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Quantifying the Latitudinal Distribution of Landforms on Mars' Southern Hemisphere, Terra Sirenum

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Abstract

As a part of a global study [1-6], we apply the grid-mapping method to quantify the geographical distribution of selected (climate-related) landforms on Mars' southern hemisphere. The study areas comprise Noachis Terra (NT) [5], Terra Cimmeria (TC) [6], as well as Terra Sirenum (TS, presented here, Fig. 1).

1. Introduction

Grid-mapping allows mapping extensive areas with efficiency and an increased level of objectivity [7], revealing relations between spatial distribution and morphologies which are only visible from a wider perspective. Thus, we are studying the distribution of possibly water- and ice-related landforms over a 100 km-wide area extending from the equator to the south pole to derive information about the latitude-dependence of landforms and the responsible climatic control.

The research area extends from the equator (centered along 173°E, Fig. 1) to the south polar cap. The study area has been selected as it consists of a representative portion of the southern cratered highlands without any other significant large topographical or geological feature in its vicinity that might influence the distribution of landforms.

2. Methods

2.1 Grid-mapping

The grid-mapping approach is based on a tick box system, overlaying various remote sensing datasets. It requires a multi-layer GIS-environment in order to combine both remote sensing imagery and a polygonal vector shapefile containing the grid boxes (each 20×20 km; Cassini-projected map). Every box is being investigated for the presence or absence of 28 pre-selected landforms. This approach is able to increase the level of intersubjectivity, as it is based on simple "Yes" and "No" decisions of the mapper. Hence it is possible for every reader to follow each of the mapper's decisions. Mapping scale is 1:25,000 and is based on CTX imagery [8], TES for albedo [9], and Dust Cover Index DCI [10].

2.2 Landforms

We mostly pre-selected landforms that are assumed to be proxies for climatic conditions. Therefore, we focus on aeolian landforms (formed by wind; dunes, transversal aeolian ridges (TARs), ripples, dust), fluvial landforms (formed by liquid water; channel networks, inverted channels), periglacial landforms (morphologies related to subsurface ice deposits; latitude-dependent mantle (LDM), scalloped terrain, viscous-flow features, polygons, gullies, pedestal craters), and glacial landforms (formed by surface ice deposits of both H_2O and CO_2 ice; polar deposits, polar pits, dark material/spiders). We will use the results of each domain in order to reconstruct the latitudinal distribution of each geomorphologic process (e.g., as in [5,6]).

3. Results

First results of the physical properties, albedo and DCI, indicate a negative correlation of both parameters (Fig. 2). We observed that the low latitudes are covered by more dust than the mid- to high latitudes. Lowest albedo is found in the mid-latitudes.

Pre-screening the study area at a mapping-scale of 1:150,000 revealed that the lowest latitudes (<11°S)

are covered by the Medusae Fossae Formation (MFF) [11]. Like in NT and TC, the low latitudes can be classified as a dry zone, lacking surface volatiles. Morphologies suggesting volatile-rich deposits are found at ≥33°S (gullies and craters filled with viscous-flow flow features). South of this latitude, the volatile-related landforms increase continuously. At ~71°S a cover of polar deposits begins to extend towards the pole.

4. Outlook

After grid-mapping of TS has been completed, we will define the extent of the environmental zones as already done in NT and TC. Finally, we will implement a synthesis of all three study areas, in order to analyze the southern highlands in general.

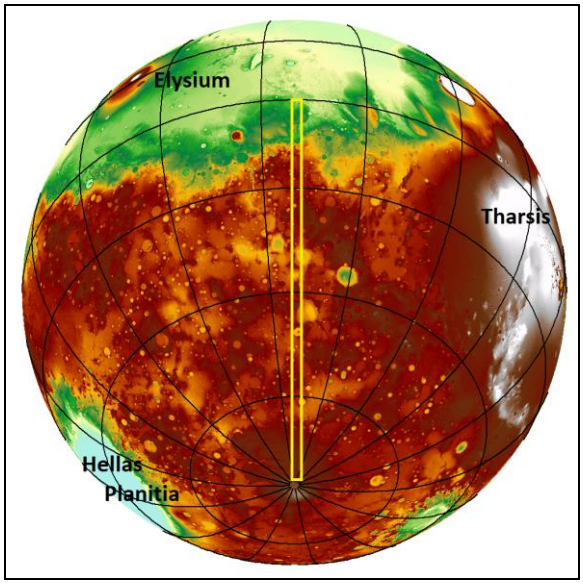
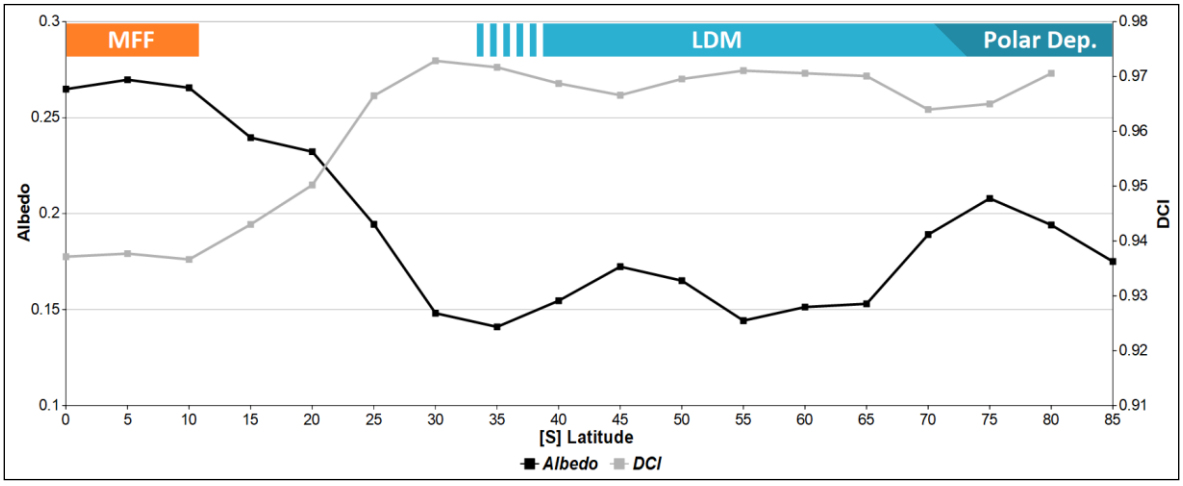


Figure 1 (left): Yellow box indicates the location of the study area in Terra Sirenum (MOLA).

Figure 2 (below): Distribution of albedo and DCI within the study area by latitude. The locations of MFF (Medusae Fossae Formation) and LDM (latitude-dependent mantle) do neither show a clear relation to albedo nor DCI. But an expected relation from high albedo to the polar deposits is evident.



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