

SIMULATING TOXIC CHEMICAL RELEASES



Identifying the factors influencing dispersion

WHY NOW?

The southeast Texas region is a pivotal hub of oil production and petrochemical industries. Industries handle large amounts of toxic chemicals both in liquid and gaseous form. The accidental release of some chemicals can cause severe damage to surrounding people and the environment. The dispersion trend of the chemical species strongly depends on the: meteorological parameters such as wind speed and direction, chemical properties, initial composition, temperature and pressure of the stored chemical and the type of exposure terrain. Simulating chemical releases can provide a comprehensive understanding of how chemicals may disperse in the community to guide emergency planning.

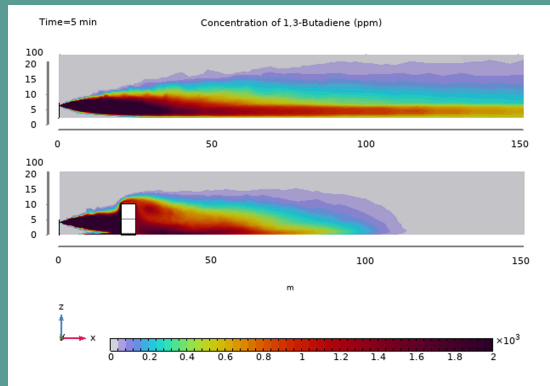
WHAT WE DID

The SETx-UIFL research team developed numerical simulation models based on the principle of Finite Element Analysis (FEA), Computational Fluid Dynamics (CFD) and Chemical Transport. The research team studied the effect of wind speed and direction during a chemical release across different kinds of terrain such as plain terrain (e.g. open space) and obstructed terrain (e.g. buildings, trees, etc.).

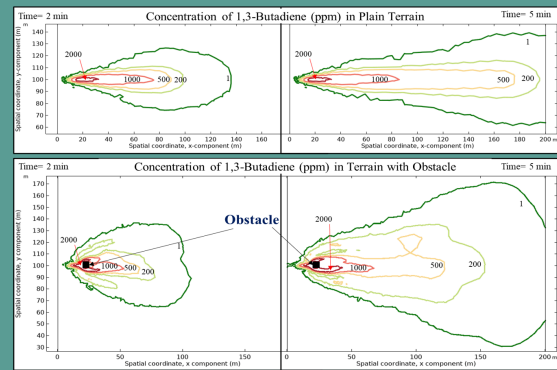
FINDINGS

- The model can predict the dispersion of pollutants based on wind speed and direction. For example, the model can predict zones and time duration of different risk levels when 1,3- Butadiene is leaked. The model also shows how the impact of risk area and duration for various wind speed, terrain structure, type of chemical species, source condition and composition.
- High pollutant build-up occurs around the obstacles (e.g., buildings, trees, etc.) in the exposure terrain. This may mean that is less safe being around buildings and trees and other “obstacles” where pollutants can linger.
- The chemical compounds spread over a wider area and move more slowly in areas with obstacles (e.g., buildings, trees, etc.) compared to open spaces and unobstructed terrains.

These are preliminary results and further analysis is needed at this time.



High pollutant build-up occurs around the obstacles



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MORE ABOUT SETX-UIFL

The Southeast Texas Urban Integrated Field Lab (SETX-UIFL) is one of four projects funded in 2022 by the U.S. Department of Energy to study how climate, environment, and urban changes affect cities. A team of over 80 researchers from UT, Lamar University, Texas A&M, Prairie View A&M, Oak Ridge National Lab, and Los Alamos National Lab has collected data and conducted modeling across hazards including flooding, hurricanes, heat stress, and air quality. Our Why: Southeast Texas faces numerous hazards, yet smaller communities like this one have often felt forgotten compared to larger cities. The SETX-UIFL was designed to explore the complex dynamics of disaster vulnerability for this economically and culturally vibrant region. We believe Southeast Texas is a bellwether for the entire Gulf Coast, and an exemplar for strategies that protect people and places. We hope this effort supports your path toward lasting resilience.



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