TOWARD AN ASSESSMENT OF EXCESS (MASS) EMISSIONS

OCEANO DUNES STATE VEHICULAR RECREATION AREA

SAG Presentation to the SLO APCD Board

MAY 15, 2024
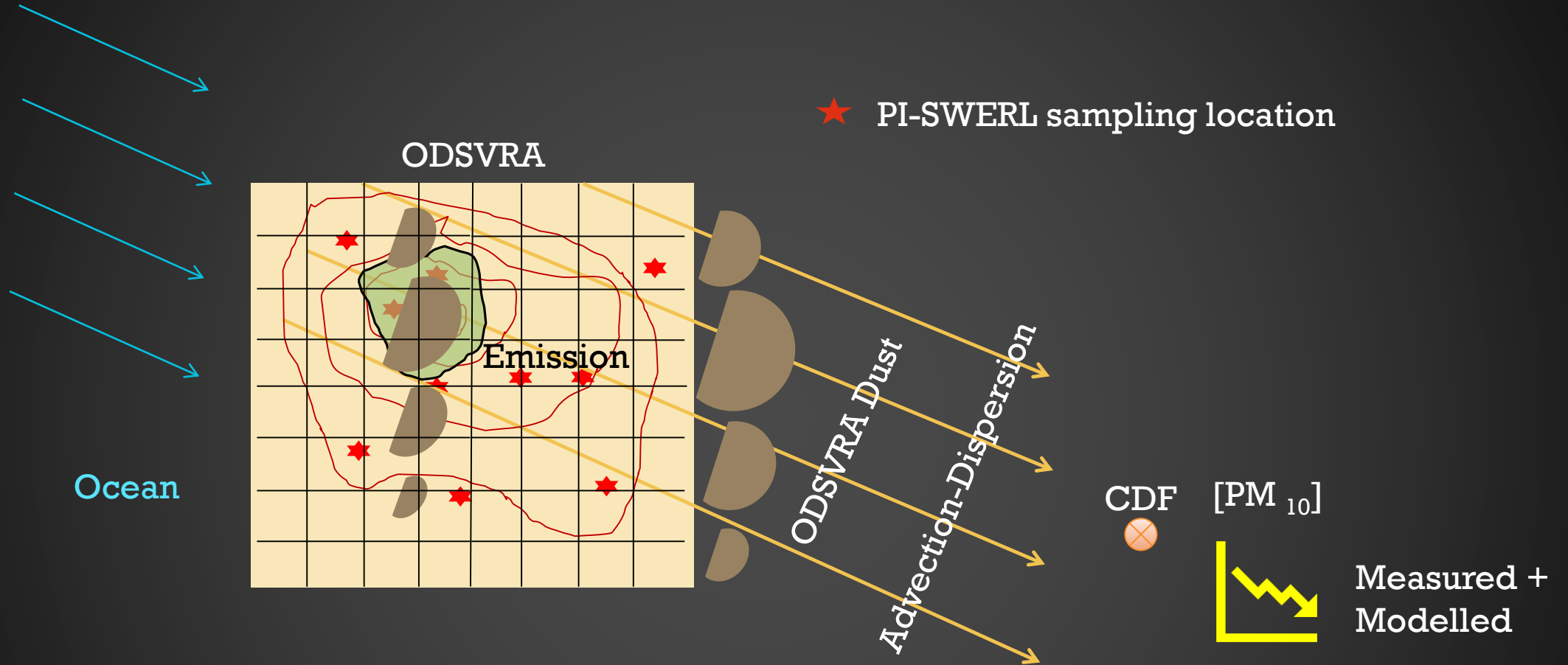
Stipulated Order of Abatement (SOA #17-01)
(filed May 4, 2018)

2. PARTICULATE MATTER REDUCTION PLAN: Respondent shall prepare a Particular Matter Reduction Plan (Plan) that satisfies the following requirements:

b. The Plan shall be designed to **achieve state and federal ambient PM$_{10}$ air quality standards**;

c. To meet the objective of 2b, the development of the Plan shall begin by establishing **an initial target of reducing the maximum 24-hour PM$_{10}$ baseline emissions by fifty percent (50%)** based on air quality modeling based on a modeling scenario for the period **May 1 through August 31, 2013**, and shall be carried out by the California Air Resources Board (CARB), or other modeling groups subject to the review of the Scientific Advisory Group (SAG), as defined in paragraph 3, below.
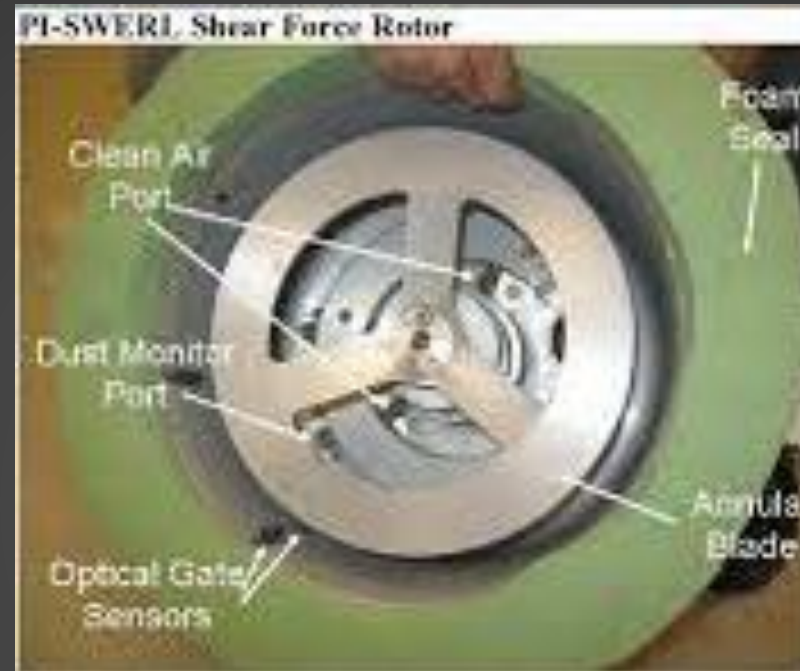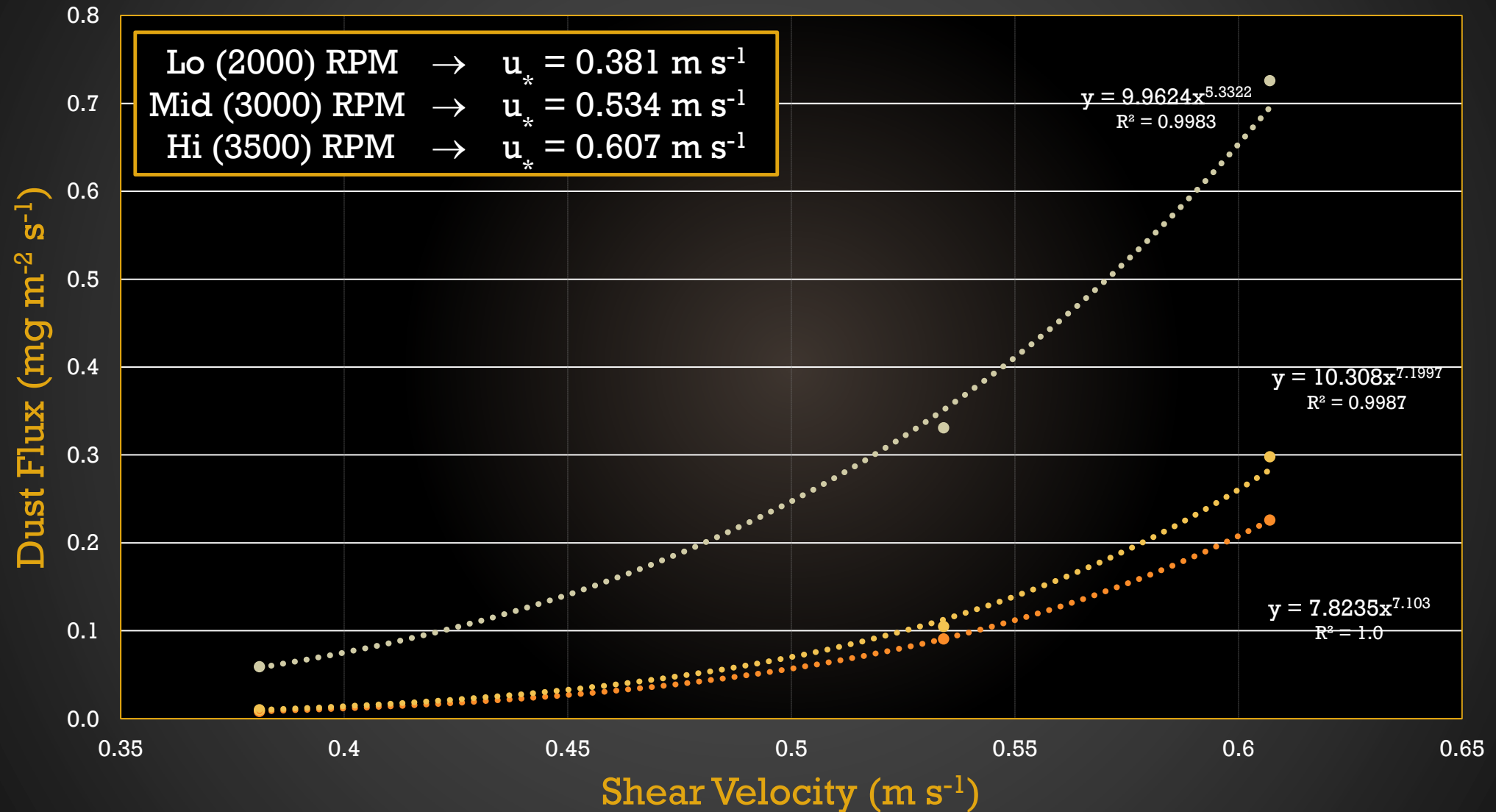
DUST (MASS) EMISSION MEASUREMENT: PI-SWERL

PI-SWERL Shear Force Rotor

Clean Air Port
Foam Seal
Dust Monitor Port
Annular Blade
Optical Gate Sensors

Lo (2000) RPM	$\rightarrow$	$u_* = 0.381$ m s^{-1}
Mid (3000) RPM	$\rightarrow$	$u_* = 0.534$ m s^{-1}
Hi (3500) RPM	$\rightarrow$	$u_* = 0.607$ m s^{-1}

Photo credits: DRI & Jack Gillies

POWER RELATIONS TO PREDICT DUST FLUX

Lo (2000) RPM → $u_* = 0.381$ m s^{-1}
Mid (3000) RPM → $u_* = 0.534$ m s^{-1}
Hi (3500) RPM → $u_* = 0.607$ m s^{-1}

$y = 9.9624x^{5.3322}$
$R^2 = 0.9983$

$y = 10.308x^{7.1997}$
$R^2 = 0.9987$

$y = 7.8235x^{7.103}$
$R^2 = 1.0$

Dust Flux (mg m^{-2} s^{-1})

Shear Velocity (m s^{-1})
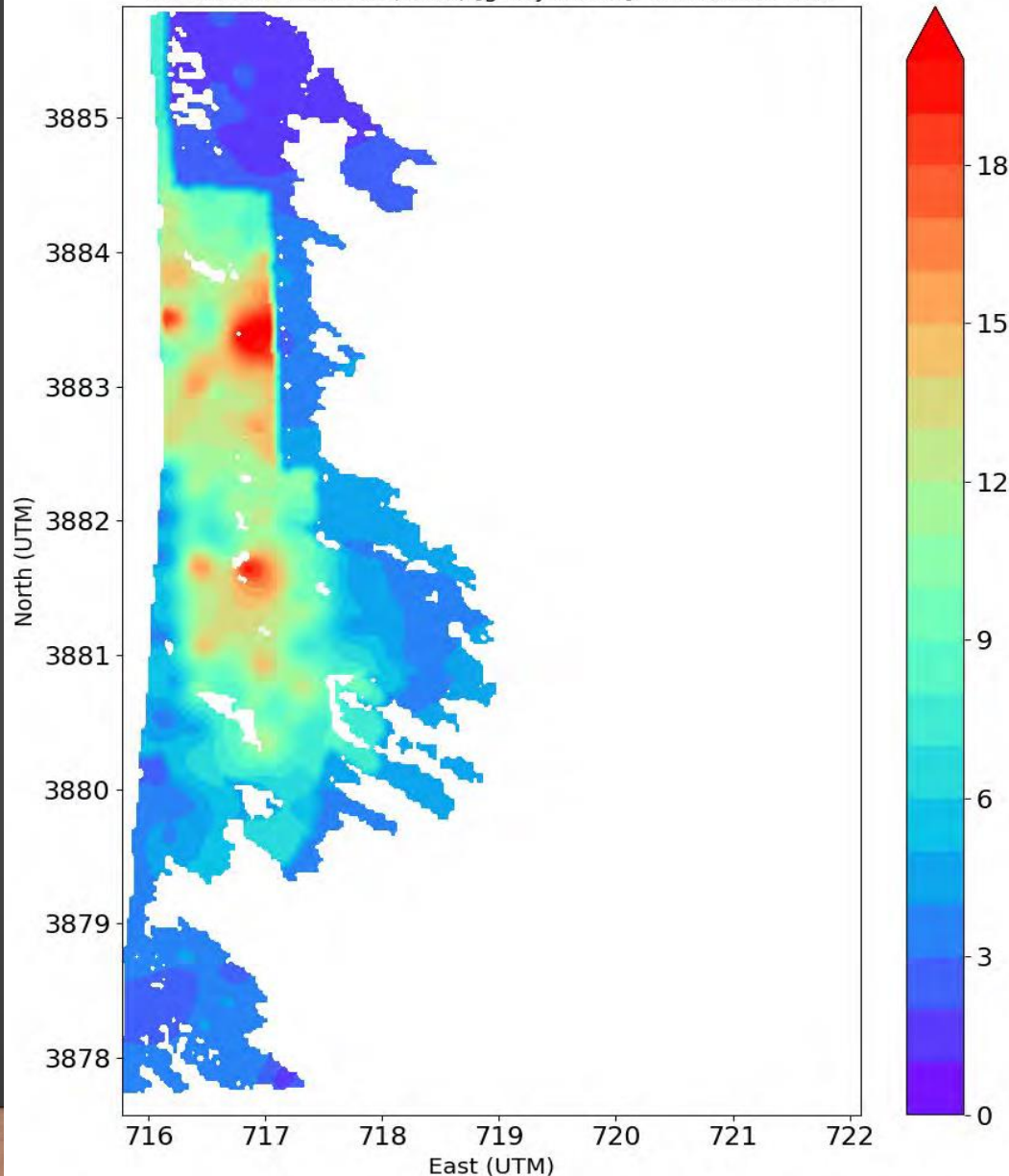
ODSVRA PI-SWERL Measurements (Aug 2013)

Riding Area
- 2013_08
- 2014_09
- 2015_06
- 2015_10
- 2016_03
- 2019_05
- 2019_10
- 2022_05

Non-Riding Area
- 2013_08
- 2014_09
- 2015_06
- 2015_10
- 2016_03
- 2019_05
- 2019_10
- 2022_05
- 2022_09
- 2022_09
- Park_Boundary

Google Satellite
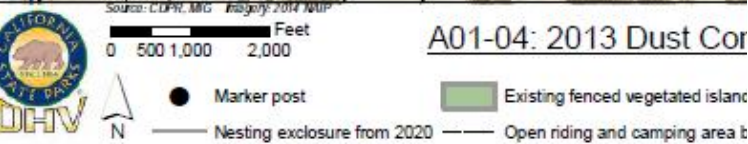
Emissions PI-SWERL (2013) [g day-1 m-2]: 1.32,6.55,21.20

2013 Mass Emissions based on Interpolated PI-SWERL Grid

Mejia, J., Gillies, J. A. (January 10, 2022). "Model-Derived Estimates of Mass Emissions of PM10 for Pre-OHV Disturbance and Past Vegetation Scenarios" [Attachment 1 of SAG report]
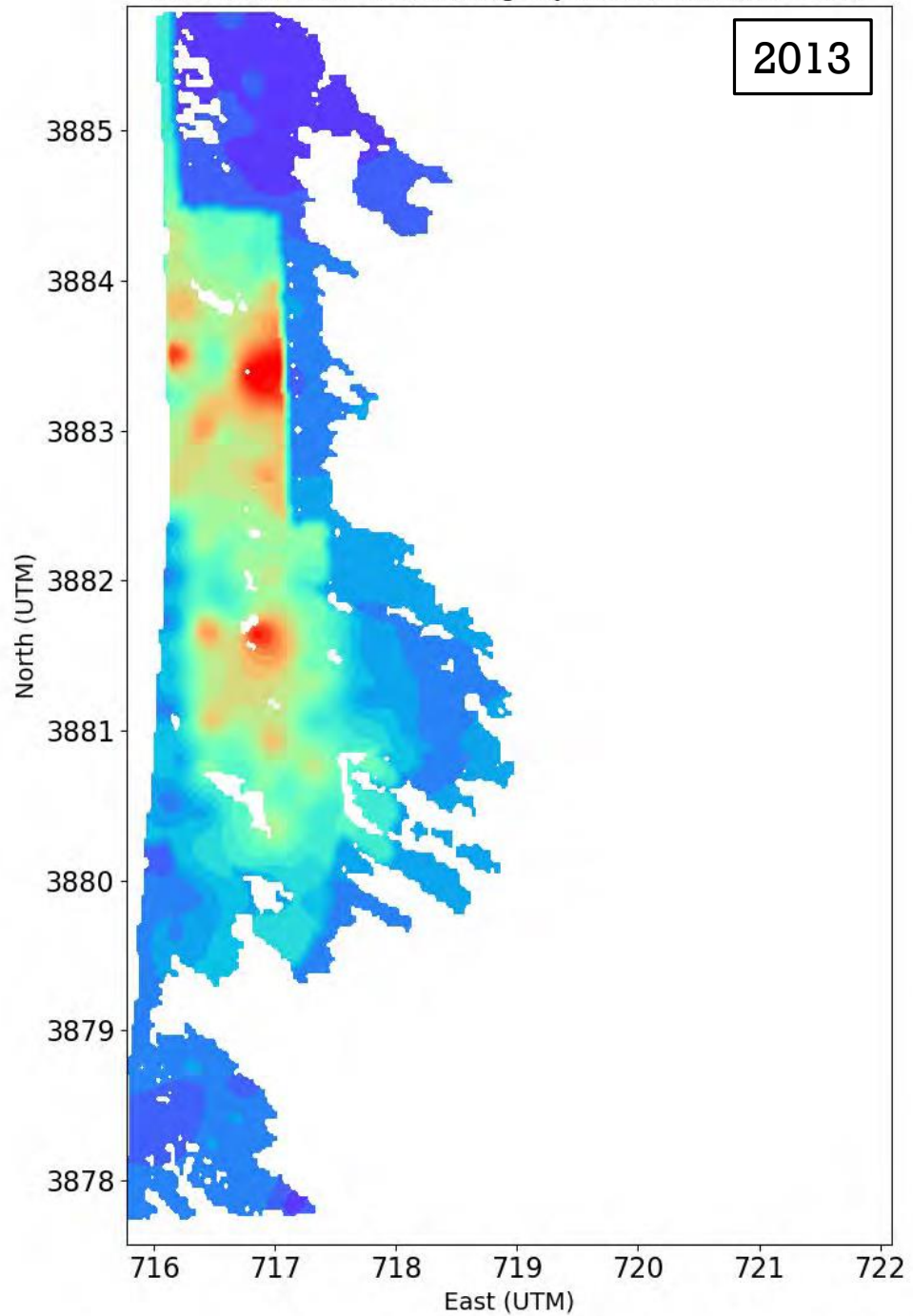
Left map (A01-04: 2013 Dust Control)

Total Acres of [...]
- New vegeta[...]
- Previous veg[...]
- Total acreage occ[...]

Labels: Pavillion Hill, Worm Valley, BBQ Flats, Eucalyptus North, Eucalyptus Tree, Eucalyptus South, Tabletop, Pipeline, Boyscout Camp, 3, 4

Annual [...]	
Dust Control Program ID	Pro[...]
3	2013
4	2013

Source: CDPR, MIG   Imagery: 2014 NAIP
A01-04: 2013 Dust Co[...]
Feet 0 500 1,000 2,000
Marker post   Existing fenced vegetated island
Nesting exclosure from 2020   Open riding and camping area b[...]

Middle map (A01-10: 2019 Dust)

Total Acres of [...]
- New vegeta[...]
- Previous veg[...]
- Wind fence [...]
- Foredune fe[...]
- Total acreage occ[...]

Labels: Pavillion Hill, Worm Valley, BBQ Flats, 24, 25, Eucalyptus North, Eucalyptus Tree, Eucalyptus South, Tabletop, Pipeline, Boyscout Camp

A[...]	
Dust Control Program ID	
24	
25	

Source: CDPR, MIG   Imagery: 2014 NAIP
A01-10: 2019 Dust [...]
Feet 0 500 1,000 2,000
Marker post   Existing fenced vegetate[...]
Nesting exclosure from 2020   Open riding and camping[...]

Right map (A01-12: 2021 Dust Control Treatment Areas)

Total Acres of Dust Control
- New vegetation (58.9 acres)
- Previous vegetation projects (157.6 acres)
- Straw treatment (27.3 acres)
- Wind fence (72.8 acres)
- Vehicle exclusion area (5.9 acres)
- Total acreage occupied: 322.5 acres

Labels: Pavillion Hill, Worm Valley, BBQ Flats, 34, 35, 38, 39, 36, 40, 41, Eucalyptus North, Eucalyptus Tree, Eucalyptus South, 42, Tabletop, 37, 43, 44, 45, 47, 46, 48, 49, Pipeline, Boyscout Camp

Annual Dust Control Measures			
Dust Control Program ID	Project ID	Alternate Name	Acres
34	2021-VG-01	Bigfoot East	14.8
35	2021-VG-02	Area 3	4.1
36	2021-VG-03	Eucalyptus Tree	7.9
37	2021-VG-04	Tabletop	5.5
38	2021-ST-01	Area 1	4.7
39	2021-ST-02	Area 2	5.5
40	2021-TV-01	Area 3	3.2
41	2021-TV-02	Area 4	2.7
42	2021-WF-01	Area 5	21.7
43	2021-WF-02	Area 6	10.8
44	2021-ST-03	Area 7	6.5
45	2021-ST-04	Area 8	5.0
46	2021-ST-05	Area 9	5.6
47	2021-VG-05	Area 10	18.4
48	2021-VG-06	Area 11	4.2
49	2021-VG-07	Area 12	4.0
		Total:	124.6

Source: CDPR, MIG   Imagery: 2014 NAIP
A01-12: 2021 Dust Control Treatment Areas
2021 ARWP
Feet 0 500 1,000 2,000
Marker post   Existing fenced vegetated islands   Park boundary
Nesting exclosure from 2020   Open riding and camping area boundary fence

Emissions PI-SWERL (2013) [g day-1 m-2]: 1.32,6.55,21.20

Emissions PI-SWERL (2019) [g day-1 m-2]: 1.38,6.11,15.57

	Treated Area (acres)	Emissions (metric tons per day)	Percent of 2013 baseline
2013 Baseline Emissions	0	182.8	-
SOA 2.c Goal	TBD	91.4	50%
As of July 31, 2021	322.2	142.0	78%
As of July 31, 2022	705.5	108.2	59%

	Treated Area (acres)	24-hr [PM_{10}] @ CDF ($\mu g\ m^{-3}$)	Percent of 2013 baseline
2013 Baseline Emissions	0	124.7	-
SOA 2.b Goal	TBD	50.0	40%
As of July 31, 2021	322.2	72.2	58%
As of July 31, 2022	705.5	65.7	53%

ODSVRA
All PI-SWERL Measurements
(2103-2022)
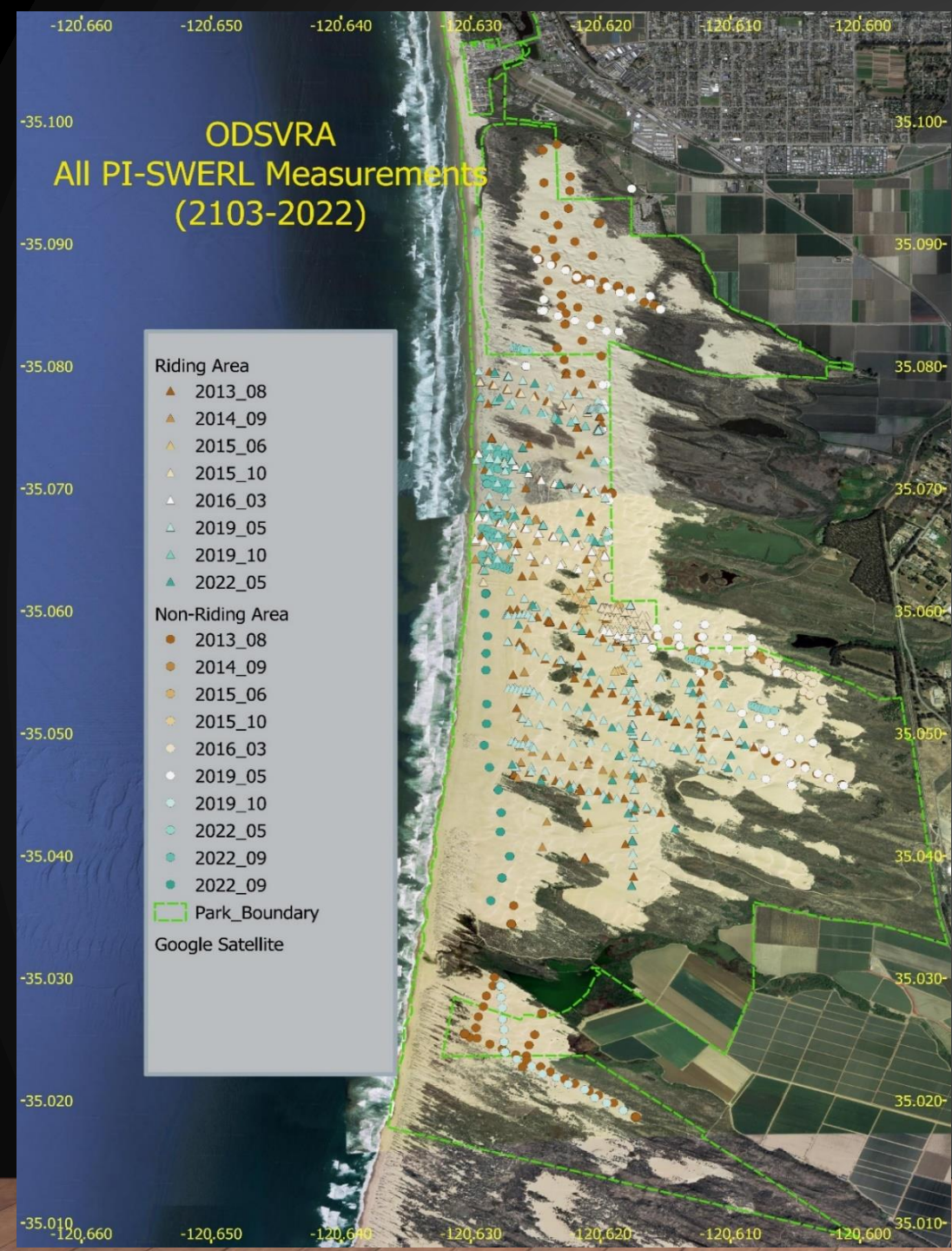
Summary of PI-SWERL Measurements at ODSVRA

YEAR_Month(s)	Riding Area	Non-Riding Area
2013_08	186	143
2014_09	45	35
2015_06	100	2
2015_9/10	165	6
2016_03	58	34
2019_05	337	124
2019_10	42	28
2022_05	51	27
2022_09		133
TOTAL	984	532

another ~ 266 measurements in seasonally exclosed areas

Stipulated Order of Abatement (2022)

3. Sections 2a-2d of the Original Stipulated Order of Abatement are modified to read:

   b. The plan shall be designed to **eliminate emissions in excess of naturally occurring emissions** from the ODSVRA that contribute to downwind violations of the state and federal PM_{10} air quality standards. By October 16, 2024, in consultation with the SAG and CARB, the Respondent shall obtain Hearing Board approval of a *final excess emissions goal*.

   c. To meet the objective of 2b, the Respondent shall initially reduce mass-based PM_{10} emissions within the ODSVRA to a level consistent with the **pre-disturbance scenario** identified by the SAG in their "Scientific Basis for Possible Revision of the Stipulated Order of Abatement," dated February 7, 2022. Emissions shall be calculated using the meteorology of the 10 highest emissions days for the period May 1 through August 31, 2013, and a *representative emissivity grid derived from PI-SWERL measurements as recommended by the SAG,* and as determined by air quality modeling carried out by the California Air Resources Board (CARB), or other modeling groups subject to the review of the Scientific Advisory Group (SAG).

CONCEPTUAL FRAMEWORK (2024-)
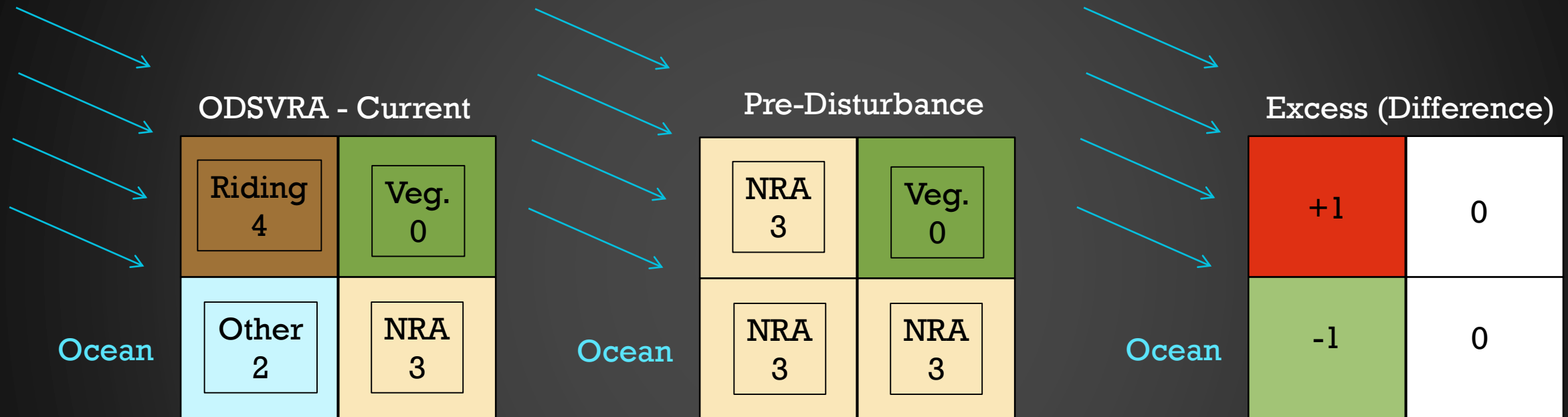
Outcome depends on (i) zones (type, area); and (ii) 'representative' emissivity values

Zonation of the ODSVRA

ODSVRA - Current

Riding 4	Veg. 0
Other 2	NRA 3

Ocean

Total Acres of Dust Control

- Vegetation (335.1 acres)
- Straw treatment (24.1 acres)
- Wind fence (53.0 acres)

Total acreage occupied: 412.2 acres

- Additional dust reduction benefit area (293.3 acres)
- Seasonal foredune beach and corridors (34.6 acres)

Dust control reduction total area: 740.1 acres*

A01-01: Cumulative Dust Control as of 7/31/22
2022 ARWP

- ● Marker post
- ▢ Existing fenced vegetated islands
- ▭ Park boundary — Open riding and camping area boundary fence

*The total dust control area without the foredune beach and corridor area is 705.5 acres.

EMISSIVITY ZONES FOR CURRENT (2024) LANDSCAPE SCENARIO

- Riding Area Central-North
- Riding Area Central-South
- Non Riding Area North
- Non Riding Area Central
- Non Riding Area South
- Foredune Restoration Area
- Plover Exclosure
- Seasonal Exclosure
- Vegetation Islands
- Revegetated Project Areas
- Park_Boundary

For details see: SAG Memo_Emissivity Grids for Future Modeling of Excess Emissions—2023.12.19
https://storage.googleapis.com/slocleanair-org/images/cms/upload/files/SAG%20Memo_Emissivity%20Grids%20for%20Future%20Modeling%20of%20Excess%20Emissions%20-%2020231219.pdf

Non-Riding Areas

Riding Areas

$u* = 0.381\ ms^{-1}$

$u* = 0.534\ ms^{-1}$

$u* = 0.607\ ms^{-1}$
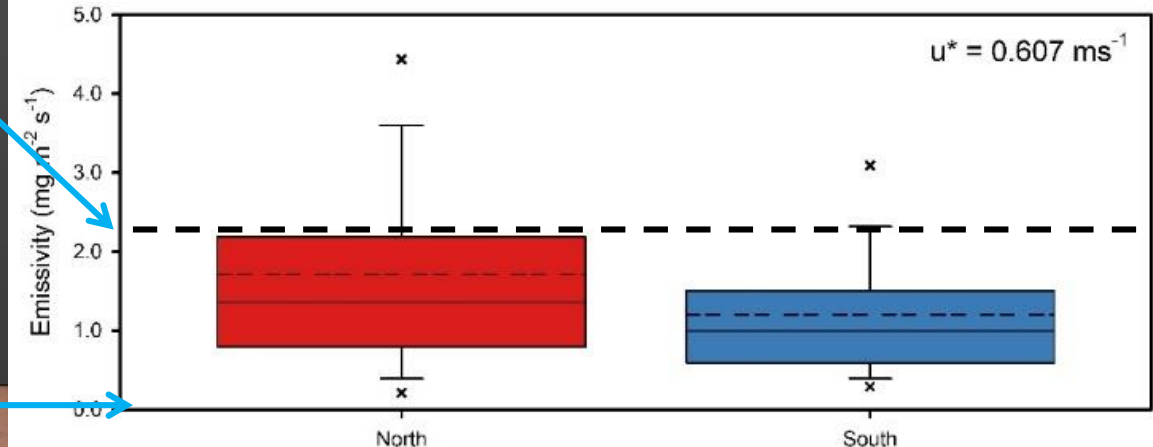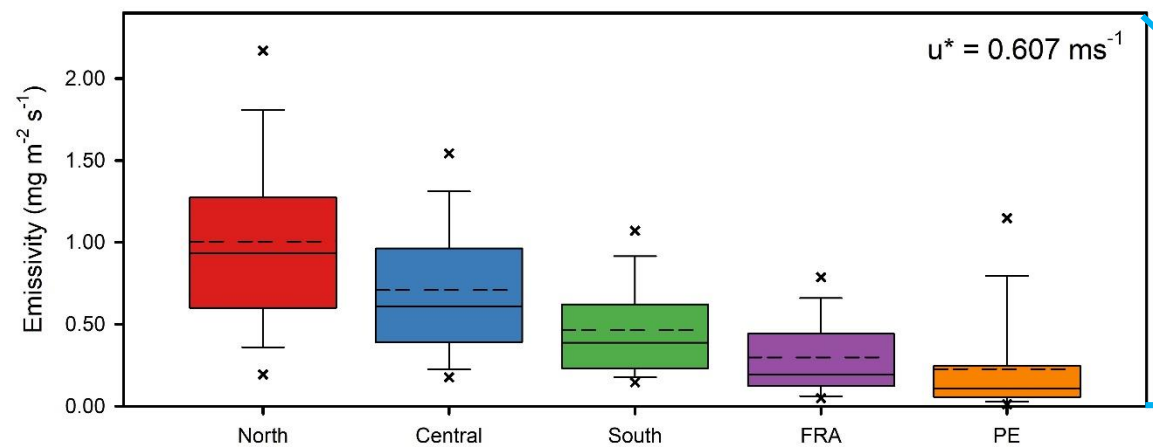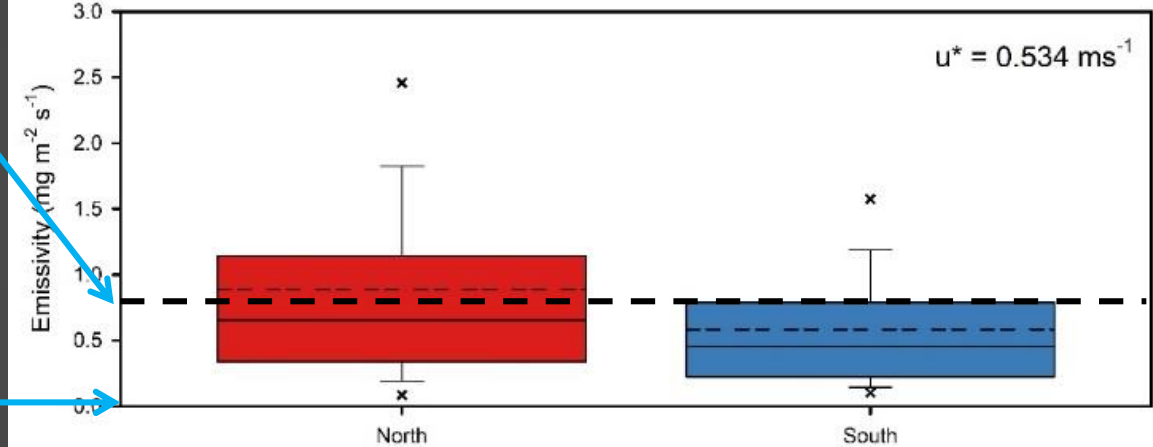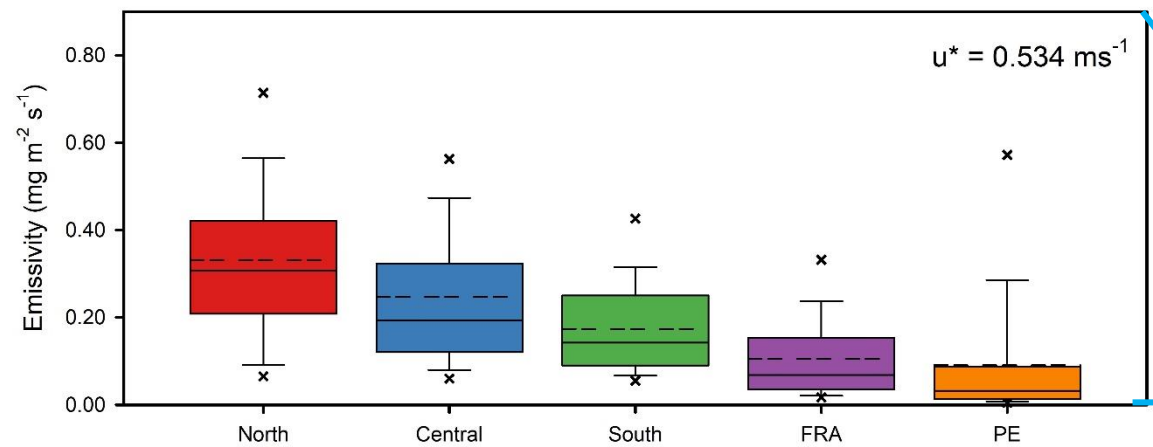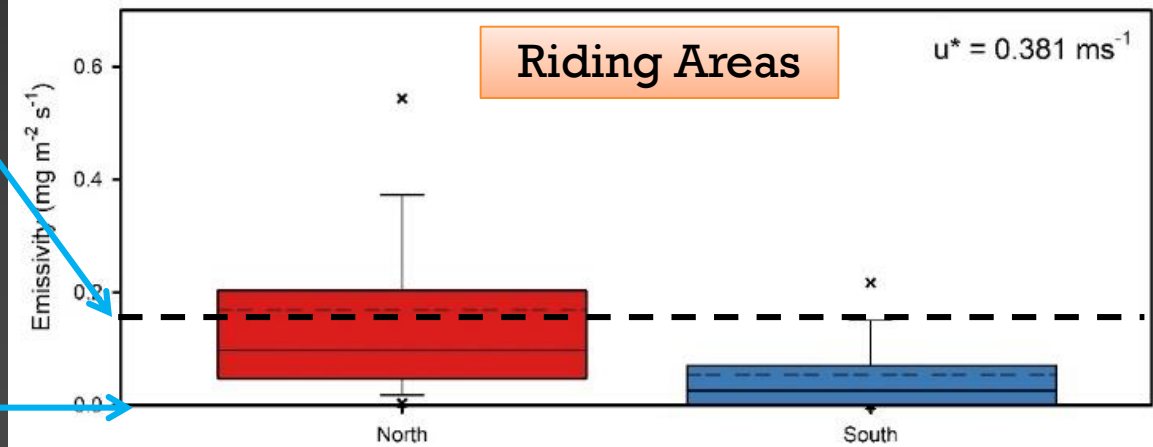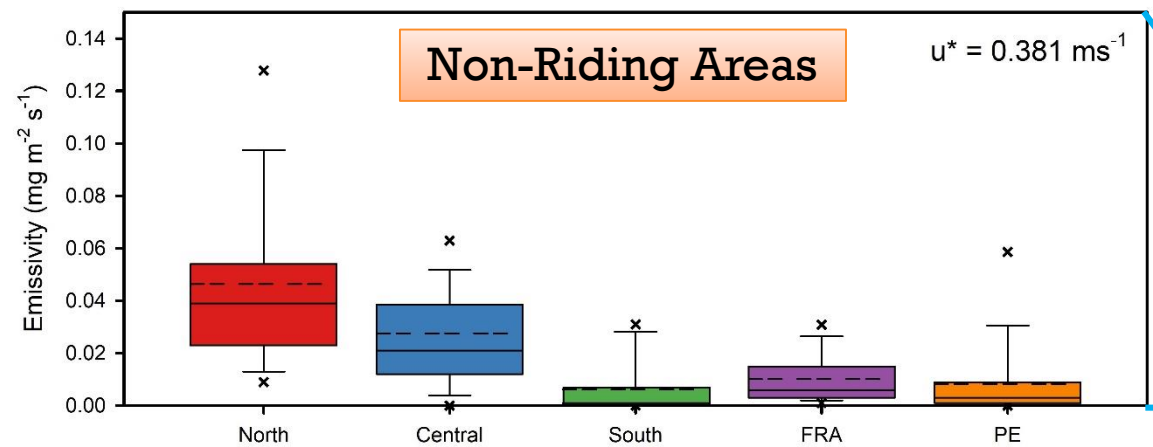
MASS EMISSIVITY POWER RELATIONS

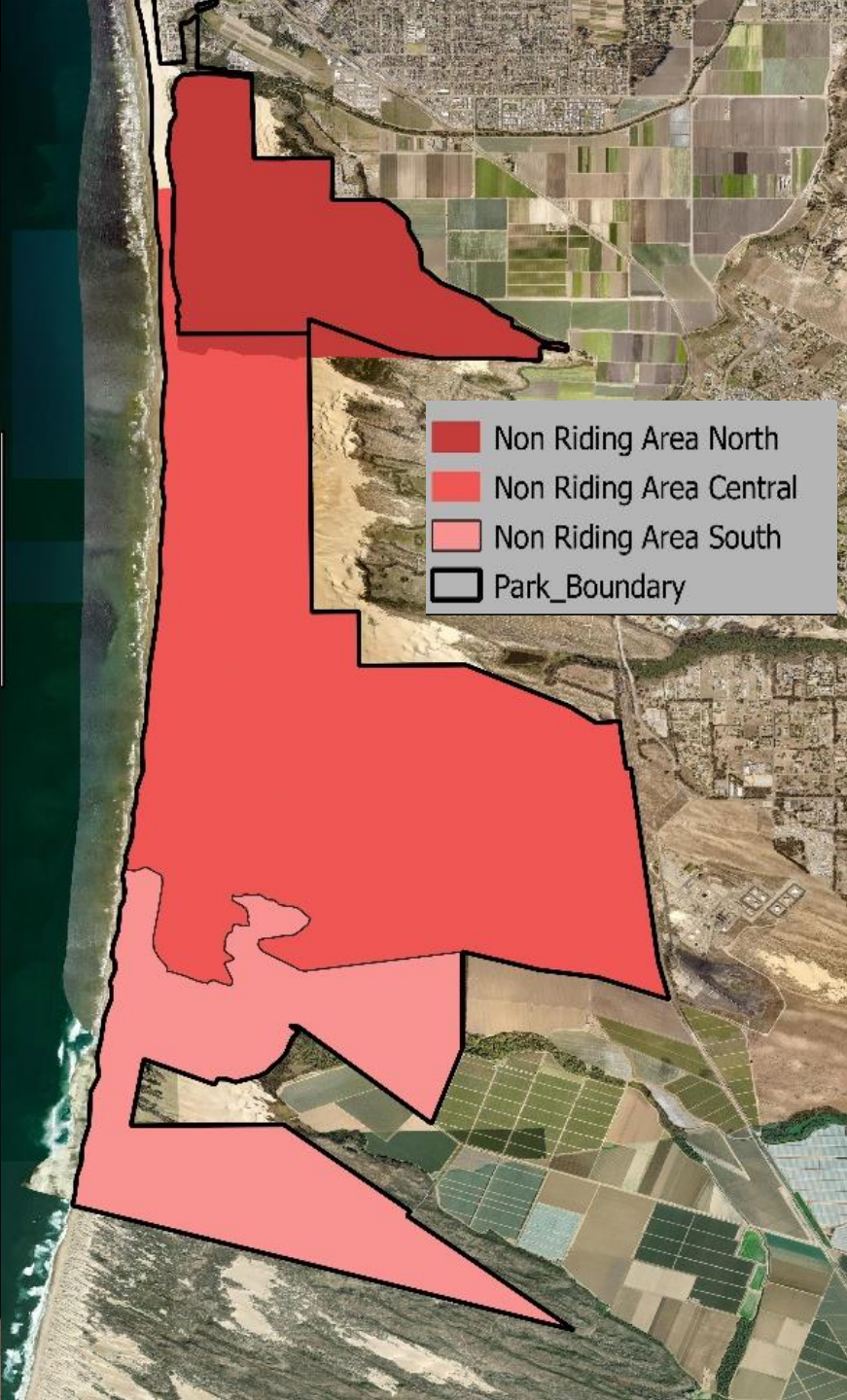|	Non-Riding Areas			Riding Areas		FRA	PE
	North	Central	South	Central-North	Central-South		
n =	111	221	67	403	574	110	23
u_* (m s^{-1})							
0.381	0.039	0.021	0.001	0.094	0.024	0.006	0.003
0.534	0.307	0.193	0.142	0.640	0.432	0.068	0.032
0.607	0.932	0.610	0.388	1.349	0.964	0.192	0.107
$F = a (u_*)^b$							
a	66.376	51.649	20.786	24.340	24.395	10.710	11.416
b	8.547	8.893	7.972	5.795	6.466	8.060	9.355
r^2	.999	.999	.999	1.000	0.999	1.000	1.000

Major changes to modeling:
1. Zones rather than interpolated grid
2. Use all available data (2013-2022[+])
3. Use MEDIAN rather than MEAN
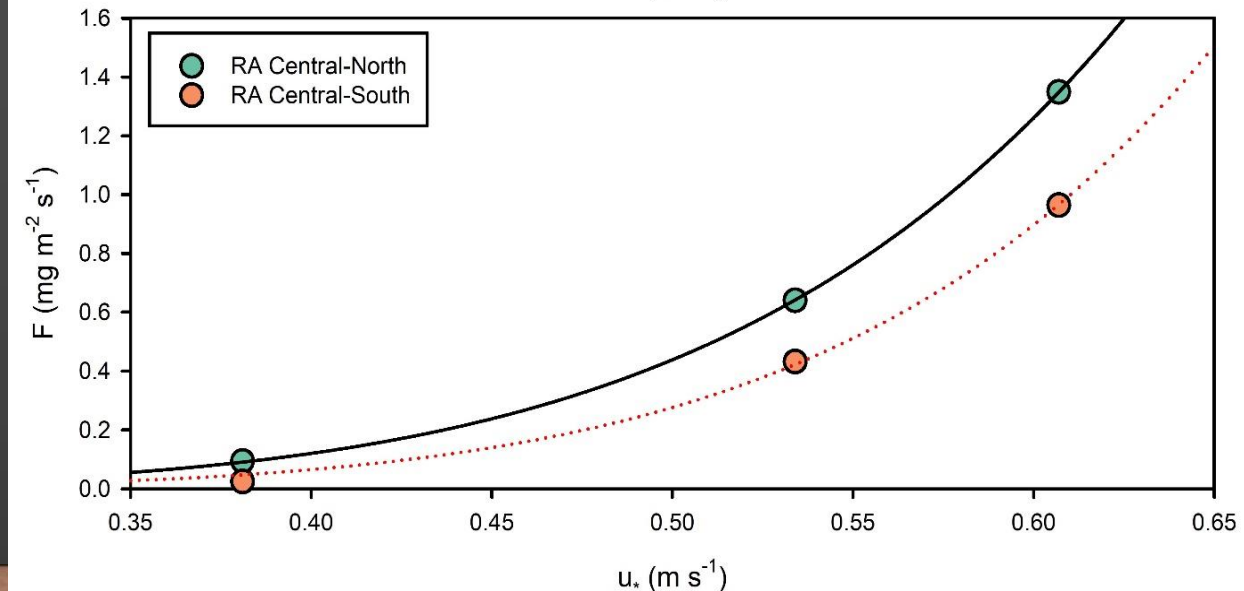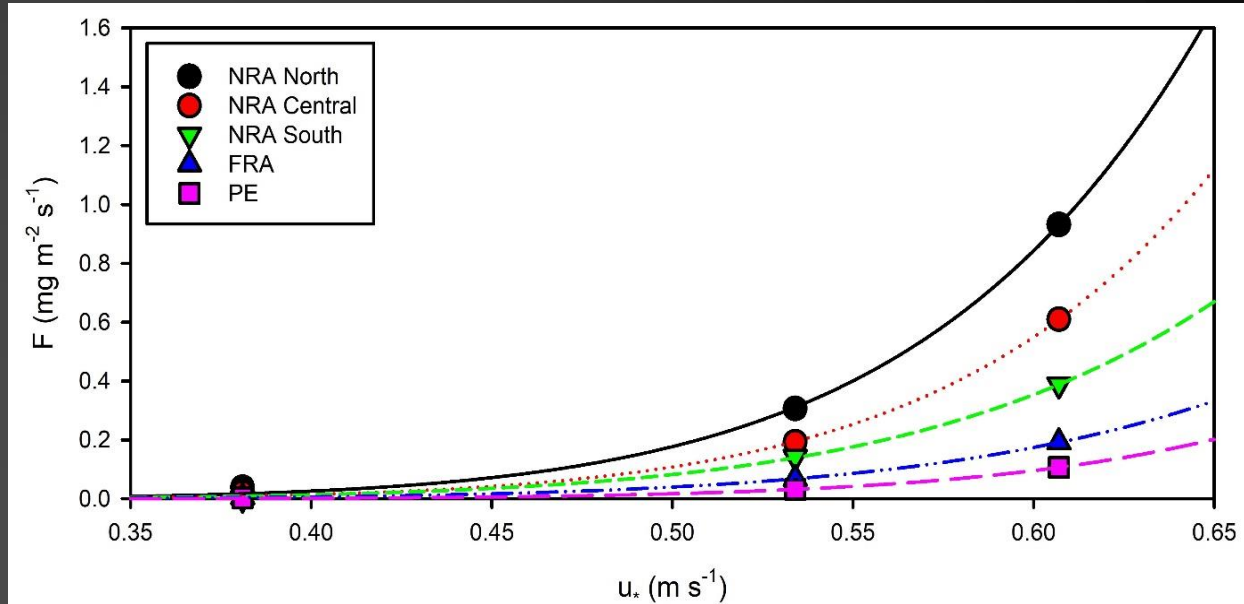
EMISSIVITY ZONES FOR PRE-DISTURBANCE (1939) LANDSCAPE SCENARIO

Zone or Sub-Region	Emissivity curves based on data from...
North (same as NRA North)	All 2013-2022 PI-SWERL measurements located in NRA North Zone
Central (same as NRA Central but also including footprint of RA areas between the north and south boundaries)	All 2013-2022 PI-SWERL measurements located in NRA Central Zone (not including FRA, PE, SE)
South (same as NRA South)	All 2013-2022 PI-SWERL measurements located in NRA South Zone

Legend (map):
- Non Riding Area North
- Non Riding Area Central
- Non Riding Area South
- Park_Boundary

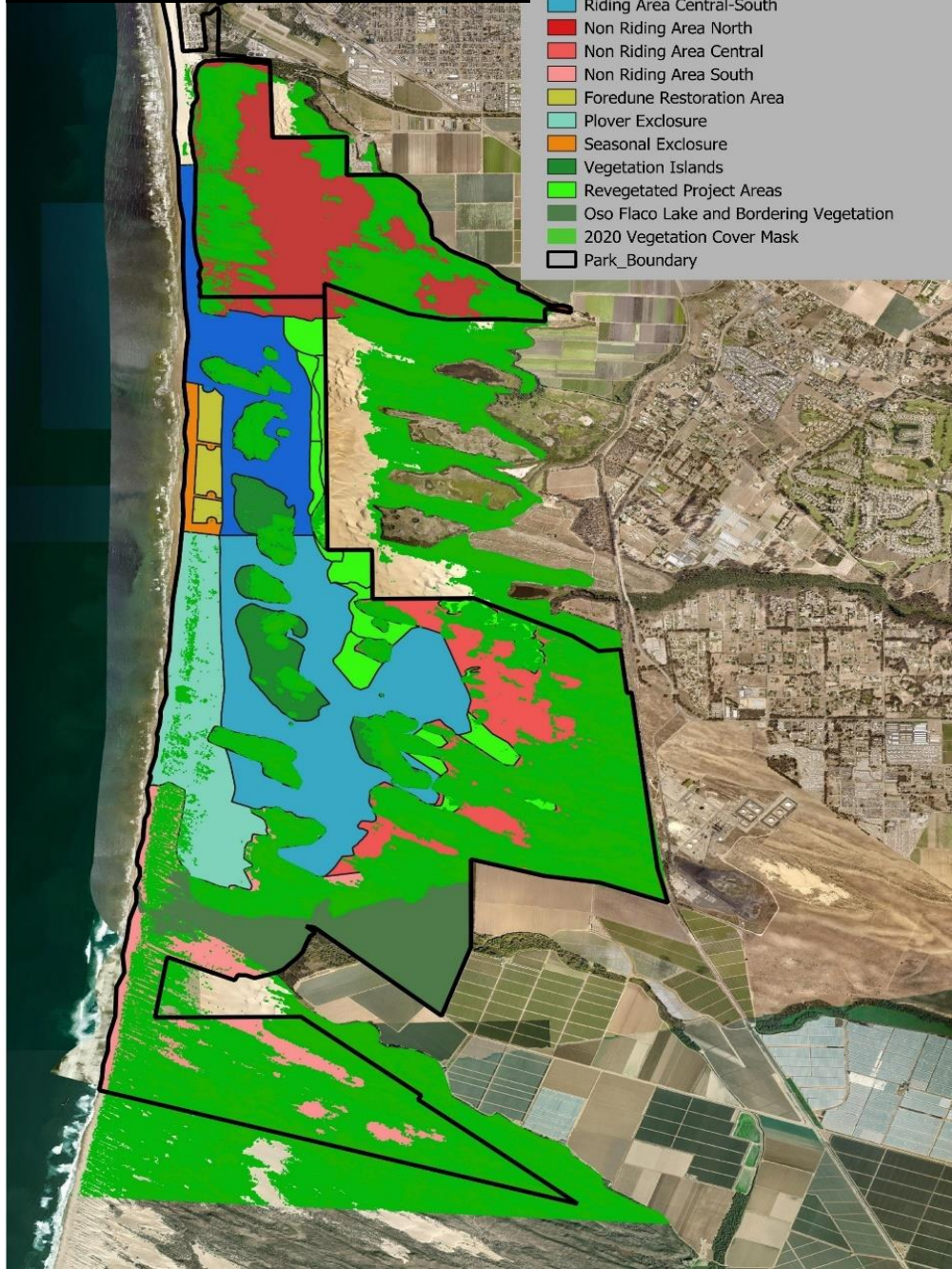1939

Pre-Disturbance Emissivity Zones
- Non Riding Area North
- Non Riding Area Central
- Non Riding Area South
- Oso Flaco Lake and Bordering Vegetation
- 1939 Vegetation Cover Mask
- Park_Boundary

2024

Proposed "Current" Emissivity Zones with Vegetation Cover Masks
- Riding Area Central-North
- Riding Area Central-South
- Non Riding Area North
- Non Riding Area Central
- Non Riding Area South
- Foredune Restoration Area
- Plover Exclosure
- Seasonal Exclosure
- Vegetation Islands
- Revegetated Project Areas
- Oso Flaco Lake and Bordering Vegetation
- 2020 Vegetation Cover Mask
- Park_Boundary
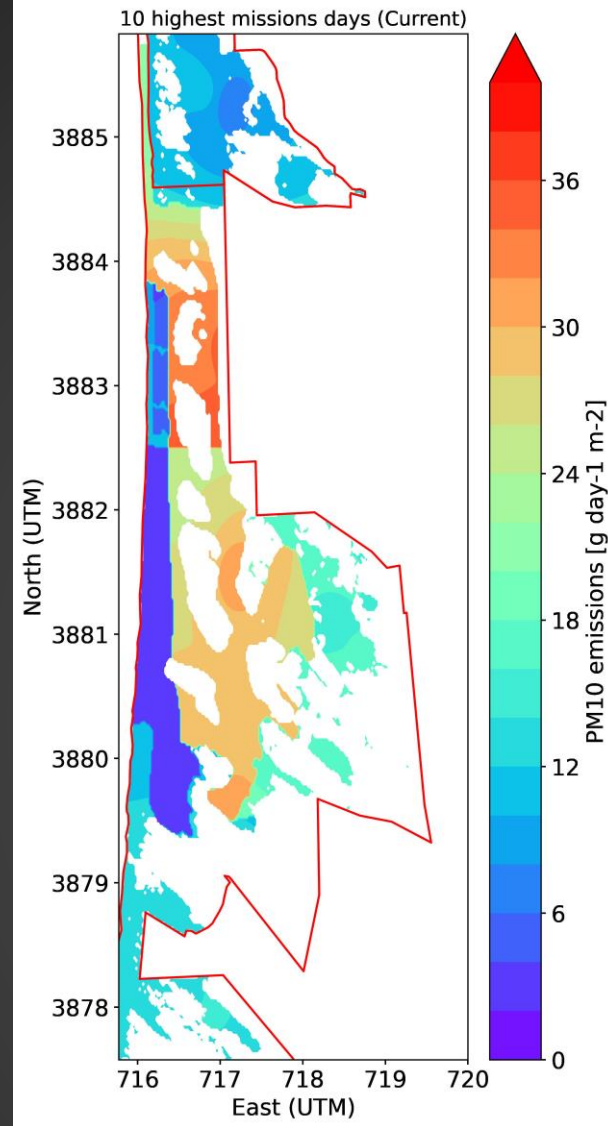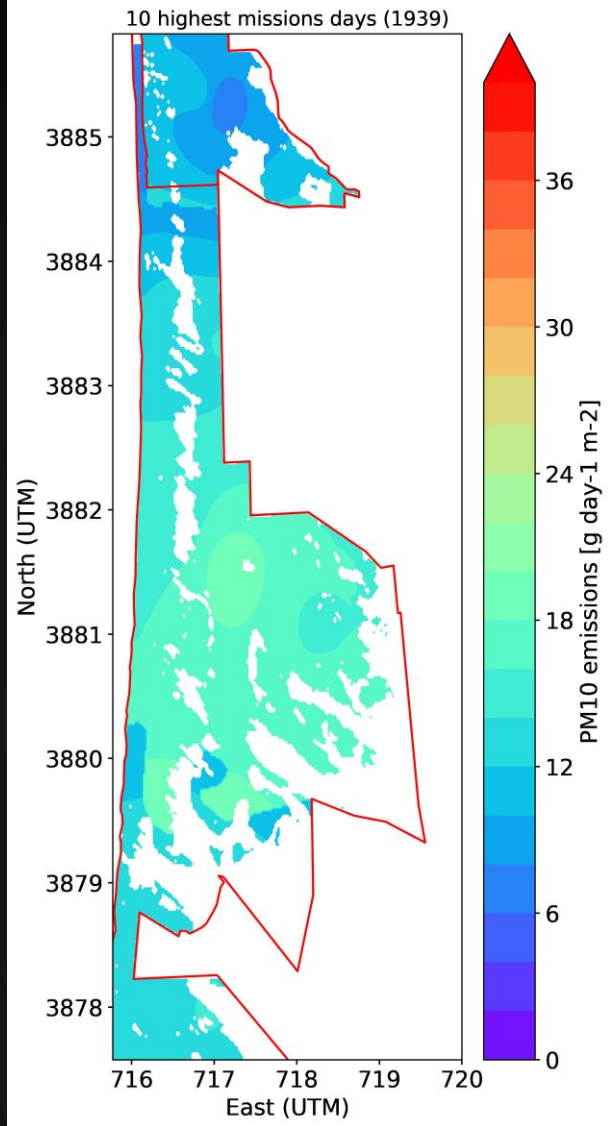
Dust emissions (g m^{-2} day^{-1}) for 1939 (left panel) and the current year (right panel) based on the meteorology of the 10 highest PM$_{10}$ emission days in 2013.

Zone	Total Emissions metric tons/day (10 Highest Emissivity Days May 2013)
1939	
Non Riding Area Central	122
Non Riding Area North	20
Non Riding Area South	24
Total	**166**
Current	
Foredune Restoration Area	1
Non Riding Area Central	18
Non Riding Area North	16
Non Riding Area South	16
Plover Exclosure	4
Riding Area Central-North	30
Riding Area Central-South	63
Seasonal Exclosure	1
Vegetation Islands	0
Revegetation	0
Total	**148**

Trends in Normalized PM_{10} Concentrations (CDF) as a function of Dust Control Acreage
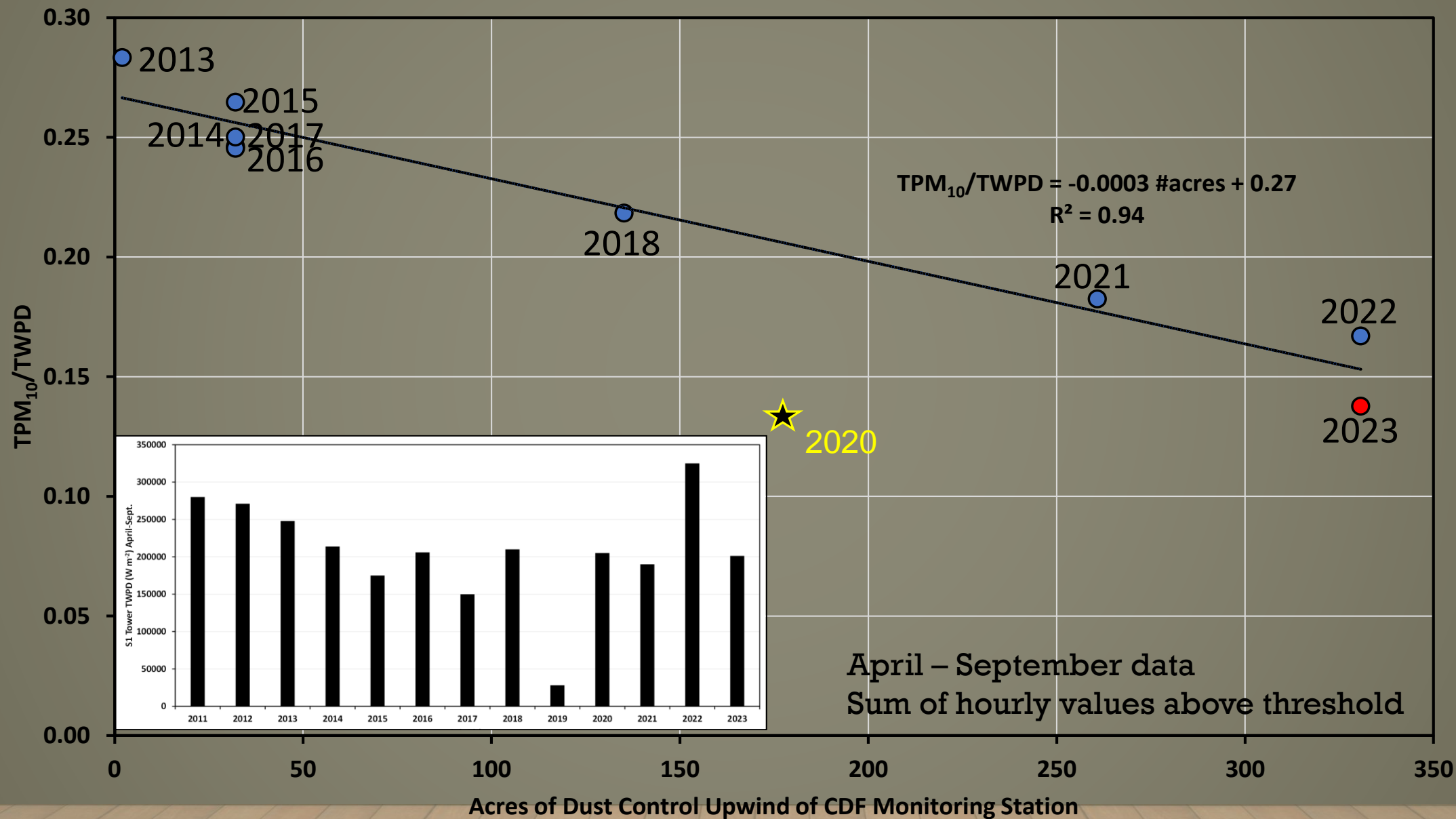
Scientific Advisory Group

Bernard Bauer (Chair)
Carla Scheidlinger (Vice-Chair)
Mike Bush
Jack Gillies
Jenny Hand
Leah Mathews
Ian Walker