Comment on os-2021-48
Yavor Kostov (Referee)

Dear editor and authors,

This well-written manuscript presents interesting and significant results highlighting the important role of ocean surface density variability in the eastern subpolar North Atlantic for driving changes in water mass transformation. I recommend publishing the manuscript subject to minor revisions.

Detailed comments:

- Title: Consider changing the preposition in the title. For example, you could say "Role of air-sea fluxes and ocean surface density for the production..." or "Role of air-sea fluxes and ocean surface density in the production..." Alternatively, you can use "Impact of air-sea fluxes and ocean surface density on the production..."
- Line 69, "density": Do you mean potential density referenced to the surface? (Here and at several other instances throughout the text.)
- Line 116, "is the potential density": Do you mean the density referenced to each vertical level z? You are computing vertical stratification, so I imagine that in this particular case you are not using potential density referenced to the surface.
- Lines 197-198, "Though a strengthening of the buoyancy forcing generally leads to an expansion of the surface area.": The correlation does not necessarily mean that this is the direction of causality. Is it possible that the direction of causality is the other way around: an expansion of the surface area can drive a buoyancy flux anomaly?
- Line 199: You could change “30%” to “less than 30%” if $R^2$ is closer to 0.27 than 0.30 ($R=0.52$ according to line 209).
- Figure 3: What does panel (f) represent, and what are the units in that panel?
- Lines 235-247: Consider adding some discussion on whether the surface density variability is dominated by salinity or temperature. This could make a difference, as salinity variability does not directly drive local surface buoyancy fluxes, while temperature variability does.
- Line 271, “the buoyancy anomaly”: Do you mean “the buoyancy flux anomaly”?
- Line 323: Consider changing “dependent” to “interdependent” (which sounds more physically intuitive) or “statistically dependent” (which is a more mathematical phrase).
Sincerely,

Yavor Kostov