“Scenario 1”and “Scenario 2” divergent results

The SLOCAPCD requested in the 2023 ARWP approval letter that an explanation be provided as to why the modeling results to estimate total mass emissions (metric tons per day) using emissivity grids based solely on 2013 PI-SWERL data and solely on 2109 PI-SWERL data (Fig. 1) have divergent results with respect to the condition of “excess emissions” with respect to the total mass emissions from the 1939 “pre-disturbance” condition based exclusively on the 2013 or 2019 PI-SWERL data. For the 2013 and 2019 emissivity grids the emission grids were “masked” to zero out or modulate the emissions based on the polygons that map the 2023 mitigation treatments (including the agreed upon zones defining the plover exclosure and foredune restoration areas) and the vegetation islands. Note the wind fields are identical in all modeling scenarios, baseline, pre-disturbance, and current year. The condition of “excess emissions” is determined through comparison with the total mass emissions (metric tons per day) from the 1939 “pre-disturbance” condition based on the 2013 and 2019 PI-SWERL data including the modulation of the emissions by the vegetation map constructed from the air photo analysis of UCSB. If the total mass emissions from the ODSVRA are greater than the total mass emissions from the 1939 “pre-disturbance” scenario the result is a condition of being in excess of emissions.

For the case of the 2013 data the modeled total mass emission estimate for the 10 baseline days was 112.3 (metric tons per day) from the ODSVRA in 2023 and 130.4 (metric tons per day) from the 1939 condition. For the case of the 2019 data the modeled total mass emission estimate for the 10 baseline days was 100.9 (metric tons per day) from the ODSVRA in 2023 and 83.2 (metric tons per day) from the 1939 condition (Table 1). For the 2013 emissivity grid with the 2023 mitigations in place, the model results suggest that 2023 is not in a condition of “excess emissions” compared to 1939 (using 2103 data exclusively). For the 2019 data the result is that a condition of "excess emissions” does occur.

DRI suggests a critical difference between the scenarios driving the divergence between the modeling results is that the spatial distribution of emissivity across the ODSVRA is not the same in 2013 and 2019 (Fig. 1) and, on average, a riding area grid cell in 2013 has an emission rate approximately three times higher than an average riding area grid cell in 2019 (Fig. 2). For the baseline years of 2013 and 2019, the areas covered by vegetation overlay the distribution of emissivity differently between the two years. For the baseline conditions of 2013 and 2019, Table 1 shows the percentage difference between total mass emissions for the pre-disturbance (2013 and 2019 PI-SWERL data) and 2013 and 2019 baseline conditions are, respectfully, +28.7% and +40.2% (plus sign indicates Baseline>Pre-Disturbance). Under this initial condition the divergence between the 2013 and 2019 scenarios as defined by the difference between them is 11.6%. This comparison represents the minimum influence of the presence of the vegetation to modulate the emissions of the baseline conditions (2013 and 2019) with respect to the pre-disturbance conditions (based on 2013 or 2019 data).

As of 2023, the dust control areas cover different portions of the emissivity grids with respect to the distribution of emissivity for the two years (Fig. 3). With increasing coverage of the ODSVRA surface by dust controls through to 2023, the difference between the pre-disturbance total mass emissions (2013 and 2019 data) and the 2013 and 2019 emissivity grids, with the 2023 dust control areas further modulating the emissions, results in an increased divergence between the total mass emissions (Table 1). For 2023 with the 2013 emissivity grid the difference between the 2023 total mass emissions and the 2013 pre-disturbance total mass emission is -29.2%. For 2023 with the 2019 emissivity grid the total mass emissions are greater than the pre-disturbance total mass emissions (+25.9% difference) and are thus in an “excess of emission” condition. DRI argues that this is a function of the position of the vegetation and dust controls with respect to the distribution of emissivity within the grid for the two different years that creates the increasing divergence in the model results.

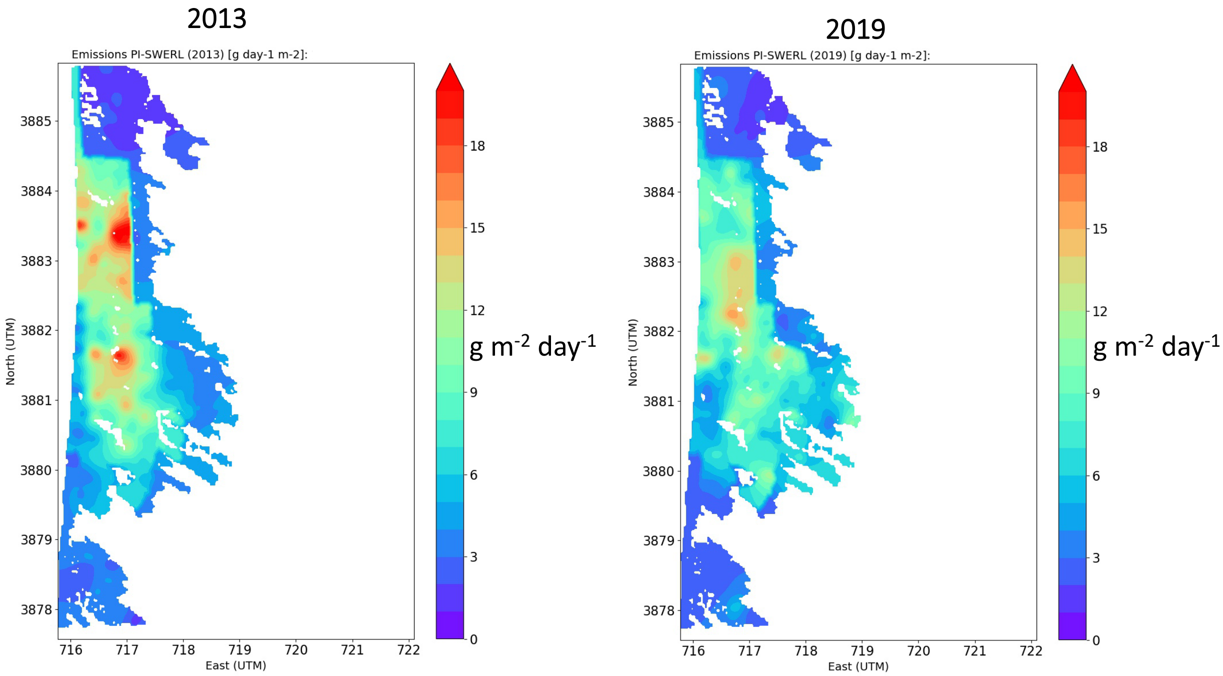

Figure 1. Emissivity distribution based on interpolating/extrapolating 2013 PI-SWERL data (left) and 2019 PI-SWERL data (right).

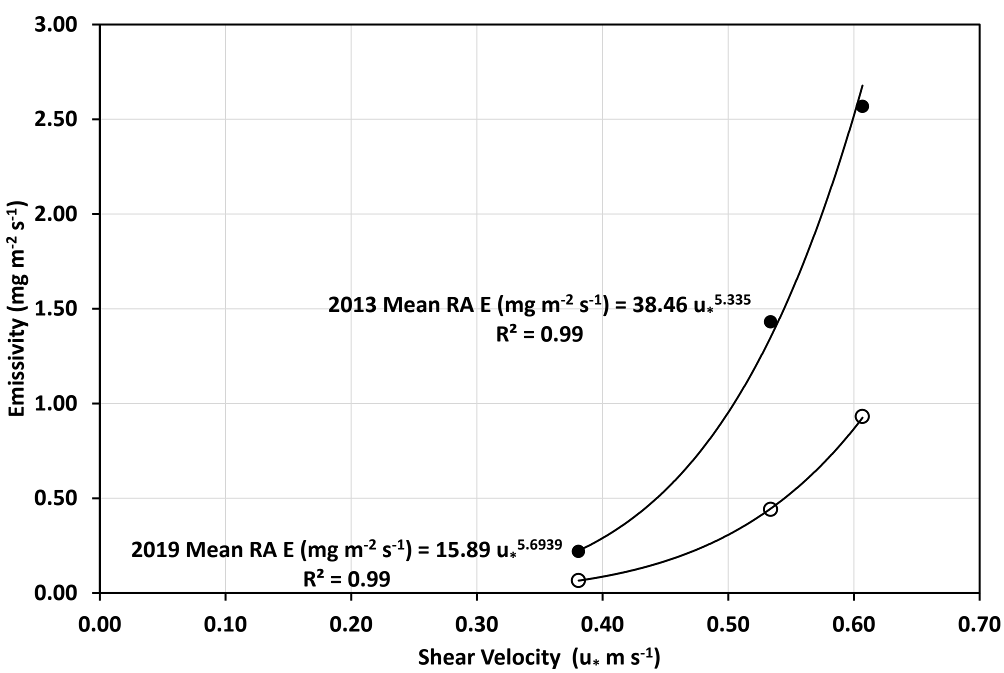

Figure 2. The mean riding area emissivity relations for the riding area for PI-SWERL data from 2013 (black circle) and 2019 (white circle).

Table 1. Differences in total mass emissions between the two scenarios.

Year	Baseline Total Mass Emissions (TME, metric tons/day)	TME 2023 (Veg and Dust controls accounted for, different base year)	% Difference TME 2023 (different base year) v. TME Baseline	TME Pre-Dist	% Diff TME Pre Dist v. TME Baseline	% Diff TME 2023 (different base year) v. TME Pre-Dist
2013	182.8	100.9	44.8	130.4	28.7	-29.2
					in excess	not in excess
2019	139.2	112.3	19.3	83.2	40.2	25.9
					in excess	in excess

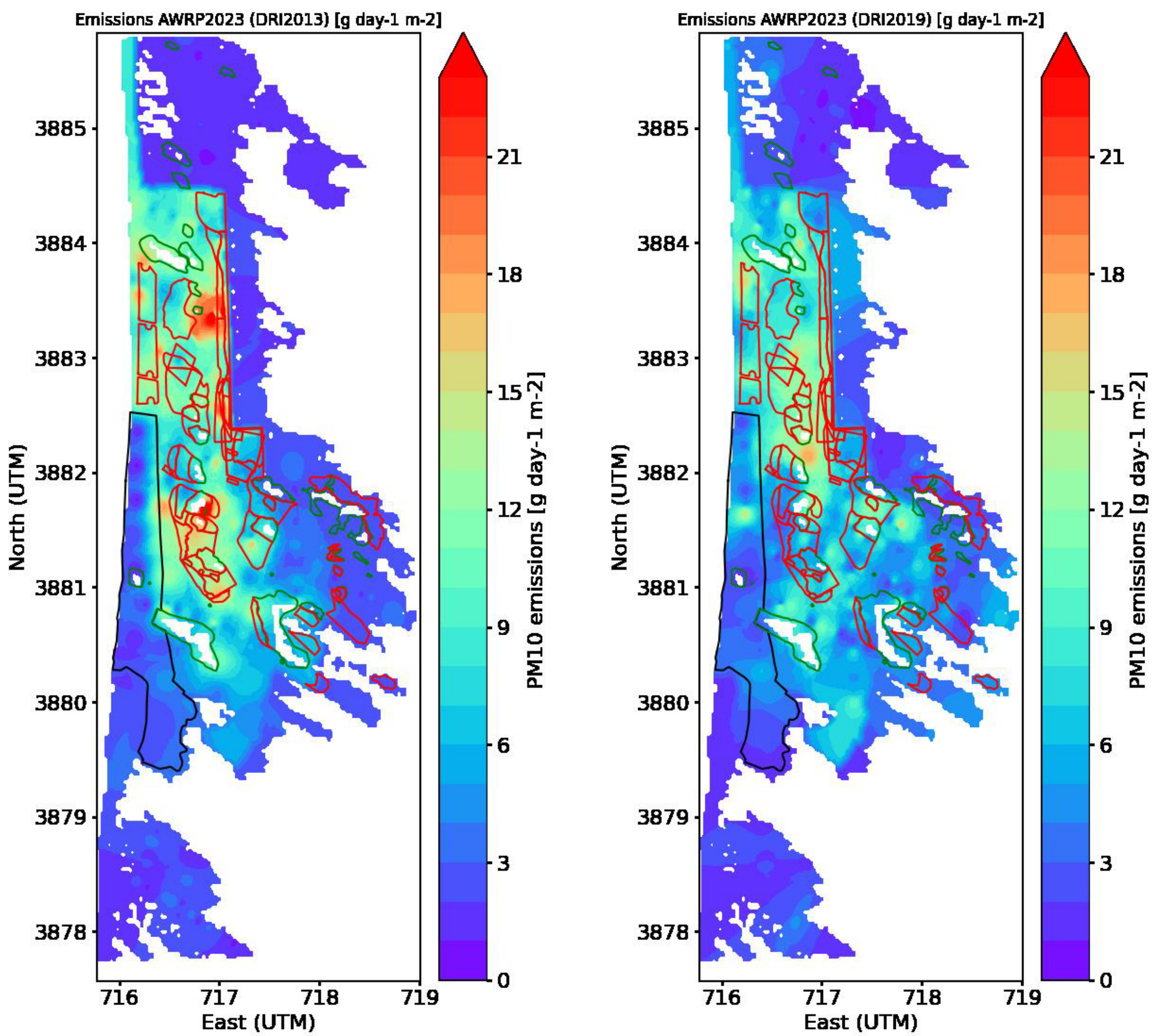

Figure 3. 2013 (left) and 2019 (right) emissivity grids overlain with the 2023 vegetation and dust control polygons.

The initial establishment of the dust control areas was designed to target the zones of higher emissivity and the potential for areas to contribute PM10 to CDF based on the 2013 PI-SWERL emissivity grid. Remember, removing cells from the emissivity grid for 2013 by adding areas of dust controls in the riding area eliminates cells that are, on average, emitting three times as much PM10 as cells in the riding area 2019 emissivity grid. As stated earlier, the areas of control initially designed to mitigate the emissivity grid of 2013 are not as well positioned for the 2019 emissivity grid to reduce emissions.

Another factor to consider is that in this modeling the emissivity grids for the ODSVRA, for both 2013 and 2019, were generated from individual PI-SWERL emissivity data at the test locations through an agreed upon interpolation/extrapolation scheme to create an emissivity relation for each of the 20 m grid cells in the domain. For the 1939 pre-disturbance emissivity grid representing the riding area spatial extent, emissivity is characterized by three zones with each zone having a single emissivity relation. In addition, the non-riding areas retained use of the interpolated/extrapolated emissivity grid. The different methods of generating the emissivity grids, interpolation/extrapolation (2013 and 2019) versus zonation (1939), which in the case of the 1939 scenario was actually a hybridized approach (i.e., three zones in the riding area and interpolation/extrapolation in the non-riding areas) could be another factor that influenced the modeled total emissions to, in part, create the divergence in the results between the two scenarios when overlain with the dust control and vegetation polygons. DRI suggests there are a multiplicity of factors that lead to the divergence in results and finding clarity of a causal mechanism or mechanisms that drives the divergence is not easily addressed.

The modeling carried out for the 2023 ARWP represents a step in the evolution of the excess emission framework methodology. Weaknesses of the 2023 modeling approach were identified and have led to the agreed upon strategy (i.e., emissivity based on median values, zonation of emissivity within the ODSVRA, use of multiple years of emissivity data, etc.) that has been developed and is being implemented for 2024. This will, hopefully, improve the defensibility of the results and reduce the degree of uncertainty in estimating the condition of excess emissions between a current year and the emissions from the pre-disturbance landscape. This is expected to offer a better guide to making management decisions in terms of the need, if any, for more dust control areas.