MODELING AIRBORNE EXPOSURES FROM FUMIGATION AT A PORT, EXAMPLE: EDN

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Introduction

Fumigation at port locations is sometimes necessary to help mitigate against pests being transferred from one country to another. Fumigation can be conducted within structures or under tarps that are sealed to minimize off-gassing to the ambient air. In either case, it is necessary to evaluate expected airborne exposures associated with the fumigation process (e.g. in range of 10-24 hours) and during ventilation at the conclusion of the fumigation activity. Dispersion modeling methods are generally used to evaluate these exposures. In this case study example, the fumigant ethanedinitrile (EDN) is hypothetically applied to logs being prepared for export at the Tauranga, New Zealand. Dispersion modeling was used to estimate 1 hour, 8 hour, and 24 hour distributions of exposure.

Methods

The amount of fumigation at a port varies on a seasonal and daily basis. The worst case situation (maximum fumigation) does not occur on a day-by-day basis. A stack was assumed to be based on sufficient logs to fill a volume that was 60 m long by 5 m wide by 2.5 m high. A spacing of ~ 1 m was conservatively assumed between each stack. In order to account for the variability in fumigation activity, it was assumed that on 10 percent of the days 30 stack were fumigated, on 30 percent of the days 20 stacks were fumigated, and on 60 percent of the days, 10 stacks were fumigated. It was assumed for modeling purposes that the stack were grouped into 3 contiguous areas as shown in Figure 1. It was assumed that the fumigation of a group of 10 stacks proceeds at a rate of two stacks per hour. The fumigation period was assumed to be 24 hours in duration.

It was assumed that the port operated on a basis that allowed fumigation and ventilation to begin only during the hours of 7:00 A.M. through 7:00 P.M. In order to realistically account for this schedule, fumigation of 10 stack groups was assigned each day on a random basis using the preceding frequency. The specific start of a group of stacks also was randomly assigned within the window of operational hours. The U.S. Environmental Protection Agency’s (EPA) AERMOD dispersion model was used, with the feature of an hourly input file to account for the emission treatment described. The meteorological data was based on a 10 m WRF-generated pseudo meteorological tower centered at the fumigation area at the port. [1] Five years of hourly data were processed on this basis for input to AERMOD. The initial vertical dispersion associated with the stack grouping was accounted for in the model in accordance with standard EPA modeling methods. Post-processing of the results computing distributions of concentrations for each receptor, which were used as the basis to plot concentration fields. Emission rates for the fumigated period were based on the highest of three trials conducted on logs. The emission rate assumed during ventilation was based on a laboratory-generated air concentration after a 24-hour fumigation period.

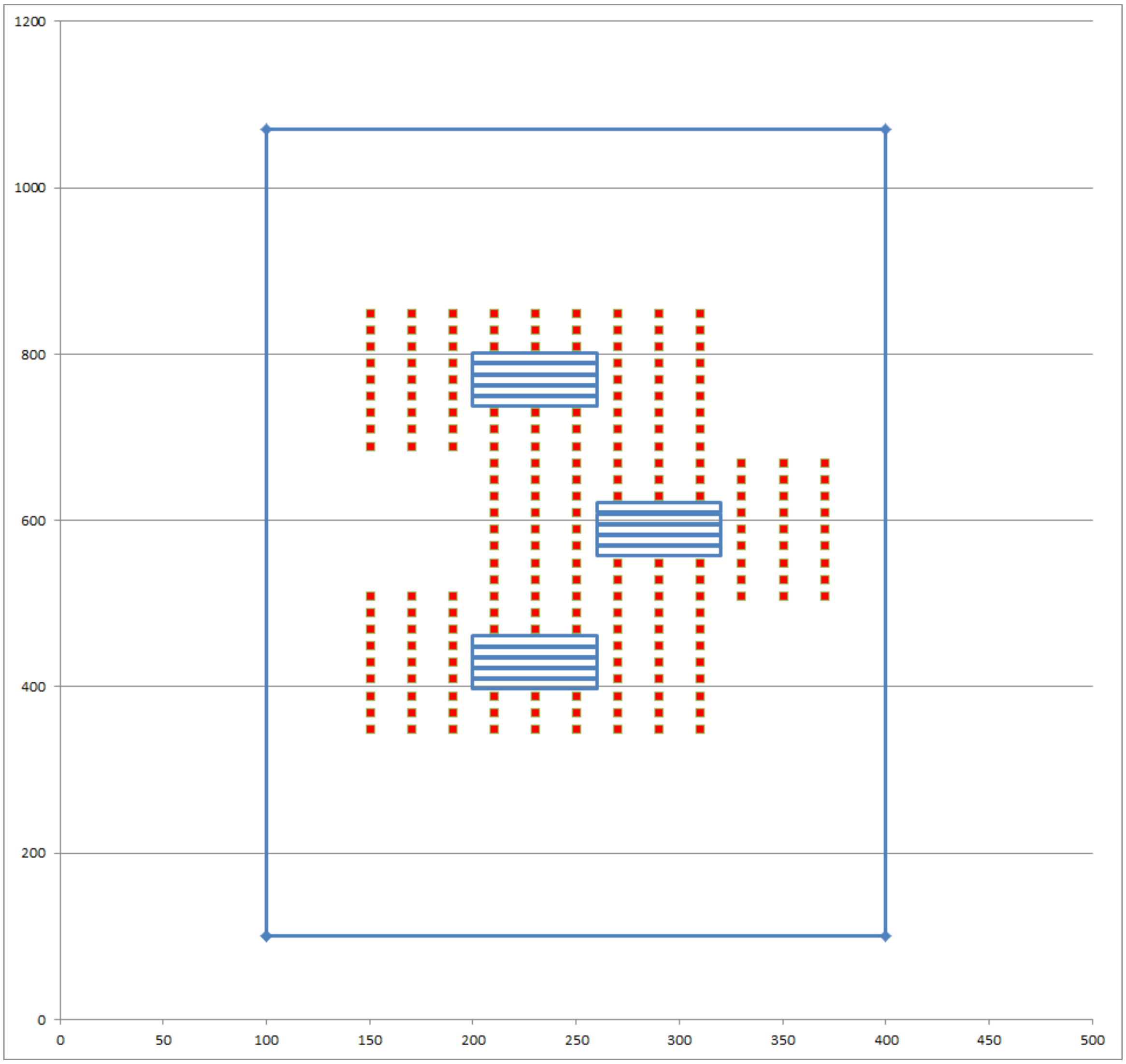
The port area where fumigation occurs is best described as land use with concrete and multiple buildings / structures. Once equilibrated to inland flow, atmospheric dispersion conditions are likely to be substantially greater than in areas with natural vegetation. On this basis, the modeling was conducted using AERMOD in the urban (less restricted nocturnal dilution) and also rural treatments (more restricted nocturnal dilution). Since the modeling domain was relatively short and initial dispersion tended to dominate in the near-field, the differences between the two approaches was not relatively large. As distance increases further, however, the urban treatment would be more consistent with expected dilution rates and with high dilution rates, than the rural treatment while the pollutants are flowing over port operational areas.

<u>Results</u>

Figure 2 presents an example of concentration fields modeled for this scenario. The 90th percentile EDN concentrations are shown based on 8-hour averaging based on the maximum modeled formulation of 150 g/m^3 application rate.

[1] The Tauranga Airport is close to the port, however, full diurnal coverage was not available to support AERMOD modeling.

Figure 1: Assumed Sources: Three Groups of 10 Stacks Each



90^{th} Percentile Airborne Concentrations (ppm) for a 150 g/m^3 Application Based on 8-Hour Averaging and Urban Dispersion Conditions Multiple Source Run