Interpreting Nipomo Mesa air quality data: Part 2

Part 2 of this informational series covers air quality forecasting on Nipomo Mesa, and how to identify projected wind conditions that can create Oceano Dunes particulate dust events.

Previously, Part 1 mentioned how a change of just a few degrees in wind direction, or a couple miles-per-hour can cause the dust plume to appear, disappear, or shift one way or another within a few minutes. The three accompanying charts can help us understand how dust events on the Mesa respond this way to wind conditions. The charts may seem self-explanatory. In that case, just skip to paragraph 4.

A *Wind Rose Diagram* shows historical distribution of wind directions and speeds. The *Wind Direction Effect* graph shows the relationship between wind direction and air quality. The *Wind Speed Effect* graph shows the way sustained winds also relate to poor air quality.

The final part of this series, Part 3, will cover how we can protect indoor air quality at home. It will be far less technical.

1. Wind Rose Diagram: Historical Wind Rose diagrams are developed by measuring wind velocity over a period of years. The wind direction, frequency, and range of speed is displayed as colored spokes on a compass wheel. For example, consider the longest spoke on the diagram, which shows West-Northwest winds. On average, WNW winds blow just over 17% of the time. The size of the red band plus thin violet band on the WNW spoke show sustained wind speeds are 12 MPH and higher about 2% of that time. These are 10-year averages, so there is seasonal variation where WNW winds will be more or less frequent.

2. Wind Direction Effect Graph: This graph shows the likelihood of having elevated particulate levels from Oceano Dunes based on wind direction. The spike in the red 'Wind Speed Factor' line tells us there is a narrow band of wind directions that generate dust events. Anyone who lives on the Mesa knows this, but it also shows that the likelihood peaks at about 300 degrees – on the dividing line between WNW and NW winds. Getting more technical, if one standard deviations (about 7 degrees) is considered 'statistically significant', then wind directions between about 290 and 310 degrees are most likely to produce a bad air event – *but* on the condition that sustained wind speeds are also strong enough to trigger a dust plume.

3. Wind Speed Effect Graph: When wind direction is within that narrow 290-310 degree band, this wind speed graph shows that the likelihood of a dust event increases rapidly with wind speeds above 8 MPH. It also shows that wind speeds greater than 16 MPH don't make a dust event significantly more likely. At the lower end of this speed range, particle pollution

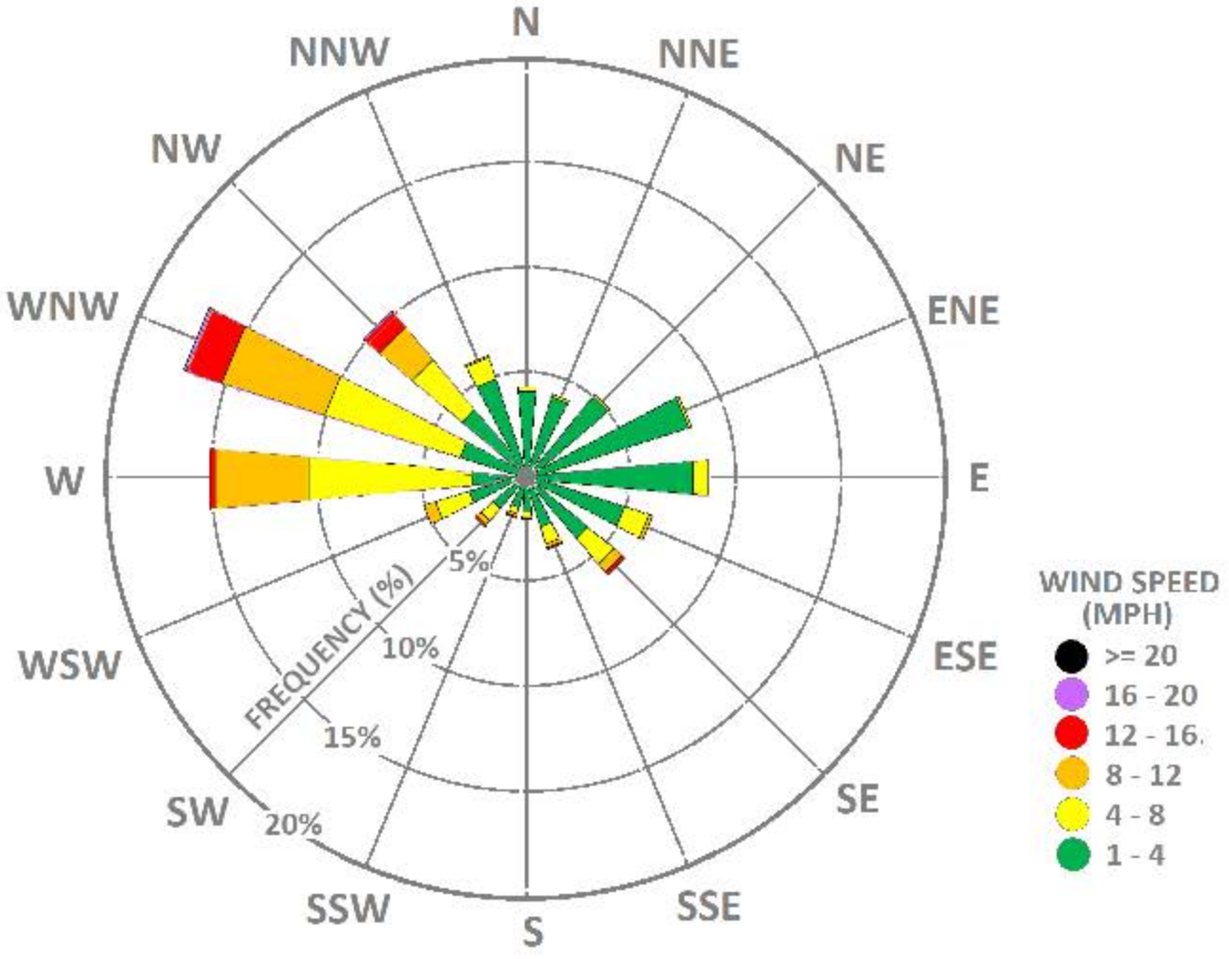
doesn't extend very far into Nipomo Mesa. At the higher end, most of the western Mesa will see increased pollution.

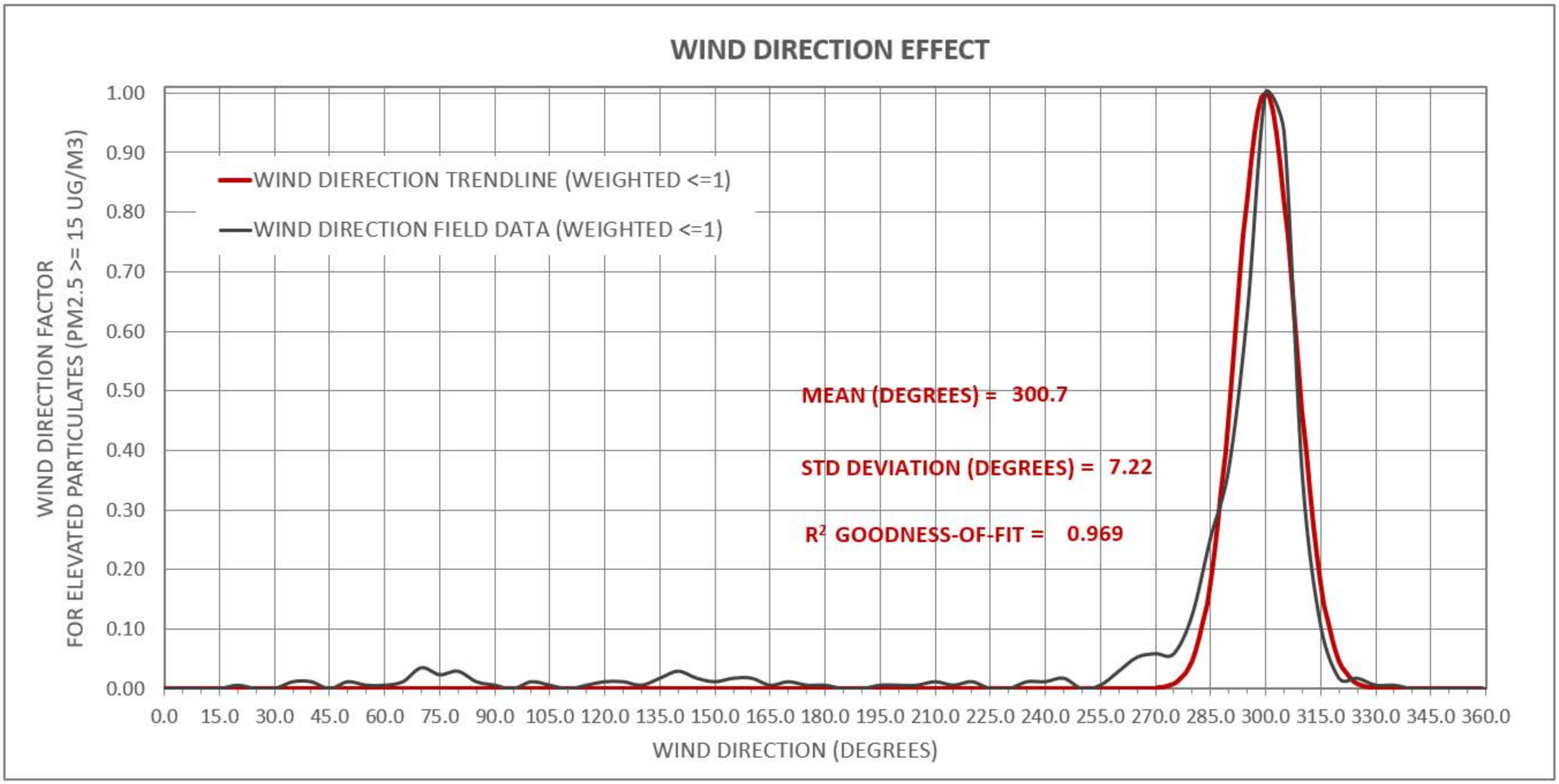
4. Predicting Dunes Dust Events: From this model, a 'perfect storm' with near 100% probability of occurring would have sustained winds over 16 MPH from a WNW direction of 300 degrees. However, the graphs only tell us when particulate levels are likely to be higher. They don't predict how high they may get for any individual event. Still, when speed and direction factors are both high, it's usually associated with more pollution.

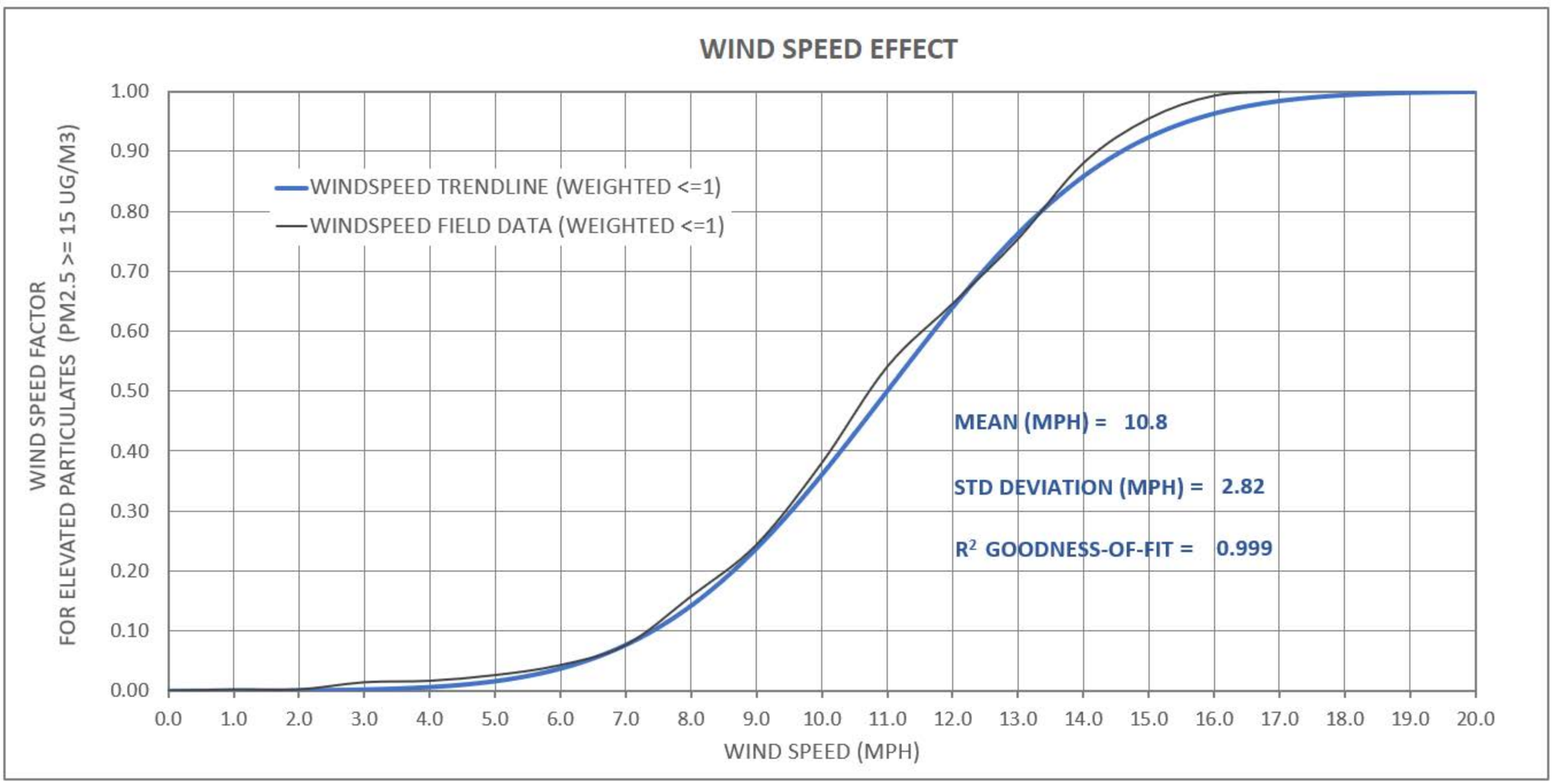
5. Wind Conditions and Forecasts: There are various online services that report the most current wind direction and speed, and also forecast future winds. One reliable global source to check is 'Windfinder.com'. You can zoom in to Nipomo Mesa from a world view, or a direct link to Nipomo Mesa is: https://www.windfinder.com/#14/35.0399/-120.5566 . Clicking on a map location brings up its most recent reported wind conditions. Selecting future times and dates on the timescale at the bottom of the map will then display forecasted conditions at that location.

6. Technical Details: The Wind Rose Diagram was developed from hourly wind velocity data from January 2010 through September 2019. The Wind Direction Effect and Wind Speed Effect graphs were based on about 1,500 data points during 2018 and 2019 elevated particulate dust events, as measured at APCD's CDF BAM monitors. The Wind Direction curve fitting was based on a binomial distribution, and very closely fit field observations with an R^2 value of 0.969 (1.0 is perfect consistency). Likewise, the Wind Speed curve had an R^2 value of 0.999 when fit to a cumulative binomial distribution. These functions were part of a more comprehensive predictive model not discussed here. Within that model, an estimated probability of having a dust event is obtained by multiplying wind speed and direction factors together.

WIND ROSE DIAGRAM




WIND DIRECTION EFFECT
WIND DIERECTION TRENDLINE (WEIGHTED <=1)
WIND DIRECTION FIELD DATA (WEIGHTED <=1)
MEAN (DEGREES) = 300.7
STD DEVIATION (DEGREES) = 7.22
R2 GOODNESS-OF-FIT = 0.969
WIND DIRECTION FACTOR FOR ELEVATED PARTICULATES (PM2.5 >= 15 UG/M3)
1.00
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
0.0 15.0 30.0 45.0 60.0 75.0 90.0 105.0 120.0 135.0 150.0 165.0 180.0 195.0 210.0 225.0 240.0 255.0 270.0 285.0 300.0 315.0 330.0 345.0 360.0
WIND DIRECTION (DEGREES)


WIND SPEED EFFECT
WIND SPEED FACTOR FOR ELEVATED PARTICULATES (PM2.5 >= 15 UG/M3)
1.00
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
WINDSPEED TRENDLINE (WEIGHTED <=1)
WINDSPEED FIELD DATA (WEIGHTED <=1)
MEAN (MPH) = 10.8
STD DEVIATION (MPH) = 2.82
R2 GOODNESS-OF-FIT = 0.999
0.0 1.0 2.0 3.0 4.0 5.0 6.0 7.0 8.0 9.0 10.0 11.0 12.0 13.0 14.0 15.0 16.0 17.0 18.0 19.0 20.0
WIND SPEED (MPH)