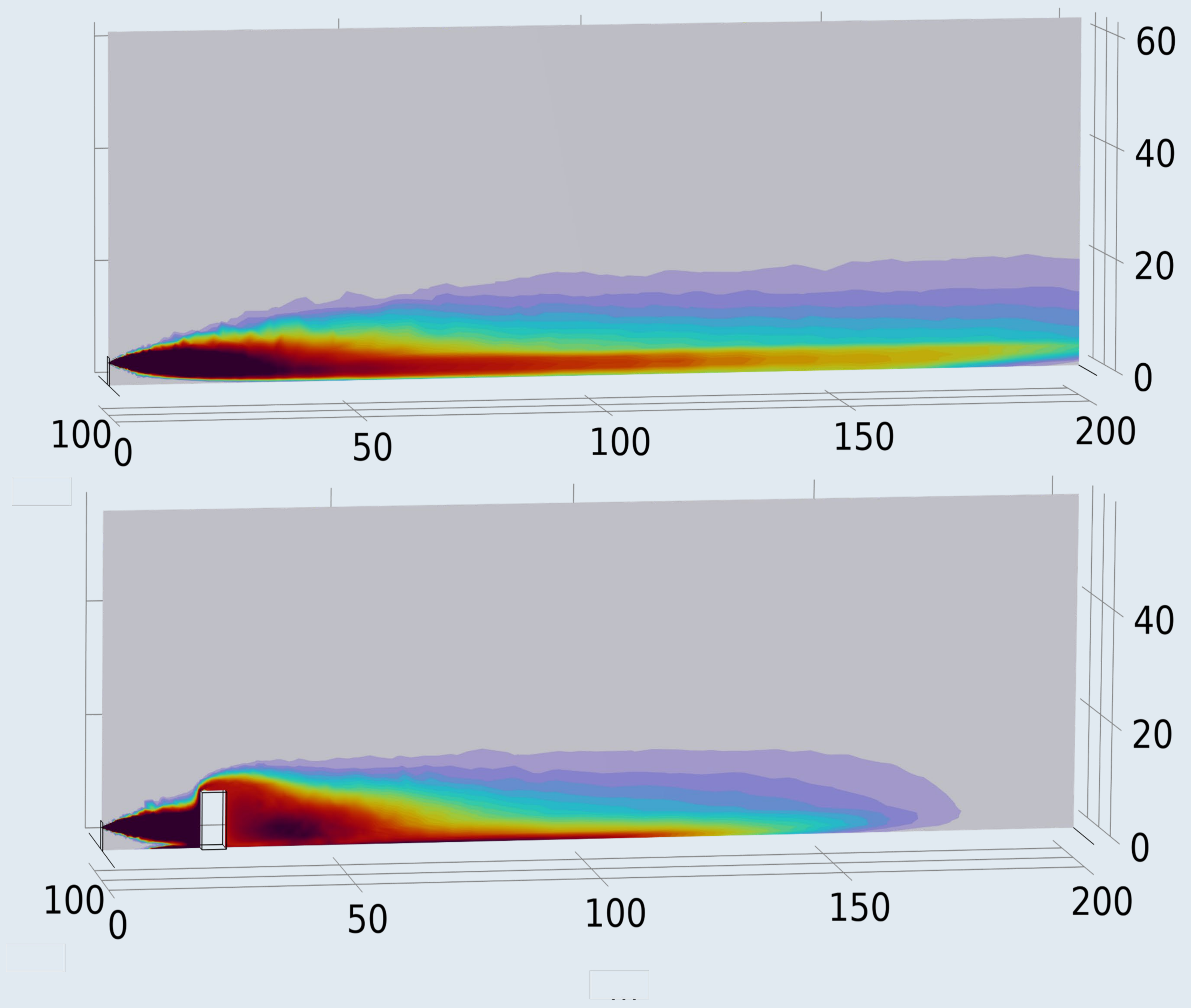

Study of Impact of Terrain Structure on the Dispersion of Accidentally Released Air Pollutants

Dispersion trend of unpermitted released chemical species depends on its nature, ambient condition & exposure terrain structure. This work investigates the effects on the dispersion trend of the release chemical.

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Introduction & Goal

Exposure into toxic/ hazardous chemicals due to unplanned release during chemical processes leaves far-reaching adverse impact on the community, facility professionals and the entire environment. Emergency rescue plan and air pollution abatement measures can be improved if a high-resolution prediction of dispersion trend of the released chemicals is available.

Dispersion trend of the chemicals is affected by ambient temperature, humidity, wind speed & direction and exposure terrain structure. A numerical simulation based on Computational Fluid Dynamics (CFD) using Finite Element Analysis (FEA) method is carried out to predict released chemical's concentration profile over time with different ambient conditions and terrain types. The dispersion of one of the commonly used chemicals in petrochemical industries, 1,3- Butadiene is investigated in this study.

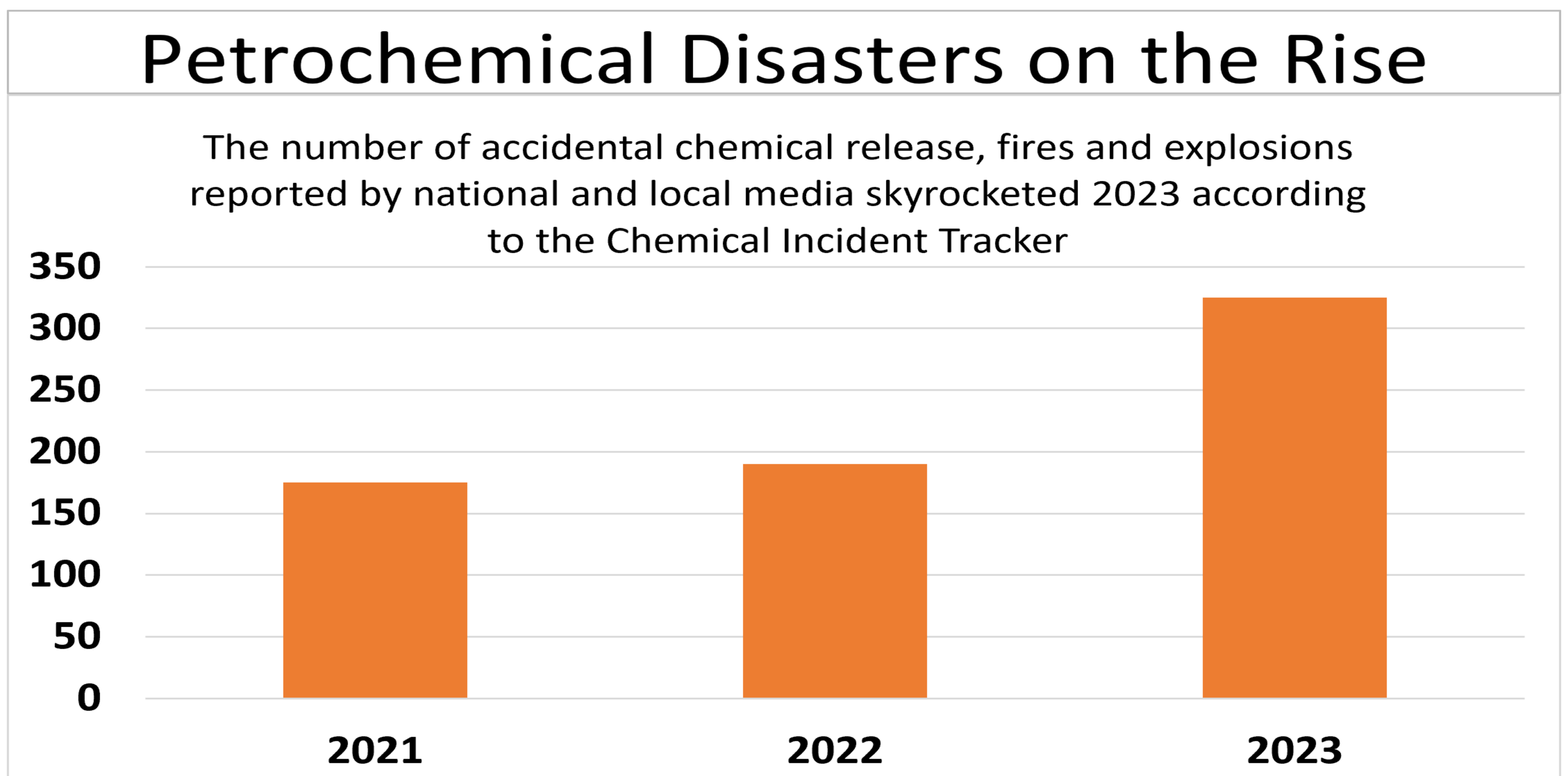

FIGURE 1. Statistics of accidental chemical release in petrochemical industries (*Source: Coalition to Prevent Chemical Disasters*)

Methodology

A 3D model of gas release from a 1,3- Butadiene storage tank has been developed. A domain of 200 m x 200 m x 300 m was considered in this study. Velocity field of ambient air was calculated using Reynolds-average Navier-Stokes (RANS) equations for a weak compressible and turbulent air flow. The *k-ε* turbulent model was chosen in this calculation. Afterwards, the Fick's 2nd law was used as the governing law for calculation of concentration of the chemical species, in which previously calculated velocity field contributes to the convection of the species in air.

Fick's 2nd Law: $\frac{\partial c_i}{\partial t} + \nabla . (-D_i \nabla c_i) + u . \nabla c_i = R$

COMSOL Multiphysics 6.2 version was used to carry out the simulation.

Result

Figure 2 shows the spatial concentration distribution of released 1,3-Butadiene for plain terrain & obstructed terrain scenarios while the wind speed is 1 m/s heading from west to east. The concentration distributions at the elevation of 1.5 m above ground are shown in this figure. Five (5) concentration levels namely 1, 200, 500, 1,000 and 2,000 ppm are selected to discern severity of chemical exposure over the area. The result indicates the difference of the dispersion trend of species between plain terrain and obstructed terrain.

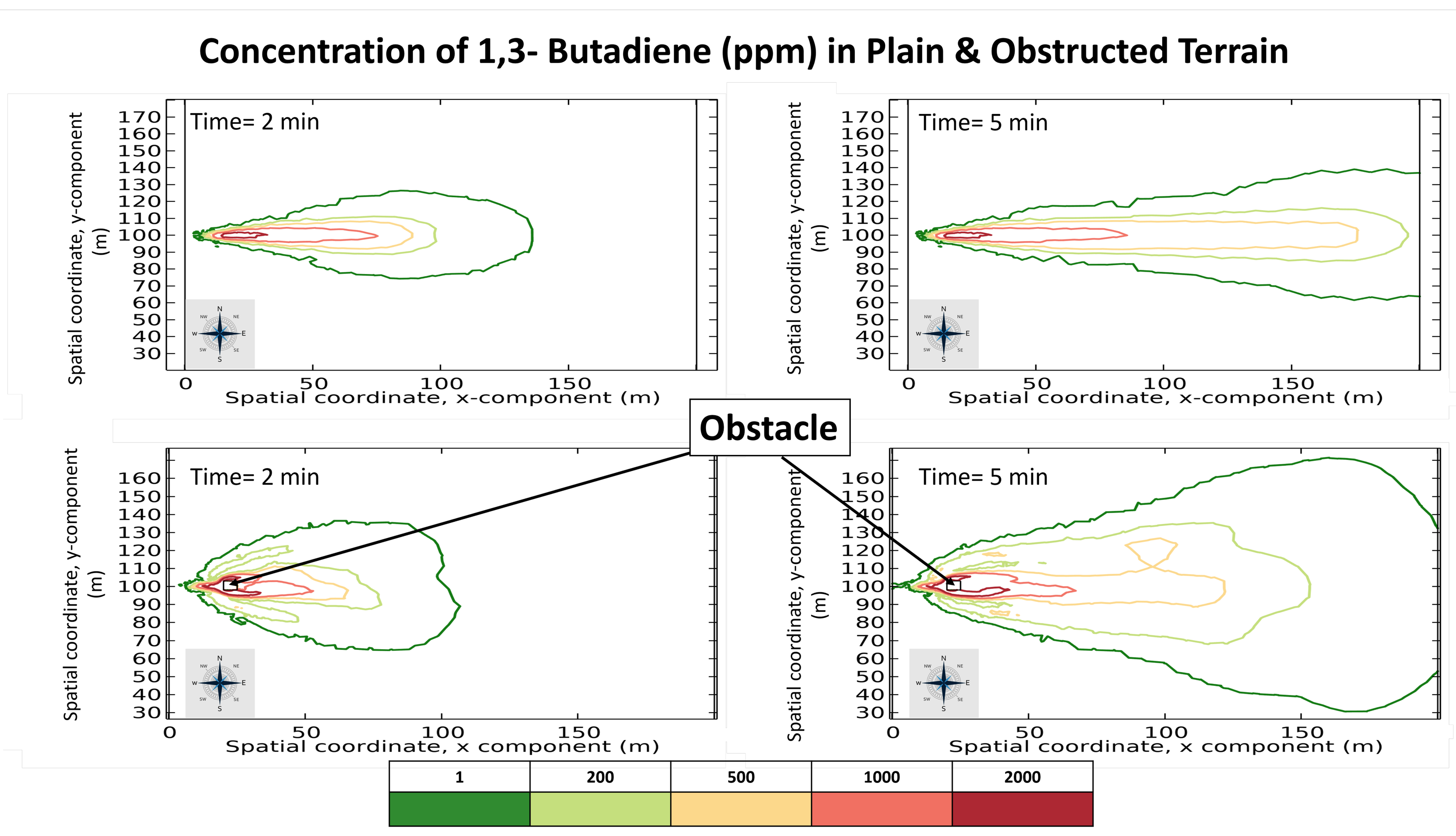

FIGURE 2. Top view of Spatial Dispersion at 1.5 m Above Ground

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