

Interactive comment on “Global XCO₂ anomalies as seen by Orbiting Carbon Observatory-2” by Janne Hakkarainen et al.

Anonymous Referee #2

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The authors present a novel technique to determine CO₂ anomalies from the OCO-2 satellite instrument, which in principle is not designed to detect such variations. This work has been first published by them in GRL (2016). In their GRL paper, the authors indicated a number of potential improvements to their technique, which have been taken into account in the present paper. They have provided a sensitivity analysis of their method and further investigated the impact of various assumptions. Besides refining their technique, the results are now covering 3 instead of 1.5 years providing a picture into inter-annual variations. They now also present seasonal variations and a global picture as opposed to selected areas in their GRL paper. They made a first attempt to interpret their results by comparing them with vegetation fluorescence (SIF) and looking at model results from biogenic and fossil fuel CO₂ signals.

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In general the paper in its current form misses an essential element. It stays too much at the level of GRL, which is generally more like a news item and possibly requires less attention to the scientific value of the results. On the other hand, the paper is now also too much focusing on the actual method, which makes it lean toward an AMT paper. The paper requires the inclusion of a discussion section for the scientific community. The introduction clearly highlights the importance of CO₂ and measures required to reduce greenhouse gas emissions (COP21). Presumably, this is also one of the reasons the authors compare model results of separated biogenic and fossil fuel signals with their observed anomalies. The authors should include in the discussion section an interpretation of the results and reach out to the modelling community highlighting how these results can be used in their models (for reference see Bergamaschi et al, 2018). This would enhance the relevance and context of the paper making it suitable to ACP were it is in its right place. They shall also provide a vision for future use of this technique combining several satellite missions and what this means for future planned missions, e.g. OCO-3, GOSAT-2, MicroCarb, GeoCARB, Chinese and European wide-swath constellation plans. Can it be applied to one or a combination of these missions? Based on the new/elaborated discussion section, the authors need to update the abstract, which now only hints in its last sentence to 'a potential'.

Detailed comments: - General: it is not clear where results are significant and what the related errors are of the derived anomalies. - P3 L12, 'latest' will be overtaken in time and should maybe best be removed. - For OCO-2 data, please indicate whether both nadir and glint data are used. - P6 L24-25, why do you expect a relation to season in the anomaly of the industrial area of South Africa, especially with the indicated relation to draw down/SIF? You have seen the same in FLEXPART which implies you could pull out the underlying reason. - The supplement provides details on data density per year in Figure S1, but it would good to also have details on the data density per season.

Bergamaschi, P., A. Danila, R. F. Weiss, P. Ciais, R. L. Thompson, D. Brunner, I. Levin, Y. Meijer, F. Chevallier, G. Janssens-Maenhout, H. Bovensmann, D. Crisp, S. Basu, E.

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Dlugokencky, R. Engelen, C. Gerbig, D. Günther, S. Hammer, S. Henne, S. Houweling, U. Karstens, E. Kort, M. Maione, A. J. Manning, J. Miller, S. Montzka, S. Pandey, W. Peters, P. Peylin, B. Pinty, M. Ramonet, S. Reimann, T. Röckmann, M. Schmidt, M. Stogies, J. Sussams, O. Tarasova, J. van Aardenne, A. T. Vermeulen, F. Vogel, Atmospheric monitoring and inverse modelling for verification of greenhouse gas inventories, EUR 29276 EN, Publications Office of the European Union, Luxembourg, 2018, ISBN 978-92-79-88938-7, doi:10.2760/759928, JRC111789

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