INNOVATIONS IN NEXT GENERATION CB THREAT CHARACTERIZATION AND ASSESSMENT FOR DECISION SUPPORT

Operationally Relevant Methodology For The Evaluation Of Inhalation Hazard Resulting From Chemical Warfare Agent Secondary Evaporation

Nathan Platt IDA **Alison Lawrence** IDA **Matthew Mendonca** IDA

Primary uses of chemical agent secondary evaporation models are estimating the human health effects of chemical agent released into the atmosphere and predicting impacts on military operations, such as how long personnel must remain in protective gear. We demonstrate a methodology for estimating hazard areas and hazard durations by simulating the subsequent transport and dispersion of the vapor mass released by secondary evaporation. This methodology can also be used when evaluating and comparing secondary evaporation models.

We define hazard area as all spatial locations where an unprotected individual staying at that location for a prescribed amount of time, T, receives an inhalation exposure above some prescribed low level toxic effect. To characterize the extent of the hazard area, we utilize a dense set of concentration samplers that capture the secondary evaporation hazardous plume. For any location recorded in the sampler output file and starting T minutes after the initial weapon impact, we perform a temporal calculation sequence of toxic exposures over the previous T minutes. We compare each element of this temporal sequence to an exposure level of interest to determine whether this particular location lies within the hazard area. Summing samplers that are within the hazard area at sampler output time tk > T and multiplying by the area represented by each sampler yields an estimate of the hazard area at time tk. Duration exposure intervals that are commonly used to evaluate Acute Exposure Guidelines Levels (AEGL) for airborne chemicals are 10 and 30 minutes and 1, 4, and 8 hours. For this analysis, we selected an exposure duration, T, of 8 hours. The human effects exposure level of interest in this analysis is mild effects in 16% of the exposed population calculated using the toxic load model.

The hazard area and hazard duration defined above are strongly dependent on the secondary evaporation model selected, surface type, and details of the meteorology utilized in the simulations. This methodology could be used to compare different secondary evaporation models based on the anticipated hazard duration. It could also be utilized to create operationally relevant hazard duration tables as well as compare anticipated hazard duration resulting from agent depositing on different substrates for a given secondary evaporation model. Given that operations are often conducted where surface types are heterogenous, care must be taken when applying the models to operational scenarios. A potential extension of this methodology utilizing either a standalone secondary evaporation model or relevant experimental observations with an atmospheric transport and dispersion models is also possible.

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