Quantitatively Characterizing Dust source Areas at Lordsburg Playa

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Arizona Dust Workshop
March 3, 2020

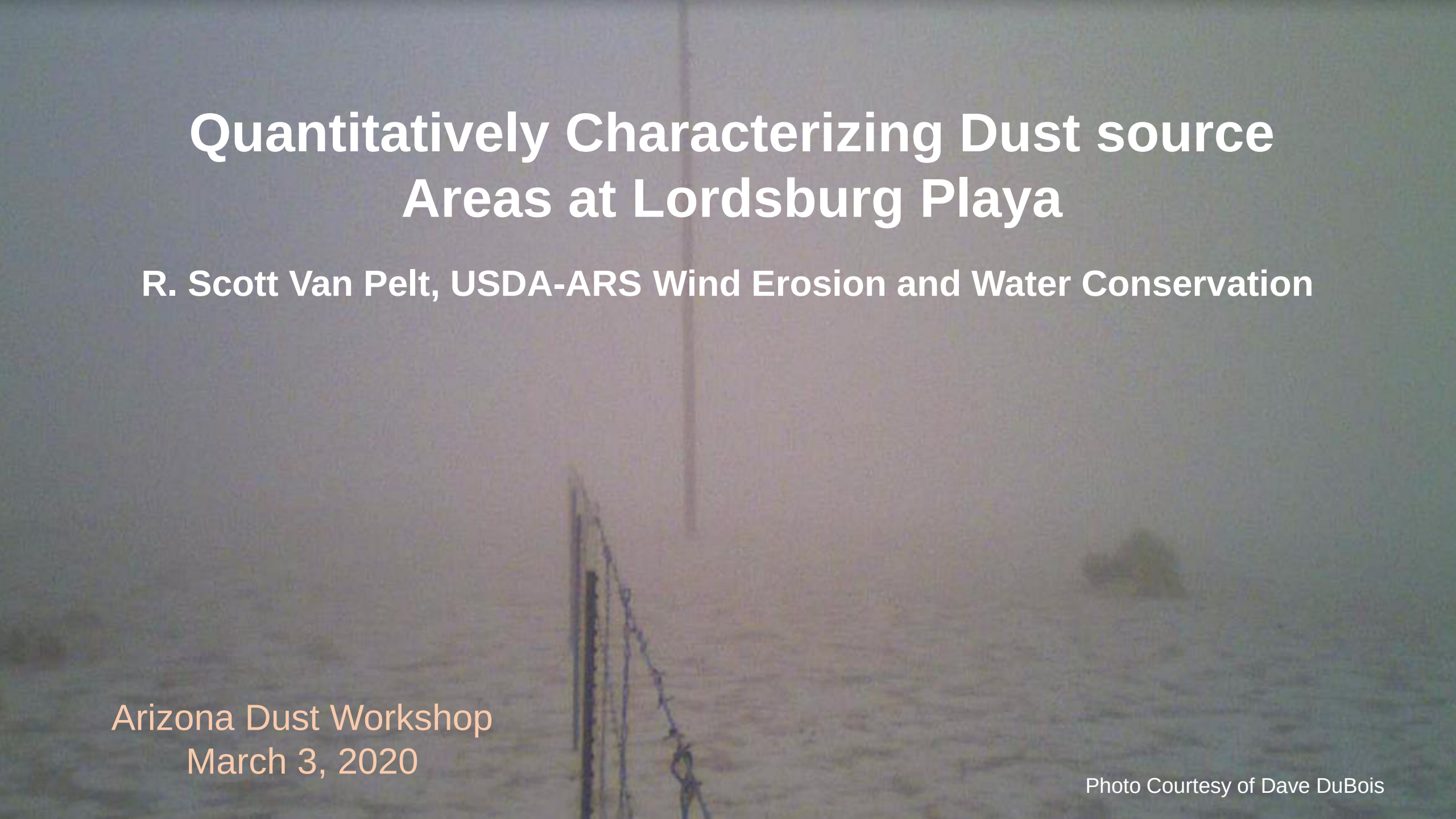

Photo Courtesy of Dave DuBois

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Photo Courtesy of Dave DuBois

Lordsburg Playa is a frequent source of dust crossed by Interstate 10

At least 55 people have perished in dust reduced visibility related crashes

Many of those deaths have occurred in recent years:

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- Seven perished in a single dust event in May 2014

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- Seven perished in a single dust event in May 2014
- Ten perished in 4 dust events during 2017

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We investigated several possible source areas using a PI-SWERL to generate and quantify dust from the surfaces

Coordinate System: GCS WGS 1984
Datum: WGS 1984
Units: Degree

True RGB Image from Sentinel-2 at
10 meters spatial resolution

Sample collection site name
Interstate Highway
Railroads

0 1.75 3.5 7 10.5 14
Miles

PI-SWERL (Portable In-Situ Wind ERosion Laboratory) is an aspirated chamber with a spinning ring just cm above the surface that creates a shear stress sufficient to initiate particle movement and entrain fine dust. That dust (PM_{10}) is quantified with an optical bench.

At each test site we also collected surface soil/sediment samples, and tested a method for estimating threshold friction velocity (u^*_t) using an air rifle

Table 1. Mean and standard deviation of longitude, latitude, percent sand, silt, clay and PM_{10} for the surface sediment samples at the test sites.

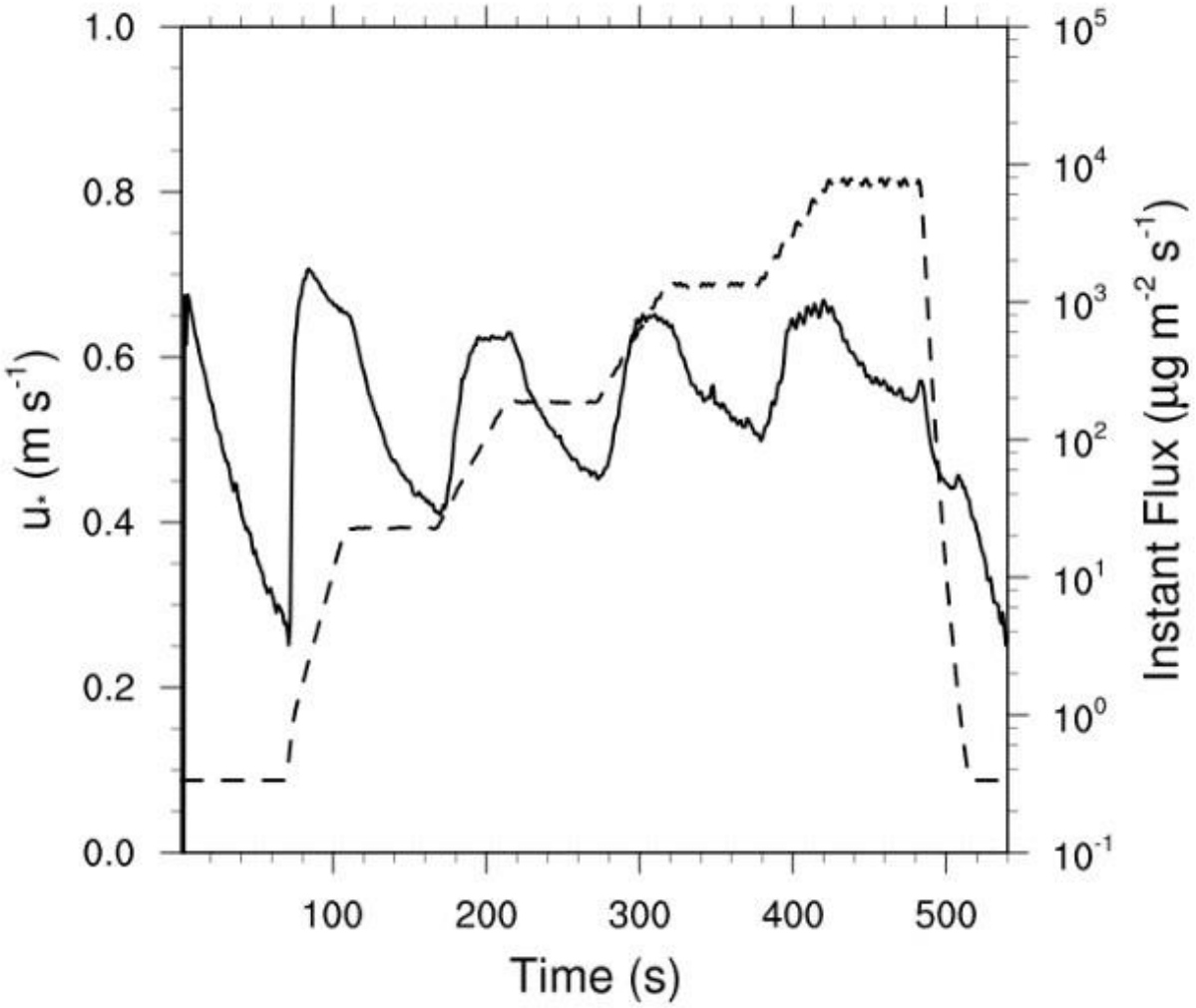
Site (Surface Class)*		Longitude Degrees W	Latitude Degrees N	Sand %	Silt %	Clay %	PM_{10} %
TS1 (D)	Mean	108.854	32.255	17.79	69.*2	12.29	41.30
	St. Dev.	1.91 E-5	8.64 E-5	1.01	1.10	0.50	1.36
TS2 (D)	Mean	108.868	32.254	28.64	57.42	13.94	42.25
	St. Dev.	3.86 E-5	3.47 E-5	4.94	4.16	3.16	7.40
TS2 (L)	Mean	108.868	32.254	30.66	57.16	12.18	37.57
	St. Dev.	1.04 E-4	3.98 E-5	5.37	7.05	1.67	2.62
TS3 (D)	Mean	108.878	32.267	18.01	70.10	11.90	45.24
	St. Dev.	8.03 E-5	5.4 E-5	1.08	1.29	1.32	3.41
RFP (L)	Mean	108.943	32.242	29.02	62.27	8.70	33.72
	St. Dev.	5.89 E-4	6.68 E-4	12.27	12.00	0.51	2.93
RFP (B)	Mean	108.944	32.242	56.72	36.17	7.11	25.22
	St. Dev.	--	--	--	--	--	--
NW (L)	Mean	108.908	32.322	17.52	54.62	27.85	57.73
	St. Dev.	3.18 E-4	2.47 E-4	3.88	1.95	2.81	4.55
EPL (B)	Mean	108.832	32.333	41.33	45.35	13.32	42.55
	St. Dev.	1.65 E-4	7.11 E-5	7.13	6.13	1.70	7.06
WPL (B)	Mean	108.933	32.315	84.59	12.23	3.17	10.80
	St. Dev	1.93 E-5	4.41 E-5	13.00	10.76	2.24	8.83

*surface classes are D = Delta, L = Lake, and B + Beach

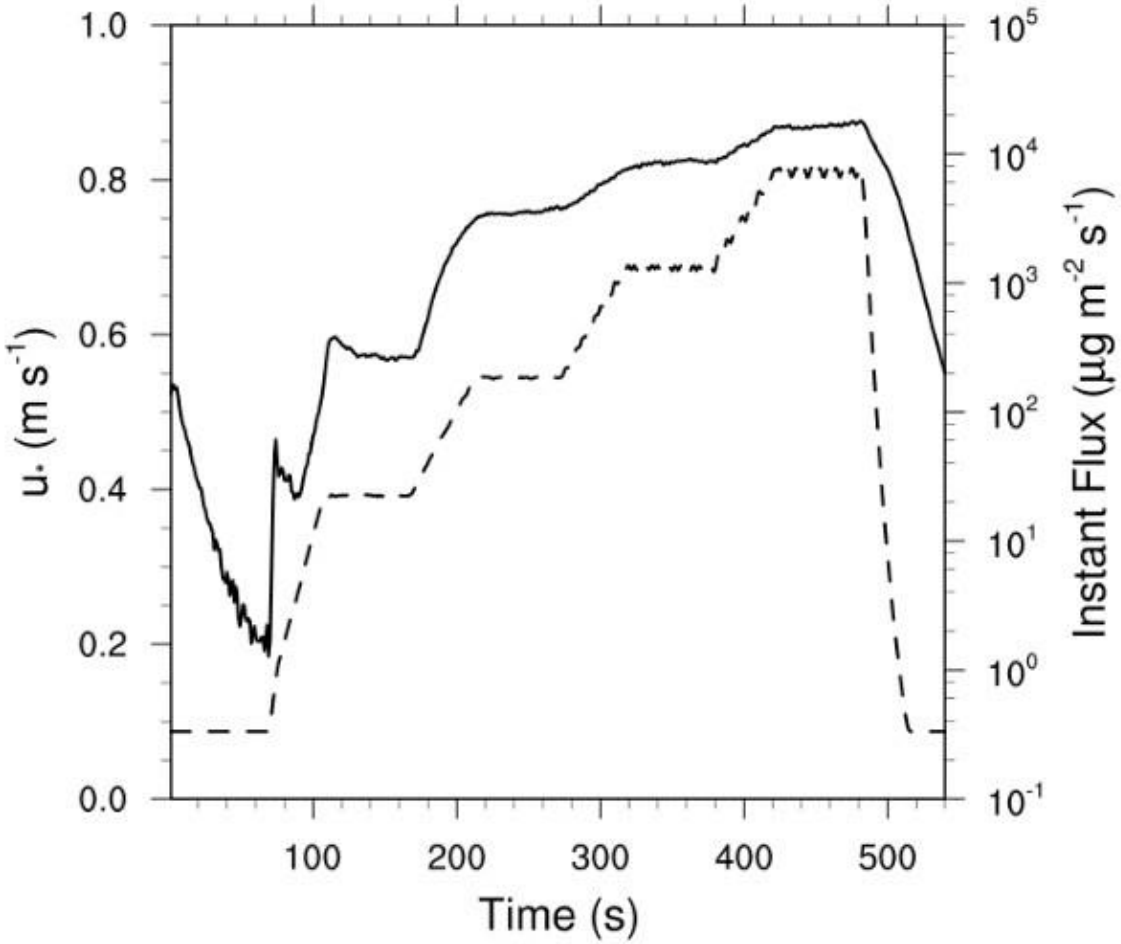
Table 2. Surface class (Delta, Lake, or Beach), disturbance class (Undisturbed or Disturbed), and mean and standard deviation of threshold friction velocity (u^*_t), friction velocity at which the NAAQS standard would be exceeded in a 30 m tall column of air (u^*_{exc}), friction velocity at which the maximum rate of PM_{10} vertical flux is observed (u^*_{maxQ}), the maximum rate of PM10 vertical flux observed (Max Q), and the total PM_{10} vertical flux for the nine minute PI-SWERL test (Tot Q) of each sample site.

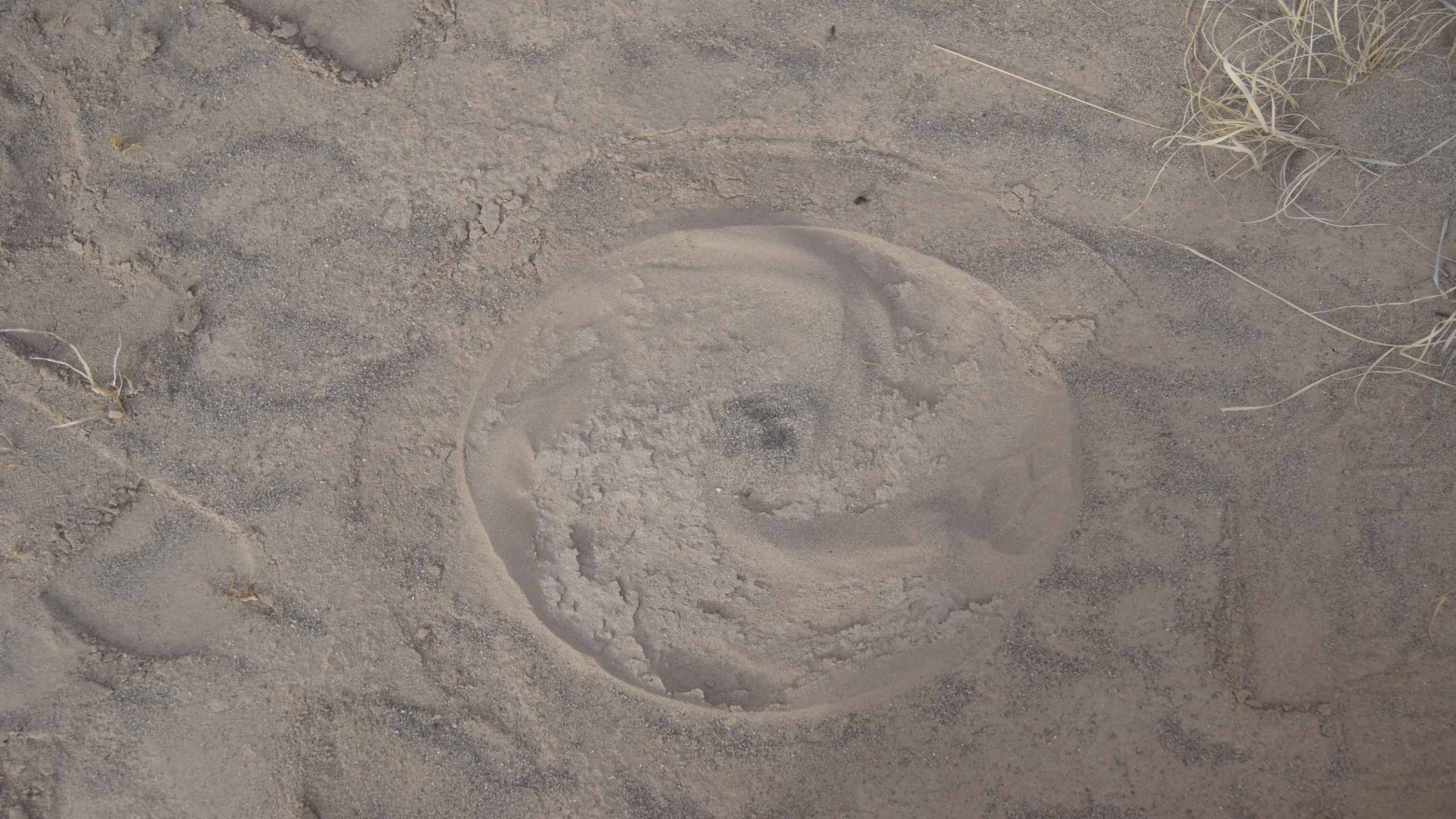
Site	Surf. Class	Disturb. Class		u^*_t ($m\ s^{-1}$)	u^*_{exc} ($m\ s^{-1}$)	u^*_{maxQ} ($m\ s^{-1}$)	Max Q ($\mu g\ m^{-2}\ s^{-1}$)	Tot Q ($\mu g\ m^{-2}$)
TS1	D	U	Mean	0.31	0.80	0.81	1325.48	84217
			St. Dev.	0.02	0.02	0.00	919.87	69106
TS1	D	D	Mean	0.31	0.62	0.81	11030.94	845554
			St. Dev.	0.02	0.07	0.01	5498.17	5168485
TS2	D	U	Mean	0.26	0.74	0.80	3098.75	193221
			St. Dev.	0.05	0.12	0.02	2021.42	131854
TS2	L	U	Mean	0.31	--	0.80	223.60	16733
			St. Dev.	0.01	--	0.00	36.49	2287
TS3	D	U	Mean	0.24	0.60	0.80	1248.26	999201
			St. Dev.	0.05	0.15	0.02	8697.52	832504
TS3	D	D	Mean	0.31	0.50	0.68	24977.63	2226249
			St. Dev.	0.02	0.03	0.05	1778.07	682823
RFP	L	U	Mean	0.36	--	0.81	476.06	45648
			St. Dev.	0.06	--	0.00	406.79	77958
RFP	B	U	Mean	0.39	0.77	0.81	2450.36	288993
			St. Dev.	--	--	--	--	--
NW	L	U	Mean	0.56	0.81	0.80	561.84	36857
			St. Dev.	0.10	--	0.02	717.75	49034
EPL	B	U	Mean	0.30	0.72	0.81	7561.78	788012
			St. Dev.	0.10	0.08	0.00	12282.01	1266773
WPL	B	U	Mean	0.28	0.50	0.80	17182.49	2727300
			St. Dev.	0.04	0.05	0.02	6844.97	1084141

PI-SWERL friction velocity and surface dust emission for a supply limited surface



PI-SWERL friction velocity and surface dust emission for a surface without supply limitations

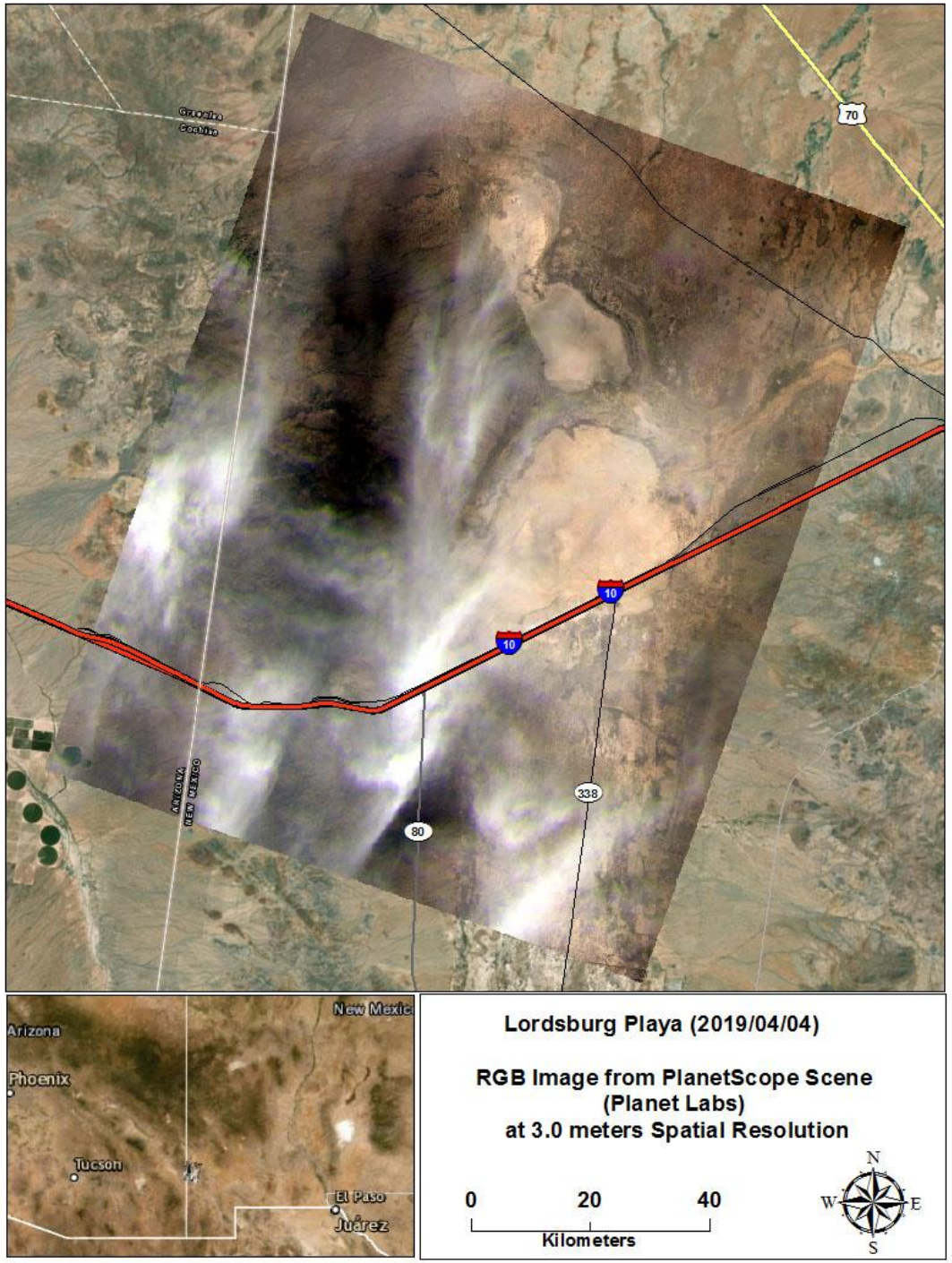




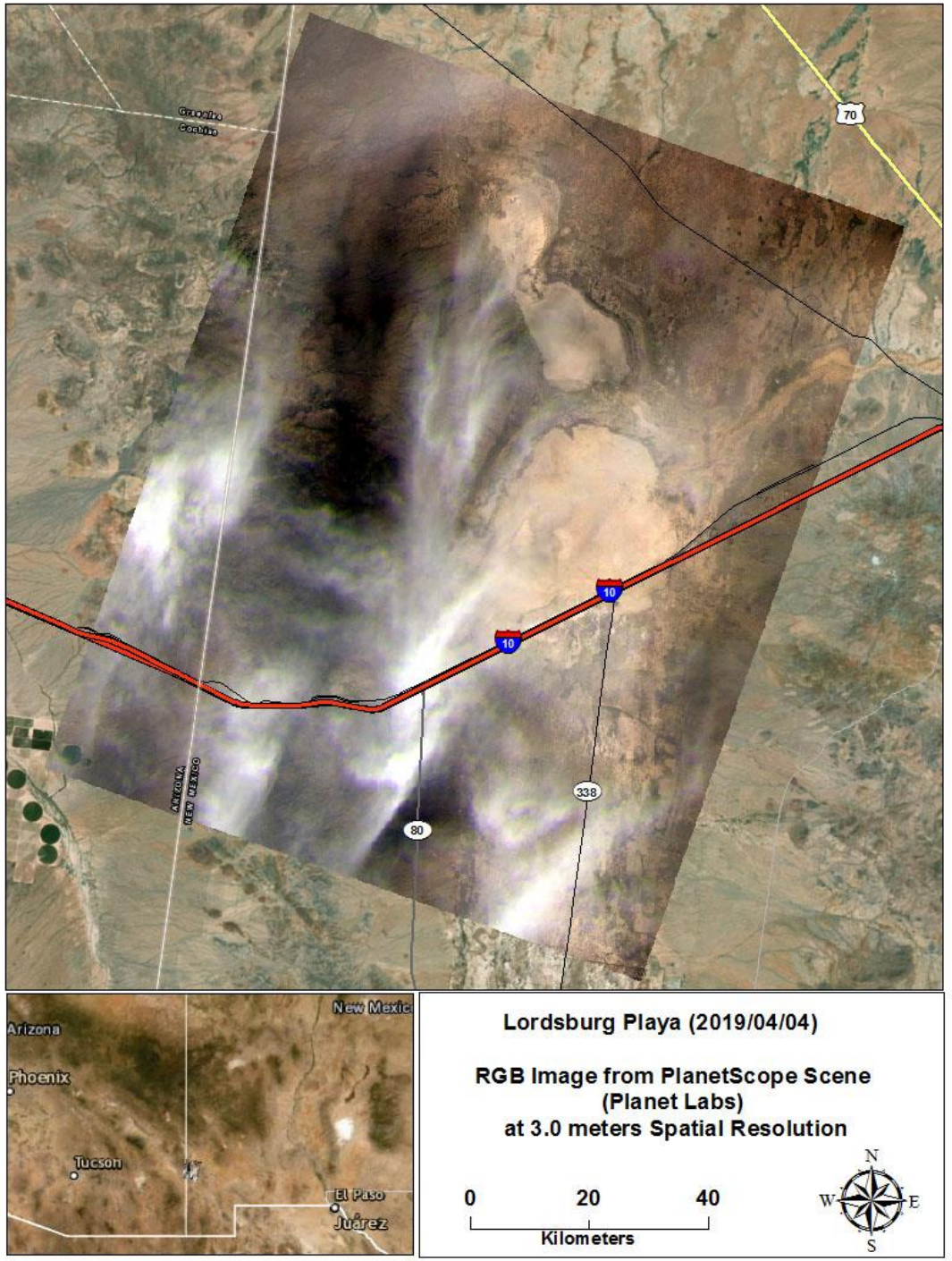
The western edge of the playa borders the bajada from the Peloncillo Mountains which is composed of coarse fluvial sediments or igneous origin.

Dams built to supply livestock water and mining needs have failed and released large amounts of coarse sediments onto the more indurate lacustrine surface.

This past spring, dust plumes emanating from the western regions of the playa surface were seen crossing Interstate 10 near the Road Forks Playa area



Questions??


70
10
10
338
80
ARIZONA
NEW MEXICO
New Mexic
Arizona
Phoenix
Tucson
El Paso
Juárez
Lordsburg Playa (2019/04/04)
RGB Image from PlanetScope Scene
(Planet Labs)
at 3.0 meters Spatial Resolution
0
20
40
Kilometers
N
W
E
S