

Workshop on Computational Fluid Dynamics (CFD) in Greenhouses: Cultivating a Sustainable Future!

Modality: Presentation and discussion of practical cases and implementations

Duration: 1.5 hours

Date: October 24th, 2023

Presenter: Dr. Francisco Domingo Molina-Aiz, University of Almería, Spain

Workshop Description:

We welcome you to the Workshop on Computational Fluid Dynamics (CFD) in Greenhouses, where we will explore the possibilities of application of CFD simulations in greenhouses. The objective of this workshop is to involve a diverse audience of researchers, engineers, farmers and all attendant interested in using CFD simulations to model the interaction between crops and the microclimate inside greenhouses, visualizing the distribution of the different parameters in space and time.

The constant evolution of the world climate because of global warming has made it necessary to search for new solutions to design greenhouses and climate control systems that allow improving environmental conditions inside greenhouses. On the other hand, the increase in the prices of the inputs, the need to reduce the use of pesticides, the scarcity of water and the limitation of the use of energy make it necessary to optimize its use in greenhouses. The CFD has been shown to be a very useful tool to analyse the exchanges of matter and energy inside greenhouses and their effect on crops.

During this workshop we will analyse the immense capabilities of the CFD for the evaluation of climate control systems in greenhouses. We will also address its limitations and the need for robust model validations in order to guaranty the accuracy of its predictions.

Workshop Highlights:

1. **Fundamentals of Computational Fluid Dynamics (CFD) in Greenhouses:** We will begin by providing an overview of CFD, and exploring how they can be applied to greenhouses. Understanding the physical and computational bases of CFD is

essential to know its potential and its limitations when simulating the microclimate inside greenhouses.

2. **Validation needs:** The usefulness of CFD models is limited by the type of validation that is performed on their simulations. At this point, the different methodologies and the main parameters that need to be measured, in order to correctly validate CFD models, will be discussed.
3. **Inclusion of plants within CFD models:** For a correct modelling of the microclimate inside greenhouses, it is essential to include the aerodynamic effects, light interception and the mass and energy exchanges produced by the crop. Different alternatives will be discussed to simulate through CFD the processes of transpiration and photosynthesis of plants.
4. **Design of greenhouses and climate control systems:** One of the main benefits of CFD is its ability to compare different prototype designs without having to physically manufacture them, thereby saving time and money. In the case of greenhouses, CFD simulations have been widely used in the design of ventilation, heating, cooling systems, insect-proof screens or thermal screens.
5. **Challenges and limitations:** Although CFD is a powerful tool for the study of greenhouse crops, its use presents important challenges for the future. In the same way, its practical application supposes a series of limitations that must be taken into account to avoid inaccurate predictions.

Interactive Session:

Through this workshop it is intended to generate an interactive discussion between CFD users and all attendees. Feel free to ask questions, share your experiences, and engage in discussions to encourage a collaborative learning environment.

The main objective is to provide an overview of the knowledge necessary to use CFDs accurately, achieving optimization of the design and management of climate control systems and crops in greenhouses.

Thank you for joining us on this exciting journey, and let's work together to cultivate a sustainable future through Computational Fluid Dynamics (CFD) in Greenhouses!

Please do not hesitate to participate in this workshop with enthusiasm, curiosity and a desire to explore the many capabilities of CFD in simulating microclimate and plant activity inside greenhouses.