POSSIBLE FACTORS INFLUENCING ON NUMBER OF CLEAN, OBSERVATIONAL NIGHTS IN THE SHAO

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Possibility of the impact of the activity of the Sun and the phases of the moon (distance from the Earth) on the number of observational nights at the Shamakhy Astrophysical Observatory of the Azerbaijan National Academy of Sciences is studied in this paper.

Keywords: Solar activity – Phases of the moon – Climate in the observatory

1. INTRODUCTION

At present, there is no doubt for astronomers and geophysicists about existence of solar-terrestrial relations. Depending on the state of the solar activity and on the position of the Earth relative to the Sun, their effect may be various. Influence of solar activity on the technical systems, as radio communications, pipelines and power lines, electronic equipment of aircraft and satellites on climate, humans and other biological objects was manifested with the development of technology. This work is a continuation of a series of works voted to the research of astroclimate in the Shamakhy Astrophysical Observatory of the Azerbaijan National Academy of Sciences. We will not talk about the importance and necessity of such works for any observatories because it was discussed much in previous works of series (see [1], [2], [3]). We will not talk about image degradation and reducing of penetrating ability of telescopes due to extra illumination from different kinds of objects, surrounding observatory (restaurants, hotels, etc.). It was described in detail in [3]. Analyses of clear observational nights and search their possible relation with active processes occurring on the Sun is the aim of this work. Figures which were presented in our works [1], [2] show how the average monthly number of clear

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observational nights varies depending on the month of the year for time intervals (1968-1987 and 1997-2002). The analogue curve built up for the interval 2004-2018 and all three curves summarized in one graph Fig. 1. We used data taken from observational journals of the two-meter telescope of ShAO, to determine the number of clear, observational nights, kindly presented to us by I. Alekperov and data collected on the initiative by one of the authors of this work - V. Khalilov. Climate data collection work in the observatory was started for several reasons (failure of electricity supply to the observatory, stoppage of works on the two-meter telescope, modernization of the telescope, etc.), which were not taken into account in observation journals of the two-meter telescope of ShAO. Data taken from the observatory's climate observation journal covers the period from 1997 to 2019. Daily data on day and night weather conditions, temperature, pressure and precipitation have been collected in this journal. Data control had carried out by comparing the number of clear nights from the observational journal of the climate and the observational journal of the two-meter telescope of ShAO. This made it possible to have a continuous series of data over quite a period (more than 20 years). Data from 1997 to 2002 have been processed previously [2].

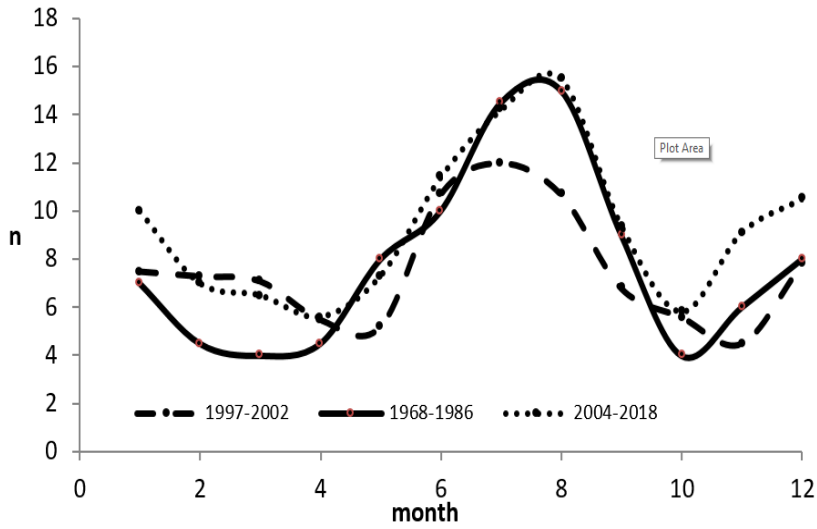

Fig. 1. The relative number of observational nights at different time intervals on average of months.

As can be seen from this figure, the run of all three curves is approximately the same, except for the summer months of 1997-2002. Possibly this is due to anomalous change of climate during that period.

Unfortunately, meteorological observations are not carried out on the territory of ShAO, and it is incorrect to take data from other weather stations due to the

difference in altitude and relief.

The relation between the Wolf numbers and the number of clear, observational nights was investigated in the same work [2].

However, then this could not be done due to the small number of continuous data (on observational nights). The two-meter telescope has been operating in a continuous, regular mode, over last 15 years and we decided to repeat this attempt because curve that built up from values of Wolf numbers shows that period 2004-2018 practically coincides with last period of solar activity and have a rather complex shape, we decided to highlight fundamental harmonic on this curve and analyze its coincidence with the number of observational nights in the investigated period. Results of the analysis shown in Table 1.

Table 1. The results of the spectral analysis of the curve of solar activity for 2004-2018.

Frequency	Period	Cosine	Sine	Periodogram	Density
		Coeff	Coeff		
0.357143	2.80000	16.32654	-5.4478	2073.637	1391.214
0.285714	3.50000	1.41147	-12.250	1064.541	1029.025
0.428571	2.33333	-3.54959	-9.9124	775.984	1033.357
0.500000	2.00000	8.47857	0.0000	503.203	746.896
0.071429	14.00000	1.43984	-4.0523	129.459	71.752
0.214286	4.66667	1.66933	3.5310	106.781	385.907
0.142857	7.00000	-0.14044	-1.3088	12.129	100.769
0.000000		1.24048	0.0000	10.771	68.093

According to data on the number of observational nights and Wolf numbers, curves built up in relative units, (all values are divided by the maximum value), and then the curves are shifted parallel to the ordinate axis, if necessary. That is done for the best perception of the figure since we are interested in the shape of curves, but the value of the correlation coefficient does not change with such a shift (see Fig. 2). Besides, the numerical values by the ordinate axis relate only to the number of observation nights.

The curve of annual average values of the number of observation nights in 2004-2018 (upper curve) and Fourier curve with a period of 2.8 years (medium curve) showed in Fig. 2. The coincidence of the curves is quite low (correlation coefficient is 0.16). In the same figure, the curve is drawn from values of Wolf numbers for the same period (lower curve). The coincidence here is lightly better (correlation coefficient is 0.23), but to talk about the existence of any relation be-

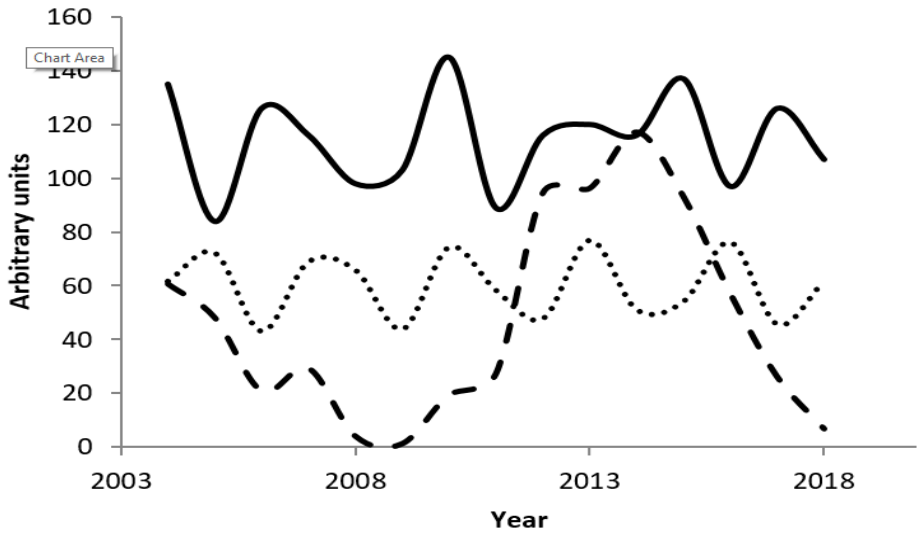

Fig. 2. Annual average values of the number of observation nights (upper curve); annual average values of Wolf numbers (lower curve); Fourier curve of a period of 2.8 years.

tween solar activity and the number of observation nights is not necessary. That result could explain for many reasons. For example, the comparatively short observation period (15 years), low solar activity in the studied cycle over the last 120 years, etc. In this paper, we analysed other solar parameters, characterizing solar activity. Convergence with the number of observational nights here is worse. Radio stream is F2800, correlation coefficient is 0.13, the neutron flux - correlation coefficient is 0.16, geomagnetic index Ap - correlation coefficient is 0.07, geomagnetic index Dst - correlation coefficient is 0.06. All data on the Sun and the geomagnetic index had taken from site NOAA (National Centres for Environmental Information) [4]. Possibility of the impact of the phase of the moon on the number of observation nights had investigated in continuation of this issue. To this aim, we recalculated observational nights, in analyzed by us period 2004–2018, from solar days to lunar days (the analogous data have taken from the site [5]) and then summed the number of observational nights in each lunar day. The obtained graph is shown in Fig. 3.

As can be seen from the figure, the number of observation nights increases from 13-14 lunar days (i.e., from the full moon) to phase of the new moon.

Besides, this effect cannot be associated with the selection; because photometric and polarimetric observations are not carried out on two-meter telescope for a long time when the moon phase plays a big role, (usually such observations are not carried out in full moon). Statistical significance of this effect is small,

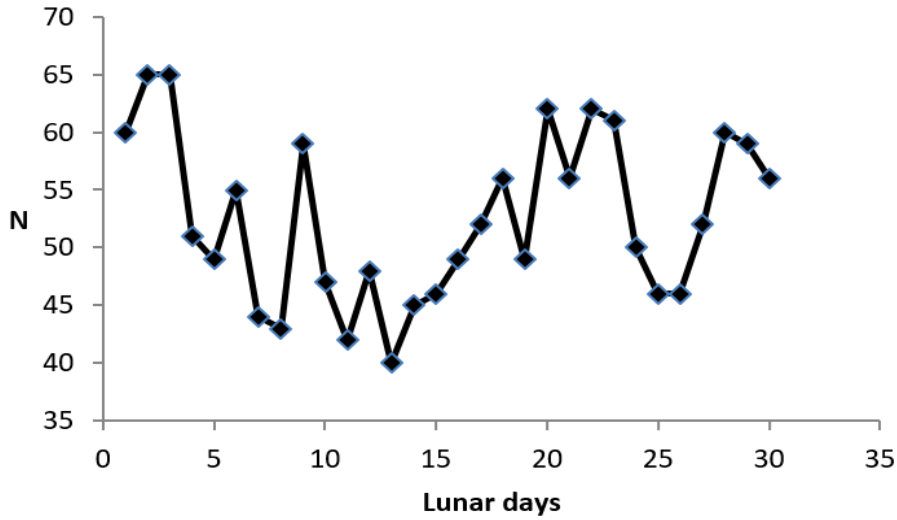

Fig. 3. The average number of observational nights depending on the phase of the moon.

the effect itself is quite interesting, and therefore, in this case, it would be useful to continue this work in the future. What is the cause of this effect? Maybe, Moon in the Earth atmosphere creates a tidal wave, as in the oceans. It is closer to the atmosphere, and the gases of the atmosphere are not water, at least in density. Reviewing the above, we conclude that works in this direction should be continued by using new data for one more period of solar activity at least.

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