Analysis of Conservation Burning

Executive Summary

As part of the Sonoma Biochar Initiative, Sonoma Ecology Center (https://sonomaecologycenter.org/) has developed a method of burning woody waste material that potentially reduces the amount of smoke produced from this type of activity while producing a byproduct that is suitable for use as a soil amendment.

According to the Sonoma Biochar Initiative the production of smoke particulates can be reduced significantly by using a technique called "conservation burning", which consists of loosely compacted piles that are ignited from the top and quenched prior to burning to completion, compared to "normal" method of lighting compacted biomass piles from the bottom.

The Sonoma Biochar Initiative, in collaboration with South Coast AQMD, coordinated with grape growers in the Thermal area in the Coachella Valley to evaluate this burn technique during a prescribed burn scheduled for December 18th and 19th 2018.

South Coast AQMD staff performed measurements to determine if there was a measurable difference in smoke emissions between the conservation burning and the traditional burning methods utilized by farmers. Two different approaches were used to compare emission rates.

In the first approach, a set of stationary particulate matter (PM) monitors (TSI DustTrak – Model 8530[1] and 8532[2]) were used to measure the pollution downwind and upwind of the burns. Results showed a slight elevation of particulate matter concentration downwind of each burn; however, due to variability in wind conditions between the two burns, and the fact that the ascending smoke plume was not representatively captured by ground-based monitors, the comparison between the two burn methods based on ground measurements was inconclusive. This was due to the fact that most of the smoke was ascending and the light winds were not able to bring the plume to the ground within the distance of DustTraks. This phenomenon was also observed visually and through the IR camera during the test.

In the second approach, a suite of air monitoring sensors was deployed on an airborne drone to continuously measure PM, formaldehyde, carbon monoxide (CO), relative humidity, and temperature above the burn piles and directly within the smoke plume. A GPS sensor was mounted on the drone to record the location and height during each flight. This technique provides measurements in the 3D space at various points above the burn piles and directly from the smoke plume. Formaldehyde was used as the tracer for the smoke since biomass burning is one of the few sources of formaldehyde in the nature. Points within the smoke plume were defined as any data point where formaldehyde was detected. Data points where formaldehyde was not detected were filtered out from further consideration. Very strong correlation was observed between $PM_{2.5}$ and PM_{10} concentrations. The correlation between Formaldehyde concentrations and PM values were poor.

Assuming similar meteorological condition, a simplified dispersion model showed that the emission rates are within the same order of magnitude for both methodologies; although, the conservation burning

[1] https://tsi.com/products/aerosol-and-dust-monitors/dust-monitors/dusttrak-ii-aerosol-monitor-8530/
[2] https://tsi.com/products/aerosol-and-dust-monitors/dust-monitors/dusttrak-ii-aerosol-monitor-8532/

appeared to produce slightly smaller amount of pollutants. The potential errors in this analysis are large and this measurement technique requires further refinement and testing. Data quality for the suite of the sensors used varied greatly. Temperature, relative humidity, and PM sensors have reasonable precision when compared to reference monitors based upon AQ-SPEC[3] evaluations. Other sensors used have not yet been evaluated by AQ-SPEC and the measured concentrations have an unknown and likely significant uncertainty.

Use of more stationary devices are recommended for future studies to capture the plume at different directions and distances. Use of drone based measurements is also recommended as this provides an ability to collect data where traditional measurement approaches are problematic, for example measuring pollutants or sampling from the plume itself. For drone measurements, longer flight times are recommended to help reduce the statistical errors.

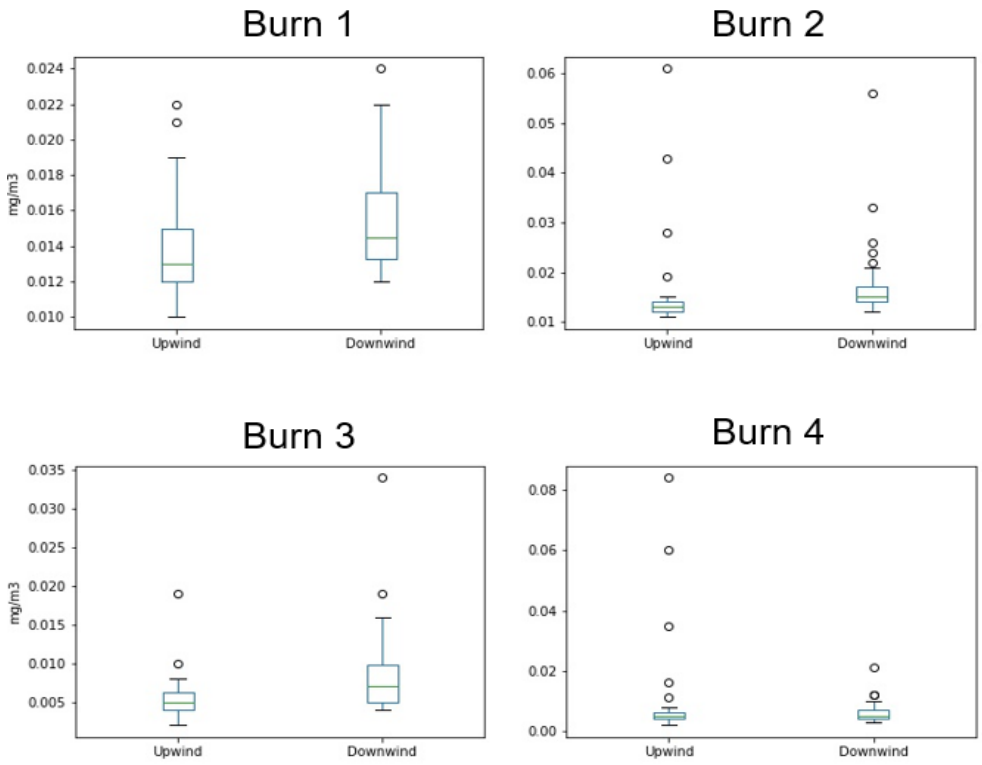

*Figure 1- Box plots of concentration values for different tests measured by DustTraks. Green line is the median, the box extends from 1st (Q1) to 3rd (Q3) quantiles, and whiskers are set by default to 1.5 * IQR (IQR = Q3 - Q1)*

A detailed technical report is available upon request: AreaSources@Aqmd.gov

[3] http://www.aqmd.gov/aq-spec