

## ***Interactive comment on “Influence of position and strength of westerlies and trades on Agulhas leakage and South Benguela Upwelling” by Nele Tim et al.***

### **Anonymous Referee #1**

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#### General comment

I appreciate reading this study as it is important to further study the impact of the SH wind system on Agulhas leakage dynamics and Benguela upwelling system –past, present, future. In this respect, I think it is important to highlight in the community the results here that reinforce some earlier findings in that the westerlies strength is important in driving leakage dynamics in comparison to older, outdated theories that are centered around the “width of the gateway” on the southern tip of Africa.

#### Abstract

Page 1 Rephrase to: Line 3: Agulhas leakage constitutes a fraction of warm and saline  
C1

water transport from the Indian Ocean into the South Atlantic.

Line 4: "The leakage is stronger during intensified westerlies and probably also when the wind systems are shifted poleward." Probably? If you are not sure or there is no evidence based on that study for that I would leave it out. Line 10: Give numbers here for the CO<sub>2</sub> emission scenarios or the RCP ones you referring to. Rephrase: Line 15: An increased contribution of Agulhas water to the upwelling system will feed water masses that will import more preformed nutrients and oxygen into the upwelling region. Line 19: with larger scale implications –like what? Line 20: change to Southern Hemisphere Westerlies and Easterly Trade winds Line 20: Here, we analyze several observational . . . .the last century and past two millennia. With the aim to understand what? Page 2 Line 28: As the Peeters et al. 2004 record is based on qualitative reconstructions of Agulhas leakage rather than quantitative numbers I would suggest to rephrase that to: “During glacial periods leakage was strongly diminished, based on qualitative reconstructions of foraminiferal assemblage counts, whereas the transport of Indian Ocean waters into the South Atlantic was enhanced during interglacial periods (Peeters et al., 2004).

#### Page 3

Line 1: Simon et al. 2013 and 2015 actually, noted that changes in temperature and salinity in the Agulhas leakage is at least partly the result of variability in the composition in the current itself and can be a poor indicator of the strength of the leakage. Hence please rephrase that part to actually refer to the citations in an appropriate way.

Line 2: I dislike the “gateway theory” of driving AL amount very much. The common assumption is that shifts of the Southern Hemisphere westerly wind belt, (in particular the position of the zero wind stress curl) would have led to the widening/narrowing of the gap between Africa and the STF, thereby controlling the amount of warm salty Indian Ocean waters leaking into the South Atlantic. However, this assumption has been questioned (De Boer et al., 2013; Durgadoo et al., 2013). These studies showed

that the position of the STF is not related to the position/shifts in the wind belt i.e., position of the zero wind stress curl and that Agulhas leakage increases with northward shifted westerlies a scenario originally proposed for a narrower gateway. It is therefore unclear whether shifts of the wind fields did in fact act to alter past rates of Agulhas leakage, which might imply that other factors, despite the movement of the STF, were equally important in determining leakage.

Page 7: Line 1-6: Here the work of Loveday, B. R., P. Penven, and C. J. C. Reason (2015), Southern Annular Mode and westerly-wind-driven changes in Indian-Atlantic exchange mechanisms, *Geophys. Res. Lett.*, 42, 4912–4921, doi:10.1002/2015GL064256. should be cited and discussed in comparison. Page 9: Line 6: Peeters et al. 2004 can't be used as reference for the LIA comparison. Moreover, there are more studies in the area that cover the LIA interval and should be taken into account here when comparing to data. e.g. Hahn et al., 2017 *Clim. Past*, 13, 649–665, 2017 <https://doi.org/10.5194/cp-13-649-2017> Moreover, if westerlies shifted equatorward and or weakened during glacials remains debated and speculative until now.

Line 13: In the weaker emission scenario, by contrast, significant trends mark a northward shift of the westerlies and a weakening of trades and westerlies.

So I wonder how the different RCP scenarios can provide such different results and hence how reliable they are then at all? If the models are struggling to reproduce the trends in the observational time period how can we believe any estimate for the RCP scenarios? Moreover, I don't understand the explanation given for the differences? Here more explanation would be appreciated with the regards to the ozone recovery mentioned.

Page 11 Fig.6: That is interesting result. Hence looking at the Agulhas Current itself it seems like that more a northerly position of the trades is linked to positive SST anomalies in the current itself but actually the opposite for the areas outside the main flow

C3

path. How is a northerly position of the trades related to warmer Agulhas SSTs in the model? That part is a bit confusing to start with in terms of which ocean areas around South Africa are correlating with what position of the trades? Page 13 Line 9: Here another perspective should be given as Beal & Elipot 2016 showed based on observations that there is a broadening not strengthening of the Agulhas Current since the early 1990s.

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C4