MAPPING PROPERTIES OF PERIGLACIAL POLYGONS ON MARS. J. Saraiva, L. Bandeira and P. Pina, CERENA, Instituto Superior Técnico, Lisboa, Portugal (jose.saraiva@ist.utl.pt).

Introduction: The detailed characterization of polygonal terrains on Mars, an almost ubiquitous feature on the surface of the planet, was initiated with recourse to a sampling strategy, which revealed some important and distinct properties of the different networks [1]. The unveiling of polygons with smaller dimensions (around 4 m in diameter) occupying large extensions of the northern plains of Mars (especially around the Phoenix probe landing site) was made possible by HiRISE images [2-5]; their presence pushed us to an effective use of an automated method to delineate the contours of the polygons and to extract their geometric and topologic characteristics [6-7]. This automated approach, besides giving global average results with relevant statistical significance, also permits a detailed analysis of the variability of parameters, thus highlighting the possible existence of anisotropies in the network or, on the contrary, its homogeneity.

Detailed mapping: The large dimensions of HiRISE images, with their high spatial resolution (25cm/pixel), forced us to devise a strategy to process the complete extensions of this kind of periglacial patterned ground seen on any given image [8-9]. The sampling of the images in overlapping squares with a side of 600 m, permits a fast and efficient automated extraction of the features of the polygonal networks on those areas, which are then merged to obtain the global mapping of the region.

As geometric (area, size, shape, among others) and topological features (number of neighbours) are obtained for each and every individual polygon of the network a detailed and complete map of the distribution of each of those parameters can be produced.

Examples of the mapping of geometric and topological features of a polygonal network are presented respectively in Figures 1 and 2 for the HiRISE image ESP-011268-2485. The maps shown correspond to a surface area of 2600x2600 m² (10400x10400 pixels), where around 400,000 polygons were detected and their features extracted in a fully automated mode. It must be made clear that the automated method is not perfect (ideally all polygons should be correctly detected and no false detections should be obtained), but due to the high performances obtained in previous studies [6] and to the large dimension of the network, no human intervention was performed to correct the small number of errors (for instance, neighbouring polygons merged into a single one). This has a very small effect on average parameters computed for the whole of the network.

Thus, the average area obtained for the polygons in this image is approximately 14,50 m²; the distribution of this parameter is presented in the inset histogram in Figure 1. The values were divided into 3 classes for visual presentation, as seen in the colour map of Figure 1; the spatial homogeneity of the dimension of the polygons of the network in this region is broken by a NW-SE band of smaller polygons that can be perceived on the image. The reasons for this difference will be looked into in future work, considering all available information about this region. We should point out that this type of structure in polygonal networks has not been detected before, and clearly demonstrates the advantages of this automated approach.

The number of neighbours of a polygon, its histogram and spatial distribution are presented in Figure 2. The average number of neighbours of a polygon is close to 6, as previously verified [7], and its spatial arrangement shows an evident homogeneity.

Conclusions: The automated approach we have developed permits the detailed mapping of the polygonal networks occurring on the Martian surface, with no need for the selection of a (necessarily small) sample for manual analysis. In this way, not only are the networks characterized with higher statistical significance but also local information becomes available. This can in turn lead to a detailed evaluation of non-homogeneities in the distribution of characterizing parameters, offering clues that allow an improved understanding of the processes that influence the evolution of this periglacial feature.


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Figure 1 – Individual mapping of areas (m²) for more than 400,000 polygons and respective histogram in a 2600x2600 m² region (corresponding to part of HiRISE image ESP-011268-2485).

Figure 2 – Individual mapping of the number of neighbours for more than 400,000 polygons and respective histogram in a 2600x2600 m² region (corresponding to part of HiRISE image ESP-011268-2485).