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Comment

***Interactive comment on “Atmospheric oxygen and carbon dioxide observations from two European coastal stations 2000–2005: continental influence, trend changes and APO climatology” by C. Sirignano et al.***

**Anonymous Referee #2**

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This paper presents a five-year record of atmospheric oxygen and carbon dioxide flask sample measurements from the two coastal stations Lutjewad, the Netherlands, and Mace Head, Ireland. This is a very valuable new data set. The continental influence is discussed by comparing the data of the marine baseline station (Mace Head) with the more continentally influenced station (Lutjewad). APO, a composite tracer of oxygen and carbon dioxide indicating the oceanic signal, is then compared to model results and it is shown that for continentally influenced stations the fossil fuel component needs to be taken into account. This is an important result for inverse modeling exercises and

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will be relevant for several other continental stations where oxygen is measured. Another very interesting but also very tricky point are the trends, as they imply an unexpected “missing oxygen sink”. A crucial point when interpreting trends and in particular with respect to the observed acceleration of the oxygen decrease is the long-term stability of the internal CIO oxygen scale. Therefore, a quantitative assessment of the long-term stability of the calibration scale as well as possible biases during sampling and storage of the flasks would greatly strengthen the manuscript and support the presented analysis of the data.

The overall presentation is well structured and clear. The paper is generally well written though some paragraphs might benefit from a more concise language. The references need to be sorted out as some are missing in the Reference section while others do not appear in the text.

In summary, I recommend publication of this paper in ACP, subject to the suggested revisions. Some specific comments are listed below.

Specific comments and questions:

P20116 lines 4-5: Depending on the timescale the oceanic biology can very well have a remarkable impact on the atmospheric carbon cycle. Make clear that seasonal variations are meant here.

P20116 lines 8-11: Rewording of this sentence might help to clarify its meaning.

P20117 line 25: The citations Tans et al., 1989, 1990 do not fit here as they are not related to oxygen concentration measurements.

P20120 line 7: Manning et al., 2001, and Sturm et al., 2005c, are missing in the References section.

P20121: I suggest to remove the factor 1000 in Equation 1. That way the  $\delta$ -value is defined independently of units and can then be expressed coherently either in ‰ ( $= 10^{-3}$ ) or per meg ( $= 10^{-6}$ ).

P20121 lines 17,20: Worthy and Huang, 2005, and Miller, 2006, are missing in the Reference section.

P20125 line 13: The Mace Head CO<sub>2</sub> amplitude is stated here as (102 ± 5) per meg, whereas in Table 1 (and in the abstract) it is (113 ± 3) per meg.

P20126 line 17: Prentice et al., 2001 is missing in the Reference section.

P20128 lines 13-17: Rewording of this sentence might help to clarify its meaning.

P20130 line 3: "... Manning and Keeling (2006)."

P20130 line 8: The anthropogenic term in Equation 5 should be positive (plus instead of minus sign after the equals sign).

P20132 line 21: It is not clear here what the difference between APO and ΔAPO is. Also, is ΔF a change in mole fraction (e.g. in μmol\*(mol dry air)<sup>-1</sup> year<sup>-1</sup>) or just a deviation from a reference mole fraction?

P20133 line 28: "the pCO<sub>2</sub>-derived...". Remove "patterns".

P20134 line 25: Either use μmol\*(mol dry air)<sup>-1</sup> or μmol/mol dry air throughout the text.

P20136 line 11: "shown in Fig. 6a (Mace Head) and b (Lutjewad)."

P20138 lines 24-26: To state that the measurements and the model data show an excellent agreement seems very optimistic given that only the trend but neither the amplitude nor the phase can be reproduced.

References: Ciais et al., 1995, Denning et al., 1999, Keeling and Whorf, 2005, Manning et al., 2003, Rödenbeck et al., 2005, Schmidt et al., 1996, and Sturm et al., 2006 appear in the References but are not cited in the text.

Table 2: The O<sub>2</sub> trends seem to be in per meg year<sup>-1</sup> and not in μmol\*(mol dry air)<sup>-1</sup> year<sup>-1</sup>.

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