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some earlier findings in that the westerlies strength is important in driving leakage dynamics in comparison to older, outdated theories that are centered around the “width of the gateway” on the southern tip of Africa.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 CO2 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
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).

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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 compos-
tion 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.

Line 6: Peeters et al. 2004 can’t be used as reference for the LIA comparison. More-
over, 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,
equatorward and or weakened during glacialss remains debated and speculative until
now.

Line 13: In the weaker emission scenario, by contrast, significant trends mark a north-
ward 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 anom-
lies in the current itself but actually the opposite for the areas outside the main flow
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.