Greenhouses climate modelling. Tests, adaptation and validation of a dynamic climate model

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Abstract

Most greenhouse climate models are specific for a particular combination of greenhouse type, crop, region and weather conditions. Models are formulated and validated for those conditions and it is not easy to directly extrapolate them to other, different conditions. In order to use them the coefficients need to be calibrated by experimental work, followed by validation of the adapted model. The main purpose of this work was the application of a formal dynamic climate model, defined and validated for heated greenhouses in continental regions of Spain, to non heated greenhouses in a mild winter region at the coast of Portugal. The original model was tested, adapted and validated so it simulated the microclimate inside unheated greenhouses. The methodology used enabled the problems to be identified, the model to be modified in a systematic way and then re-run to determine the improved performance. The new model includes new properties for some boundary components and sub-models for ventilation and stomatal resistance applicable to this greenhouse-crop system and new expressions for the convection heat transfer coefficients. In the validation process predicted and measured variables were compared graphically to show trends in the data and by using statistical parameters to characterise model performance. The model was validated with data representing different weather, ventilation operation and tomato crop conditions. Good agreement between predicted and measured data was obtained. It has been proved that this model can be used to estimate the greenhouse climate conditions, based on the weather conditions and on the greenhouse-crop system characteristics.

Additional key words: convection heat transfer coefficients, nocturnal ventilation, unheated greenhouses.

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