

the Twinkle of Stars and Aerology

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Investigating the Factors of Star Blink and Thinking about the Relationship between Star Blink and Aerology

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1. Subject

To quantitatively observe the blink of a star and analyze the effect of the atmosphere on the blink of a star.

2. Methods of observation and analysis

(1) Observations were made between 20:30 and 22:00, when radiosonde observations are conducted at the JMA's high-level weather station, under the Arakawa river bank where there is little light pollution.

The camera will be connected to an astronomical telescope with an aperture of 80mm and a focal length of 900mm, and will take video of the stars for 30 seconds.

→Two stars to be filmed at each magnitude from 0 to 5, and Venus, Mars, Jupiter, Saturn, and Sirius depending on the season.

[Analysis]

(2) Record the instantaneous **wind speed, temperature, humidity, and atmospheric pressure** data measured at the time of shooting, **airborne pollutants, average wind speed** (at 21:00), and **wind direction** (16 directions) data obtained from the Tokyo Metropolitan Government Bureau of Environment website, and **radiosonde observation data** obtained from the Japan Meteorological Agency website. **The altitude and azimuth of the stars** are obtained from the application used for the observation.

(3) Movies will be analyzed by software (I proposed that it be executed, and asked a specialist to do the programming).

[The work to be performed by the software]

(1) decompose the 30-second video into a total of 720 frame images

(2) identify relatively bright areas (a star's area) in the frame images

(3) function to obtain the average luminance of the pixels in the discriminated area.

(4) Take the standard deviation from the luminance data of 720 frames and use it as an index of blink. (Hereafter, this is referred to as the blink deviation.)

3. Observation results

→In the preliminary observation, three elements of the blink, "star magnitude," "star altitude," and "meteorological factors," were found. Each of these factors will be analyzed separately.

(1) The relationship between star magnitude and blink deviation

*From 3rd magnitude to -1.46 Sirius, the lower the magnitude, the smaller the blink deviation.

*From 3rd magnitude to 5th magnitude, the blink deviation became smaller as the magnitude increased.

[Considerations]

In the light from point sources, the lower magnitude stars have larger photon densities and are less affected by atmospheric effects, so the blink deviations are thought to become smaller as the magnitude decreases. On the other hand, stars of 4th and 5th magnitude are more susceptible to atmospheric

effects, but their low brightness prevents them from taking a wide range of brightness values, and the blink deviation for stars of 3rd to 5th magnitude is considered to have decreased with increasing magnitude.

(2) Relationship between the altitude of a star and its blink deviation

*The lower the altitude of the star, the larger the blink deviation.

[Considerations]

The lower the altitude of a star, the longer the distance that starlight passes through the atmosphere. Therefore, it is thought that the lower the altitude of a star, the more easily it is affected by the atmosphere, resulting in a larger blink deviation.

(3) Relationship between meteorological factors and blink deviation

*The larger the atmospheric pressure, the smaller the blink deviation.

*The larger the value of atmospheric pressure, the smaller the blink anomaly.

[Considerations]

Air at high pressure and low temperature is compressed, while air at low pressure and high temperature is expanded. Expanded air is considered to refract starlight more intensely due to its more active molecular motion. Therefore, the blink deviation is considered to increase with lower pressure and higher temperature. In addition, since wind speed is directly related to atmospheric turbulence, it is considered to be positively correlated with the blink anomaly.

4. References

*<https://pystyle.info/opencv-image-statistics/>

*<https://www.jma.go.jp/jma/index.html>

*<https://www.kankyo.metro.tokyo.lg.jp>

*StarSense Explorer(Application to be used during observation)

[Previous Studies]

*The Meteorological Society of Japan "Star Blink and Meteorological Elements - Kokugakuin University Tochigi High School".

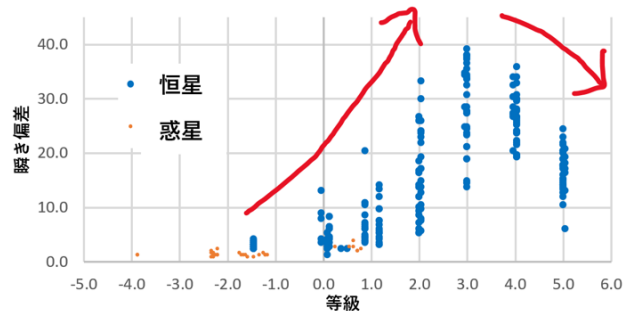
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*Quantitative Observation of Star Blink - Chiba Prefectural Funabashi Senior High School

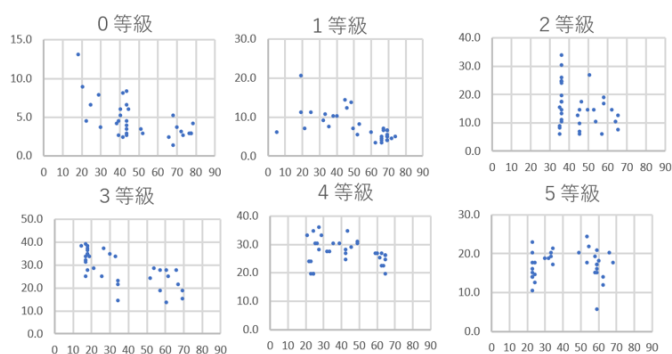
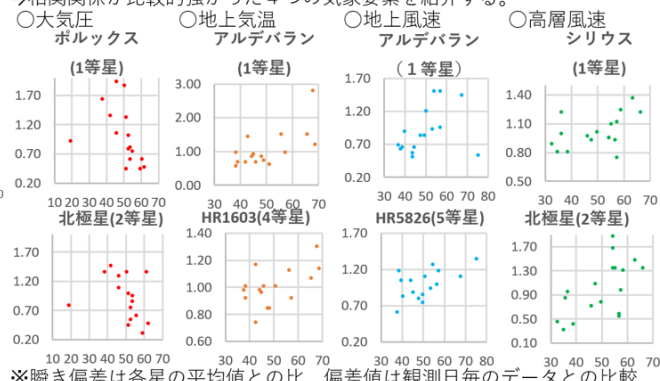
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Keywords: Star, Weather, the Atmosphere

①星の等級と瞬き偏差の関係について



②高度と瞬き偏差の関係について (横軸:高度(°), 縦軸:瞬き偏差)

③気象要素と瞬き偏差の関係について (縦軸:瞬き偏差, 横軸:偏差値)
→相関関係が比較強かった4つの気象要素を紹介する。

※瞬き偏差は各星の平均値との比、偏差値は観測日毎のデータとの比較