

Interactive
Comment

Interactive comment on “Inter-annual variability of the carbon dioxide oceanic sink south of Tasmania” by A. V. Borges et al.

Anonymous Referee #1

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General Comments

This study is one of the first to investigate inter-annual variability of air-sea CO₂ fluxes from the Southern Ocean using in situ observations of pCO₂. The manuscript is very well written and I recommend its publication, provided the following issues are addressed.

Major Comments

(1) There is some confusion throughout the paper regarding the timescales of variability that the authors are investigating. The title indicates that the major findings relate to inter-annual variability, but there is quite a bit of discussion about higher-frequency variations (seasonal time scale) and low-frequency variations (trends in the time series).

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Often times, discussions about variability on more than one time scale are grouped into the same paragraph (sometimes the same sentence). I would recommend that the authors work to establish more clearly the timescale of interest to them.

(2) It seems as though the authors are attempting to explain the inter-annual variations in SST, pCO₂, and air-sea CO₂ flux by inter-annual variations in the SAM itself, but more could be done to support this idea. Only one time series is shown in the paper (Figure 10), and I think the reader would benefit from seeing the time series of SST, pCO₂, and air-sea CO₂ flux anomalies (once the seasonal cycle is removed) in the various regions alongside a time series of the SAM index.

Minor Comments

(1) 3640, line 4 - Mention that this data is being used primarily to investigate inter-annual variability

(2) 3640, line 9 - Seasonality (winter-time input) is mixed into the discussion, which does not necessarily provide an explanation for inter-annual variations.

(3) 3640, line 12 - "the observed trend" is this a discussion of long-term trends in the sink in atmospheric CO₂, or simply a pattern of inter-annual variability?

(4) 3641, line 3 - reference Inoue and Ishii should be in parenthesis

(5) 3643, equation 1 - change subscript pCO₂sea199i and pCO₂air199i to pCO₂seayear and pCO₂airyear, to account for data for entire time series (1991 - 2003).

(6) 3644, line 12 - "using the algorithms of C", unnecessary text

(7) 3644, line 16 - "trends", word choice clarification, please change to "patterns"

(8) 3645, line 12 - "consistent" should read "consistent with"

(9) 3646, line 1 - word choice, "trends" should be changed to "patterns"

(10) 3646, line 4 - word choice, "trends" should be changed to "patterns"

- (11) 3646, line 21 - "an increase in the SAM" should read "a change in the SAM"
- (12) 3646, line 23 - "The increased SAM" should read "An increase in the SAM"
- (13) 3647, line 2 - Add here that these in situ data support this theory (do they?), and draw the readers attention to a figure showing SST time series and SAM time series (as mentioned in major comment #2)
- (14) 3647, lines 21-23 - This sentence is unclear, as the SAM itself has a relatively weak seasonal cycle. Perhaps it should be written, "These regions respond to the SAM differently in different seasons" ?
- (15) 3649, line 7 - Begin this paragraph with a clearer explanation of your methodology. As I understand it: "We lengthen the oceanic pCO₂ time series to include the years 1982 to 2005 using the reynolds SST data and our previously established relationships between observed SST and pCO₂ from 1991-2003."
- (16) 3649, line 9 - If you include a figure containing time series of the SST and pCO₂ anomalies, here would be a good place to add the newly acquired data to the time series (using a different color for easy identification). Then this sentence could be easily combined with the next sentence and put at the end of the paragraph to read "The pCO₂ and SST anomalies were added to the climatological cycles in Figs 2,3,4 and to the anomaly time series in Figure XX."
- (17) 3650, line 18 - word choice, "trends" should be changed to "patterns"
- (18) 3650, line 20 - "The small annual F anomalies in 1985...", This statement is confusing, as in the previous paragraph (line 7) it is stated "In particular, the annual F anomalies in 1985... are larger compared to other years". Please clarify this inconsistency.
- (19) 3650, line 25 - Again, if there were a figure containing air-sea CO₂ flux and SAM time series, it could be used to provide evidence in support of this last sentence.

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(20) 3650, last two lines - should be changed to "Examining the relationship between anomalies in CO₂ flux and SST on inter-annual time scales provides insights of biogeochemical responses to projected long-term trends in SST and stratification of the Southern Ocean..."

(21) 3652, lines 3-7 and lines 21-23 - Please clarify whether you are discussing inter-annual variability or seasonal variability here (see Minor Comment #14).

(22) 3652, line 25 - word choice, "trend" should read "pattern"

(23) 3653, line 1 - word choice, "trend" should read "pattern"

(24) Figures 2, 3, and 4 should be combined into one figure. They are always referenced together in the text, and it would make for ease of comparison.

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