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Impact of fog and dew induced sand moisture on barchan dune asymmetry, the example from Western Sahara

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There are many factors influencing barchan dunes asymmetry, mainly the bimodal wind regime i.e. occurrence of a secondary wind direction oblique to the barchan symmetry axis, dunes collision, asymmetrical sand supply or topography [1,2]. There were many research on the influence of surface moisture on the intensity of aeolian sand transport [3], however until now there is little work that explains the impact of fog and dew induced moisture on the aeolian sand flux within sand dunes [4]. The present study shows that this factor may also impact on barchan dune asymmetry.
The research was conducted during 7 consecutive days on an isolated barchan in Western Sahara, north of Laayoun city, about 10 km from the Atlantic coast. Symmetry axis of the barchan was parallel to the coastline and approximately perpendicular to the sunrise position. The fog and dew induced moisture content of the near surface sand layer was measured at 6 sites within the dune. The samples were collected before sunrise and then in 1 hour intervals until the sand became dry. Fog and dew collectors were located on the dune surface at the same sites and on the ground outside the dune. The air humidity and temperature as well as barometric pressure was measured permanently on the barchan and on the surrounding surface. The wind speed and direction at 1 m height were measured at 6 sites located along barchan symmetry axis and within barchan horns. The wind speed profiles were obtained for different wind speeds at the reference mast located on the flat surface near the studied barchan. Sand mass flux was measured by means of passive 0.5 m high sand traps arranged at 6 sites within barchan.
The result from fog and dew collectors showed that moisture varied within barchan between 47% and 68% weight, when the maximum amount of moisture was collected. The moisture penetrated the surface sand layer only to the depth of maximum 1.1 cm. Drying of sand observed after the sunrise was not uniform within the dune. The fastest drying was registered on the eastern horn (the sand dried in 1 hour after sunrise), due to direct insolation, and on the avalanche slope, due to insolation and lower sand density. The slowest drying occurred on the shaded part of the western horn (usually 3 hours after the sunrise the sand was still slightly moist). The morning gentle eastern wind, oblique to the symmetry axis, caused sand transport from the dry surface of the eastern horn and later also from the eastern and central part of the windward slope to the western part of dune. When the western gentle wind occurred in the morning, the moist surface of western horn prevented the sand transport toward the eastern part of the dune. As a result, the sand volume of the western part of the dune increased. During strong wind parallel to the symmetry axis, the surface sand layer was usually dry and the sand transport rate was similar on both sides of the barchan. However, due to initial volume asymmetry, the amount of sand transported on the western horn was greater than in the eastern one. As a consequence, the western horn became more than two times longer than the eastern one.
The impact of fog and dew induced sand moisture on barchan dune asymmetry may be important when climatic conditions are favorable, the sunrise position is at the right angle to the barchan symmetry axis,

and morning gentle wind (with speed slightly above threshold) is oblique to the barchan symmetry axis. Such conditions occur in the Western Sahara from November to February. For the remainder part of the year, dominated by strong unimodal trade wind, the barchans in the investigated field become symmetrical with similar horns lengths.

References:

[1] Dluzewski M and Biejat K (2012) Studies in Geography 49: 7-32

[2] Parteli E.J.R et al. (2014) Aeolian Research 12: 121-133

[3] Wiggs G et al. (2004) Geomorphology 59: 13-30

[4] Bourke M.C et al. (2013) IAG Conference Abstracts: 941