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Modeling a 1,3-Dichloropropene Application at Parlier, CA on September 19, 2017

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Introduction

The Department of Pesticide Regulation (DPR) has been monitoring ambient air concentrations of 1,3-dichloropropene (1,3-D) at Parlier (Fresno County) since December 2016 (Brown, 2016). A concentration of 15.96 ppb was measured at this monitoring site during a 24-hr sampling period starting on September 19, 2017. This air concentration of 1,3-D is among the highest concentrations measured in ambient air monitoring studies conducted by DPR. Although it did not exceed DPR's acute human health screening level of 110 ppb, it did cause the annual average at this sampling location to double and led to exceedance of DPR's regulatory lifetime cancer risk goal (0.56 ppb) estimated on an annual basis. Therefore, Air Program staff conducted an evaluation of this detection using available application use data obtained from DPR's Pesticide Use Reporting (PUR) and from data reported by DOW AgroSciences (DAS), which parallel tracks 1,3-D applications in accordance with DPR-DAS memorandum of understanding (MOU). Based on available use data, a 1,3-D application on September 19, 2017 was determined to be the likely source that led to the high detection as detailed in Brown & Gonzalez (2018). Therefore, computer modeling using the AERMOD air dispersion model was employed to simulate this 1,3-D application and examine if the measured concentration could be estimated by the model using the available application and meteorological data.

1,3-D Application

Application information retrieved from DPR's PUR database is listed in Table 1. The location of the sampler and the field is shown on Figure 1. Total field area is about 40 acres, of which only 9 acres were treated with 1,3-D on 9/19/2017. The application rate was 325 lbs/ac.

Table 1. Application Information

PUR use_no	2622607
Application Date	9/19/2017
Application Start Time	1000
Active Ingredient Amount (lbs)	2,923
Treated Area (ac)	9
PUR fume_cd	1210

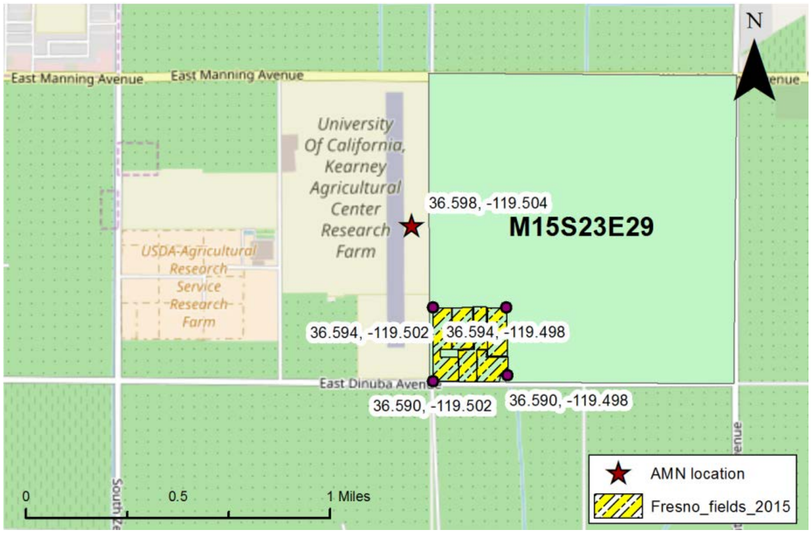

Figure 1. Location of the monitoring site (AMN location) and agriculture field where the application was conducted on 9/19/2017.

Meteorological Data

Meteorological files were processed using MetProc for this modeling. MetProc was developed by DPR to process weather data for AERMOD modeling of pesticide uses (Luo, 2017). It is an interface of AERMET, the meteorological data processer of AERMOD developed by the United States Environmental Protection Agency (USEPA). To process meteorological files for this exercise, upper air data from the Oakland International Airport (WBAN 23230) was used. The surface weather data used for this modeling consisted of combined meteorological data from two stations: [1] station #39 of the California Irrigation Management Information System (CIMIS) at Parlier and [2] Fresno Airport (WBAN 93193), located about 17 miles northwest of the monitoring site. Although the CIMIS station #39 is located about 0.5 mile southeast of the monitoring site and meteorological data from this station would be preferable for modeling use due to the proximity, CIMIS stations measure wind speed at 2 m above the ground, therefore, CIMIS collected data are only considered to be valid for use in air dispersion modeling when the surface roughness in a hour is lower than 1/7 of the anemometer height of 2 m (USEPA, 2018). Unfortunately, only a total of 10 hours of CIMIS collected meteorological data met these requirements. Therefore, using AERMET, the 10 hours of CIMIS collected meteorological data that met the modeling requirements were combined with 14 hours of meteorological measurements collected by WBAN 93193 and this combined meteorological dataset was used for modeling in this exercise. Figure 2 compares the wind roses of the AERMOD ready meteorological file compiled from WBAN 93193 and CIMIS #39 data and the CIMIS #39 data only. Although they have similar wind direction, the wind speeds recorded by CIMIS #39 were lower than that by WBAN 93193. In the CIMIS data, all wind speeds were lower than 5.7 m/s during the 48-hour period and 50% wind speeds were between 0.5 – 2.1 m/s.

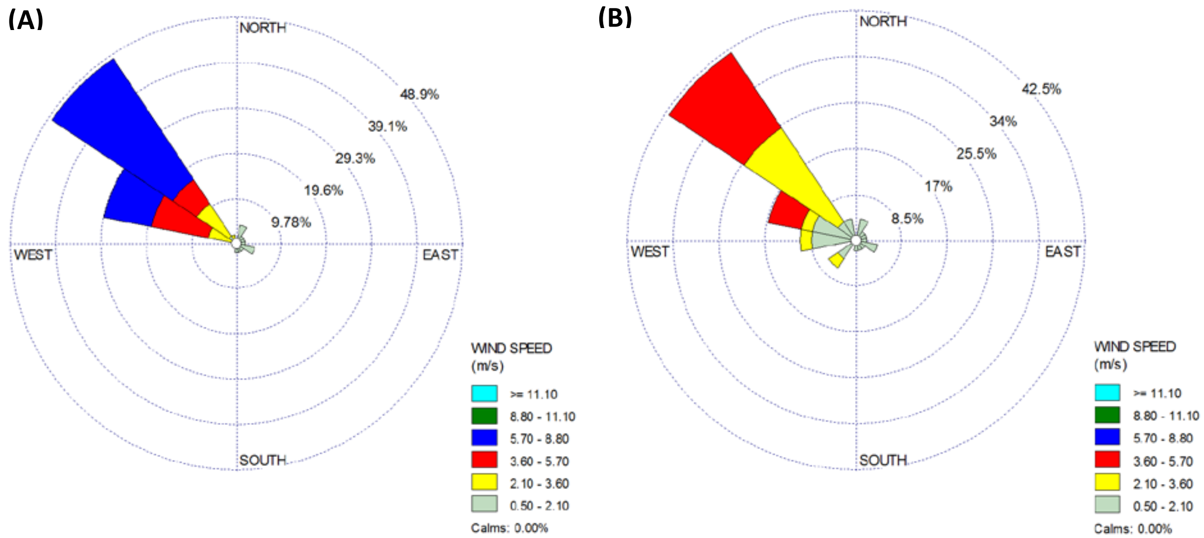

Figure 2. Wind rose for 9/19/2017 – 9/20/2017 of (A) AERMOD ready surface data using station WBAN 93193 and CIMIS 39 and (B) data of CIMIS #39.

AERMOD Configuration

The exact 9-ac treated area is unknown. Therefore, a 9-ac square area closest to the monitoring site and within the field shown in Figure 1 was used as the source location (Figure 3). For PUR fume_cd 1210, a flux of soil #5 developed by HYDRUS was used since this flux produces the highest mass loss among 16 examined soil types (Brown, 2018). The HYDRUS result was developed for a nominal rate of 100 lbs/ac and has units of ug/m^2s. It was accordingly converted to a flux (g/m^2s) with the application rate 325 lbs/ac starting at hour 11 of 9/19/2017. One receptor was set at the Parlier monitoring site with height of 4 m to match the monitoring site (Figure 3). A uniform grid of receptors is also used to output contour plot. The sampling started at 15:43 and lasted for 24 hours so the modeling period is from hour 17 of 9/19/2017 to hour 16 of 9/20/2017. The average concentration is output for this period.

Figure 3. Diagram of modeling source and receptor

Modeling Results

The average concentration at the monitoring site over 24-hour modeling period was estimated as 0.34 ppb, much lower than the monitoring measurement of 15.96 ppb. The monitoring site was located in the upwind direction of the application. In this condition, the monitoring site was not in the area where the high concentrations were expected. The concentration of 15.96 ppb was estimated at the farthest distance of 100 m away from the treated area and 5.5 ppb was estimated at a distance similar to the monitoring site but in the downwind direction (Figure 4). Based on this computer simulation, we were unable to recreate the high 1,3-D concentration measured on September 20-21, 2017.

The modeling for the Parlier application involved a couple of uncertainties. First of all, the actual 1,3-D emission flux of the application is unknown. The flux profile used in this modeling came from results of HYDRUS modeling simulation, which were developed for general 1,3-D uses in California instead of this specific application on September 19, 2017. Second, the meteorological data available for the modeling may not represent the actual field conditions. CIMIS station #39 is located 0.5 mile away from the monitoring site and its data may represent field conditions better than the data of WBAN 93193.

Compared to WBAN 93193 data, data of CIMIS #39 showed higher percentages of low wind speeds, which could lead to higher concentrations. However, most of CIMIS collected meteorological data did not meet USEPA modeling requirements due to the anemometer height of only 2 m. In addition, during stable light wind conditions, modeling results do not produce comparable simulated concentrations to those measured via monitoring due to the potential high degree of variability that exists in the modeling domain and the microscale influences on air transport and dilution (USEPA, 2017). Lastly, the exact location and shape of the area treated with 1,3-D is unknown in this case. This modeling assumed a square area closest to the monitoring site location, which may not match the actual application location and geometry. The uncertainties of the modeling results can be reduced with more accurate application information.

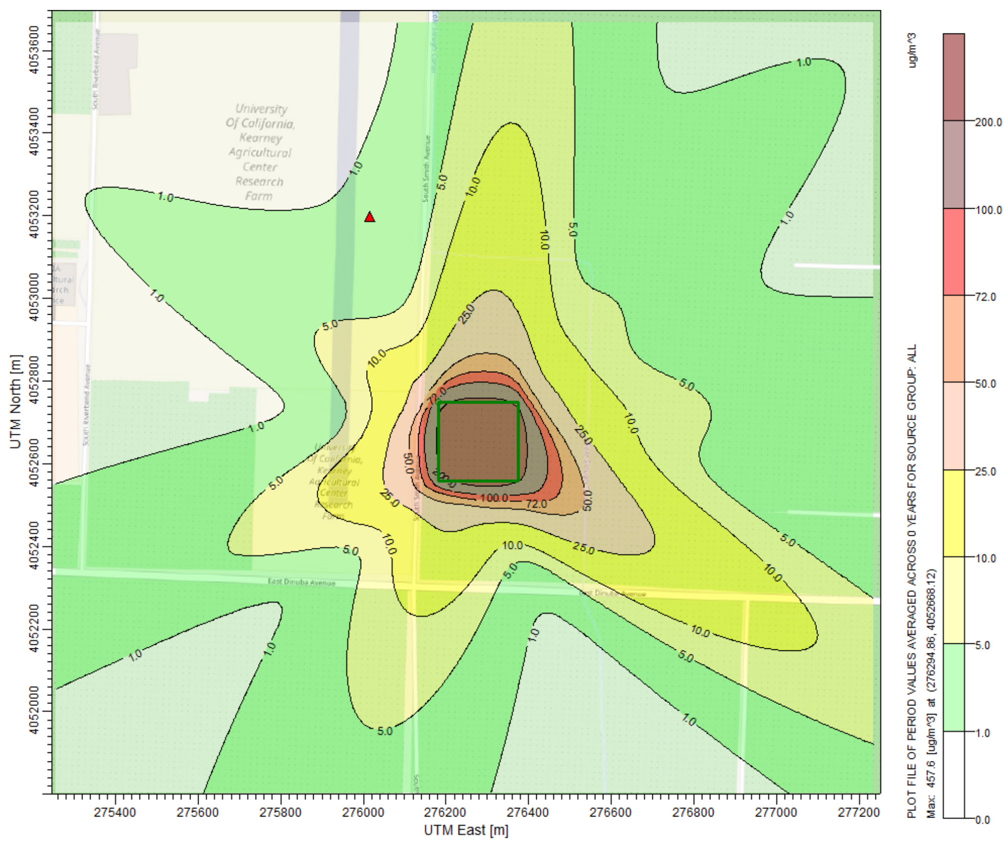

Figure 4. Contour plot of the 24-hour average concentrations around the 1,3-D treated area.

References

Brown, Colin. (2016). Study # 309: Monitoring of 1,3-Dichloropropene in Merced and Fresno Counties. California Department of Pesticide Regulation, Sacramento, CA. Available at http://www.cdpr.ca.gov/docs/emon/pubs/protocol/study309_1,3d_merced_and_fresno.pdf

Brown, Colin; Gonzalez, Jazmin. (2018). Monitoring of 1,3-Dichloropropene in Merced and Fresno Counties. California Department of Pesticide Regulation, Sacramento, CA.

Brown, Colin. (2018). HYDRUS-simulated flux estimates of 1,3-dichloropropene maximum period-averaged flux and emission ratio for approved applicatio methods. California Department of Pesticide Regulation, Sacramento, CA.

Luo, Yuzhou. (2017). Meteorological data processing for ISCST3 and AERMOD. California Department of Pesticide Regulation, Sacramento, CA. Available at http://www.cdpr.ca.gov/docs/emon/pubs/ehapreps/analysis_memos/metproc_final.pdf

USEPA. (2017). 40 CFR Part 51, Revision to the guideline on air quality models: enhancements to the AERMOD dispersion modeling system and incorporation of appraoches to address ozone and fine particulate matter. Federal Register. Vol. 82, No.10

USEPA (2018). AERMOD model formulation and evaluation, EPA-454/R-18-003 U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Air Quality Assessment Division, Research Triangle Park, NC. Available at https://www3.epa.gov/ttn/scram/models/aermod/aermod_mfed.pdf