Introduction

Climatic changes played a major role in the formation of the Mesquite Dunes. The late Quaternary time saw numerous and humid cycles occurring in the North American Arid zone [1], largely caused by climatic changes associated with the presence of ice sheets and the resulting changes in atmospheric circulation patterns [2]. The presence of alpine glaciers in the Sierra Nevada Mountains resulted in a high pressure cell, which caused the Owens river to become augmented with discharge from these alpine glaciers [3]. It then overflowed into a succession of closed basins. This created Lake Martys, which inundated Death Valley during the late Pleistocene [4]. Analysis of shore terraces performed by Elliot Blackwelder indicate that Lake Martys rose to about 34m above sea level [5], which coupled with atmospheric conditions was conducive for increased humidity [6]. These changes gave rise to a steep atmospheric pressure gradient between glacial and warmer areas, which increased aeolian activity and led to the construction of many sand dunes including the Mesquite dunes [7].

While there is much literature available detailing the origins of the Mesquite dunes, little has been published about the conditions that make the dune field look the way it does today. Our paper primarily addresses the impact of recent aeolian activity on the Mesquite dunes, and aims to determine whether the morphology of the dunes, and the trends in the sand grains found across the dune field, reflect the recent regional wind regime.

Methods

Five teams were each assigned a specific "square" in the dune field, with the squares covering a 5x5m transect. Within their squares, each team recorded the crest lines of the dunes, measuring dip directions orthogonal to the dune crest with compasses. Wind direction measurements were taken for each location, spanning on the transect. For each "square", we plotted each dip for MATLAB scripts and compared wind data from the Mesquite Wash weather station to determine relationships.

Wind Directions

Thirty years of wind data were taken from the Mesquite Wash weather station [8]. This weather station is located on the border between California and Nevada, and wind data is taken at a time resolution of 10 minutes. A separate team walked along an SE-NW transect across the dune field, stopping slightly past the highest star dune. Sand samples were collected every ~50m in a plastic bag and labeled. GPS waypoints were recorded at each collection point. The sand samples were later used to determine wind speed using a stereo-microscope. We measured the average grain size for each sample using MATLAB scripts.

Results

A separate team walked along an SE-NW transect across the dune field, stopping slightly past the highest star dune. Sand samples were collected every ~50m in a plastic bag and labeled. GPS waypoints were recorded at each collection point. The sand samples were later used to determine wind speed and size. Note that grain size increases significantly at the highest dunes.

Discussion

The dip direction data demonstrates that the dominant winds of the last large transport event in the sand zone were southwesterly. However, the dominant wind direction of the Mesquite Dunes during the last large transport event is unknown. The Mesquite Wash weather station has a northeast-trending mountain range on either side, which may cause the wind in this area to be funneled in the southwest direction. This explains the disparity between dip directions in the dune field and wind-rose diagrams from Mesquite Wash. Additionally, the driest areas of the dune field are in the southeastern part of the dune field, which may explain the disparity in wind directions, as this would cause the sands in the southeastern part of the dune field to be blown towards the north. The sand samples from the southeastern part of the dune field also show significant differences in sand grain size and orientation, indicating that the wind regime in this area is different from the rest of the dune field.

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