GRAND FALLS DUNE FIELD 2022 RIPPLE FIELD.

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Introduction: Grand Falls Dune Field (GFDF), located on the Navajo Nation, has been studied as a Mars aeolian analog site since 2013 [1-6]. Between 2013 and 2019, six years of sediment flux data was acquired and publicly released [7,8]. Starting in 2020, the focus switched to monitoring ripple migrations [9-11].

The sediment composition at GFDF is bimodal, consisting of felsic sand grains and mafic cinders [1, 5]. Ripples found within GFDF are actively migrating and range in size (crest-to-crest wavelength) from centimeters to meter-scale. The ripples at the 1-m scale (Fig. 1) are bimodal in both composition and grain size, with the larger grains composed of dark mafic cinders. These larger ripples fit the definition of megaripples [12] and often have smaller ripples located in between the crests of the megaripples.

Megaripple Monitoring Campaign: The monitoring campaign consists of three elements: (1) real-time monitoring of ripple and megaripple migration using a suite of time-lapse cameras (Fig. 2), (2) monitoring of wind conditions with a meteorological station (Fig. 3), and digital topography generation using shape from shading.

Time-lapse Cameras: A total of eight time-lapse cameras were installed surrounding a megaripple field. Three cameras were installed on the north side of the megaripple field facing approximately south, four cameras on the south side facing approximately north (Fig. 2), and the eighth camera was positioned as overwatch, thus providing context for the entire site. The cameras are set to acquire images every 10 minutes. The cameras are also equipped with an IR LED flash, which enables nighttime imaging.

Meteorological Station: The meteorological station (Fig. 3), located a few hundred meters from the megaripple study site, acquires wind speed, direction, and gusts at two meters above ground level every 15 minutes.

Digital Topography: The digital topography is derived from a process called Shape From Shading using MetaShape™ software. The input for the software is a series of high-quality images acquired from the site. The use of scale bars is needed to apply absolute scale to the resulting topography and a vertically placed rod is used to define the z-axis (Fig. 4).

Preliminary Results: The megaripple field was equipped with trail cameras on 7 Dec. 2021 for continuous monitoring and the initial data collection was conducted on 25 Jan. 2022. On both dates, additional high-quality imaging was acquired which

Figure 1: The GFDF 2022 Ripple Field is composed of megaripples, as shown by a combination of coarse-grained basaltic sediment and ripple wavelengths in excess of one-meter. For horizonal scale, the separation between camera fence posts is 1.5 m as annotated in Fig. 2. Credit: Amber Gullikson.

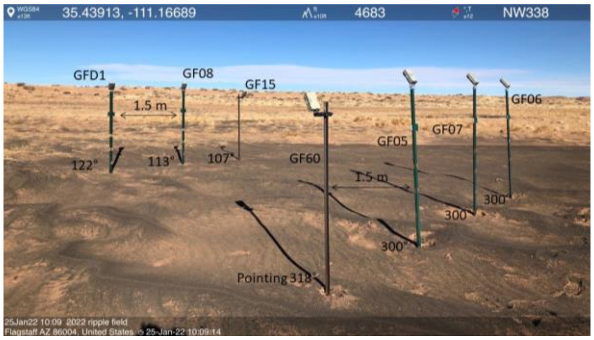

Figure 2: Layout of cameras for GFDF 2022 Ripple Field. Credit: Amber Gullikson. Cameras are set up with three on the north side of the ripple field (separated by 1.5 meters) and 4 on the south side (also separated by 1.5 meters). An eighth camera is located in an overwatch position.

Figure 3: Meteorological station used for monitoring environmental conditions, including wind velocity at 2 m above ground. Credit: Kaj E. Williams.

Figure 4: Image acquired from one of the time-lapse cameras showing the use of scales during the acquisition of high-quality images for use in shape from shading. The vertically positioned rod is used to define the z-axis when processing the images.

was subsequently used to generate the megaripple topography and an orthorectified mosaic (not shown). Considerable change had occurred during this period.

During this period, maximum winds were recorded on 26 Dec. 2021 at ~12 m/s, with an azimuth of 230° (Fig. 5). The event started at ~09:43, with small ripples starting to move as the winds reach 7 m/s. The basaltic ripples start migrating at ~10:13 as the winds reach an average speed of ~11 m/s, with gusts up to 16 m/s. The event ceased at ~16:15, as the winds drop below 10 m/s. The megaripples migrated at least a few meters during this 6.5-hour event. The timing and duration of this megaripple migration event is consistent with saltation events that occurred from 2013 to 2019 [4,13].

Acknowledgments: Fieldwork on the Navajo Nation was conducted under a permit from the Navajo Nation Minerals Department. Any persons wishing to conduct geologic investigations on the Navajo Nation must apply for and receive a permit from the Navajo Nation Minerals Department, P.O. Box 1910, Window Rock, Arizona 86515, telephone # (928) 871-6587.

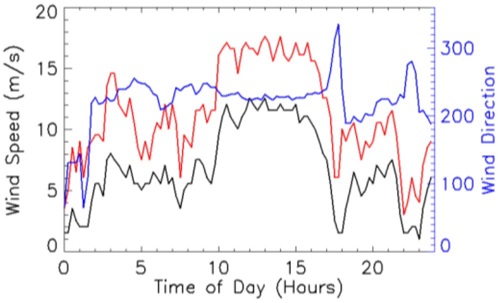

Figure 5: Wind speed, gusts, and direction for 2021 Dec. 26. The black line is the average wind speed. The red line is the maximum wind gusts. The blue line is the wind direction as measured from where the wind is originating.

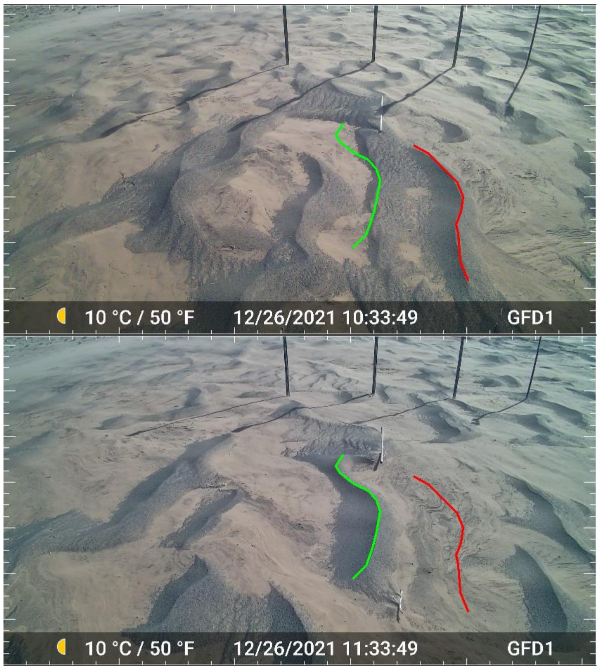

Figure 6: Example of megaripple migration over one hour. The red line was the crest at 10:33 and the green line was the crest at 11:33. These images are not orthorectified, but the distance travel was ~0.75 m. The fence posts in the background are each separated by 0.5 m.

References: [1] Hayward et al., 2010, 2IPDW, 2004 [2] Hayward et al., 2014, 8ICM, 1009 [3] Titus et al., 2016, LPSC, 1201. [4] Titus et al., 2017, 5IPDW, 3008. [5] Sunda et al., 2017, 5IPDW, 3017. [6] Sunda et al., 2020, 6IPDW, 3012. [7] Hayward et al., 2020a, doi:10.5066/P9Q58J28. [8] Hayward et al., 2020b, doi:10.5066/P9IYGDGQ. [9] Gullikson et al., 2021, WTAPE, #8065. [10] Gullikson et al., 2022, this workshop. [11] Titus et al., 2021, doi:10.5066/P9BXCN7E. [12] Day & Zimbelman, 2021, Icar., 369. [13] Titus et al., 2015, 4IPDW, 8006.