DILUTION OVER TREATED FIELDS: REFINEMENT IN MODELING OF BUFFER ZONES

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The companion paper: "*Dilution of Airborne Fumigants Over Treated Fields: Implications For Buffer Zones"* summarized field observations regarding relative differences in dispersion conditions on-field versus off-field. Based on data to date, the differences can be substantial during nocturnal conditions, which often are critical to buffer zone assessments. The objective of this paper is to describe how these observations can be incorporated into an existing dispersion model such as AERMOD to improve the reliability of buffer zone modeling.

When air containing an emitted airborne fumigant is blown across a treated field during light winds and clear sky conditions at night, it can encounter two distinctly different dispersion zone phases:

1) Flow over the treated field with moderate dispersion rates

2) Followed by flow over surfaces with inversion conditions and very limited dispersion rates.

Downwind concentrations, especially within a few hundred meters of an applied field, can be significantly affected by initial dispersion over the treated field.

Further refinements in the pilot modeling method to accommodate the dual phase dispersion have recently been made. The approach is to use standard AERMOD coding (without modification), but to redefine initial dispersion conditions when stable conditions are modeled by AERMOD based on scaling lengths (1/L) greater than zero. For hours when neutral or unstable conditions apply (moderate to vigorous dilution) modeling is unchanged from standard treatments. When stable nocturnal conditions apply, initial dispersion treatments in AERMOD are

used to account for the greater dilution that occurs up to the edge of the treated field.

Initial dispersion was considered as follows. A range of initial dispersion was evaluated as a function of field size to determine what initial dispersion was needed for various field sizes such that at the downwind edge of the treated field the dilution based on standard model treatments (stable nocturnal flow) match plume dimensions that would occur under neutral conditions. The examples available at the time of this writing are based on a simplified treatment that likely understates the reduction in concentration associated with on-field travel. Table 1 presents a summary of the results. In this manner, on-field initial conditions can be represented in a more realistic fashion, and as distance from the edge of the treated field increases downwind, the results converge with standard model treatments.

Figure 1 shows an example 20-acre source run based on a shank compaction study conducted in the Pacific Northwest (SEC Study # 2010C), comparing concentration fields based on standard modeling with the more refined treatment for nocturnal conditions. As shown, concentrations are reduced up to 50 percent in the near-field, and as distance increases, the comparative results converge.

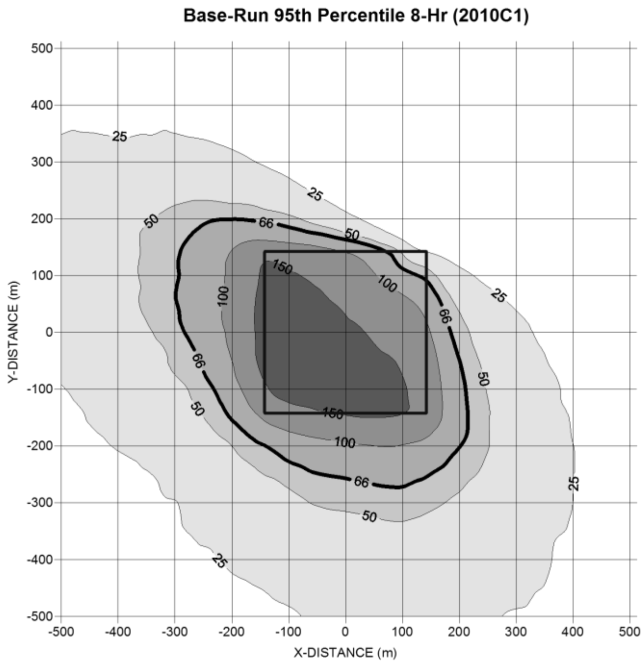
The conclusion that can be drawn from the testing to date is that model accuracy could be improved by a more accurate representation of initial dispersion over the treated field. Similarly, irrigation beyond the treated zone and towards sensitive receptors could broaden the zone of enhanced nocturnal dilution and likely would promote lower nocturnal downwind concentrations. Particularly for fumigants that have peak concentrations within several days of application, enhanced irrigation methods, when needed due to sensitive receptors, could be further evaluated to determine efficacy in reducing the most critical exposures.

Ongoing refinements in the methodology are in progress to further improve the accuracy of the initial dispersion term. Rather than only making the adjustment for the most extremely stable conditions (Pasquill-Gifford stability class (F)), future adjustments will be made for all stable conditions. Source specifications will be input on an hour-by-hour basis into AERMOD to refine the treatment of on-field nocturnal dilution.

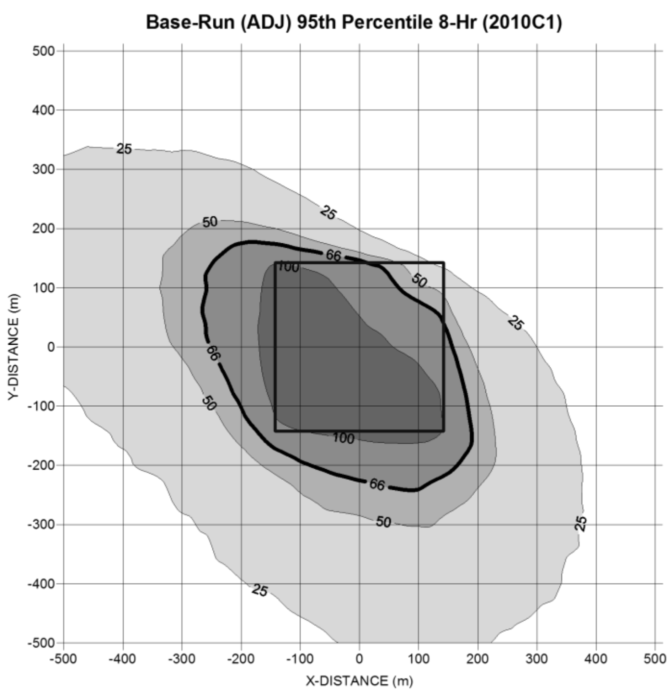
Table 1: Summary of Initial Dispersion Adjustments for Field Applications as a Function of Field Size and Scaling Length to Allow Modeling Under Stable Conditions to Match Plume Dimensions for Neutral Conditions

ACRES	HT	SIGZ
5	2.2	2.0
10	2.6	2.4
20	2.9	2.7
30	3.3	3.1
40	3.5	3.3
60	3.8	3.5
70	3.9	3.7
80	4.1	3.8

Figure 1: Example Comparison of Standard Modeling of Airborne Concentrations with Refined Treatment of Nocturnal On-Field Dispersion for a 20-Acre Source



No Adjustment for Initial Dispersion: 50% Higher modeled concentration near downwind edge



Adjustment for Initial Dispersion