

## ***Interactive comment on “Computation and analysis of atmospheric carbon dioxide annual mean growth rates from satellite observations during 2003–2016” by Michael Buchwitz et al.***

### **Anonymous Referee #1**

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The paper describes the analysis of column-average dry-air mole fractions of CO<sub>2</sub> observed by SCIAMACHY and GOSAT. The data being analysed represent over a decade of substantial international efforts and is an amazing accomplishment that is documented in many previous papers. The headline figures from this paper look impressive but the subsequent analysis is weak and does not add much to the main paper. Below I substantiate these comments. I recommend the paper be published but only after the major issues are addressed.

#### Major points

The authors will be acutely aware that it is difficult to compare NOAA ground-based

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data with XCO<sub>2</sub> data from ground-based or space-based remote sensing instruments. Columns are an integrated sum of many geographically distributed sources and sinks from a range of times that have been distributed throughout the atmosphere. Consequently, it is difficult to compare NOAA and XCO<sub>2</sub> CO<sub>2</sub> growth rates. Here, I am suggesting only that the authors acknowledge this as a difficulty.

The global growth rates determined by XCO<sub>2</sub> are I believe valid and physically meaningful. However, regional growth rates (no matter how you divide the Earth) make little or no sense because of atmospheric transport that moves air from one region (e.g. zonal band indicative of midlatitudes) to another. It is tempting to interpret regional growth rates, but they are (strictly speaking) scientifically meaningless without understanding changes in atmospheric transport. By (implicitly) ignoring atmospheric transport the authors are essentially assuming that observed regional CO<sub>2</sub> variations results exclusively from that region.

The authors' attempt at quantifying the respective role of human emissions and ENSO on CO<sub>2</sub> growth rates is unfortunately (at least in this reviewer's opinion) a fool's errand. Our knowledge of human emissions is relatively good but still poor. Liu et al 2017 (Science) showed contrasting tropical carbon cycle responses in response to ENSO. These different responses will only complicate the correlative analysis of CO<sub>2</sub> growth rate and ENSO indices.

#### Minor points

Line 6. Geological processes are only a minor sink of CO<sub>2</sub> over decadal scales. I applaud the authors being comprehensive but this reviewer suggests a focus on the timescales that correspond to the analysis being presented.

Line 10/11. Relating GtC/yr to ppm is an undergraduate exercise that barely needs a reference let alone two.

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