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A Modeling & Simulation Framework for Comprehensive CBDP Decision Support

A Methodology for the Testing and Evaluation of Aerosol Remote Sensing Technologies Using Ensembles of Realistic Transport and Dispersion Simulations

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The US invests heavily in technologies to detect and identify the intentional and/or inadvertent release of chemical and biological (CB) materials and to mitigate their impact on allied military operations. Remote sensing technologies are frequently proposed as a means to address this need and a variety of technologies can and have historically been exploited for this purpose. An ongoing challenge for the CB defense community continues to be how to select the best technology or combination of technologies for a given mission and where to make research and development (R&D) investments. With the large number of factors in play, it is not always obvious which technology, or advancements to these technologies, will meet the operational need. Choosing the appropriate technology, or technology advancement, calls for a robust scientific analysis to evaluate their performance for a specific application. In this presentation, we describe a methodology for assessing a variety of remote sensing technologies to detect the presence of chemical and biological contaminants in the atmosphere and objectively comparing and contrasting these technologies with each other.

Accurately characterizing the aerosol dispersion scenarios that the technologies will face in an operational setting is a key element of this technology evaluation. As such, our method utilizes high-fidelity, "single realization" virtual-environment data sets to address this challenge. These data sets are produced using atmospheric transport and dispersion solutions that were coupled with large eddy simulation flow field predictions. These virtual solutions are then combined with remote sensor emulation algorithms that are capable of calculating the sensor response given the aerosol contaminant concentration field representation. This unified modeling framework enables us to create and then use an ensemble of weather and CB release scenarios that are in turn used to create thousands of individual detection performance estimates. The detection statistics are then combined to provide a single value of technology performance that frames the analysis in the context of time which can be objectively used to compare/contrast different remote sensing technologies. This approach was applied to a variety of detection technologies to assess their relative abilities to meet operational objectives. The approach is demonstrated in this presentation using Raman-shifted elastic-backscatter aerosol LIDAR (REAL) and long wave infrared (LWIR) camera detection technologies.