In this study the authors analyse the role of Agulhas Leakage (AL) on the Atlantic Meridional Overturning Circulation (AMOC). They analyse the strongly eddying version of the Community Earth System Model (CESM, CMIP5 version) from the iHESP project. This high-resolution version of the CESM is needed to realistically capture Agulhas Current dynamics. They analyse two experiment: the pre-industrial control simulation and the historical forcing (1850 – 2005) followed by RCP8.5 (2006 – 2100).

The authors first analyse the drivers, variability and trends in Agulhas Leakage. There is a direct wind effect on AL changes, but other far-field contributions are also important such as Indonesian Throughflow on the Agulhas Current strength. The next step is to link AL changes to the AMOC, this is done by analysing the AL-induced freshwater (or salinity) transport along 34°S in the Atlantic Ocean. The freshwater transport carried by the AMOC, indicated by F_{ovS}, is an important indicator for AMOC stability. When AMOC carries net salinity into the Atlantic basin ($F_{\text{ovS}} < 0$), the salt-advection feedback amplifies freshwater perturbations and destabilise the AMOC. The authors show in their last step is that the AL contributes to a greater salinity transport into the Atlantic Ocean under climate change, hence the AL influences the AMOC stability.

I would like to thank the authors for their interesting study. The manuscript is well written, clearly visualised, the analyses are well conducted and (mostly) correctly interpreted. I have a few (major) remarks on the AMOC stability indicator (the F_{ovS}) and the link with an increased AL salinity transport. The comments below need to be addressed before I recommend the manuscript for publication.

Major comments and suggestions:

1. The parts of the manuscript which discuss the F_{ovS} changes from AL and links with AMOC stability need to be more carefully stated. The interpretation is not always correct and a few arguments are missing, see the following points:

    - The AMOC carries relatively salty water northward in the North Atlantic Ocean, the local F_{ov} is negative (e.g., at 40°N, see Jüling et al., 2021). When a freshwater perturbation is applied in the North Atlantic Ocean (in a hosing set-up), the AMOC strength and associated salinity transport reduce. The reduced salinity transport may amplify the original freshwater perturbation, leading to an even greater freshwater perturbation and further decreasing the AMOC strength: the (positive) salt-advection feedback. This feedback is only effective (see section 4b in Huisman et al., 2010) when velocity-induced and salinity-induced freshwater transport changes (under a freshwater perturbation) do not oppose each other. This is only the case when the AMOC carries net salinity into (exports net fresh water out of) the Atlantic basin, and hence $F_{\mathrm{ovS}} < 0$. For the case when $F_{\mathrm{ovS}} > 0$, the North Atlantic freshwater perturbations are usually 'flushed out' of the Atlantic Ocean and there is no positive salt-advection feedback. So the quantity F_{ovS} only represents whether the AMOC amplifies (North Atlantic) freshwater perturbations, this is mentioned by the authors (line 353).

      The study by Haines et al. (2022) questions whether the F_{ovS} is a useful metric for AMOC stability analysis in fully-coupled climate models (under constant pre-industrial conditions). They show that F_{ovS} changes hardly influence the North Atlantic freshwater transport and a North Atlantic freshwater change is needed to modify the AMOC strength (Rahmstorf, 1996). However, van Westen et al. (2024a) demonstrated that the F_{ovS} is a useful metric for AMOC stability analysis in the (low-resolution) CESM and this was consistent with previous work (e.g., Huisman et al., 2010). The differences between Haines et al. (2022) and van Westen et al. (2024a) could be related to the magnitude of the freshwater perturbations, where the latter study varies a North Atlantic freshwater flux forcing between 0 and 0.66 Sv.

Relatively small freshwater/salinity perturbations at 34°S may be ineffective in modifying the North Atlantic Ocean freshwater content. This doesn't imply that there are no relations between AMOC strength and F_{ovS} (e.g., Figure 8a in van Westen and Dijkstra, 2024). The F_{ovS} is also positive in the CESM (before 2070, Figure 10) and in this regime it is not very likely that AL changes destabilise the AMOC. The authors could argue that a greater AL salinity transport under climate change is preconditioning the AMOC to a more sensitive regime. You could also use the arguments that the CESM has known freshwater transport biases (van Westen and Dijkstra, 2024) and the observed F_{ovS} is negative (Arumí-Planas et al., 2024). My main point here is that the conclusions drawn from the AL changes on AMOC stability (e.g., lines 468 – 469) are sometimes strongly phrased. These parts need to be revised and a better discussion on the role of F_{ovS} is needed (in both the introduction and discussion).

- To continue with my previous point: the interpretation of F_{ovS} changes under strong transient responses. The quantity F_{ovS} can only be used under (quasi-)equilibrium conditions (Rahmstorf, 1996) and these conditions include the equilibration of the Atlantic Ocean interior. Under strong climate change (RCP8.5) or large freshwater flux changes (Oríhuela-Pinto et al., 2022; Jackson et al., 2022) the F_{ovS} responses and its effect on AMOC stability are much more difficult to interpret. It should be noted that the AMOC responses under climate change are dependent on the initial/historical F_{ovS} value (Liu et al., 2017; van Westen and Dijkstra, 2024). The AL influences the F_{ovS} under climate change (Figure 10) and directly connecting this to AMOC stability is difficult, as we consider the transient case. Once the CESM is equilibrated to the new 2100 radiative forcing conditions, the more negative F_{ovS} suggests that the AMOC is closer to its tipping point, but this can't be verified from the transient results. Again, a more careful interpretation is needed when analysing the transient F_{ovS} and AMOC responses.

- Lines 66 and 357: The authors suggest that a negative F_{ovS} (in the AMOC on state) allows for a bi-stable AMOC regime. This is indeed the case in many conceptual (AMOC) models and models of intermediate complexity (Dijkstra 2024). However, the recent quasi-equilibrium hysteresis hosing simulation performed with a low-resolution version of the CESM (van Westen and Dijkstra, 2023) indicates that positive F_{ovS} values (in the AMOC on state) are also part of the bi-stable AMOC regime. Sea-ice feedbacks, which were poorly captured in idealised models, modify the AMOC hysteresis behaviour (van Westen et al., 2024b) and allow for positive F_{ovS} values to be part of the bi-stable AMOC regime. Climate model biases also shift the saddle-node bifurcations and negative F_{ovS} does not exclusively indicate the bi-stable AMOC regime (Dijkstra and van Westen, 2024). Recent work by Lohmann et al. (2024) demonstrated a multi-stable AMOC regime under varying freshwater flux forcing, so not only bi-stable.

2. Line 227: The total freshwater transport at 34°S can be decomposed (Jüling et al., 2021) into four different contributions: overturning, azonal (gyre), barotropic (≈ 0) and eddies. I would argue that Agulhas rings, which are part of the AL, would end up in the eddy component and not (directly) in the overturning component. Have you considered determining the eddy-induced freshwater transport by AL? In Jüling et al. (2021) there is a negative freshwater transport trend in the eddy component (their Figure 7). I agree with the authors that oceanic adjustment by Agulhas rings or Rossby waves can eventually influence the overturning component (line 297), but this is relevant on time scales longer than one year.

3. A low-resolution (1°) companion CESM simulation is available within the iHESP project (line 120). Climate model projections at 34°S (and elsewhere) are model resolution dependent (van Westen and Dijkstra, 2024) and could be relevant in the AL responses. Such a resolution comparison is also useful when considering other (1° resolution) CMIP6 models. I was wondering why the low-resolution CESM was not included in the analysis, at least a clear motivation is missing.

   I would like to encourage the authors to conduct the analysis on the most interesting quantities in the low-resolution version of the CESM from the iHESP project. For example, it would be very interesting to see Figures 9 and 10 for the low-resolution CESM and to compare against the high-resolution CESM results. The low-resolution CESM results should go in the Appendix and are discussed in the main text. I'm not asking for a complete low-resolution CESM nor CMIP6 analysis, this is too much work and beyond the scope of the paper. The high-resolution CESM results are (and should be) central here.

Minor comments and suggestions:

1. Lines 1, 20, 25, and throughout manuscript: 'the warm and salty waters'. Refer to the *relatively* warm and salty waters (or quantify warm and salty waters). Please check and fix throughout manuscript.
2. Line 41: Maybe helpful for the reader to provide the time-mean formation rates and propagation speeds of the Agulhas 'eddies'.
3. Throughout manuscript: Perhaps use Agulhas *rings* instead of Agulhas *eddies*. Ocean eddies arise from baroclinic instabilities, while ring shedding is a different processes.
4. Line 58: The salt-advection feedback is the dominant destabilising AMOC mechanism and has been demonstrated in climate/AMOC models of varying complexity (Dijkstra, 2024). This sentence suggests that there are more (equally important?) feedback mechanisms, which ones did you consider? Note that the AMOC can be weakened through rapid climate change (e.g., Gérard and Crucifix, 2024) or large freshwater flux change (Oríhuela-Pinto et al., 2022), but these AMOC responses are related to the imposed forcing and not to a self-amplifying feedback loop (see also Major point 1).
5. Line 67: '... lead to an AMOC collapse (Rahmstorf, 1996)'. I would add the study by van Westen et al., (2024a), they demonstrate an AMOC collapse in a modern complex climate model under quasi-equilibrium hosing conditions. The study by Dijkstra (2024) is also relevant here, as it provides a review of AMOC tipping behaviour in a hierarchy of climate models.
6. Line 97 – 98: Only one RCP scenario is available within the iHESP project, namely the RCP8.5 scenario. This suggests that more RCP

scenarios are available for the CESM and you only selected the RCP8.5 for the analysis. Please refer to the RCP8.5 scenario here (or motivate why you have focussed on the RCP8.5 scenario).

7. Line 120: ‘lower resolution counterpart’ → lower (1°) resolution counterpart. Good to quantify the resolution here.
8. Lines 127, 151, 161, etc.: ‘absolute dynamic topography (Sea Surface Height above geoid)’. I would recommend to use ‘dynamic sea level (DSL)’, following the terminology proposed by Gregory et al. (2020). The DSL corresponds to the ‘SSH’ variable from the CESM output.
9. Line 128: ‘model’s capacity’, which model are you referring to? The FOSI?
10. Line 129: This product → The altimetry product. The reference to ‘this product’ is not clear to me.
11. Line 207: Figure A5, maybe re-order the appendix figures so that they appear in their reference order as in the main text. So Figure A5 → Figure A2 (and move/re-label these figures in the Appendix).
12. Line 226: salt flux and freshwater flux. I suggest to use salt *transport* and freshwater *transport*, which is then consistent with the definition used in line 227 (annual freshwater transport). Check this throughout the manuscript.
13. Line 244: Upsream → Upstream (typo)
14. Line 247: In the model → In the CESM (mention the CESM here).
15. Line 264: Is this the variability between 2 – 5 years, the period with significant (95%-Cl) peaks? Good to quantify the ‘inter-annual variability’ here.
16. Line 265: Alternatively, you could determine the confidence level at which the 40–50 year period is significant (similar to the p-value of 0.06, line 169).
17. Line 405: transport volume → volume transport

18. Line 410: A recent study by Arumí-Planas et al. (2024) quantified the F_{ovS} from available observations, the present-day F_{ovS} is indeed negative. This study is worth mentioning here.

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17. van Westen et al., (2024b): The Role of Sea-ice Processes on the Probability of AMOC Transitions, https://arxiv.org/abs/2401.12615