Environmental assessment of chemical warfare attacks

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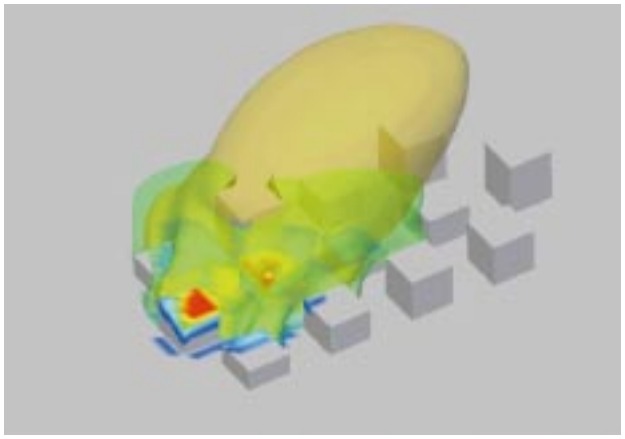
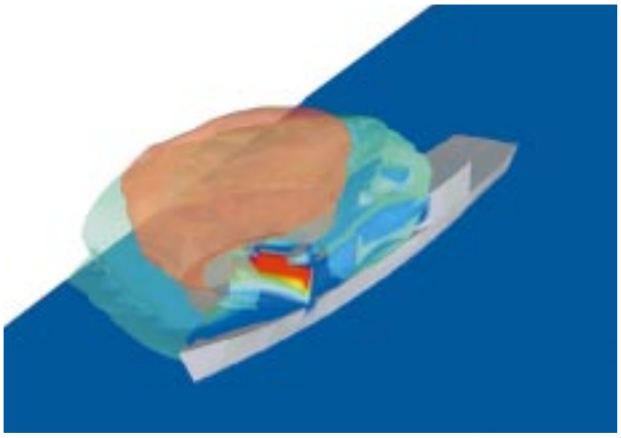
NSWCDD (Naval Surface Warfare Center Dahlgren Division) is one of the US Navy's largest research and development laboratories. Interdisciplinary teams of scientists and engineers, using a systems engineering approach, are engaged in analysis and testing to ensure that Navy and Joint Forces are able to complete their mission in a wartime environment. The NSWCDD's role is to provide research, development, test and evaluation, engineering and fleet support in a variety of areas.

The threat from a potential CBW (chemical/biological warfare) attack is uniquely influenced by the air flow in and around objects such as ships, tanks and buildings. Currently, there exists an effort to develop and use an integrated (commercial and Navy-developed) algorithm to realistically predict the transport, diffusion and deposition of chemical and biological agents in and around 3-D structures. Following research into commercial CFD codes, NSWC acquired a perpetual license for CFX. It has been using this since 1995, and is tailoring it to its needs by incorporating algorithms via user Fortran.



CBW attack in an urban setting. Initially wholly liquid, the isosurfaces represent constant concentrations of the liquid and evaporated agent. The building surfaces are colored according to the liquid agent deposition.

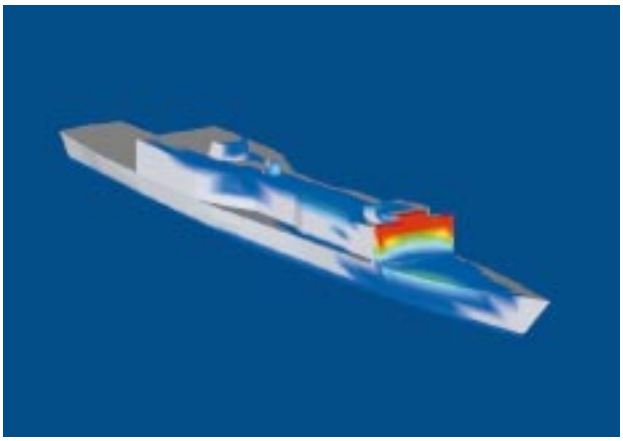
Present capabilities include: the representation of various Pasquill stability categories (which characterize atmospheric stability below the mixing layer); CBW agent source characterization; the transport, diffusion and evaporation of liquid agent droplets in air; and droplet deposition on surfaces.



CBW attack on an FFG-7 class ship with a relative wind speed of 15m/s. The liquid isosurface is green and the vapor is red.

Some of the future efforts are to incorporate the output from VLSTRACK (NSWC's mesoscale transport and diffusion Gaussian puff model) as an input boundary condition to CFX, to calculate the amount of evaporation from the liquid droplets that have been deposited on a surface, and obtain concentration histories at ship vents for NSWC's VENM ventilation model.

Results from various scenarios have been obtained using CFX, including CW attacks on an FFG-7 class ship and on a group of buildings representing a low-density urban setting.



Deposition patterns on the lee side of the ship. The recirculations which cause this can only be predicted using CFD.