VARIATIONS IN BEDFORM WAVELENGTH BY ELEVATION ON MARS. M. J. Ballard[1], R. C. Ewing[1], M.G.A. Lapotre[2]. [1]Department of Geology and Geophysics, Texas A&M University, 3115 TAMU, College Station, TX, 77843, rce@geos.tamu.edu; [24]Division of Geological and Planetary Sciences, California Institute of Technology, Pasadena, CA, 91125.

Introduction: Wind-blown bedforms are ubiquitous across the surface of Mars[1] and are found in ancient sedimentary deposits of the Martian rock record[2]. The morphologic characteristics of the modern dunes, transverse aeolian ridges (TARs), and ripple are recognized to vary with spatially changing evnrionmental boundary conditions across Mars. Dunes shape, for example, is affected by the frozen, sediment availability-limted conditions of Mars' north polar region[3]. Ripple wavelength was found to scale with variations in surface pressures across the high-altitude regions of Mars[4]. Understanding how bedform morphology varies with different boundary conditions in the modern martian environment could help interpret stratification and, in turn, changing climate conditions in Mars' deep past.

Methods: Here we use High Resolution Imaging Science Experiment (HiRISE) images to compare the wavelength of four scales of bedforms to variations in elevation, and thus pressure, across Mars' surface. We measure the wavelengths of dunes, dune-adjacent Transverse Aeolian Ridges (TARs), ripples that mantle the stoss slope of Martian dunes, and protodunes, which are low-relief hummocky bedforms that develop on sand sheets adjacent to dune fields[5,6]. Twelve HiRISE were selected for the study. Each image had ~30cm/pixel resolution and a range of bedform types. These sites were chosen for the wide range in elevation they cover.

Each image was imported into the ArcGIS software. In each scene, a region-of-interest (ROI) was created to cover an area of approximately 1 sq. km. One-hundred random points were generated within each ROI. The type of bedform was visually deteremined to be either a dune, ripple, TAR, or protodune based on previous studies[7.8]. A polyline shapefile was created to measure the wavelength of ripples and transverse-aeolian-ridges (TARs). If a random point fell on or near an aeolian feature, the wavelength was measured twice, on either side of the point. This was done by creating a polyline feature perpendicularly from crestline to crestline. If the point fell on a non-bedform feature, it was ignored. Dune wavelengths were were measured for the entirety of each image to gain a large statistical sampling. Elevation measurements for each HiRISE image were collected from Mars Orbiter Laser Altimeter (MOLA) data.

Results and Discussion: The range of values for ripples is bounded by 1 and 5-7 meters with a clear peak in the distribution at the median wavelength around 3 meters. TARs vary in wavelength from 2 meters to 60 meters and do not show a characteristic peak wavlength. Measurements of ripples, TARs, and dunes were combined and plotted against frequency to demonstrate these scale breaks in Lapotre et al.[8] Box plots of ripple wavelength were created for all ripple measurements and compared to elevation (Fig. 1). The plots show a reasonable correlation between median ripple wavelength and elevation, which is consistent with previous work[4]. Preliminary results indicate that protodune wavelength similarly scales with elevation, whereas TARs and dunes do not. However, sample size for these bedforms is limited, at this stage of work.

Conclusions: We find that there is a reasonable correlation between global elevation and ripple wavelength and a tentative correlation with protodunes. This relationship implies that ripple wavelength maybe affected by pressure and temperature differences controlled by elevation over a wide range of latitudes on Mars's surface. It is not yet clear how seasonal atmospheric pressure differences might influence ripple development. Given proposed shifts in atmospheric pressure in Mars' past, it is feasible ripples in the Martian past were a different wavelength[8] .

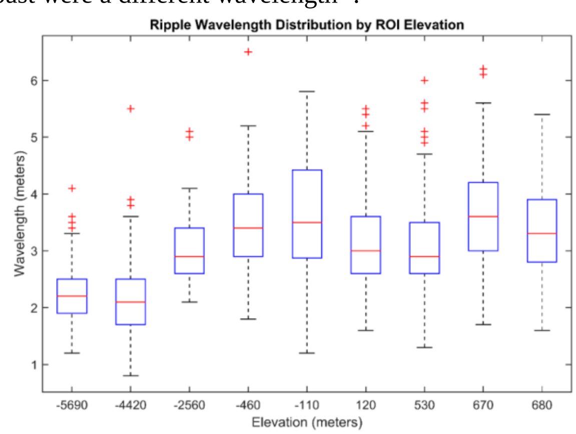

Figure 1: Box plot showing the distribution of ripple wavelengths over -6 to +1 km elevation. The shortest wavelength ripples appear in the lower elevations of the northern latitudes.

References: [1] Hayward et al., (2007) JGR-Planets, E11007, 1-17 [2] J. P. Grotzinger et al. (2005) *EPSL*, 240, 11. [3] Hansen et al. (2011) Science, 331, 575-8. [4] Lorenz R. D. et al. (2014) *Icarus*, *230*, 77-80. [5] Kocurek et al., (1992) Journal of Sedimentary Petrology, 62, 622-635. [6] Ewing et al., (2015) Geomorphology, 240, 44-53. [7] M. Balme et al. (2008) Geomorphology, 101, 703-720. [8] Bridges et al. (2012) Nature, 485, 339-342. [M.G.A. Lapotre et al. (2016) LPSC 47).