

Mars Digital Dune Database: A Quantitative Look at the Geographic Distribution of Dunes on Mars.

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Introduction: The Mars Global Surveyor (MGS) Thermal Emission Imaging System (THEMIS) has acquired 100m resolution infrared (IR) daytime and nighttime images covering 75% and 98% of the surface Mars respectively. The combination of high-resolution and global coverage makes the THEMIS IR data set the logical choice for a planet wide inventory of moderate to large-scale dune deposits. Initial steps in developing a digital dune database in a global geographic context for Mars have been completed, resulting in a proto-type, ARC-based database. This database currently contains information delineating the dune fields between +/-65 degrees latitude, including numerous physical and image parameters [1]. While far from comprehensive, this database will provide the first quantitative dataset as well as a stable, centralized archive of pertinent information for global baseline analyses of Martian aeolian processes.

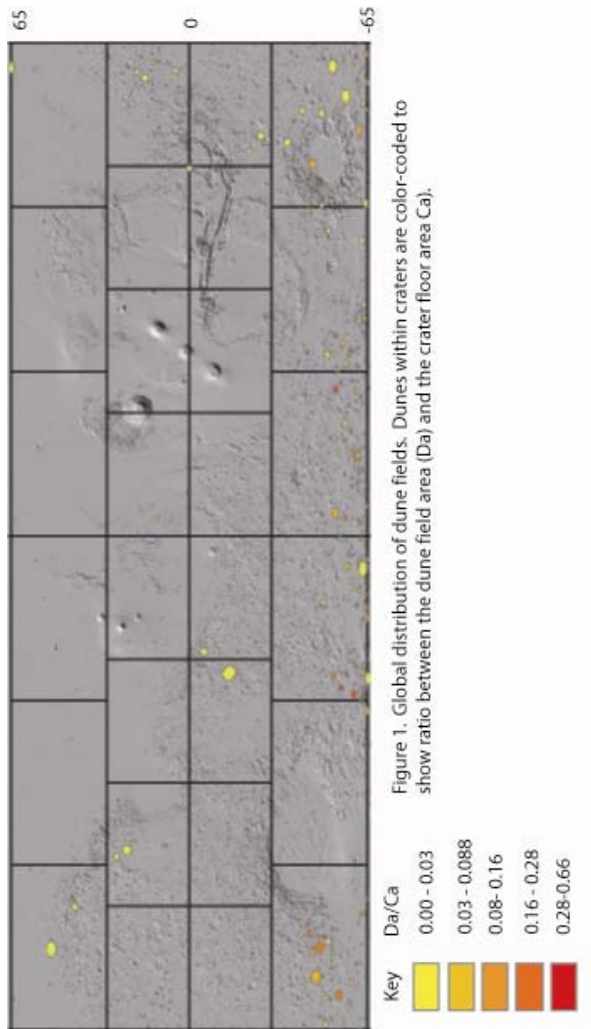
Geographic distribution. Using a combination of JMARS, ARC-MAP and in-house software we have studied over 40,000 THEMIS-IR images and culled ~1,000 containing clearly identifiable dune features. Using these images as a base we have identified and delineated 626 dune field polygons between +/-65 degrees latitude on Mars covering a cumulative area of 60,068 km². (Figure 1). In general the dunes deposits in this region of Mars can be broken down into two categories; whether deposition occurred in the northern or southern hemisphere and whether or not the fields are found on crater floors. Excluding the dune deposits at both poles, the preponderance of dune deposition is located in the Martian southern hemisphere and is scattered across the cratered highlands terrain. These 577 deposits cover 55,178 km², and comprise almost 92% of the total dune area between +/- 65 latitude. The remaining 4,875km² is in the northern hemisphere lowlands. Approximately 475 of the dune fields (about 76%), totaling 45,158 km², were deposited within craters. As one would expect, given crater distribution on Mars, most of the crater dunes again fall in the southern hemisphere. The southern hemisphere contains 413 crater dune fields with a cumulative area of 41,049km², while the northern hemisphere only accounts for 42 crater fields with an area of 4,160km². For dune polygons falling within crater boundaries we also digitized the crater rim and calculated crater floor

area, crater diameter, crater centroid, dune polygon centroid, and $D_{Area}/Crater_{Area}$ (D_a/C_a in Table 1). When available, our crater centroid will be labeled to conform to the crater latitude/longitude ID convention currently undergoing revision by Barlow [2].

Current research. In addition, we have identified the relative position of each dune field within a crater by calculating the azimuth between the centroid of the crater and the centroid of the dune field. We will use the azimuths calculated for these 475 dune fields as a base for comparison with wind vectors as predicted by Global Circulation Models (GCM's) supplied by Haberle[2] and run at 8 equally spaced times of the Martian year and at four times during each 8 sols. We believe that crater quadrant location should be correlated with dominant wind direction such that the windward crater rim slope will act as a sediment trap for the accumulation of sand, thus acting as a secondary indicator of regional prevailing winds. Correlation, or lack thereof, with regional wind patterns could have implications regarding recent activity of Martian dunes.

Area	Diam	Cnt	Sum Dune Area
8.8	3.35	1	1.1
20.3	5.09	1	5.5
133.8	13.05	1	47.7
31709.	200.9		1712.
2	3	5	2
239.9	17.48	1	18.0
51.5	8.10	1	8.0
350.4	21.12	1	15.1
1103.7	37.49	1	72.9
1185.1	38.85	1	113.6
308.7	19.83	1	19.1
251.0	17.88	1	20.1
1469.5	43.26	1	103.1
855.9	33.01	1	28.5
1712.1	46.69	1	159.8

Table 1. Example of a small portion of the dune database showing crater area, diameter, number of dune fields within that crater, and sum of dune field area. Data for Kaiser crater is in row 4.



We have also begun looking at the relationship between dune distribution and elevation using the Mars Orbiter Laser Altimeter (MOLA) global data set. Although it's obvious that local topographic lows such as craters can serve as sediment traps there may be more regional deposition patterns related to sediment source and elevation that aren't as apparent.

References: [1] Hayward R.K., Titus, T.N., Mullins, K.F., Fenton, L.K., Bourke, M.C., Christensen, P.R. (2004) *AGU, P21B-0984*. [2] Barlow, N.G., (2003), LPI Abs., 2003 Mars Conf. 3073 [3] Haberle, R.M. et al. (1993) *JGR*, 98, E2.