AGRICULTURE EFFICIENCY

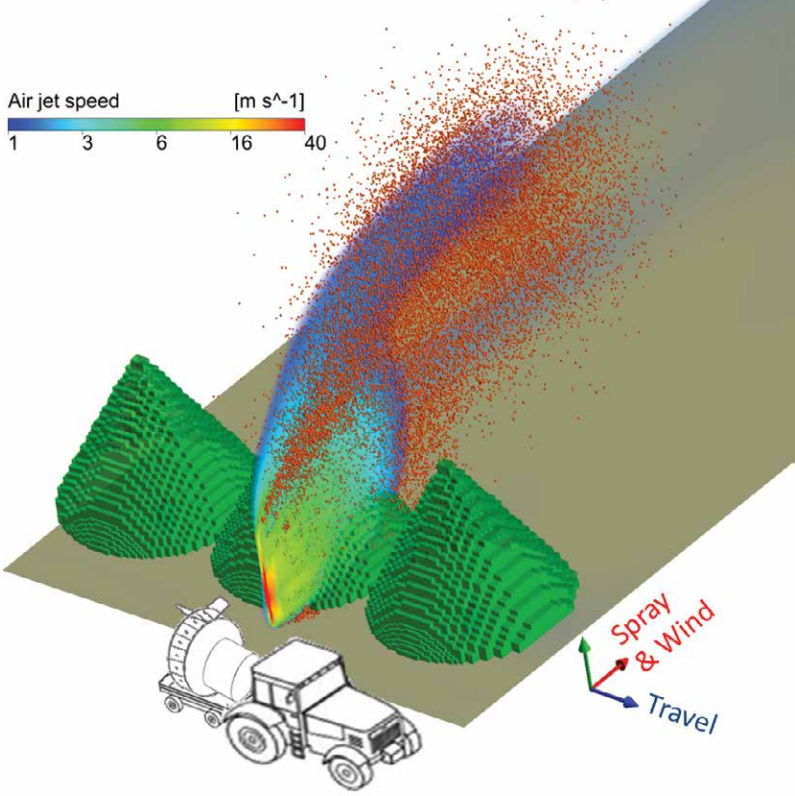
Through CFD, Zhao's group visualizes more efficient farming

The agricultural industry strives to maintain a balance between keeping up with consumer demand and maintaining a safe, clean and sustainable environment for humans and animals. Lingying Zhao, Ph.D., and her research group at The Ohio State University, conduct research to find solutions that help the industry strike this balance. Zhao's research group in the Department of Food, Agriculture and Biological Engineering has been using computational fluid dynamics to model everything from air flow in chicken coops to pesticide spray application on orchards.

"We want to understand the environment to help farmers first assess the problem, if any, and second, help them improve their management, environmental quality and production efficiency, with the ultimate goal for sustainable food production," Zhao said.

Much of the research done in Zhao's group is funded by Agriculture and Food Research Initiative grants from the U.S. Department of Agriculture. Since it's not feasible to collect data from every farm, Dr. Zhao's group extrapolates from the collected data, using intensive mathematic modeling to simulate and understand different environmental conditions of large-scale commercial farm facilities.

Ryan Knight, a graduate student in Zhao's group, is building an electrostatic precipitator, a device that captures particles from gas, for mitigation of dust on farms. The precipitator consists of two grounded metal plates with high-voltage wires that run between them, creating an electrical and magnetic field. When dusty air from the field flows between the plates, the dust particles become ionized and can be collected on the plates. This gives Knight an idea of how much dust is in the air. However, testing and building a prototype is time-consuming and expensive. Knight uses OSC's COMSOL license to model the electrostatic precipitator.



Zhao's research group produced this CFD simulation of pesticide droplet drifts discharged from an air-assisted orchard sprayer.

"Using the Ohio Supercomputer Center and COMSOL allows me to simulate a wide range of scenarios with different values for these parameters," Knight said. "I'm able to figure out what the optimal configuration of these parameters might be, and so once we have the optimized parameters then we can move forward with building a prototype and testing that in the lab.

"Instead of me spending months and months in the lab…having to do that manually, I can just tell COMSOL 'try all these cases at once,' so it definitely saves me a lot of time."

As Zhao pointed out, students pursuing graduate and doctoral degrees have a limited time to conduct research, with an average of about three to four years. To physically simulate environmental conditions or model equipment could take students upward of a year. Access to OSC's high performance computing resources, as well as COMSOL and ANSYS FLUENT software licenses, saves students valuable time and money.

"We appreciate this nice facility and capacity," Zhao said. "(OSC) enables us to do a lot of research work we could not do before without this resource." ◄

PROJECT LEAD // LINGYING ZHAO, PH.D., THE OHIO STATE UNIVERSITY RESEARCH TITLE // COMPUTATIONAL FLUID DYNAMICS APPROACH FOR AIR QUALITY AND BIOENVIRONMENTAL ENGINEERING RESEARCH FUNDING SOURCE // U.S. DEPARTMENT OF AGRICULTURE WEBSITE // FABE.OSU.EDU/OUR-PEOPLE/LINGYING-ZHAO