



EGUsphere, referee comment RC1
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Comment on egusphere-2022-1101

Anonymous Referee #1

Referee comment on "Future changes in atmospheric rivers over East Asia under stratospheric aerosol intervention" by Ju Liang and Jim Haywood, EGU sphere, <https://doi.org/10.5194/egusphere-2022-1101-RC1>, 2022

In this manuscript, the authors presented results of a series of greenhouse gases and stratospheric aerosol forcing experiments conducted in UKESM1. They focused on future changes in atmospheric river activity, ARs contributions to total rainfall and heavy rainfall, and associated background changes, including upper tropospheric westerly jet, thickness, and lower tropospheric circulation. The results are comprehensive and novel. Although number of tested AR detection scheme and model are limited, these analysis results are beneficial for readers of this journal. I also think further improvements, particularly discussion on future changes in atmospheric circulation and associated AR frequency on global scale, are still needed.

It seems to me that discussion on physical reasons for changes in upper tropospheric thickness, atmospheric circulation, and AR activity are not sufficient. Previous studies identified that forcing factors and ocean warming result in different patterns of changes in thickness and atmospheric circulation over East Asia (e.g. [doi:10.1007/s00382-014-2073-0](https://doi.org/10.1007/s00382-014-2073-0), [doi:10.1007/s00382-014-2146-0](https://doi.org/10.1007/s00382-014-2146-0), [doi:10.1038/ngeo2449](https://doi.org/10.1038/ngeo2449), [doi:10.2151/sola.2018-010](https://doi.org/10.2151/sola.2018-010)). Such discussion, especially in terms of land-sea warming contrast, should be added to help better understanding on physical mechanisms of different changes in upper troposphere in response to different forcing factors.

I also recommend to include global maps of thickness, geopotential, and wind patterns in response to SSP, sulfur, and solar forcing. Such global figures may help more reasonable understanding on changes in atmospheric river activity over East Asia.

Line 211: I don't think the results of these simulations support the SAH expansion. Increasing geopotential height are found outside of SAH region. The increase in geopotential height at 40-60N doesn't indicate SAH expansion but enhanced land-sea contrast over East Asia.

I also think more discussion on future changes in summertime storm track is needed for better understanding on changes in AR activity. Previous studies pointed out shift and weakening of storm track over the summertime North Pacific (doi:10.1029/2020JD032701, doi:10.1007/s00704-008-0083-8). Such changes in storm track and associated changes in jet stream should be investigated in more detail, because such mid-latitude disturbances should be essentially important for AR activity.

In figures 9 and 10, the authors investigated changes in heavy rainfall associated with ARs. The results are very interesting. However, when you discuss fractional contribution of ARs to heavy rainfall, you need to discuss effect of tropical cyclones. As indicated in many previous studies (e.g. doi:10.2151/sola.2017-002), future changes in tropical cyclone frequency/intensity are primarily important for future changes in heavy rainfall over the western North Pacific. Therefore, discussion on AR frequency itself is not sufficient for discussion on fractional contribution to heavy rainfall. I recommend the authors to add discussion on future changes in TC-related heavy rainfall over this region in these simulations.