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Interactive comment on "Disentangling the response of forest and grassland energy exchange to heatwaves under idealized land–atmosphere coupling" *by* C. C. van Heerwaarden and A. J. Teuling

Anonymous Referee #2

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This paper examines land-atmosphere feedbacks for heatwave conditions, contrasting forest and grassland cover types. Results suggest that the stomatal sensitivity to vapor pressure deficit is the leading factor for explaining the observed differential responses of forest and grassland to heat waves. Results also suggest that albedo, roughness, and minimum stomatal resistance are all secondary contributors. It is an elegant analysis and presentation on an interesting, important, and timely topic of fairly broad interest. However, the treatment of grassland versus forest physiology is flawed, particularly the prescribed stomatal sensitivity to vapor pressure deficit. Given that all

of the paper's findings are sensitive to this treatment. This should be corrected before final publication can be recommended.

1) Parameters for grassland are incorrect All of the work's results depend on the different parameters assigned to grassland and forest so it is essential to get this right. Furthermore, one of the key conclusions that emerges stems directly from the way the authors parameterize the response of ET to VPD for grassland versus forest. The work assumes no VPD response of grass transpiration, which is terribly far-fetched. One need not look far to find plant physiological ecology literature documenting that stomatal conductance tends to exhibit an exponential decline with vapor pressure deficit. This was raised by the first reviewer and has been debated and defended by the authors mainly using the defense that this grassland assumption is the default in a weather model but that hardly seems like a solid argument. I agree that additional work documenting how the stomatal sensitivity to VPD compares between grasslands and forests (note: Teuling et al. 2010 Nat Geo did not examine this), but the assumption that grasslands are entirely insensitive is surely wrong. Being that the core findings of the paper rely so heavily on this treatment, it seems as though some additional work needs to be done to get this parameterization right and adjust results and conclusions accordingly. Some papers that might help: Oren et al. 1991, Plant Cell and Environment Collatz et al. 1991 Agric and Forest Met, Collatz et al. 1992 Austral. Journ. of Plant Physiology Jones H, Plants and Microclimate, 2nd edition p. 156 Monteith 1995, Journal of Hydrology, 251-263

2) It does not seem correct that the scalar roughness length (zoh) is one tenth the momentum roughness length (zom) for grass but the two are equal for forest. What justifies this treatment?

3) Fig 6 seems to show that initially forests have higher LE than grasslands, but then as things move toward heat wave conditions forests transition to having lower LE. That does not seem to be consistent with Teuling et al. 2010 which shows grasslands having higher ET than forests in normal conditions, nor with the synthesis by Williams et al.

2012, which shows forests having similar if not lower ET compared to grasslands.

4) I find the indirect heating feedback loop through entrainment to be rather puzzling, particularly the h to theta positive relation. Why is this a positive effect? I expected the entrainment to bring in cool air, thus cooling the boundary layer's potential temperature, not increasing it. Please explain or modify.

Details: Fig 3 y-axis label should be modified because SWin and Q are not 'heat fluxes'. L 360: graph only extends to 35 hPa not up to 38. L364: dashed [white] lines... not red L372: change an to a L377: responsible [for] the minimum L400: The most imporan[t] change to the system if the albedo of forest is [replaced with that of] grassland is the increase... Fig 6: I would recommend taht you make the red solid lines black so tehy show up more clearly on the red shading of delta LE. L493: we have [performed] sensitivity L520: closure of the [leaves] of trees... L528: VPD [alone] is active. L536: -perture[no s] increases

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Interactive comment on Biogeosciences Discuss., 11, 5969, 2014.