THERMAL BEHAVIOR OF DOKKA CRATER AND ITS SURROUNDINGS IN THE NORTH POLAR REGION OF MARS. A. Kuti[1,2], [1]Eotvos Lorand University of Sciences, Department of Astronomy (H-1518 Budapest, Pf. 32., Hungary), [2]Hungarian Astronomical Association, adrienn.kuti@index.hu.

Introduction: Analyzing the present day morphology in the north polar region of Mars plays an important role in a better understanding of the climatic fluctuation forced by orbital changes and the paleoclimatic chatracteristics of the planet. Based on theoretical computations and observational evidences, the latitudinal distribution of H_2O ice on Mars changes according to the orbital changes on geologic timescales [1], [2]. There are water ice "islands" separated from the northern permanent polar cap within the circumpolar dunes [3], which could be remnants of a former and greater water ice polar cap. As a result they may contain substantial amount of deposits, water ice, dust or even CO_2-ice mixed together.

The water ice related phenomena around and beyond the northern receding seasonal cap edge were put into two categories: (i) *H_2O annulus*: it is composed of H_2O ice and it widens as it recedes [4]. (ii) *Frost outliers*: in several craters (Korolev, Lomonosov, Louth) there are bright terrains that keep their high albedo during summer too, even when they are already separated from the residual cap itself [5-9].

The intent of this work is the analysis of such frost outliers in and around Dokka crater. Dokka is 50 km in diameter, located at 77°N, 214°E. Its interior is presumably a remnant of a former polar cap with larger extension so it could provide information about the past Martian conditions.

Methods: For the analysis MGS TES bolometer data were used. Bolometric brightness temperature and Lambert albedo were retrieved for three Martian years (MY24, MY25, MY26). Three main regions were chosen in the north polar region, arranged at different latitudes: 1. „below Dokka" (BD; 145°-146.9°W, 75.8°-76.3°N), 2. the crater floor of Dokka (ID; 145°-146.9°W, 77.0°-77.5°N), 3. „above Dokka" (AD; 145°-146.9°W, 78.0°-78.5°N), as well as three additional ones for comparison, without summertime frost inside: BDW (150°-151.9°W 75.8°-76.3°N), DW (150°-151.9°W 77.0°-77.5°N) and ADW (150°-151.9°W 78.0°-78.5°N). The size of the analyzed regions was chosen to be small enough to be homogenous but large enough to have reasonable data from different solar longitudes. Besides that, four different units could be outlined around the crater: crater interior deposit (CID), crater interior deposit-southern part (CIDS), undulating crater ejecta (UCE), non-crater frost patches (NCFP), some of them superimposed on the previously mentioned regions but not identical to them (Fig. 1).

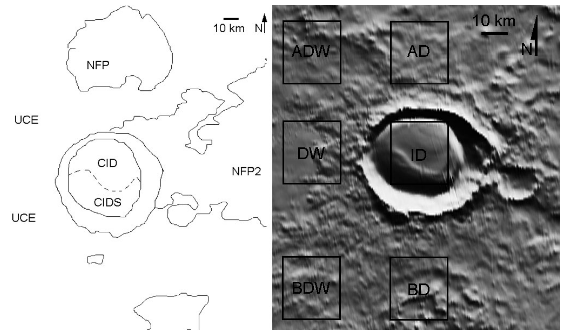

Fig. 1. Units outlined in the surrounding of the Dokka crater (left), MOLA shaded topography map and the analyzed terrains (right).

Discussion: There are several meridional asymmetric, probably exposure related characteristics in the morphology of the analyzed structures. The surface of the CID appears to be smoother compared to the CIDS. There were also differences in the surrounding trench depths and maximal slope angles. The general tilt of the CID plain as well as the CIDS are probably related to the variant amount of insolation, reaching the parts facing to different directions, and to the possible differential erosion/accumulation in connection with recent climate changes. While the CID shows a regionally continuous frost cover, the outliers characterized by the NCFP are patchy with smaller frost-free parts inside them in summertime, and have zig-zag outlines. Regarding the NCFP, frost volatility was found only at the southern slopes. The frost-free surfaces in the NCFP are present southward at the slopes with stronger exposure and solar insolation.

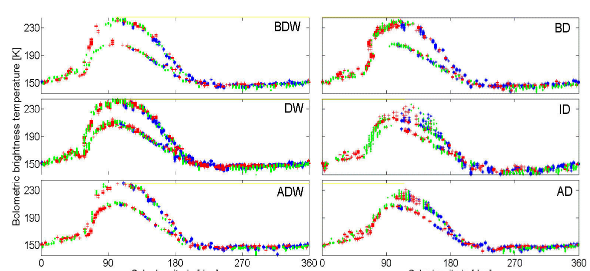

Fig. 2. Comparative curves of temperature distributions for the three main regions (right side) and the three additional ones (left side). Blue stars: MY24, red crosses: MY25, green dots: MY26.

Based on the analysis of annual temperature and albedo changes, a repeating cycle was found. The rapid temperature rise at around Ls=58° corresponds to the crocus date of the crater floor, indicating the final disappearance of CO_2 ice. Surface temperature reaches its maximum value not much after Ls=90°. Inside the crater, daytime temperature climbs up to 215 K during the northern hemisphere summer, while at night it drops back to 150 K. The small area AD clearly shows an opposite thermal behavior than the region BD, with much lower temperature values, but similar to ID. The reason for this behavior cannot be meridional difference based on the comparison of brightness temperature profiles with nearby regions (Fig. 2). If the only factor effecting the meridional temperature distribution would be insolation, we would expect to see similar behavior of areas located in the same latitudinal band but the prominent summertime temperature differences between ID and DW, as well as between AD and ADW indicate that the observed thermal phenomenon is less likely produced by the latitudinal location of the regions.

Regarding albedo, at BD it stays low during the whole summer, around the value of 0.20-0.25, in contrast with the crater floor that shows a re-brightening between Ls=80-170°, indicating some frost coverage that causes the high summertime values (Fig. 3). Since this time of the Martian year the temperature is too high to be CO_2 frost but it is still too cold and bright to be barren surface, this ice coverage is presumed to be water-ice. The albedo of the regions without summertime frost coverage stays low during the whole summer season and become high only around Ls=339°, when albedo determinations are possible again. That second peak after the crocus date is caused by high albedo summertime deposits within the crater and above it. This corresponds well with what has been found for Korolev crater and its surroundings [10]. After reaching the peak, there's a slighter decrease in temperature until Ls~210°, when CO_2 starts to condensate onto the surface. According to the altitude of Sun, daytime and night-time temperatures become indistinguishable after Ls=201° and the surface temperature is well stable around the condensation temperature of CO_2.

Summary: The crater floor of Dokka and the region above it show different thermal behavior than the surrounding areas. Our results imply that the reason for this behavior is the summertime frost coverage. That is also supported by the fact that there is a typical trend in albedo, showing a second, summertime peak between Ls=80° and 170° in the frost covered regions (with maximum values varying between 0.34-0.45). Since the temperature this time is too high to be CO_2 frost but it is still too cold to be barren surface, this ice coverage is presumed to be water-ice.

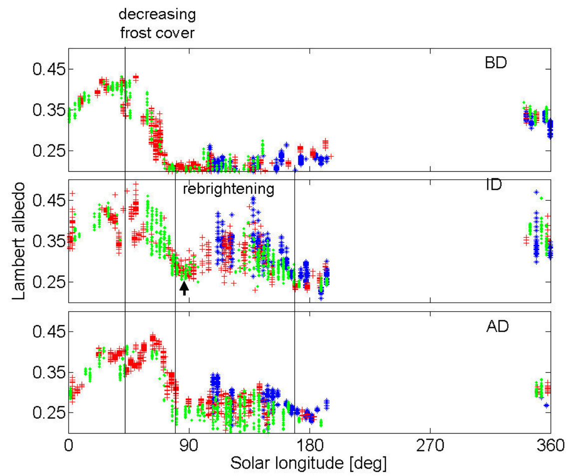

Fig. 3. Annual albedo behavior in the three chosen regions. A re-brightening of the terrains can be seen on the two bottom panels in contrast with the top one. The slight and relatively short period of the decrease in albedo at the ID (arrow) suggests the defrosting of parts of the ice cover to a certain extent.

There are numerous similarities between Dokka and Korolev crater that also suggest that these high albedo deposits are composed of H_2O ice [10], [11].

Analyzing the seasonal changes of water ice and the possibility of interfacial water [12] may give insight to a better understanding of the polar regions. Being acquainted with the properties Dokka will prove useful in understanding the role of frost outliers in the water cycle of Mars, as well as other polar craters with summertime frost inside [7], [13-15].

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