GEOGRAPHIC POSITION OF DUNES RELATIVE TO THE BELET SAND SEA MARGINS AND CORRELATION WITH DUNE WIDTH AND SPACING. B. Bishop[1], J. Radebaugh[1], E. H Christiansen[1], R.C. Lewis[1]. [1]Brigham Young University, Department of Geological Sciences, Provo, UT 84602, *b.radleybish87@gmail.com*.

Introduction: Eolian dune fields found within Titan's equatorial region between ±30° latitude cover approximately 15-17% of the moon's surface [1]. These dominantly linear dunes are similar in form, size, and radar reflectivity to the large dunes of the Namib, Saharan, Saudi Arabian, and Australian deserts [2, 3]. Earth analog studies indicate that the presence of linear dunes suggests adequate sediment supply, sufficient wind, and minimal sediment loss through transport or trapping by liquids [2, 4, 5]. Analysis of parameters such as dune width and spacing has revealed important aspects of dune-forming processes, regional conditions and relative ages for Earth [7], Mars [13] and Titan [8]. These studies may also help us better understand the interplay between the surface and atmosphere, and to ultimately discover potential sediment sources and further constrain global transport pathways [7, 13, 8].

Within Titan's dune fields, initial studies of dune parameters utilizing a broad, global approach have shown that greater dune width tends to correlate with low latitudes [3, 8]. The relationship between dune width/spacing with sediment supply and distance from sand sea margins, however, is not as well understood on Titan [9]. In this study, we discuss results from new width and spacing data gathered from Cassini's Synthetic Aperture Radar (SAR), and implications of the geomorphological variation throughout one of Titan's major sand seas, Belet.

To help constrain the nature of Titan's sediment transport, we analyzed results from previous studies on dune width and spacing from Earth analogs, in particular the Namib and Australian deserts. In the Namib Sand Sea, the greatest dune width, and additionally sediment accumulation, is located near the center [10]. The same is true for the linear dunefields of the Strzelecki and Tirari Deserts of Australia [11]. Common to both these analogs is greater sediment volume towards the middle of the sand seas, which is also postulated for Titan, based on an increase in SAR-dark, and therefore sandy, interdunes in the sand sea centers [12]. Detailed analyses of width and spacing across the sand seas will help us determine the relationship between Titan's sand seas and the Earth analogues.

Approach: Our current study focuses on the Belet Sand Sea located on Titan's trailing hemisphere between -30° and 25° latitude, and 65° and 150° W longitude. [3] and [12] describe Belet as the largest sand sea on Titan with an estimated area of 3.3 + 0.6 million km^2 and a sand volume of 610,000-1,270,000 km^3, double the size of the Arabian sand seas on Earth. The dune forms in Belet appear to be tightly spaced, exceptionally straight and long and with SAR-dark, sand-rich interdunes in the center of the sand sea [5, 2, 3]. We analyzed the relationship between approximately 2,470 measurements of dune width and spacing with their associated distance from the sand sea margins [8] (Fig. 1).

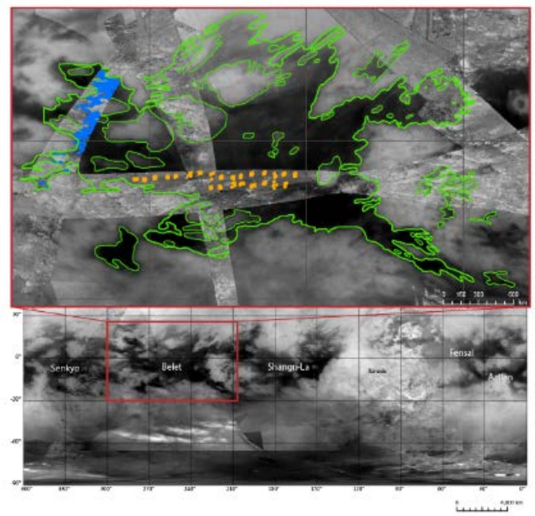

Fig. 1 Dune width and spacing locations shown on Cassini SAR swath relative to the maximum extent of the Belet dune field. *Blue points were measured from swath T21, 12 Dec, 2006 [8]. Orange points measured from swath T08 28 Oct, 2005[9].*

Sand Sea boundaries were previously mapped by defining a correlation of dune covered regions in SAR to near-infrared images from the Cassini Imaging Science Subsystem (ISS) [12]. Dune width and spacing measurements were obtained in discrete locations across Belet, 90 km^2 each in area (Orange markers in Fig. 1) [8]. The average width/spacing values associated with these areas were then compared to the distance measured from the nearest none-dune material, which in some cases included relatively small, bright obstacles scattered within the defined sand sea [8, 9]. That study revealed a slight correlation between dune width and the distance to obstacles and/or the sand sea margin [9].

We continued to investigate the relationship between dune width and spacing with the distance to the sand sea margin through increasing the sample size and

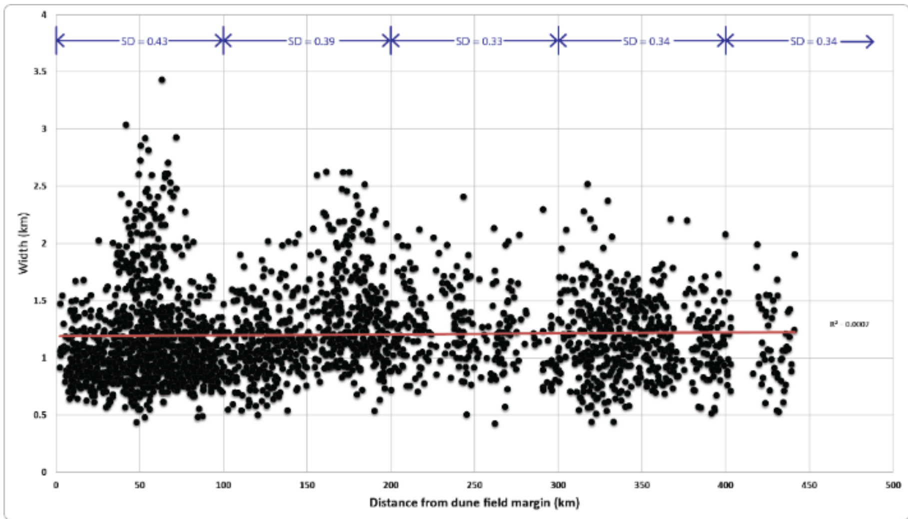

Fig.2 Graph shows high variability of dune width throughout Belet. Width variability tends to decrease with increasing distance from Belet's sand sea margins. Standard deviations are shown in blue for 100 km distance intervals.

redefining the sand sea boundaries to account for size variations of obstacles. Instead of using the average width and spacing values for the 90 km^2 areas, we incorporated all the measurements in our analyses. Using the near analysis proximity tool in ESRI's ArcMap 10.1, we calculated the shortest path to the sand sea margin from the locations of width/spacing measurements.

Results and Discussion: Dune width verses the distance to the nearest sand sea margin is shown in Fig. 2. This shows that dunes of all widths can be found at all distances from the margins. Separating the width data into distinct groups at 100 km intervals from the sand sea margin showed a decreasing standard deviation with increasing distance from the margin. One explanation for this is that as distance from the margin increases, the variability of input parameters for dune formation likely decreases, whereas the longer-term morphological stability of dunes increases. The distribution of all recorded width data in Fig. 3. The average width is comparable to widths of linear dunes on Earth [8]. We are currently considering how dune forms are affected by their position and distance relative to obstacles within the sand sea. These obstacles will likely have a greater impact, compared to the smaller ones, on sediment supply, wind variation and velocity, and the adjacent basin topography. The different dune morphologies within Earth's dune fields represent particular interactions between the surface and the atmosphere.

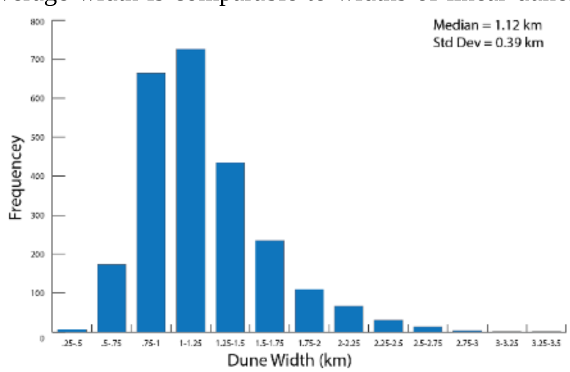

Fig. 3 Positively skewed histogram shows dune width frequencies across Belet's sand sea (n= 2,470). Average dune width is 1.2 km, the median is 1.1 km, and the standard deviation is 0.4 km.

Conclusions: While the correlation between dune width and spacing with latitude has been demonstrated [3, 8], we have yet to see a strong correlation of dune width with distance from the sand sea margin. We have shown that measuring the distance from the nearest edge of obstacles found within the dune field yields only a weak relationship to dune width and spacing [8]. Likewise, there appears to be a faint correlation, if any, when the interior obstacles are removed and distances are measured from the outermost edge of the sand sea. We will continue to investigate these obstacles and their relationship to dune patterns and sediment transport pathways. Ultimately, we seek to describe with confidence the interplay of atmospheric processes with Titan's surface.

References: [1] Rodriguez et al., (2014) *Icarus 230*, 168-179. [2] Lorenz, R.D. et al., (2006) *Science 312*,724-727. [3] Le Gall, A. et al., (2011) *Icarus 213*, 608-624. [4] Radebaugh, J. (2013) *Aeolian Res 11*, 23-41. [5] Radebaugh J. et al., (2008) *Icarus 194*, 690-703. [6] Kok, J.F. et al., (2012) *Rep. Prog. Phys. 75*, 106901. [7] Ewing, R.C., et al., (2006) *Earth Surface Processes and Landforms 31*, 1176-1191. [8] Savage, C.J. et al., (2014) *Icarus 230*, 180-190. [9] Williams and Radebaugh, J. (2014) *DPS Abstracts.* [10] Lancaster, N. (1989) *A.A. Balkema Rotterdam Brookfield.* [11] Fitzsimmons (2007) *Geomorph 91*, 146-160. [12] Arnold K. 2014 *MS Thesis, BYU.* [13] Ewing and Kocurek (2010) *Geomorph* 175-187. [14] Lancaster (1995) *Routledge.*