EGUsphere, referee comment RC2
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Comment on egusphere-2022-959

Anonymous Referee #2

Referee comment on "Buoyancy forcing: a key driver of northern North Atlantic sea surface temperature variability across multiple timescales" by Bjørg Risebrobakken et al., EGUsphere, https://doi.org/10.5194/egusphere-2022-959-RC2, 2022

Review of the manuscript "The role of buoyancy forcing for northern North Atlantic SST variability across multiple time scales" by Risebrobakken et al.

This manuscript presents an excellent combination of observational data, paleoclimate data and modeling. The authors tried to provide an explanation for the different scenarios observed in the Pliocene data (from sedimentary records), and, also, to understand the mechanisms that may bring different scenarios in the future. This manuscript illustrates perfectly how the paleoclimate data may be extremely useful to obtain a better understanding of the climate forcings and to predict future scenarios, as stressed in the last IPCC report.

The manuscript is well written and can be easily followed. Figures and tables are clear and illustrate the text clarifying some of the descriptions. I particularly liked figure 11 and Table 2, which summarize the main results of the experiments.

I am not an expert in modeling, and, therefore, I cannot evaluate if there are any flaws in the modeling experiments performed. From my perspective the manuscript presents a set of experiments that allowed the authors to assess the role of buoyancy forcing on different scenarios. According to the observations of the Pliocene data, the authors investigated the main drivers of the phase relationships observed between the sea surface temperatures in the North Atlantic, Norwegian Sea and Iceland Sea. It is very interesting that those experiments investigating the role of buoyancy forcing in different scenarios, only provided a robust explanation for 3 of the 4 scenarios. For the scenario in which the Norwegian Sea is out phase the authors propose 2 alternative changes in ocean circulation and/or in water column stratification. Since the experiments are only evaluating the role of buoyancy forcing, I wonder if there are other mechanisms that could affect the SST during those intervals. If so, could you just mention what other factors may be causing that kind of phasing? I understand that you will probably need a new set of experiments to evaluate those other factors, but it will be nice to acknowledge that maybe buoyancy forcing is not the only forcing. Also, maybe a sketch with the 2 alternative explanations for

the Norwegian Sea out of phase will clarify the proposed hypothesis.

Minor comments:

Figure 1. The figure caption indicates a, b and c panels but those are not indicated in the figure, please add the letters in each panel.

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