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

**Anonymous Referee #1**

Received and published: 18 November 2007

### General Comments

This study is one of the first to investigate inter-annual variability of air-sea CO<sub>2</sub> fluxes from the Southern Ocean using in situ observations of pCO<sub>2</sub>. 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, pCO<sub>2</sub>, and air-sea CO<sub>2</sub> 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, pCO<sub>2</sub>, and air-sea CO<sub>2</sub> 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 CO<sub>2</sub>, 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 pCO<sub>2</sub>sea199i and pCO<sub>2</sub>air199i to pCO<sub>2</sub>seayear and pCO<sub>2</sub>airyear, 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"

**BGD**

4, S1944–S1947, 2007

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(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 pCO<sub>2</sub> time series to include the years 1982 to 2005 using the reynolds SST data and our previously established relationships between observed SST and pCO<sub>2</sub> from 1991-2003."

(16) 3649, line 9 - If you include a figure containing time series of the SST and pCO<sub>2</sub> 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 pCO<sub>2</sub> 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 CO<sub>2</sub> 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 CO<sub>2</sub> 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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Interactive comment on Biogeosciences Discuss., 4, 3639, 2007.

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