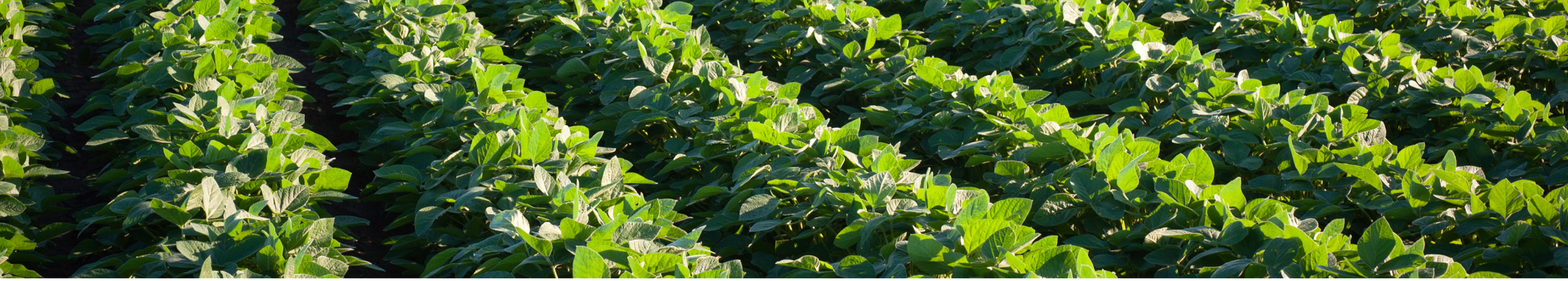


PARTICULATE DISPERSION

Kumar leads investigations of air pollution problems

For generations, farmers have applied biosolids to their fields to improve soil fertility, leading scientists to examine its effects on human health. A University of Toledo research team led by Ashok Kumar, Ph.D., has leveraged resources at the Ohio Supercomputer Center to study air quality issues such as these in outdoor and indoor environments.

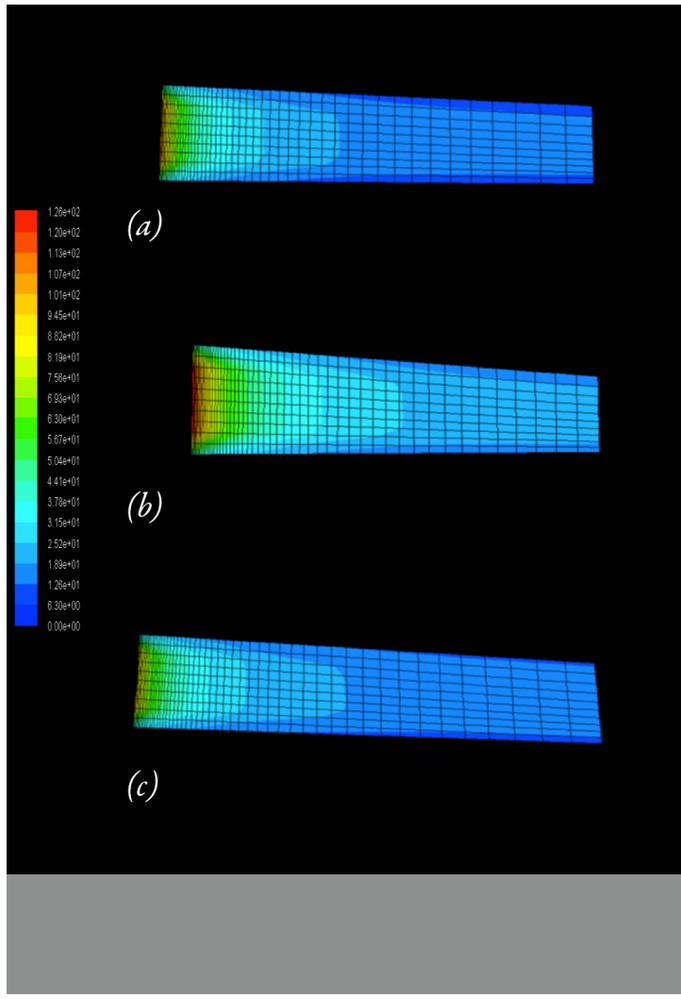
"The use of computational fluid dynamics (CFD) to simulate environmental problems has increased significantly over the last two decades, with more emphasis on solving new and complex air dispersion problems," Kumar explained. "The dispersion of particulate matter and gases emitted from indoor and outdoor sources can be simulated using mathematical models with varying degree of accuracy. The models can predict the contaminant concentrations at different downwind distances from the source under diverse atmospheric conditions."

Graduate student Abhishek Bhat developed a numerical model that simulated particulate dispersion outside the biosolids application field under real-world conditions and validated the model with field data collected earlier using statistical indicators. Meanwhile, graduate student Praneeth Nimmatoori conducted an extension of the work, predicting the ground-level concentrations at various downwind distances of an Ohio agricultural field to which biosolids were injected. The study focused on near-field dispersion problems, which has received little attention in atmospheric dispersion literature.

"Several research studies have developed empirical and analytical models to predict the contaminant concentrations from the application of biosolids," Kumar said. "Empirical methods and analytical modeling have advantages such as simplicity, less time consumed and limited data needs. The disadvantages include oversimplification of physical phenomenon and the need for approximations related to atmospheric turbulence. Moreover, the empirical models are usually site-specific."

Studying the airflow patterns inside a farmhouse, graduate student Srikar Velagapudi is focusing on predicting minute particulates and various gases. Numerical simulations will be used to calculate the velocity, pressure and temperature values for individual indoor spaces, providing a detailed airflow distribution inside the original geometry.

Biodiesel exhaust is the center of graduate student Akhil Kadiyala's studies; he collected indoor air quality data at two points inside a test bus operating on biodiesel. He obtained the ambient concentrations of PM2.5 and gases (inputs) from the Environmental Protection Agency. To model bus geometries, he obtained test bus plans from the Toledo Area Regional Transit Authority and simulated a preliminary 3-D turbulence model to help predict in-vehicle pollutant concentrations.



Predicted concentration of particulates from the edge of a farm field in Ohio during pre-application (a), application (b) and post-application (c) of biosolids.

Project lead: Ashok Kumar, University of Toledo
Research title: CFD modeling of outdoor and indoor air pollution problems
Funding source: Department of Agriculture, Department of Transportation
Web site: http://bit.ly/OSC-RR-Kumar