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Comment

Interactive comment on “Current systematic carbon cycle observations and needs for implementing a policy-relevant carbon observing system” by P. Ciais et al.

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We thank Dr. D.G. Feist for evaluation of article published in J. Biogeosciences Discuss. The manuscript was substantially modified. A list of Author’s comments/responses and report on edits made to the manuscript are listed below.

1) Thank you for picking up this important topic and producing a rather complete wrap-up of what is needed to make meaningful carbon observations. Coming from the ground-based remote sensing community (TCCON), I have some comments: TCCON and its significance are mentioned many times. Still, no-one from that community is actually on the author list.

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– The Authors contacted TCCON community with certain proposal for contribution to paper and co-authorship. However, the opinion of the TCCON coordinator was that this paper would serve the TCCON better if people are not in fact co-authors. At the same time, we have got some valuable suggestions on a way of representation and recent references to TCCON.

2) Section 3.3.4: References Fig. 3c for the TCCON stations. In fact, it is Fig. 3b.

– We have made the required corrections to figure numbers. It is Fig.3b now, not Fig.3c for the TCCON stations.

3) The fact that ground-based FTS instruments can measure several trace gases at once should be more stressed. The current TCCON standard product already consists of XCO₂, XCH₄, XCO, XN₂O, XH₂O, XHCl, XHF, XHDO (all routinely submitted to TCCON data archive). More species are possible and could be retrieved from the already existing measured spectra. An extension of the TCCON wavelength range (instrument upgrade required and more costly logistics -> cooling) would allow measurements of XOCS, XC₂H₆ and many other species. The "vicarious" means are typically air-craft measurements with instruments that are commonly used for continuous in-situ measurements. The uncertainties are mostly due to parts of the atmosphere that are not easily accessible to in-situ measurements (stratosphere) but are seen by both ground-based and space borne remote sensing instruments. Both the calibration factors for XCO₂ and XCH₄ and their uncertainties have been well-established (Geibel et al. ACP 2012, Messerschmidt et al. ACP 2011, Wunch et al. AMT 2010).

Section 4.5.2:

One should not only guarantee the continuity of TCCON but also its extension to regions that are crucial to carbon cycle science (e.g. tropics) as well as satellite validation (e.g. oceans, deserts). It should be mentioned (again) that a ground-based reference like TCCON is absolutely crucial for existing and future satellite missions. Besides, a TCCON station has a large footprint. Strategically placed, it could cover a large region

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that is otherwise difficult to reach with in-situ measurements.

An important point that is missing: keep GOSAT running as long as possible to provide a maximum overlap with OCO-2, GOSAT-2, and other upcoming satellites. This might be obvious to the scientists but not necessarily to the GOSAT funding agencies.

– We are grateful to D. G. Feist for detailed description of instruments, products and uncertainties achieved by the TCCON, as well as its importance for future satellite missions and that is taken into account in the next version of manuscript. Please see revised sections 3.3.4 and 4.5.2.

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