An encroaching dune through the eye of time-lapse photography at Grand Falls Dune Field. A. M. Sunda¹, T. N. Titus¹, and G. Cushing¹, ¹U.S. Geologic Survey Astrogeology Science Center, 2255 N Gemini Drive, Flagstaff, AZ 86001 USA, asunda@usgs.gov.

Introduction: The Grand Falls Dune Field (GFDF), located on the Navajo Nation, is used as a Mars analog study site. The initial purpose behind establishing the GFDF equipment suite was to test equipment candidates for deployment to Mars to study sediment flux [1]. The equipment suite, established in 2013, included three weighing Big Spring Number Eight (wBSNE) sediment catchers, one imaging Big Spring Number Eight (xBSNE) sediment catcher, three anemometers, a SENSIT (piezoelectric sensor that measures grain impacts), and a CR-1000 datalogger [1]. The equipment suite was expanded in 2016 to include a multi-tier SENSIT (SFINX), a time-lapse camera, and a motion-activated camera that records short video clips, the most reliable of which are the time-lapse and motion sensor cameras [2]. In the process of testing these equipment suites, we also monitored sediment flux at GFDF to better constrain the dynamics of how sand particles move.

The peak wind for GFDF typically occurs in March. In the spring of 2019, we captured the slip face of a small encroaching dune in time-lapse photography. A review of the imagery demonstrated that the cameras are able to capture the frequency and size of grain flow avalanching on the slip face of the encroaching dune. According to [3], the frequency of grain flow avalanching is dependent on two components: 1) sediment flux over the brink as it relates to accommodation space, and 2) change in mean critical angle of the slip face with time as it relates to the magnitude of turbulent shear stresses with wind speed. With the recently acquired GFDG imagery dataset, we can begin to test the hypothesized importance of accommodation space, mean critical angle of the slip face, and the magnitude of shear stress[1.e., 3]. This work differs from [3] in that they analyzed dunes of different sizes and incorporated terrestrial laser scanning of the slip face, whereas we analyzed a single dune over time via photography. Analysis at GFDF initially focused on one large dune that later spurred a smaller dune; it is the slip face of the smaller dune that we have focused on in the imagery. Additionally, data for GFDF is collected remotely over the course of years while the field measurements taken by [3] at Jericoacoara occurred for five days.

Data: A time-lapse camera programmed to take an image every fifteen minutes between the hours of 06:00 and 20:00, on 8 March 2019, captured a series of images that exemplifies the slip face grain fall avalanching typical of the GFDF (Figure 1). For comparison, a series of images captured on 13 March 2019 has been included (Figure 2). The image series are representative of the available data and are accompanied by a graph of wind speed recorded at 20 cm above ground level (Figure 3).

Figure 1: Series of time-lapse imagery throughout the day of 8 March 2019.
Conclusion and Future Work: A review of the imagery shows many grain fall avalanches occurred during March of 2019. The next step is to analyze the sediment flux and shear stress and compare that information with the time of day and rate of grain fall avalanching. Additionally, we will look at other changes in slip face morphology, such as accommodation space and the infilling of the accommodation space, as shown in the imagery from 13 March 2019.

At this time, we have been able to conclude that grain fall avalanching has occurred at GFDF, regardless of the time of day. Additional work involving shear stress and sediment flux will enable us to better constrain their effects on this process. The use of LiDAR scans across the dune slip face will help to address the accommodation space and critical angle hypothesis of [3], though this work has not been implemented in the project thus far. We will also look at the infilling of accommodation space as visible in the imagery and how that correlates with wind measurements and grain fall avalanching.

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