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A Preliminary Comparison of the Frequency of Transient Lunar Phenomena with Routine Observations

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Abstract

In a previous study we found that Transient Lunar Phenomena (TLP) are more frequent at the end of April than at other times of the year and that TLP appeared to be more prevalent around local lunar sunrise. By normalizing the TLP data against a new database of routine non-TLP observations, and assigning weights to observations, we now show that neither effect is apparent, although an increase towards local noon appears present in the local time of day analysis.

1. Introduction

Transient Lunar Phenomena (TLP) have been observed on the Moon's surface for centuries [1] and are sometimes referenced as evidence for lunar outgassing [2] or for electrostatic charged dust clouds [3]. We analyzed the catalogs of Middlehurst [4], Cameron [1,5], and the archives of the British Astronomical Association (BAA) and the Association of Lunar and Planetary Observers (ALPO) to recover a total of 2639 TLP reports. The BAA and ALPO archives also provided us with a representative sample of 6429 routine non-TLP observations. We investigated histograms of TLP frequencies per time of year, and per local time of day at TLP sites, both with respect to routine reports. The latter are used to check for selection effects.

Table 1: TLPs are assigned the following weights initially, and then adjusted up or down one level depending upon additional supporting evidence. The table lists the frequency of occurrence of each weight and the proportion of the total of TLPs.

Weight	Description	Frequency	Proportion
1	Report from an inexperienced observer	1016	38%
2	Good report from an inexperienced observer, so might be real	700	27%
3	Observation from an experienced observer, so might be real	574	22%
4	Confirmed report from more than one observer, at least one of whom is experienced	111	4%
5	Definitive unambiguous TLP	48	2%

2. Analysis and Results

Both TLP and routine datasets needed to be filtered to remove unspecific areas e.g. "East Limb" etc, leaving 2449 TLP and 4397 routine reports. The TLPs were further categorized into weights (see table 1) that we consider more reliable than those used in the Cameron catalogs [1,5].

We selected data bins of 1 week wide in order to study the time of the year, and 10° wide for local hour angle, centred on local noon at each feature concerned. Because our non-TLP dataset was likely to be a fraction of a very large unknown quantity of observations ever made, we compare TLP frequency to non-TLP frequency through ratio plots.

2.1 Times of the year

We see from Figure 1 that there is tremendous scatter in the frequency of TLP ratios per week. A closer inspection (not shown here) reveals strong periodicities in both datasets related to monthly cycles. This hinders us from easily establishing a correlation with individual meteors showers [6]. Two peaks do appear to coincide with showers, however these are from weight 1 observations. There is though a higher of TLP ratio during the middle of the year for at least the first three types of weights.

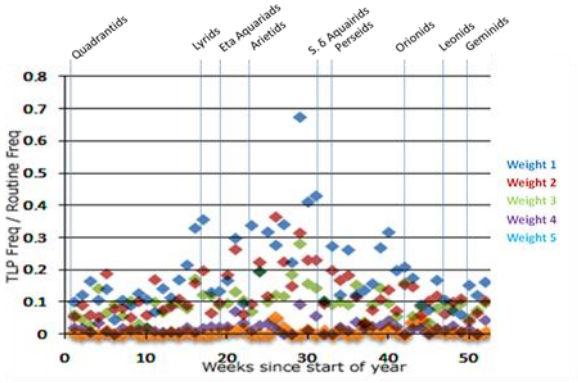

Figure 1. The frequency of TLP of different weights per week of the year, in ratio with the number of routine observations made per week. For comparison meteor shower dates are indicated.

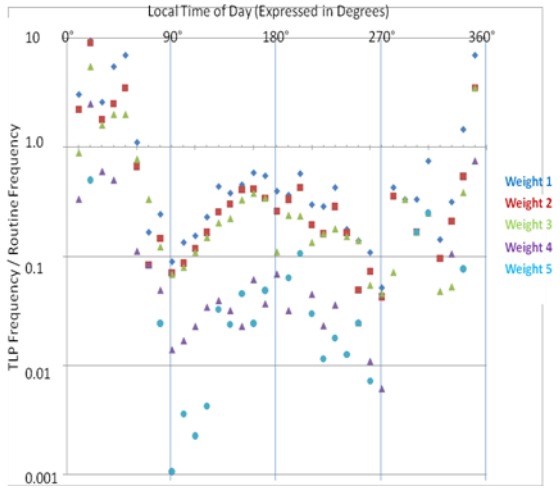

Figure 2. The frequency of TLP according to local time of the day at the lunar features concerned, divided by routine non-TLP frequency. Plotted for different reliability TLP weights (1-5).

2.2 Local time of the day

When we examine frequency of TLP per time of day at the feature concerned, we see an order of magnitude increase from sunrise to just prior to noon for TLP weights 1-3, followed by a slower, less organized decay in the local afternoon. Much higher ratios are experienced in the lunar night, especially within 30° prior to, and 60° after, local midnight.

3. Summary and Conclusions

Based upon the use of a representative non-TLP dataset, and observation weights, we can now show that two of our previous findings [6] need to be revised, namely the fact that TLP appear to occur more frequently at certain times of the year, is probably an observational selection effect resulting from the lunation cycles. No trend was present in the different weights of observations used. Concerning the excess in TLP seen in Summer months, this maybe because the bulk of the observers live in the northern hemisphere, and during the Summer months the Moon is lower in the sky and more susceptible to poorer atmospheric observing conditions? This may result in observers being more prone to observational error and mis-identification for lower weight TLP.

Concerning the frequency of TLP according to the local time of day on the Moon, we see no significant effects after sunrise or before sunset, but do see an order of magnitude proportional rise in TLP towards just prior to local noon. The former does not provide strong evidence to support the theory of electrostatic clouds of charged dust particles forming along the morning terminator [7]. Although the apparent increase in TLP activity towards local midnight is intriguing we need to perform more rigorous tests for observation selection effects in the routine dataset.

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