Factsheet

Dust and aeolian research in Sahara: the best desert for dust studies

IbnBattuta centre

The Sahara is a good, continent-wide, analogue to Mars. The Aeolian deposits and processes are among the best subject for the comparative analysis of the Martian environment due to the geological history of the desert and its current environmental conditions.

To mobilise dust it is necessary a dry and hot environment to provide the condition to the lifting of dust from the surface. Cold deserts bear always too much humidity for provide large amount of dust to the atmosphere

The Sahara desert is the arid area with the largest concentration of sand and dust and it shows a complex Aeolian circulation that intruce and transport both sand and dust. Of course sand is basically transported by near the sedimentary interface with saltation processes, while dust is present as suspended load.

Sahara with its large concentration of dust is the perfect analogue for studies related to Aeolian sand and dust.

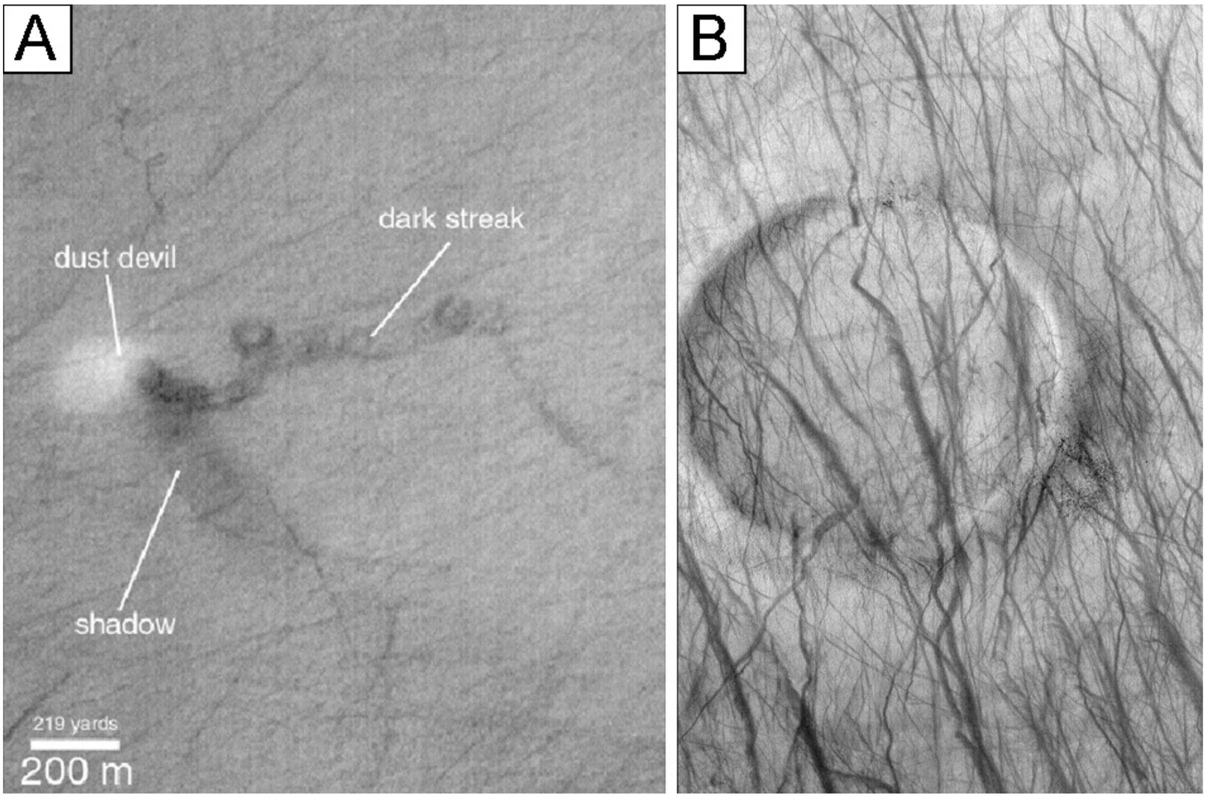
Desert and locality	Aerosol index (max mean value)
Bode´le´, Depression of Central Sahara	>30
West Sahara, Mali and Mauritania	>24
Arabia, Southern Oman Saudi border	>21
Eastern Sahara, Libya	>15
Southwest Asia, Makran coast	>12
Taklamakan, Tarim basin	>11
Etosha Pan, Namibia	>11
Lake Eyre Basin	>11
Mkgadikgadi Basin, Botswana	> 8
Salar de Uyuni, Bolivia	>7
Great Basin of the USA	>5

(After Goudie and Middleton, 2001)

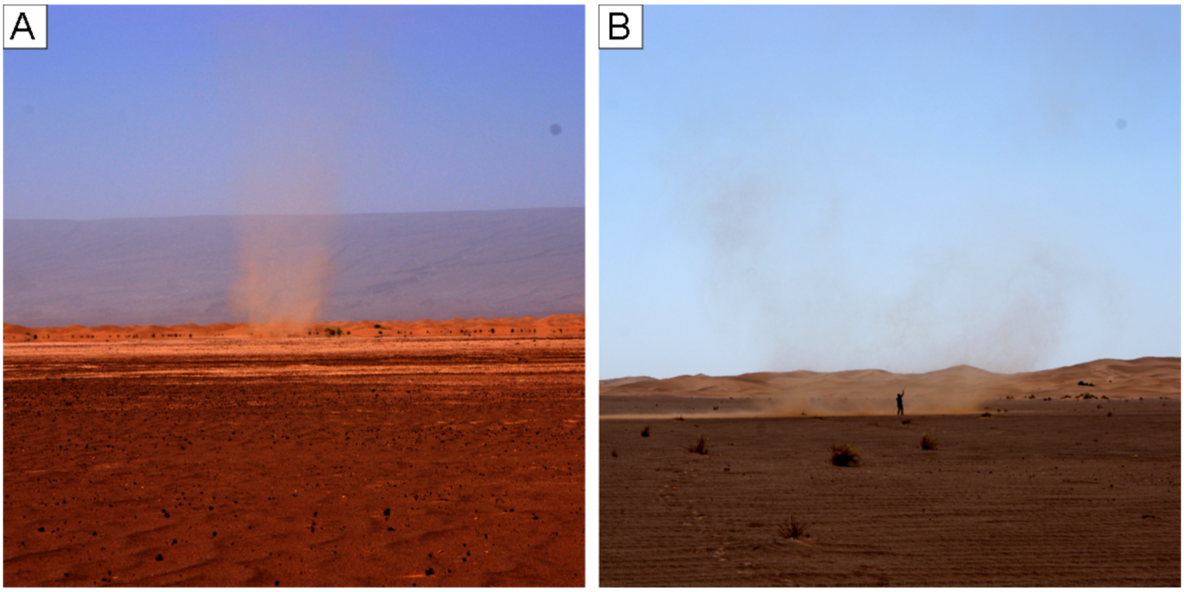
The Aeolian system is remarkably constrained in Sahara with a large number of information about wind patterns, sand and dust transportation, timing of Aeolian storms, etc.

The Ibn Battuta Centre has been involved in several activities studying the dust and Aeolian System in the Moroccan Sahara.

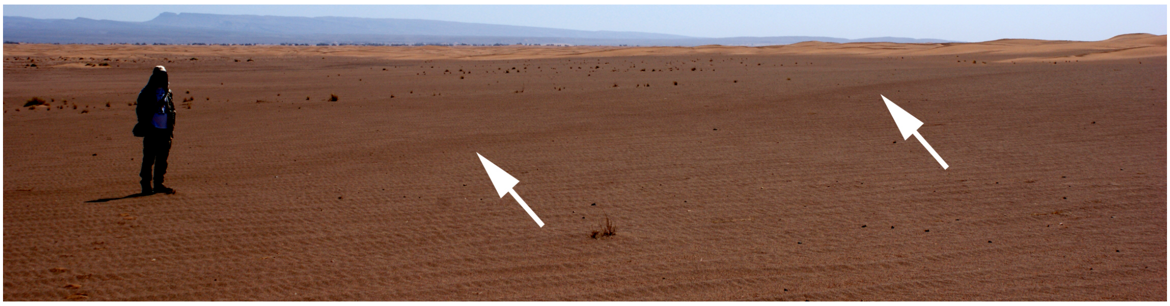
With a team of the University of Muenster (Germany) the Ibn Battuta investigate several aspect of the dust devils. Dust devils are low pressure vortices formed from unstable near-surface warm air generated by insolation and are common on Earth and Mars. They are visible as dust devils due to the entrainment of fine particles. Dust devils are contributors to the background atmospheric opacity on both planets by their ability of lifting fine particles even in higher atmospheric layers. On Mars, many dust devils create dark tracks on the surface and are important component of the Martian atmospheric circulation. Their formation is not well understood and can rarely be observed on Earth. We analyzed dust devils and their tracks in situ during a field campaign in April 2012 in southern Morocco, west of the town of M’hamid. Dust devils occur frequently in southern Morocco due to the arid climate that favors dust devil formation. The study focused on 1) in situ sampling of active dust devils in different heights (up to ~ 5 m) to constrain which surface grain sizes are mobilized by the dust devils and 2) detailed in situ investigations (e.g., grain size distribution, albedo differences, microscopic imagery) of observed dust devil tracks. The analysis of dust devils contribute to the understanding of the dust mobilization and deposition and is useful in understanding the interaction among instruments and Aeolian system.



(A) Satellite image of an active dust devil on Mars leaving a track (NASA/JPL/MSSS). (B) Satellite image of numerous dust devil tracks in the southern hemisphere on Mars (image width 3 km, NASA/JPL/MSSS).

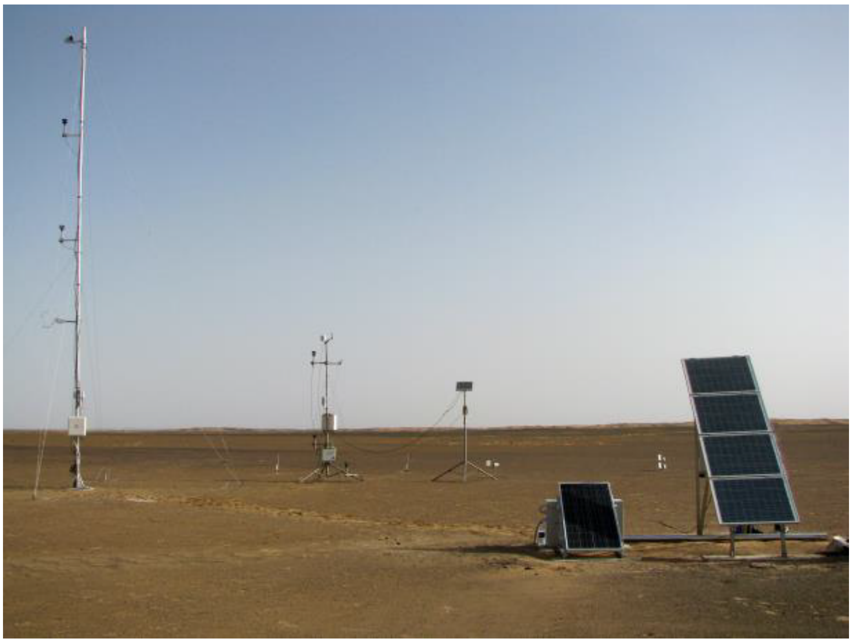


(A) One of the larger observed dust devils (~30 m in diameter) in the study area. (B) Active dust devil (~18 m in diameter) sampled during the field campaign.



Dust devil track analyzed during the field campaign.

The Dreams project with the Ibn Battuta Centre has also tested for three consecutive Aeolian storm season instrument Dreams that will be on board of ExoMars 2016. Field campaigns were performed in the desert Merzouga region (Morocco) in spring 2012 and, more consistently in the periods July-September 2013 and June – August 2014. Summer period in Merzouga is characterized by intense dust activity peaking in July. The chosen sites of these campaigns were flat surfaces constituted by Quaternary lake sediment beds. Both sites have the same mineralogical depth profile. The main difference between them comes from the fact that the lake sediments of 2014 site are covered with pebble gravel size (desert varnished shale eroded material), that forms a centimeter sized mesh whose openings serve for the fine sand (merely quartz and carbonate in composition) entrapment. The sand is shadowed by the pebble height making it reside long periods on the surface, influencing the topsoil overall electric behavior. The soil of the site chosen for year 2014 campaign is also drier than the one chosen for year 2013.



Measurement station mounted in the Merzouga desert in the 2014 field test campaign.