

## 659 Supplement

660 The supplement presents details regarding 1-the acquisition and processing of the DEM shown in  
661 Figure 2, 2- the meteorological data from the local station in Qatar, 3-the sand grain distribution  
662 analysis, and 4-the drift potential analysis.

### 663 **Drone flight details**

664 We used a drone (DJI Phantom 3 professional) and the structure from motion technique to generate a  
665 high quality DEM (Figure 2). The acquisition of the pictures was done using the Point of Interest flight  
666 mode where the aircraft continuously circle around a selected coordinate, respectively the center of the  
667 dune for our study. The flight was carried around 4pm, local hour. Four flights were needed for battery  
668 reason, each lasting around 15 minutes. Over 300 photos were taken at different angles around the dune  
669 and at different elevation. We used then the AGISOFT software to calculate the DEM. The alignment of  
670 photos accuracy parameter was set to high and the density of the point cloud generated was fixed to  
671 medium for computational reason. The software then produces a DEM from this point cloud, interpolating  
672 between the points. The end-product is a meshgrid with a ground sampling distance of  $\sim 0.6\text{m}$  and vertical  
673 accuracy depending on the density of common points found by the software between the pictures. We  
674 found that the upper portion of the dune seems reasonably defined whereas the lower part had a stronger  
675 bias (slight depression in the DEM that should not be present) because of the fewer common points found  
676 by the software due to the slick surface of this dune's section.

### 677 **Mast rotation and data gap bias**

678 The mast of the installation has been rotating gradually to the West throughout the years. This shift in  
679 azimuth is assumed linear in time and the wind direction has been consequently corrected for it (Figure  
680 S1). Additionally, a bit more than one day of data is missing between those 2 years. Considering the total

681 amount of data, this void will have in the end a minimal impact on the calculation of  $Q_s$ , especially since  
682 almost all of it happened during the calm spring season.

### 683 **Sand grain distribution**

684 Each grain size sample collected from the field was split in half four times using a grain sample splitter to  
685 ensure that no bias was introduced during grain size measurement. Grain size distributions were  
686 measured using a Retsch-Camsizer. The Camsizer digitally imaged millions of particles per sample and  
687 grain size distributions were generated from the nominal grain diameters measured from 19  
688 logarithmically-spaced size classes between 0.04-0.85 mm. Diameter is measured by the Camsizer as the  
689 shortest axis in a planar projection, which is equivalent to the intermediate axis of a 3d particle shape.  
690 The results are shown in Figure S2 and Table S1.

### 691 **Drift Potential analysis**

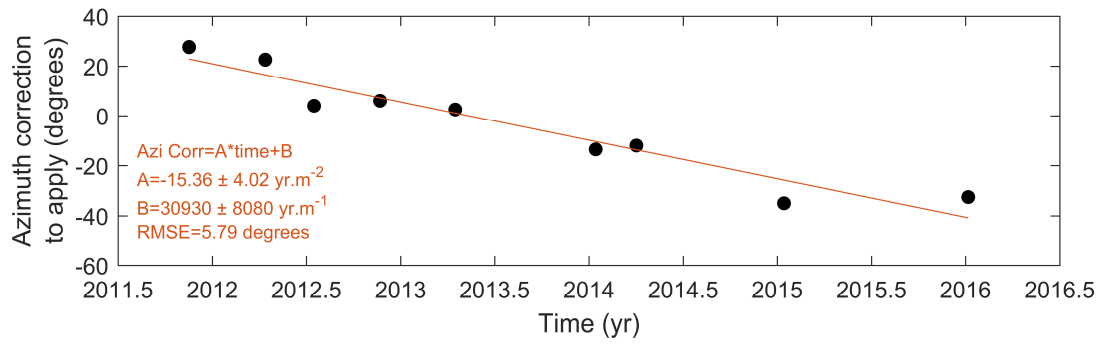
692 The Drift Potential (DP), the resultant DP (RDP), RDP/DP and Resultant Drift Direction (RDD) (Fryberger,  
693 1979) have been calculated using  $u_{*t} = 0.261$  m/s (value using  $Dp = 236 \mu$  m and Equation (7) in the  
694 main text) (Figure S3). Those estimates are for wind at 10m height. We observe that longer time averaging  
695 diminishes RDP and DP, which is a direct consequence of the increasing dilution of strong winds. Going  
696 from 1-minute to 6-hour averages, the RDP/DP increases from 0.87 to 0.92, indicating a dilution of the  
697 direction variability of the wind as the time window averaging is increased. The RDP/DP is for all cases  
698 very high, stressing the mono-directionality of Qatar winds.

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### **Bibliography**

Fryberger, S.G. and Dean, G., 1979. Dune forms and wind regime. In *A study of global sand seas* (Vol. 1052, pp. 137-169). US Government Printing Office Washington.

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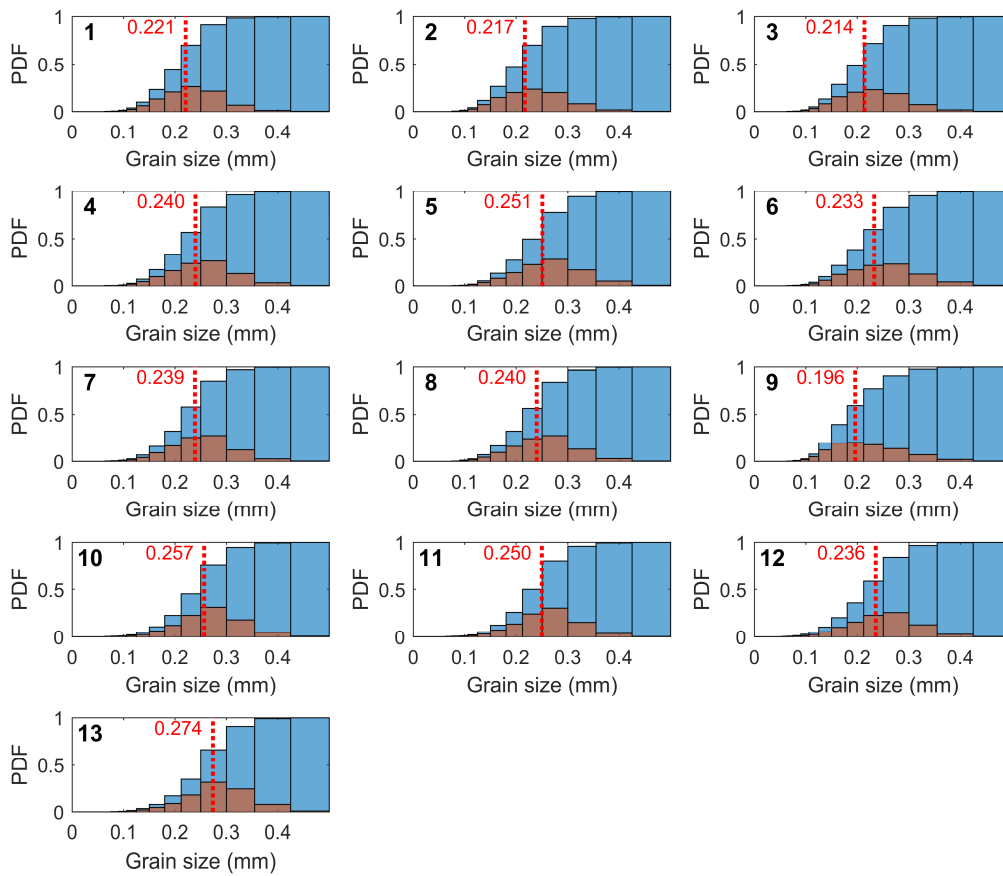


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703 *Figure S1. Azimuth drift of the mast. The black dots indicate the measured mast azimuth correction needed at those date. The*

704 *orange line is the linear fit of those measurements.*

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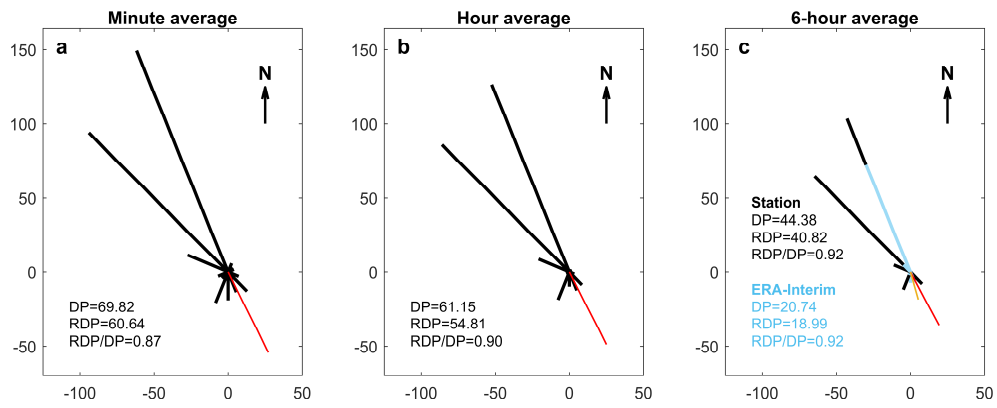


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707 *Figure S2. Particle size histograms for each samples indicated in Figure 2. Samples (which numbers are indicated in black in this*  
 708 *figure) are located from NW (sample 1) to SE (sample 13). The orange histograms represent the Probability Density Function*  
 709 *(PDF) of the grain size distribution. The blue histograms represent the cumulative PDF of grain size distribution. The red dotted*  
 710 *lines, and their associated red number, indicate the median grain size.*

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714 *Figure S3. Drift potential (DP) analysis for each time average (in  $m^3/s^3$ ). Black lines correspond to the DP rose of the*  
 715 *meteorological station. Red lines indicate the resultant drift direction (RDD) of the meteorological station. Blue lines in (c)*  
 716 *indicate the DP rose of ERA-Interim. The yellow line indicates its resultant drift direction (RDD).*

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720 Table S1. Grain size distribution analysis of the 13 sand samples. Their location is indicated in Figure 2, going from sample 1 in  
 721 the NW to sample 13 to the SE.

Sample	d50	d90	d10	grain size Wentworth- scale adjectival classification	Sorting (Folk and Ward (1957), Phi)	sorting adjectival classification
1	0.221	0.294	0.15	fine	0.374	well sorted
2	0.217	0.301	0.145	fine	0.398	well sorted
3	0.214	0.297	0.142	fine	0.400	well sorted
4	0.24	0.322	0.16	fine	0.372	well sorted
5	0.251	0.334	0.17	medium	0.357	well sorted
6	0.233	0.327	0.141	fine	0.403	well sorted
7	0.239	0.315	0.163	fine	0.355	well sorted
8	0.24	0.319	0.162	fine	0.364	well sorted
9	0.196	0.297	0.131	fine	0.425	well sorted
10	0.257	0.334	0.178	medium	0.341	very well sorted
11	0.25	0.325	0.172	medium	0.343	very well sorted
12	0.236	0.317	0.148	fine	0.393	well sorted
13	0.274	0.351	0.189	medium	0.345	very well sorted

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