

Analysis of sunspot observation data over 70 years and future prospects

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Background:

Tachikawa High School's Astronomy and Meteorology Club have been observing sunspots for more than 70 years since 1947. Five years ago, seniors created a continuous graph of relative sunspot number from a record of about 5,500 days. Three years ago, we measured the rotation period of the sun point from an observational sketch and studied on the differential rotation of the sun. In this study, we added new data to the prior research, and measurement scan was reviewed for differential rotation, and detailed analysis was performed.

Objective:

We analyze the sunspot observation data over 70 years and analyze the three points between the increase or decrease in , the tendency of differential rotation, and the relationship between the sunspot area and the relative sunspot number.

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1)About the relative sunspot number

We added the observation data about 500 days' worth of observation data to create a continuous graph of relative numbers. In addition, compared the cycle 19, which was observed the highest sun score in the maximum period in the school data, cycle 24.

2)About differential rotation

25 data was added to the 53 sunserp of the maximum period, select the sunspot group capable of calculating the rotation period, read longitude and latitude of the sunspot group and the moved angle with a dedicated tracing paper. Next, we get a revolution period, taking into account the rotation angle of the earth. Next, we reviewed measurement data ,and was graphed the relationship between thie average latitude of the sun point and the rotation period . The theoretical value was determined by the formula of the rotation period of the earth according to the chronological sycientific tables , considering the revolution period of the earth.

3)About area of sun spot and relative sunspot number

For the white full light image of the sun observed by the National Astronomical Observatory (1997-2019), the area of the sunspot was calculated by the program (Python) using openCV, and the relationship between this value (number of pixels) and the relative sunspot number of our school was chronology.

Results and Considerations:

1)About the relative sunspot number

The change in the number of relative number over the 70 years, which added recent observation data, was roughly consistent with the public observation agencies. The relative sunspot number of in cycle 24 is very small compared to cycle 19, and in view of the large flow of the greatest period, the next cycle 25 may be even smaller than this time.

2)About differential rotation

The regression curve of the estimate sedate from the measurement of our school showed the tendency of differential rotation, and it was almost consistent with the theoretical value in the low latitude. In addition, in the high latitude showed a larger value, but a long sunspot of the rotation cycle was measured many, there was a considerable width to the variation of the data.

3)About the sunspot area and the relative sunspot number

The area of the sunspot (number of pixels) calculated from the data of the National Astronomical Observatory and the relative sunspot number of our school showed a tendency of the same increase or decrease, and a positive strong correlation was observed. It is thought that the area of the sunspot becomes large as the activity of the sun is active.

Issues on future observations:

In the future, the appearance of sun scores will decrease, and as a part of the department, there is a concern that the number of opportunities for observation will decrease. Since there are complex procedures for sunspot observation and it is not easy to learn, we have prepared a manual that explains the observation methods in an easy-to-understand way of using illustrations and photographs. We have also attempted observations using the $H\alpha$ Solar Telescope, but it is difficult to use them, and we are considering whether there are any new observation methods. Public observers have changed from sketch observation to CCD image observations, and although web data can be obtained every day, we would like to continue sketching observations and conduct research.

Keywords: sun, sunspot, differential rotation, area of sunspots



図1 15cm屈折望遠鏡

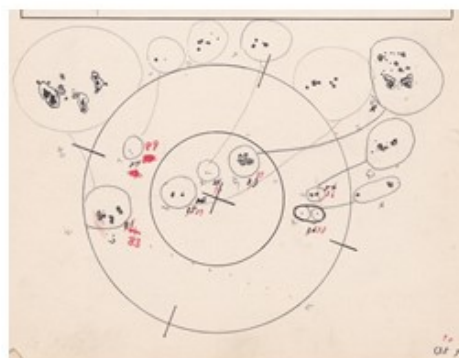


図2 実際のスケッチ

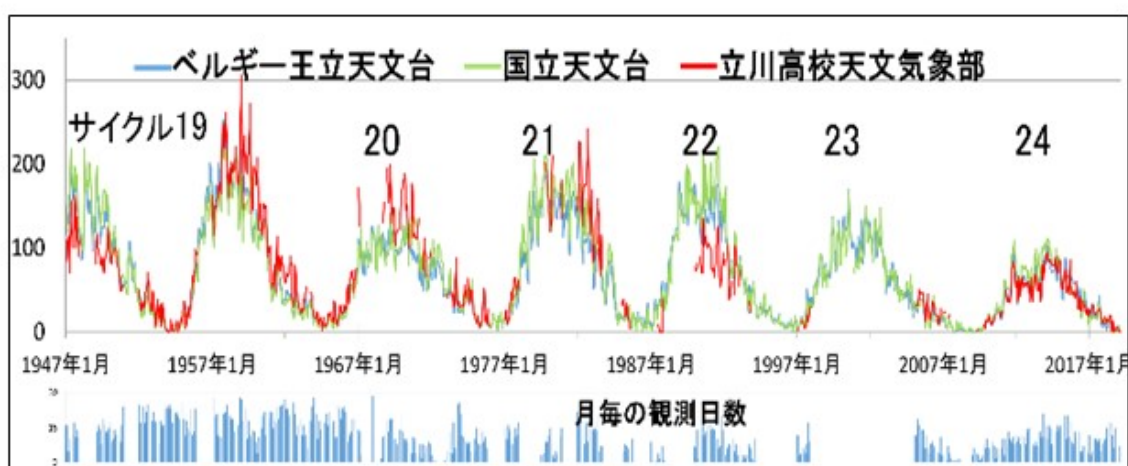


図3 1947～2018年黒点相対数（月平均）

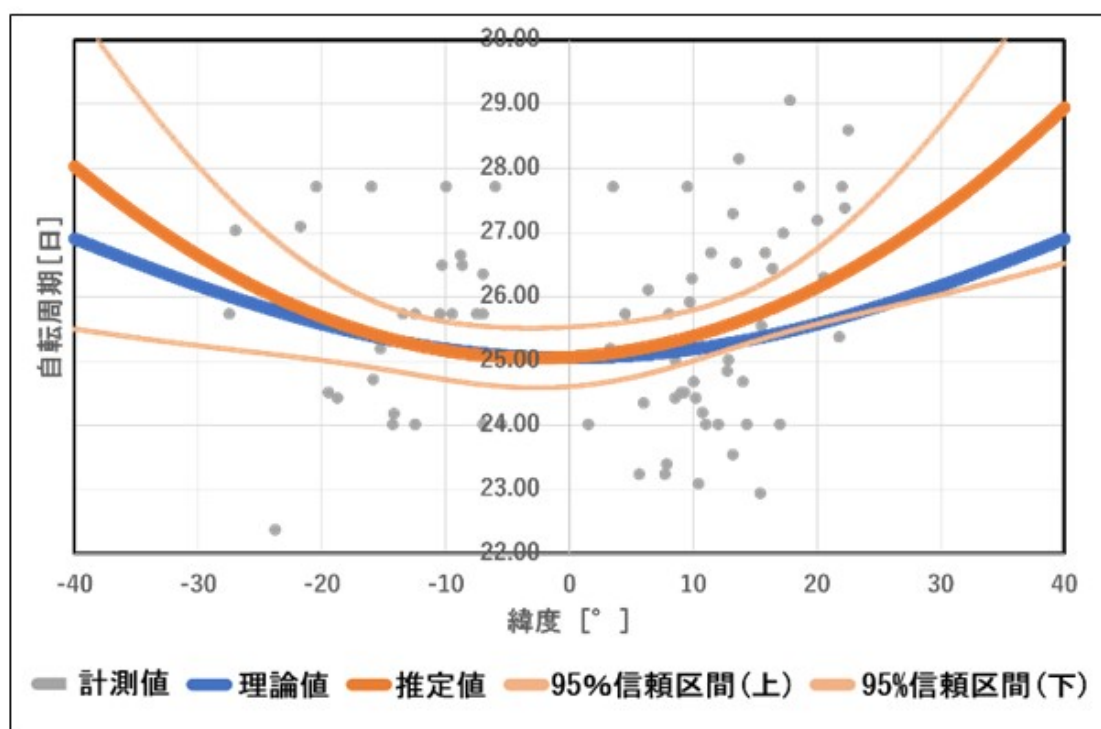


図4 平均緯度と自転周期の関係