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Interactive comment on "Canopy temperature and heat stress are increased by compound high air temperature and water stress, and reduced by irrigation – A modeling analysis" *by* Xiangyu Luan and Giulia Vico

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Review of Canopy temperature and heat stress are increased by compound high air temperature and water stress, and reduced by irrigation – A modeling analysis by Xiangyu Luan, Giulia Vico as submitted to HESSD

The manuscript submitted by Luan and Vico investigates a relevant topic and does so using a newly developed mechanistic model that allows to develop a better understanding in the processes and feedbacks that determine the coupled impact of water

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and heat stress in irrigated crops. Irrigation can alleviate water stress but can also lower the maximum canopy temperature and period of heat stress experienced during heat waves.

The manuscript focuses on presenting the model and benchmarks its performance in a case study for wheat. Along with the manuscript comes an excellent and extensive model description included in the supplemental material. I advise the authors to eventually publish their full model and code in a citable open source repository.

I commend the authors for focusing on transparency and simplicity, for instance in defining the crop and phenology stage specific threshold temperatures that would trigger damage from heat stress. The authors explicitly consider the stochastic effects of temperature and precipitation. While I appreciate the illustration of the model in the case for a hypothetical wheat crop, I do look forward to further scrutiny of the model against data from field experiments. A next challenge will be to untangle the net effects on biomass and yield. By lowering temperature, irrigation is also delaying harvesting and thus allowing for a longer grain filling period. The research also has implications for water management in spelling out the relative benefits and limitations of irrigation used specifically for cooling during heat waves. This was lacking previously (e.g. Van der Velde et al., 2009).

One point of clarification needs to be made with regard to soil water balance and effective rooting depth. Research has shown that deeper rooting vegetation and thus access to soil moisture can lead to contrasting responses of vegetation and canopy temperature to heatwaves (e.g. see work of Teuling et al., 2010, but also Zaitchik et al., 2007). Have you done sensitively test of your model with respect to effective rooting depth parameter (now 0.3 m)? While not necessary to consider for this manuscript, you may detail this a bit further by referring to your previous work.

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References (included for information)

Saadia, R., Huber, L., Lacroix, B., 1996. Modification du microclimat d'un couver de mais au moyen de l'irrigation par aspersion en vue de la gestion des stress thermiques des organes reproducteurs. Agronomie 16, 465–477.

Teuling A.J., Seneviratne S.I., Stockli R., Reichstein M., Moors E., Ciais P., Luyssaert S., (...), Wohlfahrt G., 2010. Contrasting response of European forest and grassland energy exchange to heatwaves Nature Geoscience, 3 (10), 722-727.

Van der Velde, M., Wriedt, G., Bouraoui, G., 2010. Estimating irrigation use and effects on maize yield during the 2003 heatwave in France. Agriculture, Ecosystems & Environment, 135, 90-97, doi:10.1016/j.agee.2009.08.017.

Zaitchik, B.F., Macalady, A.K., Bonneau, L.R., Smith, R.B., 2006. Europe's 2003 heat wave: a satellite view of impacts and land-atmosphere feedbacks. Int. J. Climatol. 26, 743–769.

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