Blowouts and Wind Interactions

Sarah DeGraaf, Hans Leisman, Megan McNamara, Samuel Sukaria

Calvin COLLEGE 1876

Abstract

The blowout formations on Dune 3 in P.J. Hoffmaster State Park allowed a unique location to study blowouts and wind interactions. Our study looks specifically at a large trough blowout that is connected to two smaller saucer blowouts. The study methods utilized were hand-held anemometers, stadia rod measurements, GPS, and sand trap measurements. We used handheld anemometers to measure the wind speed and direction at the entrance and exit of the trough blowout. Additionally, we took sand trap measurements at the crest of each of the three blowouts. The results of the study show that wind speed and sand transport is greatest at the top of the trough blowout. With this research we can better understand how trough blowouts affect wind speed and sand movement.

Introduction

Focused studies on blowouts are necessary because of the scarcity of the studies on the subject [1]. The focus of this particular study was on blowouts and how they affect wind and sand transport. We recorded wind speed, evaluated topography, and measured sand transport (Fig. 1).

Figure 1: Researchers on Dune 3

Objectives

- Record characteristics of blowouts
- Record wind patterns
- Record sand transport patterns

Study Area

The study area was at P.J. Hoffmaster State Park in Muskegon, Michigan (Fig. 2). We studied three blowouts in a large parabolic dune known as Dune 3 (Fig. 3). The dune features two small saucer blowouts and one large trough blowout (Fig. 4). Wind data were also obtained from an instrument tower located south of our site.

Figure 2: Hoffmaster State Park

Figure 3: Dune 3

Figure 4: Aerial view of Dune 3

Methods

Characteristics of the blowout were measured by straight-line surveys of blowout profile and GPS mapping of blowout features. Using handheld anemometers, wind speed was measured at the entrance and exit of the trough blowout (Fig. 5). A compass was used to measure wind direction. Sand traps were used to measure sand transport.

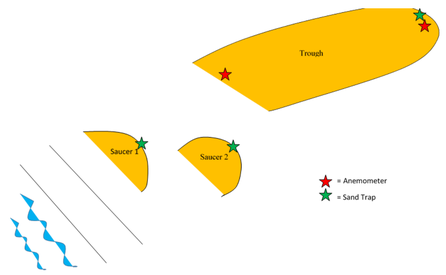

Figure 5:Anemometer and sand trap locations

Results

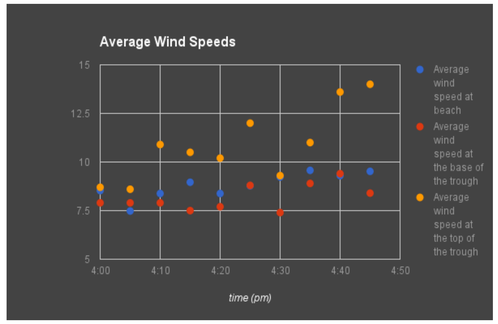

Figure 6: Average wind speed

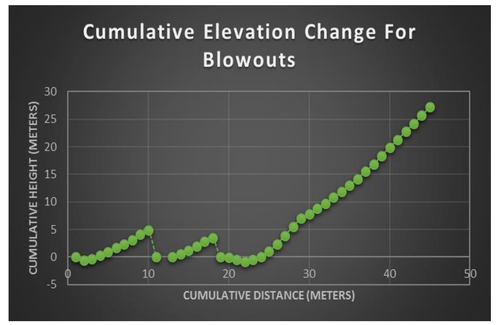

Figure 7: Trough blowout topography
*The dotted lines indicate an unknown height difference

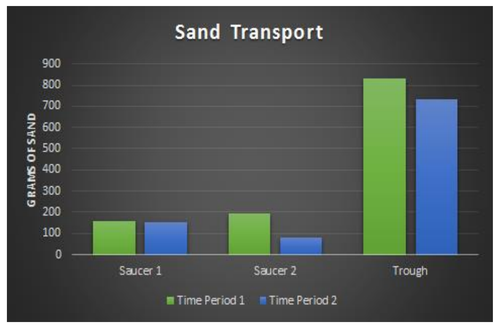

Figure 8: Sand transport
*The sand trap for saucer 2 time period 2 fell off before the time period was over

A blowout is a depression area of a dune that has been eroded by wind. Our study area was a series of three blowouts. The average wind speed at the top of the trough was greater than the average speed at the base of the trough blowout (Fig. 6). The maximum wind speed at the bottom was 7.4 meters per second, the top was 14 meters per second. The slope of the trough blowout increases as the height increases (Fig. 7). Sand transport increases as the wind moves further through the series of blowouts (Fig. 8).

Discussion

Our results are consistent with other studies that show a correlation between wind speed and sand transport [2] and that an increase in wind speed causes increased deposition of sand on the slipface [3]. Our results showed that over the entire series of blowouts wind speed and sand transport increased. Wind speed increases as the wind moves through the blowout, and decreases again as it reaches the crest, causing deposition of sand on the slipface (Fig. 9). In each sequential blowout, the wind speed increases again, causing more sand to be picked up and greater sand deposition with each consecutive blowout.

Figure 9: Deposition area

Conclusions

Blowout topography causes an acceleration in wind. There was also found to be an overall increase in wind speed and sand transport over the entire blowout system. In November 2015, wind and sand transport were found to be greatest at the top of the trough blowout.

Acknowledgments

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References

[1]Hugenholtz, C. H., and S. A. Wolfe. 2006. "Morphodynamics and Climate Controls of Two Aeolian Blowouts on the Northern Great Plains, Canada." *Earth Surface Processes and Landforms* 31: 1540-1557.

[2]Hesp, Patrick A. and Robert Hyde. 1996. “Flow Dynamics and Geomorphology of a Trough Blowout.” *Sedimentology* 43: 505-525.

[3] Hesp, Patrick A. 2002. “Foredunes and Blowouts: Initiation, Geomorphology and Dynamics.” *Geomorphology* 48: 245-268.