N89-10796

INTERANNUAL DIFFERENCES IN THE REGRESSIONS OF THE POLAR CAPS OF MARS: K. Iwasaki, Y. Saito, Kwasan Observatory, University of Kyoto, Kyoto 607, and T. Akabane, Hida Observatory, University of Kyoto, Kamitakara, Gifu 506-13, JAPAN.

Analyses of the behavior of the Martian polar caps in the recent spacecraft and ground-based observations seem to reveal the existence of year to year variations on their regressions(i.g. James et al. (1), James and Lumme (2), Iwasaki et al. (3), for the south polar cap; Iwasaki et al. (4), James (5), Iwasaki et al. (6), for the north polar cap).

In order to investigate the interannual differences in the regressions of the polar caps, we reexamined the earlier data by Fischbacher et al.(7), which were based on the measurements of the large number of high-quality photographic plates and films collected from 1905 to 1965 at the Lowell Observatory. Their data, consisted of the cap edge latitudes for each longitudes, are now projected onto a plane tangent to the pole of Mars using a polar stereographic projection in units in which the planetary radius is set as 0.5 after James and Lumme (2). Each circle, which shows the polar cap boundary, is derived by least squares fitting to these data points.

In figure 1, the south polar cap radius is plotted against the areocentric longitude of the sun, Ls. The regression data show a significant difference from year to year and the maximum difference occurs near Ls=250°. The best fit circles for the south polar cap boundaries of recorded years are shown in figure 2. The centers of the circles do not differ so much, but the radii are different significantly. We therefore conclude that there is an interannual difference in the regression of the south polar cap.

James et al. (1) reported that the 1977 dust storms seemed to have a significant effect on the south polar retreat. We examined the relation between the interannual difference in the regression of the south polar cap and dust

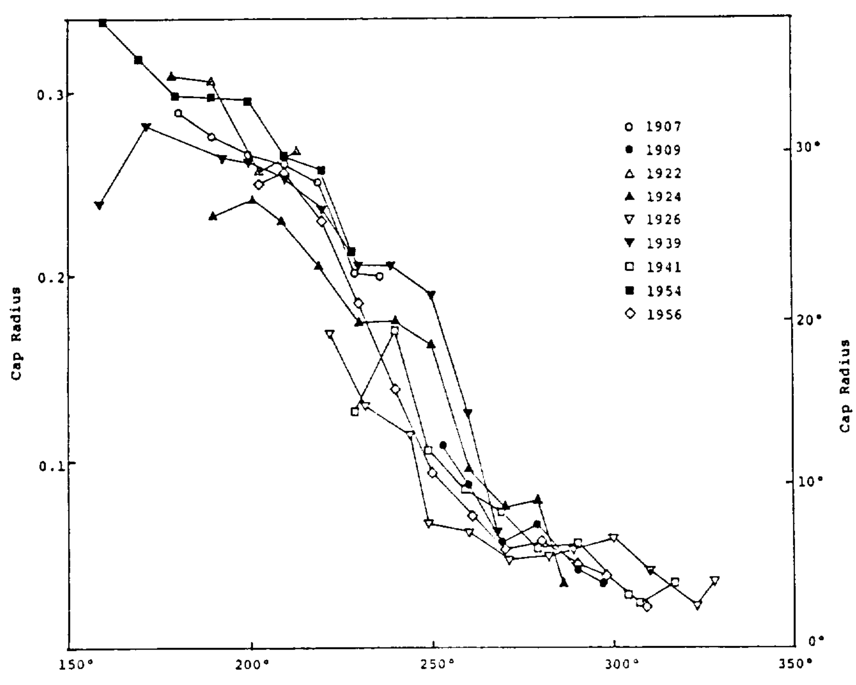

Fig. 1. The south polar cap radius (Mars diameter=1) as a function of Ls.

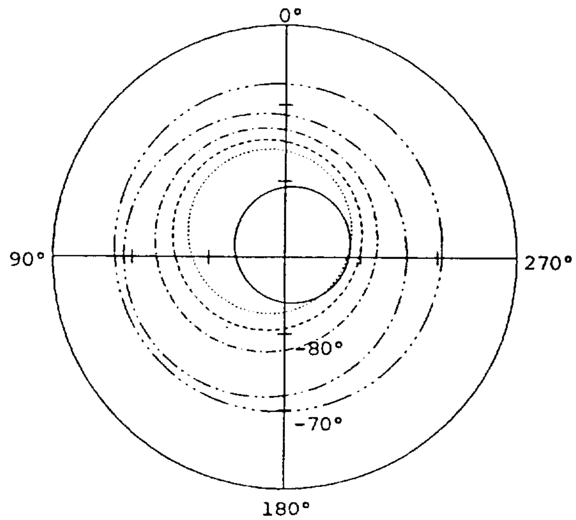

Fig. 2.
South polar cap boundaries at Ls=245°-254°

------ 1909   ··—··— 1924   ——— 1926
···—— 1939   ·—·— 1941   ·········· 1956

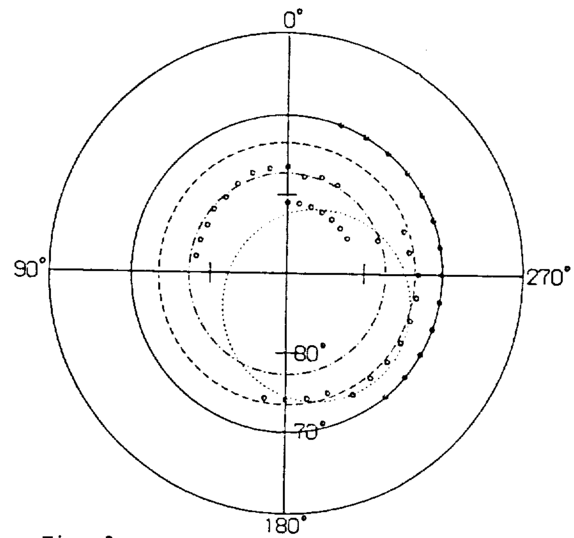

Fig. 3.
North polar cap boundaries at Ls=65°-74°.

——— 1916   ·-·-·-·- 1948
----- 1950   -·-·-·- 1965

storms, and found that the dimension of the south polar cap near Ls=250° tends to be larger in the year when the first dust storm occurs near Ls=200°.

In figure 3, the best fit circles of the north polar cap boundaries of observed years are shown. In figure 4, the north polar cap radius is plotted against the Ls. The mean regression curves for the north polar cap and south polar cap, obtained from our reexamination, are also shown for comparison. The regression data for the north polar cap also show a significant difference from year to year. The maximum interannual difference occurs near Ls=70° before the period of the permanent north polar cap.

As is seen in figure 4, the accumulation of the data is poorer for the north polar cap because the observational data must be obtained while the planet is near the aphelion of its orbit. But we can clearly see the smaller north polar cap and the standstill in its recession before Ls=40°, when compared with the south polar cap before Ls=220°. Also we see the larger north remnant cap after Ls=100°, when compared with the south remnant cap after Ls= 280°. Comparing figure 1 and 4, we can say that the maximum interannual difference occurs in the same season in each of the polar caps. However, the maximum interannual difference of the latitude of the north polar cap (8°) is smaller than that of the south polar cap (14°). This smallness seems to be related to the difference of the distance from the sun. That is, in the season of the regression of the north polar cap, Mars is farther away from the sun and receives weaker energy from the sun. Great dust storms do not occur and the atmosphere is relatively clear and quiet. Therefore the interannual difference of the north polar cap seems to be smaller than that of the south polar cap. The mean regression curves of the north polar cap and the south polar cap are compared with the theoretical regression curves by James and North (8). The theoretical regression curves show that the north polar cap is always smaller than the south polar cap. On the contrary, in our reexamination of the observational data the north polar cap is larger than the south polar cap during the period of Ls=40°-77°.

Acknowledgments: We gratefully acknowledge the hospitality of the Planetary

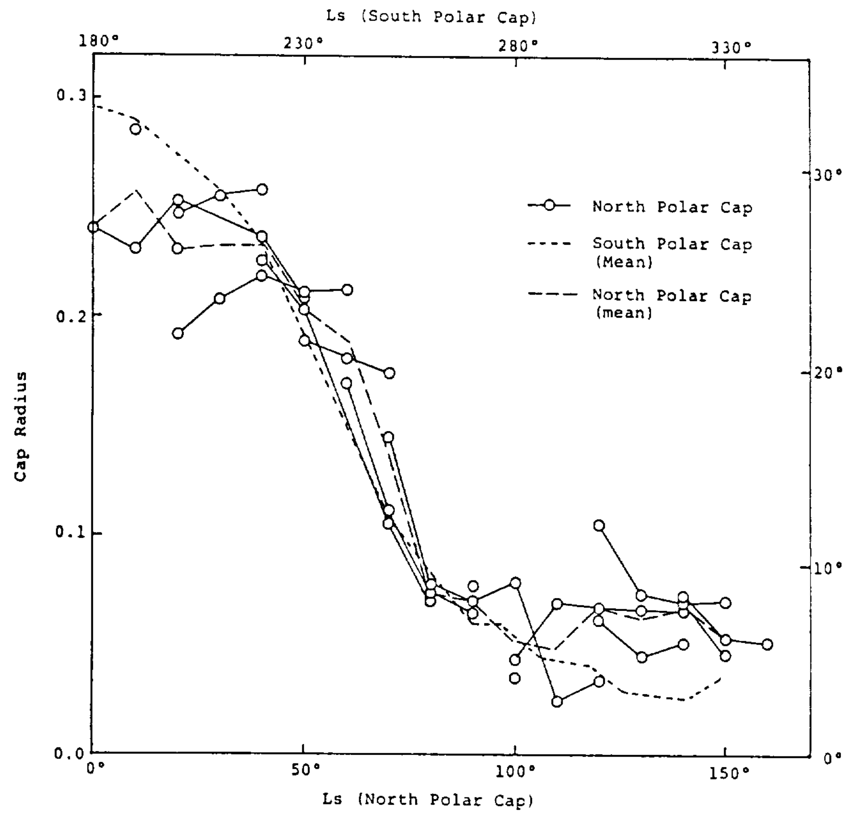

Fig. 4. The cap radius (Mars diameter=1) as a function of Ls.

Research Center of Lowell Observatory in supplying Mars data used in this study.

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