Modeling of 1,3-D concentrations at community receptors in M07S12E during 2024

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Background

As part of DPR regulation 22-005, modifications were made to 3 CCR 6448.4 requiring issuance of an annual report including a modeling-based evaluation of the townships within California during each calendar year with the highest adjusted total 1,3-D use. The modeling approach for these evaluations relies upon repeated runs of an air dispersion model to predict air concentrations at many locations within a township based on randomly placed sources with size and emissions characteristics reported usage data (Luo 2022), and the 95th percentile of concentrations of all locations is reported as the highest estimated air concentration within that township. In the 2024 1,3-D annual report, the highest estimated annual air concentration produced in this manner was 0.41 ppb, occurring in township M07S12E (Merced County), which also had the highest adjusted total use of any township in the state during 2024. DPR does not currently monitor in this township. While the 0.41 ppb annual average does not exceed DPR's 70-year lifetime regulatory target of 0.56 ppb, it is higher than the maximum 1-year average of 0.35 ppb previously calculated by DPR when assessing the likely effect of the non-occupational bystander regulation (Segawa & Luo, 2022).

This report describes a refined evaluation of 1,3-D air concentrations within township M07S12E during 2024. The analysis considers the exact location of treated fields and evaluates the 1,3-D concentrations in residential/urban areas specifically.

Methods

Usage information was obtained from the PUR database and key matched to data from CalAgPermits, an online permitting and pesticide use reporting system used in all counties in California. CalAgPermits contains field boundary spatial data, which was provided to DPR by request. Records from the PUR were retrieved on the basis of those falling within the M07S12E township, as well as records within the eight immediately adjacent townships; this 18-by-18-mile area also comprised the extent of the modeling domain. A script was then created to match pesticide use records with field boundary data. For each match, a centroid was extracted for each record.

Meteorological data was retrieved from the National Weather Service and prepared using the DPR-developed meteorological pre-preprocessor METPROC (Luo 2023). Surface data was retrieved from the Merced Regional Airport (WBAN 23257) and upper air data from Oakland International Airport, the nearest acceptable meteorological data sources. Onsite data was retrieved from DPR's meteorological tower in Delhi, located approximately 10 miles to the northwest of the township center. National Land Cover Database data for 2021 was used to describe surfaces and the adjusted surface friction velocity parameter (ADJ_U*) was not used. Flat terrain was assumed.

A 50-meter receptor grid was generated over the township, totaling approximately 37,000 receptors. This grid was then joined to the National Land Cover Dataset and filtered to include receptors having low-to-

high intensity development. These classifications are associated with at least 20% impervious cover, and commonly include residential and commercial or industrial areas. The list of receptors was then filtered to retain only those intersecting with the U.S. Census Bureau's 2020 Place TIGER/Line shapefiles, which in this region included the communities of McSwain and Atwater. A total of 614 receptors were classified as falling within community boundaries according to this procedure. Receptor height was set at 1.5 m, per DPR convention.

Emission sources (i.e., fumigated agricultural fields) were treated as circular area sources scaled to match the treated area reported in PUR records (Figure 1). In cases where multiple applications occurred at a single site on the same day, application acreage and mass applied were combined to generate a single source. Compliance of each source location with mandatory setback requirements was evaluated using an algorithm referencing the application method, rate, size, and date/season of application to setback tables, and comparing the minimum setback distance to the distance between the source edge and the nearest receptor.

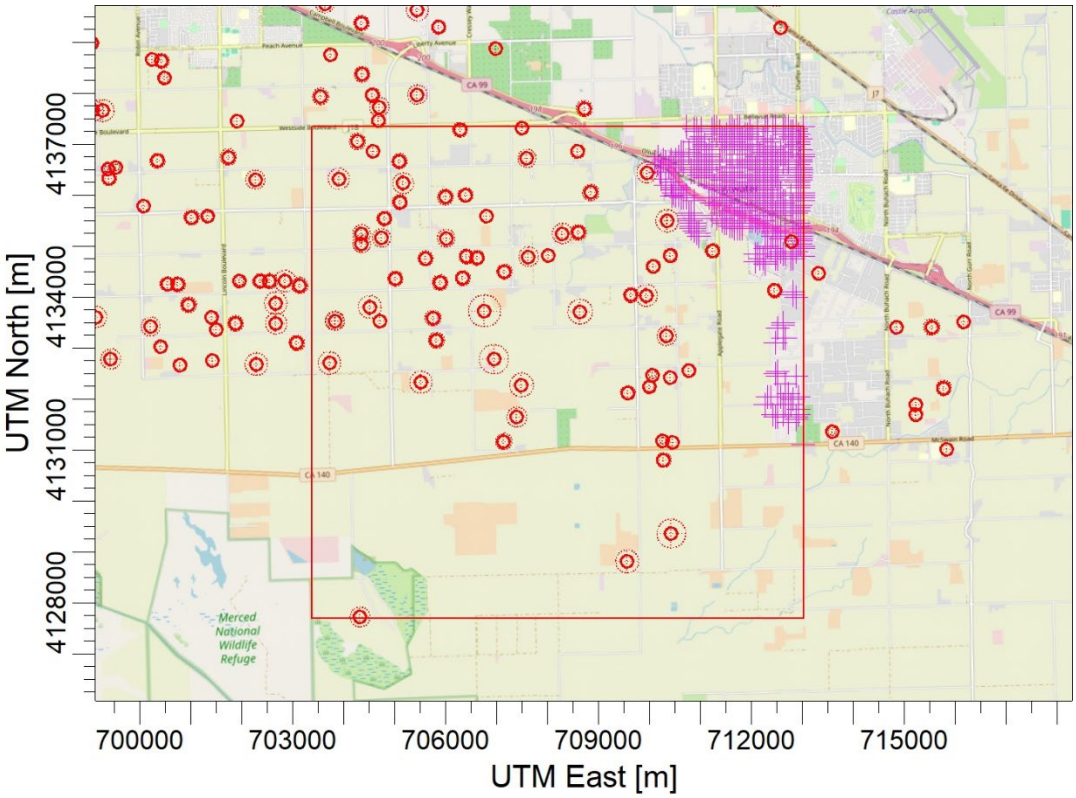

Figure 1. The central township M07S12E, bordered in red, with developed receptors within the township indicated as pink crosses. Sources are represented by open red circles and are included within the surrounding 3-by-3 township (18-by-18 mile) region.

Time-variable hourly emission files were prepared for AERMOD in R (R Core Team 2024) sourced from the hourly emission profiles for 1,3-D developed by Brown (2022). Those emission profiles were developed for 21 different soil conditions, and here a single emissions profile was calculated for each application method based on the mean hourly flux rate across those 21 soil conditions.

AERMOD results were output in 12-hour increments. A rolling average function was used in post-processing to calculate maximum 72-hour (acute) and maximum 13-week (subchronic) concentrations at each location on the basis of 12-hour increments, and an annual average. Statistics for 72-hour, 13-week, and 1-year air concentrations were then calculated based on the maximum predicted concentrations across all receptors.

Results

The refined analysis produced a median annual concentration of 0.06 ppb across all 614 receptors evaluated, with a 95th percentile of 0.14 ppb and a maximum predicted value of 0.25 ppb. The maximum predicted annual concentration occurred within a residential development situated alongside the western boundary of Atwater and adjacent to agricultural fields.

Conclusion

As required by the regulations, DPR conducted additional modeling that simulated maximum air concentrations at urban receptors within township M07S12E, located within Merced County, based on 1,3-D use patterns in the region during 2024. The analysis took into account usage both within the township and within the eight surrounding townships. The maximum predicted air concentrations of 1,3-D at residential and commercial/industrial locations throughout township M07S12E were consistently below chronic screening levels. The maximum predicted 1-year concentration was likewise below the 70-year target for lifetime cancer risk of 0.56 ppb.

Sources cited

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