This paper describes an interesting new hypothesis for the increase in tree drought mortality risk during heatwaves, and explores the consequences of the hypothesis using a mechanistic model. I suspect this hypothesis probably won't stack up when compared to field data on transpiration rates during heatwaves, but feel that it is nonetheless worth recommending in order to encourage experimentalists to test properly. Before recommending, however, there are a number of things that should be done to improve the quality of the presentation.

Some major things about presentation:

- Units should be added throughout, particularly in the methods where many terms are introduced without giving their units. Check that all units are consistent (e.g. is Kplant in mmol s-1 MPa-1 (Figure 1) or in mmol m-2 s-1 MPa-1 (Table 1)?).
- Citations should be given to support model equations and assumptions.
- More details of the underlying model need to be given. There are many assumptions that are not described that determine the outcome of the simulations. What are the basic assumptions of the model framework? E.g. How is soil moisture depleted? How does stomatal conductance respond to soil drought? How is cuticular conductance incorporated? Is there hydraulic isolation of the plant from the soil at some point, and if so when? Is there refilling of the stem overnight? Etc.
- The code should be made publicly available, and a link given in the text.
- The paper suggests that experiments are required to follow up on this hypothesis. It would be useful to indicate what kind of data would be helpful.

One major thing about the science:
I'm concerned that the model is not representing the effects of high T/ VPD on transpiration correctly. For example, the introduction states "A rise in air temperature strongly increases leaf transpiration via its exponential effect on air saturation vapor pressure". I am not actually sure that this is supported by data. It assumes that the plant does not shut its stomata in response to higher VPD, which most plants do in fact do. Monteith (1995, Plant Cell & Environ 18:357-364) highlights that in most cases there is a three-phase response of E to D – initially it increases, but then plateaus and decreases. Whole-tree chamber and sapflow data during heatwaves show that transpiration tends to decrease, not increase (e.g. Pfautsch & Adams 2012 Oecologia DOI 10.1007/s00442-012-2494-6; Duursma et al. 2014 Agric For Meteorol 189-190: 2-10; Drake et al. 2018 Global Change Biology DOI: 10.1111/gcb.14037).

It's not clear from the paper how stomatal conductance is being modelled. The paper must describe how the gs response to VPD, T and soil moisture content is being represented, and provide some evidence or rationale to support the approach. This lack of information seriously undermines the value of the paper, as the reader spends most of the time wondering what the model is doing and whether or not the outputs make any sense. The impact of the heatwaves, for example, appears to be dependent on transpiration increasing during the heatwave – contrary to evidence.

Another important point is that the paper is not quite as clear as it should be what the "new mechanism" is, and what it adds. It is generally understood that plants die earlier during hot conditions because of the increased evaporative demand, which means soil moisture stores are depleted faster. That mechanism is very well known and incorporated in pretty much all process-based models. My understanding is that the author is proposing here an additional mechanism, namely that under high temperatures gmin increases, and that will cause plants to cavitate even faster, due to faster water loss. The author does not make clear why this additional mechanism is needed, and does not clearly differentiate what the new mechanism adds. I would suggest that the Introduction needs to make it clearer why this mechanism is needed, and outline the logic of how the simulations are going to explore this and other impacts of temperature on hydraulic function. The presentation of the results should be more careful to distinguish when this mechanism is under consideration in the simulations. The discussion should also take the time to explain how the new mechanism impacts on the simulated time to mortality, compared to the control case in which gmin is constant. The problem is that the discussion argues that runaway cavitation during a heatwave is caused by the increase in gmin – but runaway cavitation would still occur if gmin were constant, just a bit later. Do we really need this new mechanism?

Detailed comments:

Introduction, "These die-offs seem clearly driven by climate change" – this kind of unsupported speculative statement is unhelpful. There is a very worrying tendency in the literature to run ahead of our capacity to attribute tree mortality to climate change. I would omit this statement and instead focus on the (better-substantiated) observation that tree mortality appears to be higher during heatwave conditions. Some more appropriate citations could also be found (the Williams et al 2012 paper cited in the first paragraph refers to death of people, not trees, during heatwaves, which seems rather tangential?)

Also, avoid the word "drastic" which is too subjective to use in a scientific paper. "Extreme" is better, as it is quantifiable.

There's an issue with the definition of eleaf (eqn 1), which is described as being the vapour pressure "at leaf level" and at "leaf surface" – presumably this is intended as the intercellular vapour pressure, not the leaf surface vapour pressure? These are not the same thing. The definition must be made precise. Please give citations for each of the equations in this section.

Eqn 5, Tair will only have a strong effect on transpiration if it is assumed that gleaf is constant .. which it is most definitely not! Are these equations assumed only to apply once stomatal closure has been achieved, and we are only considering cuticular conductance? This must be clarified.

"In Figure 1 I assume that root temperature is constant .." Clearly there are a number of other assumptions being made here. Clarify how conductance is being partitioned among the different organs.

Define terms in Figure 1 caption.

As above, more details of the model framework need to be given, as do basic assumptions.

Why is the model timestep 1 millisecond? Seems excessive?

If there is a leaf energy budget module – then why is transpiration simulated using equation 5? Why not Penman-Monteith?

It seems like the "typical" plant is a sapling growing in a pot? A plant of 1.3 m with a rooting volume of 50 L? Any reason for this choice? Perhaps rather than calling it "a typical plant", explain that the simulations refer to a potted sapling?

In Table 1, why are there two values of gsmax? What is slope?

Explain how the soil type (clay) is used to translate soil water content to soil water potential. What is the maximum soil water holding capacity?

Explain what are Tair-min, Tair-max etc in the second Table 1 (perhaps make this Table 2!)

Figure 4 is nice. However, the conclusion drawn from this figure is not clearly supported:
The time to hydraulic failure appears clearly more determined by the water losses beyond the point of stomatal closure rather than the speed at which plant empty the soil water reserve when stomata are still open.
To better support this statement, add a second set of curves (or second panel) to show also time to stomatal closure, so as to understand where in the drydown the sensitivity to temperature principally occurs. (Also fix typo in y-label).

Figure 5: Add units to axis labels. Explain the dashed vertical lines? And consider more distinctive colours – I am not sure which is green and which is blue! Why are there several red lines?

It would have been interesting to have a bit more exploration of the model behaviour during the heatwave simulations. The only thing that is shown is time to PLC. What about soil moisture content over time? Transpiration over time? Loss via cuticular conductance over time? Such exploration would be helpful in understanding what is really going on in the model, and might also help to identify the types of experimental data that could be used to test this hypothesis.

It would also be very interesting to show leaf temperature. I'm assuming there are no adverse impacts of high leaf temperatures in the model (it would be good to confirm this). It's possible that the increased gmin with high temperatures would serve to help cool the leaves – shortening the time to hydraulic failure, yes, but also avoiding lethally high leaf temperatures.

Discussion: The paper overlooks the capacity for plants to modify gmin in response to warmer temperatures. There's some evidence that plants can down-regulate gmin in response to warmer or drier conditions (Duursma et al. 2019, New Phytologist). It would have been nice to explore the impact of downregulation of gmin in the simulations – failing that, a mention in the discussion of this mechanism would be appropriate.

The discussion should touch on how these results could be tested. I would anticipate that potted plants would definitely experience hydraulic failure faster in hot conditions – but how might one go about demonstrating that increased cuticular conductance was playing a role, above and beyond higher evaporation rates?

It would also be appropriate to consider how the results might apply to full-sized trees that are not limited by soil volume.