Middle-East Journal of Scientific Research 13 (2): 220-223, 2013
ISSN 1990-9233

DOI: 10.5829/idosi.mejsr.2013.13.2.1789

Sky Brightness Condition During Total Solar Eclipse on July 22, 2009

[1]*Mohd Zambri Zainuddin,* [1]*Saedah Haron,* [2]*Mohammaddin Abdul Niri,*
[1]*Nazhatulshima Ahmad,* [2]*Mohd Saiful Anwar Mohd Nawawi,* [2]*Saadan Man,*
[2]*Mohamad Zakuwa Rodzali,* [2]*Rushdi Ramli,* [2]*Raihana Abdul Wahab,*
[2]*Khadijah Ismail and* [2]*Nurul Huda Ahmad Zaki*

[1]Department of Physics, Faculty of Science,
University of Malaya, 50603 Kuala Lumpur, Malaysia
[2]Department of Fiqh and Usul, Academy of Islamic Studies,
University of Malaya, 50603 Kuala Lumpur, Malaysia

Abstract: A total solar eclipse is suspected to have influence to the physical parameter of an environment area particularly the brightness of the sky and other environmental parameters such as temperature and humidity. The brightness of the sky, temperature and humidity were measured during the total solar eclipse on 22nd July 2009 by using the SQM (*Sky Quality Meter*) and hygrometer. The results obtained show changes in sky brightness, temperature and humidity during the totality.

Key words: Solar eclipse · Sky brightness · Astronomical phenomena · Islamic astronomy · Sun · Moon

INTRODUCTION

Prophet Muhammad (p.b.u.h.) said in his traditions narrated by Bukhari [1] and Muslim [2] that those who witness the eclipse hasten to perform *ibadah* until the time has left. Such practice is also mentioned in the *sirah* that it was done by the Prophet (p.b.u.h.) and his companions on the same day of the Prophet son's demise, Ibrahim which was on 10H. Hence, *ibadah* plays significant role as the main factor that encourages Muslim astronomers to study the astronomical phenomena.

According to Ibn Yunus in the introduction of his writing *al- Zij al- Kabir al-Hakimi*: The observation of heavenly bodies is connected with religious law, since it permits knowledge of the time of prayer, of the time of sunrise which marks the prohibition of drinking and eating for him who fasts, of the moment when daybreak finishes, of the time of sunset whose ending marks the start of the evening meal and cessation of religious obligations and moreover knowledge of the moment of eclipses so that the corresponding prayers can be made and also knowledge of the direction of the Ka'ba (towards Mecca) for all those who pray and equally knowledge of the beginning of the months and of days involving doubt and knowledge of the time of sowing, of the pollination of trees and the harvesting of fruit and knowledge of the direction of one place from another and of how to find one's way without going astray [3, 4].

In this paper, we report the observation data we have collected during the total solar eclipse of July 22, 2009. The data consist of sky brightness data, temperature, humidity and pressure.

MATERIALS AND METHODS

Solar eclipse is an astronomical phenomenon which occurs when the moon passes between Earth and the Sun. This configuration can only occur when the Moon phases is in the state of new moon, where, the Sun and Moon are in conjunction as seen from the Earth.

A total eclipse occurs when the apparent size of the Sun is same with the Moon when these two bodies in conjunction. Once the Sun entirely covered by the Moon, only the Sun's corona can be seen and the totality is visible only from umbra area on the surface of the Earth while a partial eclipse might be seen within the Moon's penumbra.

Corresponding Author: Mohd Saiful Anwar Mohd Nawawi, Department of Fiqh and Usul,
Academy of Islamic Studies,University of Malaya, 50603 Kuala Lumpur, Malaysia.
Tel: +603-79676011, Fax: +603-79676141.

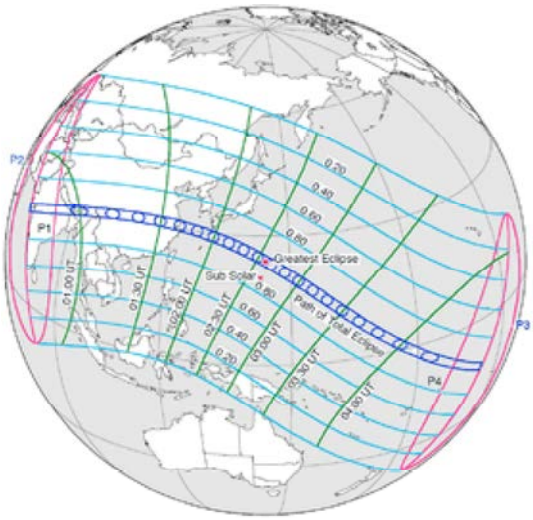


Fig. 1: Total Solar Eclipse Visibility Chart on July 22nd 2009 [5, 6].

Fig. 2: (a) SQM-L and (b) SQM-LE

On July 22nd 2009, a total solar eclipse occurred and it was the longest total solar eclipse to happen in the 21st century where it lasted a maximum of 6 minutes and 39 seconds. The total solar eclipse was visible from the narrow track which presents the umbra area. It covers India, Nepal, Bangladesh, Myanmar, China and lastly end on the Pacific Ocean and a partial solar eclipse can be seen from the broad track which is presents the Moon's penumbra (Figure 1).

According to Figure 1, the intensity in the Moon's umbra and penumbral shadow area is dimmer than other area that has no visibility of solar eclipse as an effect when Sun and Moon is in conjunction. The light scattering in the Earth atmosphere due to Mie scattering and Rayleigh scattering would be weaken as the Sun light being blocked slowly by the Moon and definitely change the brightness of the sky at certain value [7].

Therefore, the objective of this experiment is to measure the changes on the environmental parameters at the observation site during the whole process of total solar eclipse. These parameters are brightness of the sky, temperature, pressure and humidity.

Table 1: 22nd July 2009 Total Solar Eclipse Time Table

Event	Local Time	Altitude	Azimuth
Start of partial eclipse (C1) :	08:21:14.9	+38.7°	87.2°
Start of total eclipse (C2) :	09:34:10.2	+54.4°	97.1°
Middle eclipse:	09:36:41.8	+54.9°	97.5°
End of total eclipse (C3) :	09:39:14.5	+55.5°	97.9°
End of partial eclipse (C4) :	10:59:09.3	+71.9°	119.3°

Observation and Measurement: The observation of the total solar eclipse were made at Wildland Resort area, Hangzhou, Zhejiang, China (Latitude = 30° 10' 2" N, Longitude = 120° 2' 54" E) on 22nd July 2009 where it begun at 08:21 and last until 10:59 Local Time while the totality takes 5 minutes 4 seconds. The times of contacts at the observation site are given in Table 1:

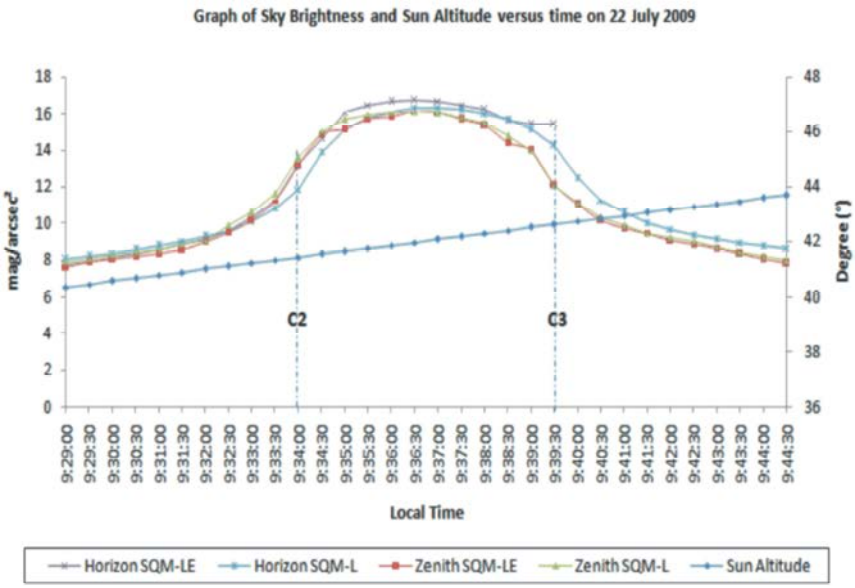
SQM (Sky Quality Meter) was used for the measurement of the sky brightness while data for temperature and humidity was taken using hygrometer and barometer was used to obtain pressure. Two types of SQM were used in this measurement, SQM-L (Sky Quality Meter with Lens) and SQM-LE (Ethernet Connected Sky Quality Meter). SQM-LE is automatic reading connected to the computer via ethernet while the SQM-L is manual reading [8].

SQM is a light sensitive device which used for measuring the sky brightness in the unit of magnitude per square arcsecond. The term of "magnitude" is a way of describing the brightness of an object. The values shown are reversed. For an example, a star with brightness of 6th magnitude is brighter than a star with magnitude of 11th. Thus, larger value indicates lower in brightness. If the SQM gave a value of 20.00, it mean that the brightness of 20th magnitude being speared out in every unit square of arcsecond in the sky. The maximum value could be recorded by SQM is 22.0 mag/arcsec^2 [8].

Temperature, pressure and humidity reading started on 07:30 Local Time. This is 51 minutes before the eclipse begins at 08:21. The temperature, pressure and humidity recording was done in several minutes of interval until end of eclipse [8].

The sky brightness reading cannot be determined at the beginning of the eclipse progress due to the high intensity of the sky which too high for SQM to be detected and functioned normally. The SQM started to show reading on 09:10 Local Time, which is 24 minutes before the maximum eclipse [8].

The results of the sky brightness, temperature, pressure and humidity is plotted through graph.



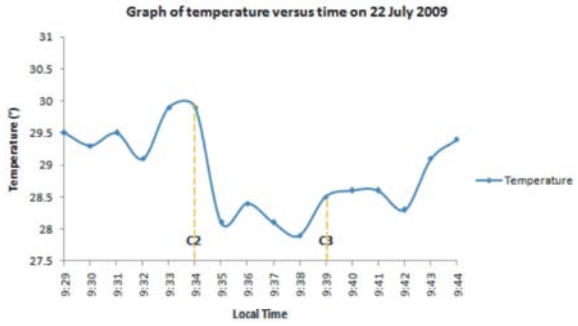
Graph 1: Sky brightness (mag/arcsec^2) and Sun altitude (°) versus Local Time during totality on 22 July 2009

RESULTS AND DISCUSSION

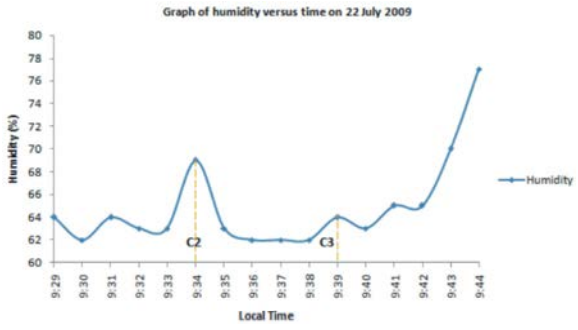
In Graph 1, the distribution shows increase in every mag/arcsec^2 and reaches the peak value at 16.71 mag/arcsec^2 at 9:36:30 Local Time for the SQM-LE that pointed near to the horizon. A peak value of 16.13 mag/arcsec^2 is taken from the SQM-L that pointed to zenith. This happen during the totality phases of the solar eclipse and present the minimum level of sky brightness. The changes in brightness are seen very clearly through the graph. However, the SQM-LE that pointed to the horizon is ended at 09:39:30 Local Time. It is due to the sensor failure in the device and it had shown constant reading.

Graph 2 and Graph 3 present the distribution data of temperature and humidity versus local time. A little change is observed through the graph plotted for temperature and humidity which shows the drop pattern near to the totality phase of the eclipse between second contact (C2) and third contact (C3) at 09:34 to 09:39 Local Time. Then, temperature and humidity start to increase after the third contact (C3).

From Graph 2, the maximum temperature is 29.9°C before the totality and the minimum is 27.9°C during the totality. The average value of temperature during the totality is 28.8 °C. While, the maximum value of humidity according to Graph 3 is 77 % after the totality and the minimum is 62 % during the totality. The average value of humidity during the totality is 63.67 %. Graph 4 shows constant value of pressure on 1006 mb.

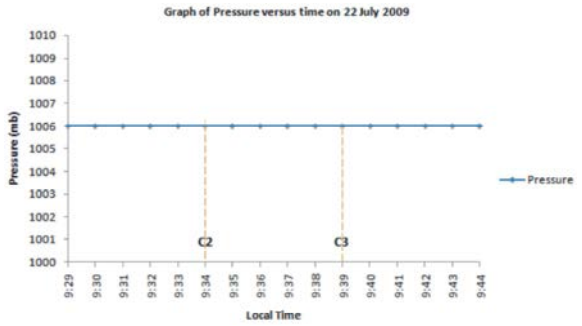


Graph 2: Graph of temperature (°C) versus Local Time on 22 July 2009 during totality



Graph 3: Graph of humidity (%) versus Local Time on 22 July 2009 during totality

Both data of temperature and humidity shows unstable reading. It is possible due to the unstable condition of local site, firstly the equipment was placed at the balcony near to the air-conditioned room and was exposed to the heating from balcony fence.



Graph 4: Graph of pressure (mb) versus Local Time on 22 July 2009 during totality

Secondly, the sky during the observation time is too cloudy. Instead, no change was occur for pressure during the totality.

CONCLUSION

The measurement has shown that the changes on environmental parameters only occurred on temperature, humidity and sky brightness during the solar eclipse. No change occurred in pressure measurement during the solar eclipse. The parameters particularly the sky brightness changes rapidly as the time of the eclipse totality approaches. The brightness curve rapidly turns downward immediately and it starts to turn upward rapidly after the eclipse totality.

The bad weather seem contributed less influence on the measurement of sky brightness while it affected large influence on temperature and humidity. In addition, the instability of temperature and humidity also contributed by the environment where the equipments were placed to obtain data. Thus, it is suggested for the next measurement of temperature and humidity taken at an open space after considering the environmental factors near to the equipment that can affect the reading such as from local heating and nearest building condition.

ACKNOWLEDGEMENT

This research is supported by Grant RG056/09AFR funded by University of Malaya, Malaysia. Authors thank to the University for providing the grant.

REFERENCE

1. Al-`Asqalani, A.H., 1993. Fath al-Bari Bi Sharh Sahih al-Bukhari, Riyadh: Dar al-Salam.
2. Al-Nawawi, M., n.d. Sahih Muslim bi Sharh al-Nawawi. Beirut: Dar al-Fikr.
3. Morelon, R., 1996. General Survey of Arabic Astronomy in Rashed, R. (ed.), Encyclopedia of The History of Arabic Science, Vol. 1, London and New York: Routledge, pp: 15.
4. Stephenson, F.R.F., 1997. Historical Eclipses and Earth's Rotation, Cambridge: Cambridge University Press, pp: 457-467.
5. Retrieved September 27, 2012 from http:// eclipse.gsfc.nasa.gov/ Semono/ TSE2009/ TSE2009.html.
6. Espenak, F., 2009. Eclipse During 2009. Retrieved September 27, 2012 from http:// eclipse.gsfc.nasa.gov/ OH/OH2009.html.
7. Mollmann, K.P. and M. Vollmer, 2006. Measurements And Predictions of The Illuminance During A Solar Eclipse. Eur. J. Phys, 27: 1299-1314.
8. Instruction Sheet for SQM-L and SQM-LE, Unihedron. Retrieved September 27, 2012 from http://www.unihedron.com/.