Diminishing of Martian Southern Polar Cap in Apparition 2020–2021

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Abstract

We present some results of diminishing of Martian Southern Polar Cap (SPC) during the apparition 2020–2021 by Finnish amateur data. We have selected a sample from ca 150 images and converted them into a polar projections using the WinJUPOS software. Then we have measured the northernmost latitude of SPC from each image.

The diminishing rate is consistent with to the data from earlier apparitions, e.g. by British Astronomical Association and American Lunar and Planetary Observers.
The SPC asymmetry and misplacement from the Martian South Pole is clearly visible.

Novus Mons feature was observable as a separated icy fragment near the edge of the SPC during the period 14–21 Aug 2020.

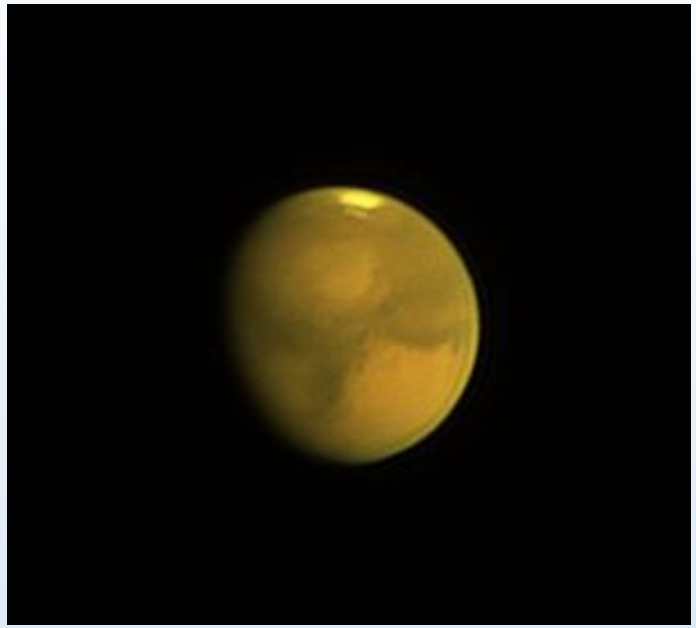


Figure 1. Image by J. Jantunen 19 Aug 2020 at 22:58–23:01 UT (CM = 294°) with 0.28-m SCT and QHY5III224 planet imaging camera.

Introduction and Observations

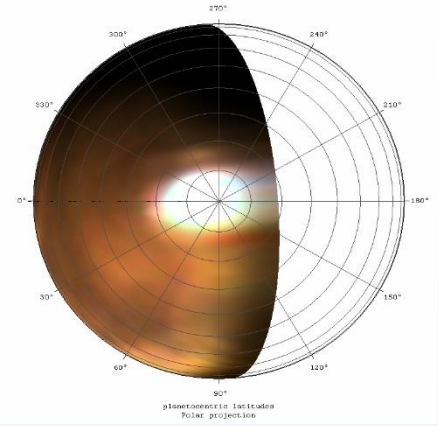
Background

The Martian apparition 2010–2011 was the best for the high latitude observers for almost 15 years. The perihelion on 3 Aug 2020, just two months before the opposition, offered a large angular diameter of the planetary disc and the axial position of the planet made possible to study the southern polar cap (SPC).

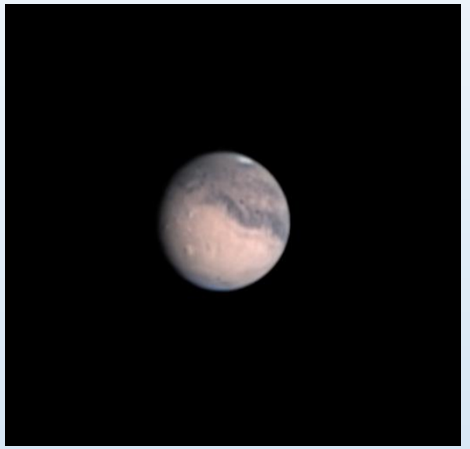
Observations and Measurements

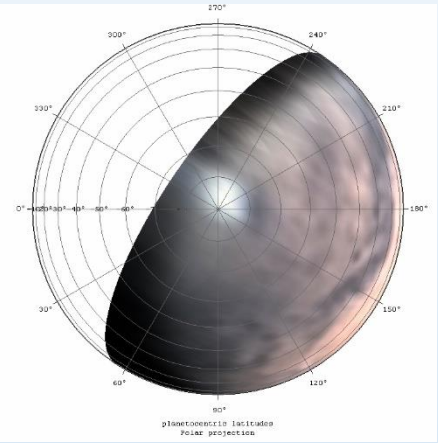
We had ca 150 images taken by the members of the Lunar and Planetary group of Ursa Astronomical Association. Observations were made with 0.10-m up to 0.40-m telescopes mainly with planet imaging cameras. Image data cover the period from May 2020 to May 2021 [1].

We selected a large sample of images where the polar cap is clearly visible. Then we converted the sample images into a polar projection with planetocentric latitudes using the WinJUPOS software [2]. We measured the northernmost latitude of SPC from each projected image.



Figures 2–3. Image by M. Ankelo 16 Aug 2020 at 01:15 UT (CM = 4°) and corresponding polar projection.





Figures 4–5. Image by L. Ekblom 7 Sep 2020 at 00:18 UT (CM = 273°) and corresponding polar projection.

Results: The Diminishing Rate

We were able to monitor the diminishing rate of Martian SPC by detecting its northernmost latitude from May to December 2020. The results are show in the Figure 6. The polynomial fitting of the diminishing rate is consistent with the data from earlier apparitions, e.g. by British Astronomical Association and American Lunar and Planetary Observers [3, 4].

Due to poor weather conditions in midwinter 2020–2021 the disappearance of the SPC is unsolved. In January 2021, the SPC is not detectable in the Finnish data, albeit there are some reports of its visibility in the observations of British Astronomical Association [5].

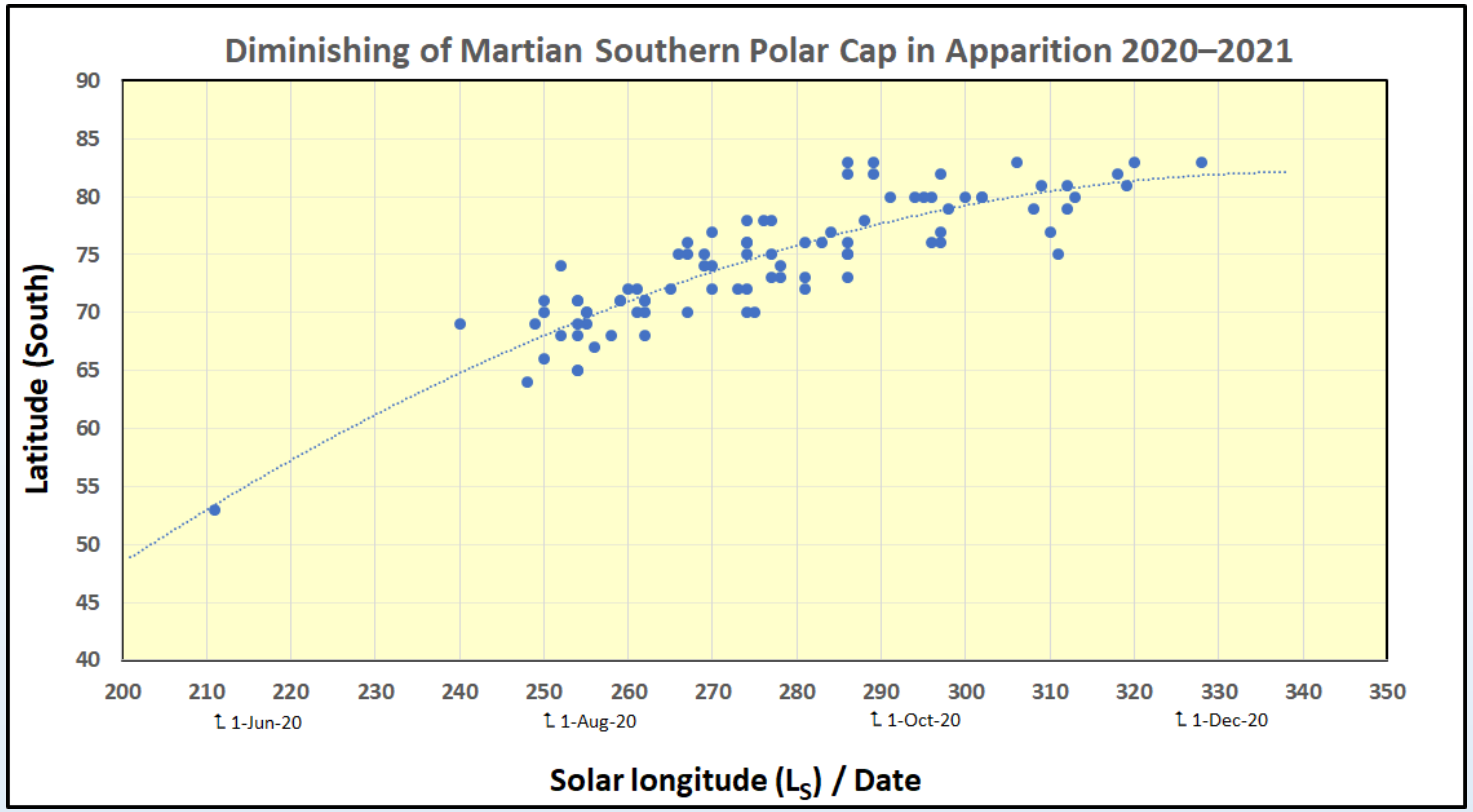


Figure 6. The northernmost latitude of the SPC edge by Finnish observational data. The dotted line shows a 2nd order polynomial fitting of the data points. The X-axis shows the solar longitude (L_S) and corresponding date.

Results: Shape and features of SPC

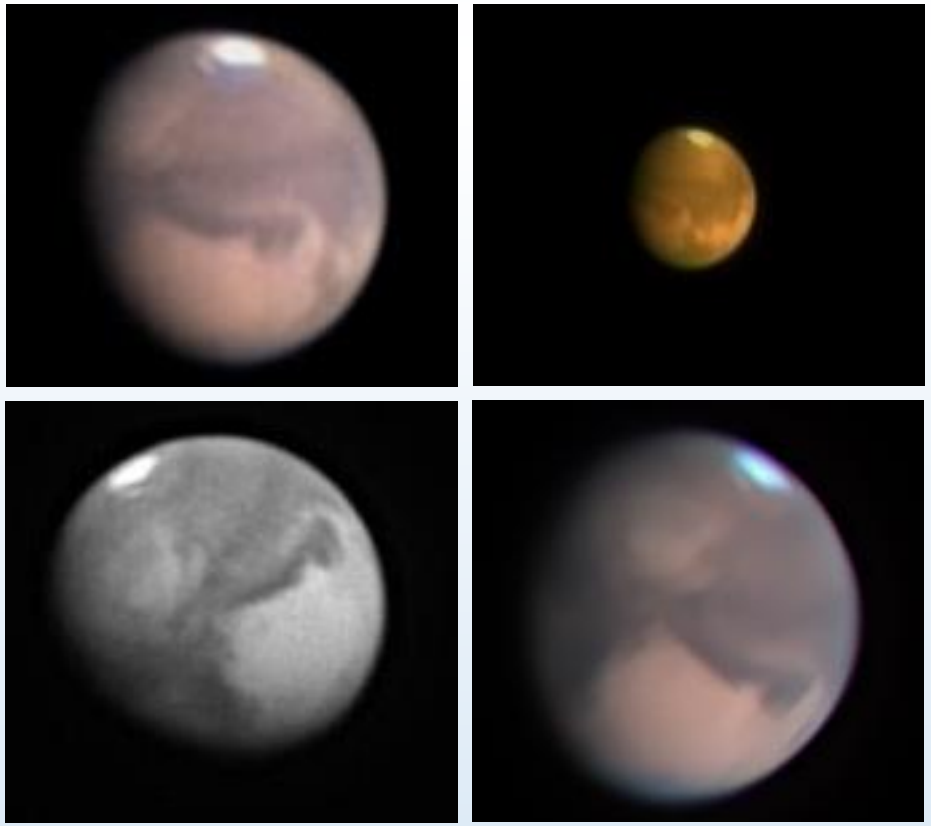
In the early phases of the diminishing process the SPC was more or less oval-shaped. Especially in the August 2020 observations the shape was clearly non-circular.

The SPC asymmetry is clearly visible. The centre of the polar cap was misplaced from the Martian South Pole. The northern edge of SPC extended towards 330–60° longitudes. The midpoint was located around the 80–85° latitudes.

Novus Mons feature

Novus Mons, aka “Mountains of Mitchel” area was visible in late August 2020 observations. In the early August observations it was observable as a “bump” in the edge of SPC. As a separated icy fragment near the edge it was visible during the period 14–21 Aug 2020 (L_S = 258–262°).

The areographic location of the feature was around 300–330° W and 70–75° S.



Figures 7–10. Images with Novus Mons feature. From upper left: by L. Ekblom 16 Aug 2020 at 23:58 UT (CM = 336°), by J. Kankaanpää 16 Aug 2020 at 23:04 UT (CM = 7°), by M. Koskimo 19 Aug 2020 at 23:59 UT (CM = 308°) and by A. Haavisto 21 Aug 2020 at 0:41 UT (CM = 310°).

Discussion and Conclusions

The results are consistent with earlier studies e.g. by British Astronomical Association and American Lunar and Planetary Observers [3, 4]. The polar projection method proved useful to study the polar cap evolution and features.

Three main factors compromising the latitude measurements accuracy are:

- Due to asymmetry of SPC, observations made from the opposite direction of the extend edge easily produce too high latitude values
- The quality of observations, e.g. poor seeing conditions, small aperture telescopes and image process weaknesses decreases the accuracy
- Manual positioning of the images in the JUPOS software, e.g. adjusting planet disc and axis direction, cause some deviation to the results

The asymmetry and the misplacement of the polar cap centre from the planetary pole are clearly detectable from the amateur data. Asymmetry have been noticed by Huygens already in 1672. Maraldi noticed the misplacement from the pole in 1719 [6]. Later these are confirmed by e.g. Mars missions data [7]. These phenomena have been explained by topographic and climatic features in Martian western hemisphere near the southern polar region [8, 9]. The large and deep impact basins Hellas Planitia and Argyre Planitia are assumed to change climatic conditions on the Martian southern hemisphere.

The Novus Mons feature is discovered by O. M. Mitchel in 1845 [4]. The mountain region keeps shortly its ice cover when the SPC is melting and the edge is shrinking southwards.

References

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