Broad context and summary of the present study of Ivanovich et al.:

Specifically in the context of global warming, it is vital to study the drivers of heatwaves and possible future changes in their frequency and intensity. Expanding our understanding is particular important for regions with high population and possibly increased vulnerability.

Fittingly, the authors of this study investigate the drivers of a particularly early and severe heatwave that affected the city of Rio de Janeiro in late November 2023. It is shown that the heatwave was associated with an intensification of the South American Subtropical Anticyclone, possibly linked to a strong El Nino event. The heatwave was possibly further aggravated by a preceding unusual dry spell, high SST temperatures off the coast and anomalously strong northerly winds shutting down sea breeze-related cooling.
The authors extend their study by reviewing possible future changes of heatwaves in the Rio de Janeiro region by means of fitting GEV distributions to bias-corrected projected austral spring temperature extremes, based on a number of different climate models and warming scenarios.

General comments:

Overall, this paper constitutes a well-written and valuable case study of this severe heatwave event. The manuscript is well-structured and presents most of the research results in a clear way.
In terms of the scientific content and its novelty, the manuscript could see a few improvements. In my opinion, the authors could have elucidated a bit more deeply whether any particular heatwave driver was particularly significant, as most of the reported anomalies are commonly found in heatwaves outside of the deep tropics (e.g. intensified anticyclones, reduced soil moisture).
While I generally welcome the addition of a section about future heatwave projections, I think that the overall objective of this paper becomes a bit less clear, while at the same time the novelty and depth of each of these topic sections is slightly compromised.
However, I am very positive that this work can be published after some major revision.

Comments/suggestions about identifying the significance of the multiple heatwave drivers:

It would be beneficial if the authors could provide some additional analysis into what are the major drivers behind this nearly unprecedented heatwave. Is it really the long dry period and the corresponding increased surface sensible heat fluxes or is the strong northerly wind and its suppression of a sea breeze circulation most important? Or does the northerly wind exacerbate the heat through downslope winds (something that was reported to intensify a summer heatwave in South Brazil in *Stefanello et al., 2022*)?
I understand that it is not easy to produce a physically sound decomposition of the temperature anomaly, such as what has been done within a Lagrangian framework in *Roethlisberger and Papritz (2023)*.
One way to go forward would be to produce a detailed map showing the differences between the maximal heat wave day and the 99th percentile composite, something that is missing in the current manuscript (If I am not mistaken, I have only seen heatwave minus climatology, and 99th percentile warm days minus climatology, which makes it hard to make out small but possibly important features of that particular heatwave).
In addition, the authors could maybe include a comparison not only against the 99th percentile, but to the temporal course of some recent heatwaves of comparable duration and magnitude. To this end, figure 5 could be improved. In its current form, the grey lines in the background are not really helpful, as they are always just showing the non-highlighted other variables.
I would recommend that the authors could show the temporal course of the respective anomalies for

some other 10 recent heatwave events of comparable magnitude.
Maybe the authors could also provide a similar plot to Fig S4, but showing the correlation between near-surface meridional wind and maximum temperatures.

Comments/suggestions about heatwave drivers in future projections:

I wonder whether some of the better models, for instance those with a Perkins skill score above 0.8, do also perform well in capturing some of the characteristics of the identified heatwave drivers? If yes and in case these variables are available at a daily scale, it would in my opinion be very valuable to extend the analyses of the future projections by including projections for systematic changes in the suspected heatwave drivers. For instance, one could investigate whether the frequency of days with strong northerly winds is projected to change, or whether there are any substantial changes in the position and strength of the South American Subtropical Anticyclone. A more in-depth analysis into the changes of the suggested main drivers of the exceptional November 2023 heatwave would in my opinion tie the two results sections of the paper closer together and thereby really improve the manuscript.

Minor comments:

In general, the text is well-written and does not seem to contain many typos or other minor errors. However, for a further revision, line numbers would be helpful.

The figures are at quite a low resolution.

Figure 8:
Just out of personal curiosity: Are there any ideas about why heatwaves become more frequent in early spring, whereas the end of the heatwave season has not shifted further into early autumn?

Figure 9:
It would be helpful to add, for each scenario, some additional markers for the return level of temperature extremes of the same likelihood of the 2023 heatwave event or something similar.

Figure S8:
The color bar and/or its caption does not seem to be correct for a) and b). Doesn't the plot show a correlation coefficient?

References:

Stefanello, Michel, et al. "Spatial–temporal analysis of a summer heat wave associated with downslope flows in southern Brazil: implications in the atmospheric boundary layer." *Atmosphere* 14.1 (2022): 64.

Röthlisberger, Matthias, and Lukas Papritz. "Quantifying the physical processes leading to atmospheric hot extremes at a global scale." *Nature Geoscience* 16.3 (2023): 210-216.