**Ocean Science**
Discussions

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# *Interactive comment on* "Variability and stability of anthropogenic CO$_2$ in Antarctic Bottom Waters observed in the Indian sector of the Southern Ocean, 1978–2018" *by* Léo Mahieu et al.

**Anonymous Referee #1**

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General comments: This manuscript deals with temporal variations of anthropogenic CO2 in bottom waters in the Southern Ocean. The Southern Ocean is said to take up 40% of anthropogenic CO2 absorbed by the ocean. Thus, investigations of temporal variability of anthropogenic CO2 are very important to evaluate ocean's capacity of absorbing atmospheric CO2, information of which is indispensable for the projection of global warming. In terms of oceanic observation, the Southern Ocean is one of the regions, where the number of measurements, especially for chemical and biological properties, is scare. In this point also, it is worth of being published in the journal. The manuscript is well organized, and is easy to read. The approaches used in the study are not new, but traditional ones. It is not a problem. It would be necessary

to adopt an approach, which has been demonstrated to be useful for the detection of small signals of anthropogenic CO2 variations. The authors attempt also to relate the variations to those of AABW formation, although not clearly found. As a whole, it seems that the manuscript is worthy of publication in the journal, but after a moderate revision. A few major comments are stated in the followings, and the minor ones are stated in the specific comments. In this paper, temporal variability of anthropogenic CO2 is examined using historical data collected at OISO. The data have been quality controlled by some data synthesis activities such as GLODAP. Nevertheless, I have a question on this point; the data syntheses have been done with a purpose of obtaining data consistency of a basin-scale. By contrast, the authors examine temporal variability of a local scale. In addition, data consistency is usually confirmed by data in deep layers of > 2000 m. This paper deals with data in deep layers. From these points, it is necessary to show that results obtained in the present study is not influenced by the data synthesis. Furthermore, for the recent data, quality control is made independently. Is there any possibility that the Cant stability is caused by the quality control? I recommend the authors to conduct quality-control on OISO data independently. In discussion, the authors attempt to relate variations of anthropogenic CO2 in AABW to changes in AABW formation region. It is well discussed, but information of water mass age of AABW is lacking. It is necessary to show that linkages between variations of AABW formation region and observed AABW signals at OISO are appropriate in terms of water mass age. O2 and AOU are used simultaneously. I think, it is enough for one of which, probably AOU.

Specific comments: Line 18: "from about +7 ïĄ■mol kg-1", increase from what?

Line 20: "CT", this is the first appearance in the abstract. Write it in full.

Line 23: "ïĄŚ, S", they are the first appearance in the abstract. Write them in full.

Lines 90-91: "station 430", depth?

Line 91: "405 km and 465 km", away from where?

Line 109: "the PET sector", is it usually used? I do not understand where it is.

Line 150: "AT", Probably this is the first appearance. Spell out here.

Line 160: "ïĄŚ and S", spell out here.

Lines 163-165: according the description, it seems that the figures are not accuracy but repeatability.

Line 236: "January", which year. In this paper, all the data are analyzed assuming that seasonal variations in deep waters are negligible (lines 154-156). It is not appropriate to refer to months.

Line 276: "underlying", do you mean a water mass below AABW?

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