

Comment on wcd-2021-34

Anonymous Referee #1

Referee comment on "Future summer warming pattern under climate change is affected by lapse-rate changes" by Roman Brogli et al., Weather Clim. Dynam. Discuss.,
<https://doi.org/10.5194/wcd-2021-34-RC1>, 2021

"Future summer warming pattern under climate change is regulated by lapse-rate changes" by Brogli et al uses a variety of regional and global simulations with climate models to investigate the relationship between the spatial structure of surface warming and changes in tropospheric lapse rates particularly over Europe but also over other continents. Building on previous work, the authors conclusively show that – across the tropics and most interestingly across mid latitudes – surface warming and lapse-rate changes are intimately linked through low-level moisture availability. This idea has previously been used to understand the land-ocean warming contrast in the tropics and subtropics, but this is the first study to show its applicability to the extratropics. For this reason, I think this paper is important and significant, opening up interesting avenues for applying similar methods to understand and constrain regional temperature changes around the globe. In addition, I find the pseudo global warming simulations to be elegant and insightful for isolating the roles of uniform tropospheric warming vs changes in lapse rate for the surface warming pattern. I recommend swift publication and have only a few minor comments to address:

- *Lines 134,135:* Maybe I'm misunderstanding the results in Fig. 3, but it doesn't look to me like "the Mediterranean amplification is absent in TD". Rather there seems to be some Med amplification, but it's just weak compared to the FCC and TDLR simulations. Can you clarify this point?
- *Lines 160-165:* The relatively homogeneous warming aloft in the summertime extratropics is interesting, and linking it to the weak eq->pole temperature gradient and associated weak baroclinicity is a neat idea. I hope future research investigates this hypothesis in more detail!
- *Lines 182,183:* When discussing the below-average increase in specific humidity in the Med, it would be good to state that this implies a reduction in relative humidity in those regions. You could also show the changes in RH directly in an additional figure. More generally, it might be worth commenting on the effects of climatological dryness vs changes in dryness (i.e. decreasing RH) for the lapse-rate changes and surface warming pattern.

