NRIAG Journal of Astronomy and Geophysics 7 (2018) 22–26

Contents lists available at ScienceDirect

NRIAG Journal of Astronomy and Geophysics

journal homepage: www.elsevier.com/locate/nrjag

Full length article

Twilight observation by the naked eye of the dawn sincere at Hail and other areas in Saudi Arabia

N.S. Khalifa[a,b,*], A.H. Hassan[a], A.I. Taha[a]

[a] National Research Institute of Astronomy and Geophysics (NRIAG), Helwan, Egypt
[b] Basic Science Dept., Deanship of Preparatory Year – Girls Branch, Hail University, Hail, Saudi Arabia

ARTICLE INFO

Keywords:
Hail
Different locations
Desert area
True dawn
Naked eye observation

ABSTRACT

Naked eye observations of morning twilight phenomenon at Hail and other areas of Saudi Arabia are recorded. During the interval from 2014 to 2015, about 80 morning twilight observations were carried out in Hail at longitude $\lambda = 41^{\circ}42'$E and latitude $\varphi = 27^{\circ}31'$N for a desert background. The phenomena was followed over azimuth angles ranged from 0° to 20° of solar vertical direction and from 0° to 10° along the altitudinal range. By selecting 32 days with a very good visibility, it was found that Sun depression, D_o, lies in a range between 13.48° and 14.69° with an average of 14.014° ± 0.317. The difference between our obtained value and that one which is currently applicable in Saudi Arabia is about 4°. The results indicate that dawn (white thread browser) occurs at a sun vertical depression angle $D_o = 14.66^{\circ}$ (mean + 2SD) according to the normal eye estimations. The results at different areas in the deep desert in KSA showed that the beginning of morning twilight and true dawn is at sun vertical depression $D_o = 14.88^{\circ}$ (mean + 1SD). The current study shows significant results, which are comparable with both naked eye observations and photoelectric measurements of true dawn in both Egypt and Libya for desert background.

1. Introduction

In some Arab countries, areas which are populated by some Muslims in U.S.A. and Europe, Pakistan and its surrounding areas like Bangladesh, Afghanistan and India, no religious signs for beginning and end of twilight are considered and the currently applicable value of beginning and end of twilight is fixed at Sun depression of 18° below the horizon which corresponds to that of astronomical twilight. For sun depression of 18° below the horizon, the eye receives the least possible non-perceptible light in all wavelengths which isn't enough to enable the normal eye to distinguish any horizon. So, people in the sea depend totally on stars of the sky to find their directions. North America, Canada, parts of U.S.A. and U.K. took a value of 15°. However, Saudi Arabia and all Gulf countries considered Um Al-Qura calendar which is adopting a value between 18.5° and 19° for beginning and 22.5° for the end except in Ramadan that value is increased to be 30°. Egypt, some African countries, Syria, Iraq and Lebanon follow the published values of the Egyptian General Authority of Survey 19.5° for beginning and 17.5° for end of twilight Hassan et al. (2009). The current degree of dawn prayer in Saudi Arabia is 18.5° (http://www.prayer-now.com/calculations.html).

The main aim of the present work is to determine the beginning of twilight (True dawn) in Hail city Peninsula desert and different locations (in the deep desert) in Saudi Arabia using the naked eye observations.

2. Methodology and sit observations

The observations were taken by the authors themselves. The authors based on naked eye morning twilight observations over an area of persistent light very light from neighboring areas for the desert background in the time interval (2014–2015) at Hail (Lat. = 27°31′N, Long. = 41°42′E, Elev. 1015 m). An overall of 80 observations were carried out with few of them carried out in an area of about 80 km in the way between Hail to al Medinah al Monawra. In addition to the observations of several different sites deep in the desert (see Table 3). To convert the local time of true dawn ($B.T_N$) to Sun vertical depressions, D_o, the equations of Hassan et al. (2009, 2016), were used and the results were checked by Moon calculator 6.0 (Monzur Ahmed, http://www.starlight.demon.co.uk/mooncalc). The depth of the desert means that these places are far from civil activity with their airborne pollutants, light pollutants or any human activity.

Peer review under responsibility of National Research Institute of Astronomy and Geophysics.
* Corresponding author at: National Research Institute of Astronomy and Geophysics (NRIAG), Helwan, Egypt.
E-mail addresses: ns.khalifa1976@gmail.com (N.S. Khalifa), ahhassan210@yahoo.com (A.H. Hassan), ayman_ismail1@yahoo.com (A.I. Taha).

https://doi.org/10.1016/j.nrjag.2018.01.001
Received 3 May 2017; Received in revised form 9 January 2018; Accepted 15 January 2018
Available online 15 February 2018

Table 1
Monthly variation of the metrological conditions at Hail (http://www.weatherreports.com/Saudi_Arabia/Tabuk/averages.html).

Month	T. High, ˚C	T. Low, ˚C	Prec., mm	R.H%	Pressure (hpa)
Jan	27	−10	20.8	40.9	1021
Feb	29	−7	19.1	33.4	1017
Mar	34	−4	21.4	37.6	1017
Apr	37	0	27.6	23.1	1016
May	42	10	15.5	15.9	1014
Jun	44	16	0	13.1	1012
Jul	44	17	0	11.1	1011
Aug	45	16	0	12.9	1013
Sep	42	14	5.4	14.2	1015
Oct	38	5	12.9	33.1	1018
Nov	31	5	50.6	58.4	1019
Dec	38	5	12.3	54.8	1022
Year	36	5.17	15.47	29.1	1016.3

High temperature (T. High ˚C), Low temperature (T. Low ˚C), Prec. (precipitation, mm), Relative humidity (R.H%).

There are two types of dawn, the false dawn (pseudo dawn) is a pyramid shape that shows with difficulty and the best time to see it on the second or third day after the beginning of the lunar month in the autumn season and first appears around the 18˚ under the horizon and then disappears and shows the true dawn as a white thread increases and expands horizontally more than vertically at a lower degree from 15 under the horizon. The observer here focuses and monitors the beginning of the true dawn (Hassan et al., 2009).

The monthly variation of the metrological conditions at Hail during the observation interval to give an impression of the monitoring zone is summarized in Table 1. It is important to note that the lower temperature (T. Low ˚C) to be pre dawn and this entails that the thickness of the atmosphere as a function of the temperature is less than the thickness of the atmosphere at the end of twilight heat.

3. Results and discussion

3.1. Naked eye observation at Hail in Saudi Arabia

Distribution of D_o (degree) indicates that the range of normalization of data is around ± 2 as it illustrated in Fig. 1. Fig. 2 represents the third order of sort data fitting of D_o and visibility (observed by the naked eye, 0–8 Okta) as a function of air transparency, for the total data (80 days). Fig. 3 represents the frequency of D_o (degree) which consists of 13 bars of 0.1˚ width and cover by Gaussian distributions.

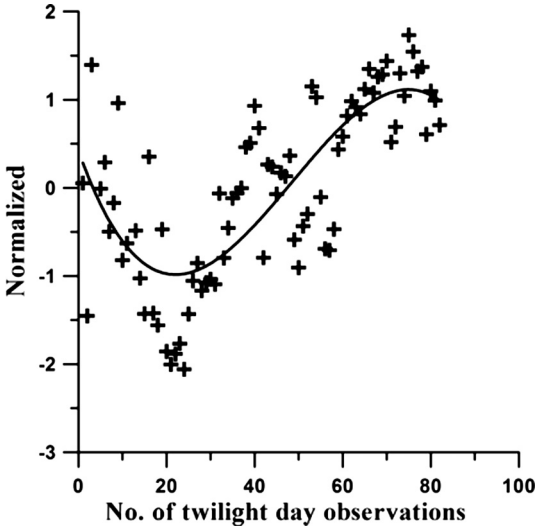

Fig. 1. Normalized distribution of D_o at Hail.

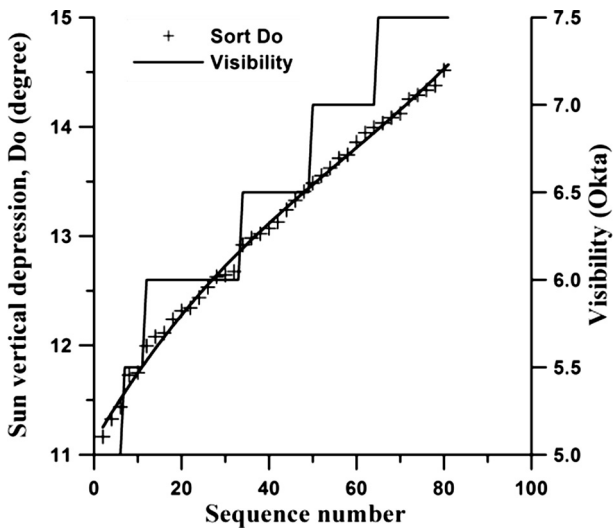

Fig. 2. Sort of D_o and visibility variation.

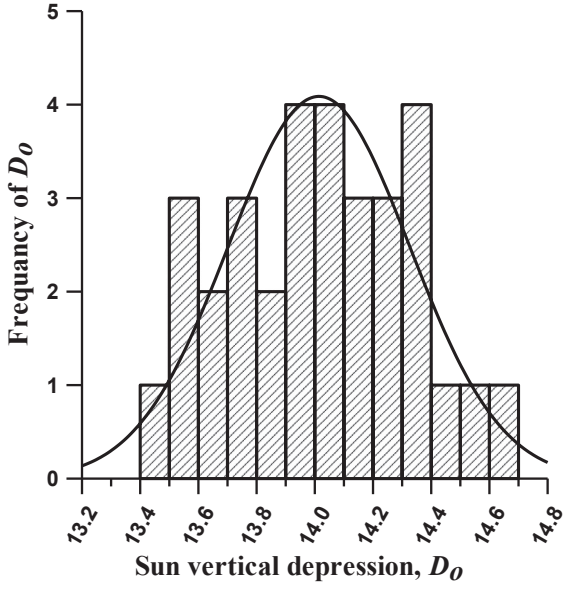

Fig. 3. Frequency of D_o at Hail.

Table 2
Statistical analysis of the naked eye twilight observations of the Sun vertical depression (D_o) and visibility (Vis.) for the total cloudless morning (80 days) and selected of high visibility days (32 days).

Statistical Results	80 days		32 days	
	D_o	Vis.	D_o	Vis.
Minimum	11.1651	5	13.4851	7
Maximum	14.692	7.5	14.692	7.5
Range	3.52696	2.5	1.20691	0.5
Mean	13.0824	6.51	14.0146	7.27
Median	13.1039	6.5	14.0186	7.5
SD	0.93067	0.733	0.31714	0.254
D_o (mean + 2 SD)			14.664	

The statistical analysis of naked eye twilight observations of the Sun vertical depression (D_o) and visibility (Vis.) for the total cloudless morning are summarized in Table 2. For the overall 80 days, the ranges of the data are 2.5, 3.5˚ and 0.93˚ for visibility, D_o and SD (Standard deviation) respectively. For the selected 32 days of high visibility, the ranges of data are 0.5, 1.2˚and 0.32˚for visibility, D_o and SD