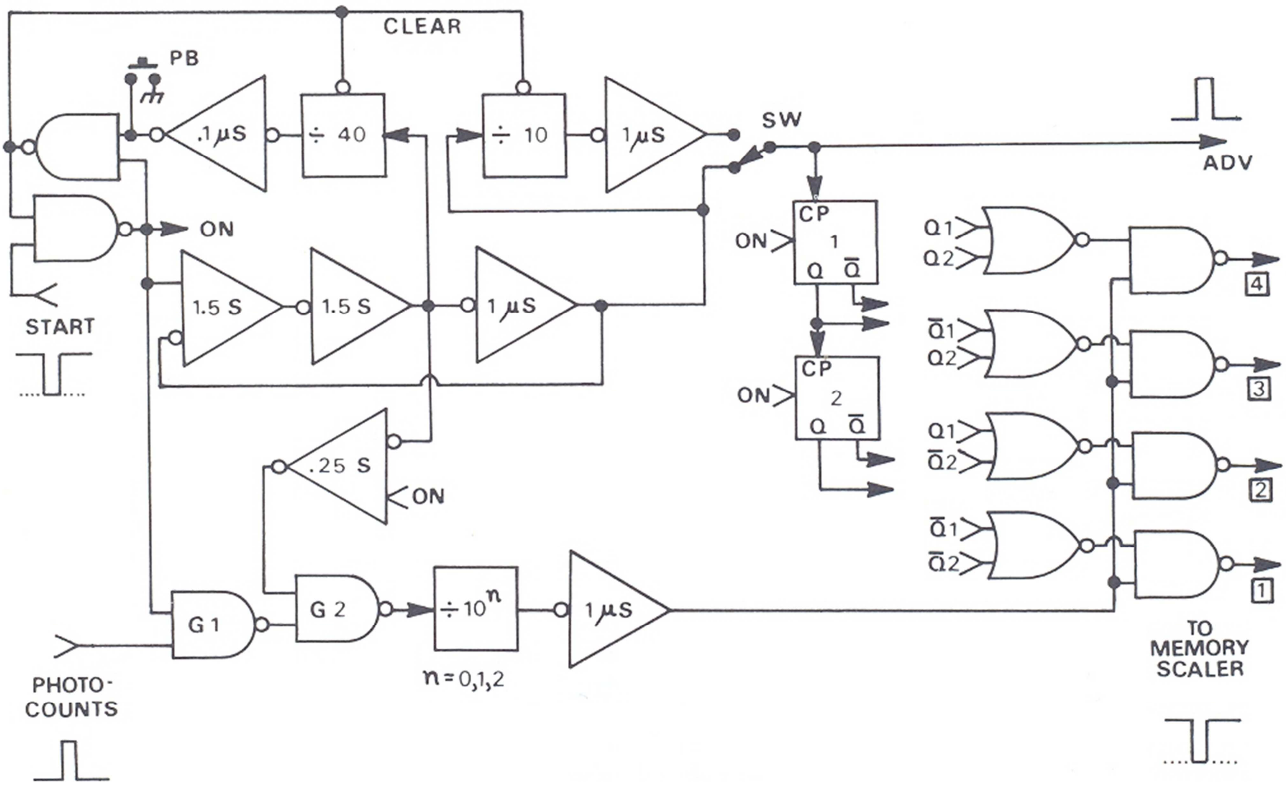

Figure 3. *The circuit diagram.*

3. Result and Discussion

Observations have revealed that the approximately 8 min. after sunset the sky brightness increases with the slope of intensity curves are observed. These discontinuities are clearly displayed as maxima on the curves of logarithmic gradients of intensity represented by $\frac{d \log I}{da}$ (α is the effective height of the earth's shadow) against the solar depression below the observer's horizon figure 4, the time of fading for the late twilight glow has been interpreted in terms of an aerosol layer in the lower stratosphere by using shadow heights [6, 10].

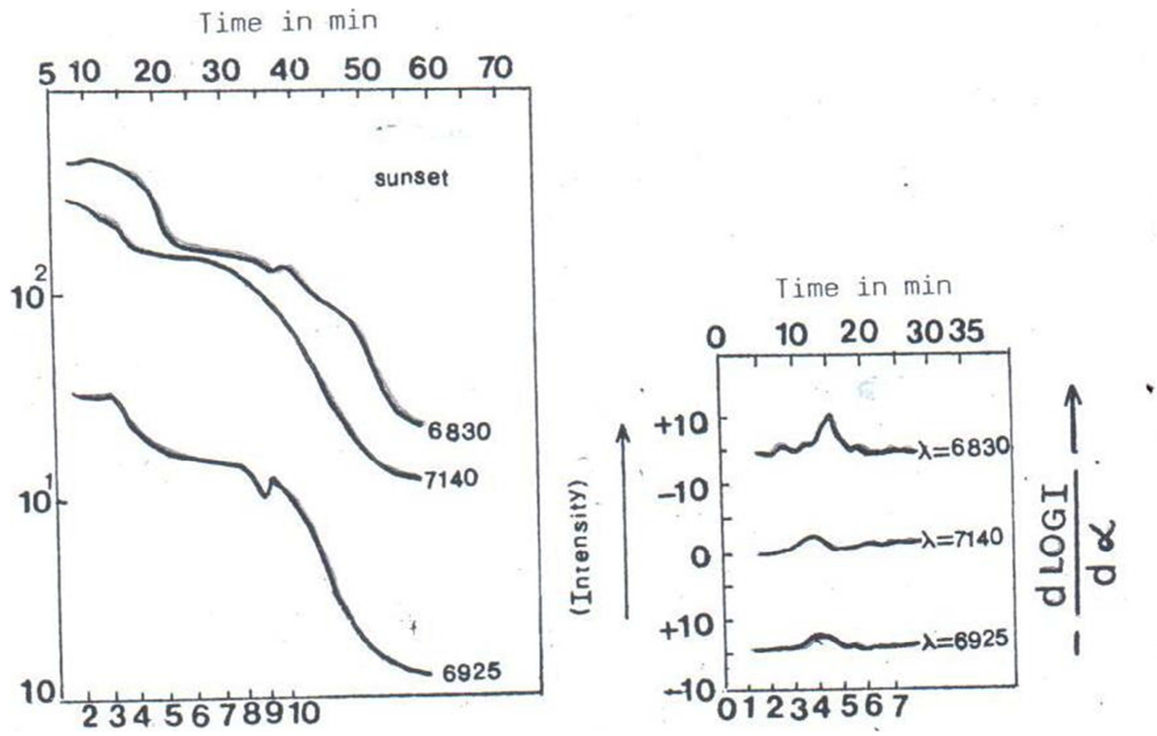

Figure 4. The late twilight glow.

Figure 5, shows that geometry of the situation for zenith observations. The Solar rays illuminating the aerosol caterers sulfur attenuation during their passage through the layer at sun set (t=o) and aerosol layer at a mean height ΔH is fully illuminated. At sun set (t=o) and aerosol layer at a mean height ΔH is fully illuminated.

Due to the curvature of the Earth and the finite thickness of the layer, the total light path through the layer and the extinction are reduced after time t_l, at time t_2 the shadow of the Earth begins cutting off the illumination to the layer from the lower end. At time t_3, the shadow has completely cut off the layer and the intensity drops to normal twilight level. Various colors of the sun, such as pink, red, and green, were observed worldwide after the eruptions. These effects result from scattering and absorption of light by particles in atmosphere especially in the stratosphere, which are introduced directly and indirectly by the eruptions.

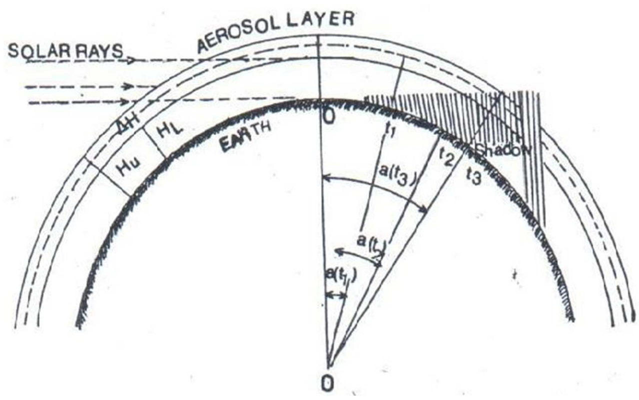

Figure 5. Geometry of the situation for zenith observations.

The lower height of aerosol [12, 13]. Layer H_L has been evaluated from time t_2 [7-9].

$$H_L = R[I - \cos\alpha(t_2)]\cos Z / \cos\psi .$$

Table 1. Accumulation of stratospheric aerosols.

Date	Wavelength	ΔH (in km)	H_L (in km)	Hu (in km)
	0.6830 Å	8.56	18	33.5
13.3.2012	0.7140 Å	7.94	12.6	30.5
	0.6925 Å	7.84	14.5	33.5
	0.6830 Å	5.34	14.8	38.5
21.3.2012	0.7140 Å	5.74	14.2	34
	0.6925 Å	6.34	14.5	36.95
	0.6830 Å	5.84	16.8	38.4
23.3.2012	0.7140 Å	6.34	12	33.5
	0.6925 Å	5.54	15.1	36.5
	0.6830 Å	3.24	18.2	29.82
18.5.2012	0.7140 Å	5.44	13	24.1
	0.6925 Å	3.24	13	27.1

Where,

$$\psi = Z - \alpha(t_2).$$

An upper limit to the height H_u is determined in similar way. For layer thickness (ΔH) at time t_l, $\Delta H \approx R\alpha^2(t_1)$. Where, R is radius of the Earth.

4. Conclusion

The purpose of using the operational amplifier is signifying the output signal from the photometer as the time of fading arises for the late twilight glow. The observation of twilight in this method is applicable for the study of stratospheric aerosols of volcano eruption. This observation is done by twilight photometer consisting of filters in near IR region. The intensity of direct solar radiation shows a diurnal and annual variation due to its dependence on the sun's elevation. The results are given in Table 1. At Tehran (Firuzku mountain), the average of maximum dust accumulation is about 33 km with the lowest of 14 km and thickness about 6 km.

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