

Biogeosciences Discuss., referee comment RC2  
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## Comment on bg-2022-22

Anonymous Referee #2

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Referee comment on "Summer trends and drivers of sea surface fCO<sub>2</sub> and pH changes observed in the southern Indian Ocean over the last two decades (1998–2019)" by Coraline Leseurre et al., Biogeosciences Discuss.,  
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Leseurre et al. use a 20-year observational data set to interrogate trends in seawater fCO<sub>2</sub> and pH in three zones of the Southern Indian Ocean. They find a range of rates of change due to different processes in each of the zones. This study offers a unique data analysis in a data-poor region important to ocean CO<sub>2</sub> uptake. Given the variety of observations made, this study also allows for valuable comparisons of different approaches to estimating carbon chemistry and Cant.

### Major comment:

Data grouping and analysis methodology – The methods of determining and applying data groupings need to be explained in more detail. How were the size/shape of the boxes in Figure 2 determined? It's not clear whether this was a practical decision based on the density of data or whether the boxes map to the science questions for each of the three domains. What is the difference between the red and yellow boxes/lines? Do the boxes only refer to data grouping for the surface underway data, or are underway data also grouped with surface measurements from the discrete data at stations O6-O12 and A3? Are the trends presented in Table 2 for stations O6-O12 and A3 just trends for the near-surface measurements, or do those trends also include subsurface water column data? Or all measurements in the mixed layer as alluded to in the results? If so, what are average summer mixed layer depths in these domains? All this needs to be clarified in the methods.

### Other comments:

Page 6 lines 18-19 – Please describe the typical frequency of the summer cruises.

Figure 3 – This figure includes winter data, but only summer data collection is described in the methods. Please explain.

Equation 1 – It may be useful to provide the r squared value to show the correlation between measured and estimated alkalinity.

Captions of Tables 1 and 2 – Student “t-”test?

Figure 4c – What is the reason alkalinity trends are so different between the underway and O7 and O8 data sets? I see later in the discussion the interpretation that this is due to biologically-driven changes in alkalinity not captured by the underway data. Could there also be changes in alkalinity deeper in the water column that vary from the surface?

Page 14 line 32 – Are the results not shown from chlorophyll data collected as part of this study, or from another analysis of satellite ocean color?

Page 14 line 33 – How would interannual variability of biological processes bias the trends? Do you mean cause increased uncertainty (via noise) in the trends?

Page 14 line 35 – Given the strong decadal variability in the Southern Ocean as pointed out in the introduction, is calling a 10-20 year trend a long-term trend accurate? It may be more accurate to call them decadal trends.

Page 15 line 23 – Do you mean no significant “deviation in CO<sub>2</sub> uptake from equilibration with the atmosphere” during the summer?

Page 16 lines 15-18 – Isn’t this partially explained by what’s presented in Figure 6?

Page 17 lines 10-11 – Aren’t there caveats to this? Some but not all properties? Biogeochemical processes are happening in the subsurface over that previous year while the water is not in contact with the atmosphere.

Figure S1 – Since the discussion in section 4.4 relies completely on data presented in the supplemental, it may be worth moving the saturation state data from this figure to the main portion of the manuscript.