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Comment

# ***Interactive comment on “Terrestrial carbon sink observed from space: variation of growth rates and seasonal cycle amplitudes in response to interannual surface temperature variability” by O. Schneising et al.***

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First of all, we would like to thank the reviewer for the helpful comments. Below we give answers and clarifications to all comments made by the referee (repeated in italics).

*This paper uses SCIAMACHY data from 2003 to 2011 to investigate variations of growth rates and seasonal cycle peak-to-peak amplitudes in observed XCO<sub>2</sub>. They find significant interannual variabilities (IAV) of XCO<sub>2</sub> growth rates and seasonal cycle amplitudes, and the IAVs correlate with growing season surface temperature anoma-*

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lies. The results from SCIAMACHY data show good agreement with those from CarbonTracker. SCIAMACHY is only the satellite to provide XCO<sub>2</sub> over a decade, and it covers wide areas over the globe as opposed to accurate but localized surface measurements. The paper is well written and focused. It is well worth being published to show the usefulness of long-term satellite observations to global carbon cycle studies.

## Specific comments

*Page 22736, line 2: More than two years data is now available for GOSAT (e.g. ACOS, NIES) though they are still shorter than SCIAMACHY's long-term data.*

It was meant that previous publications analysing the interaction of CO<sub>2</sub> IAV and surface temperature using GOSAT data were based on two years of data. It is mentioned in the revised version that Wunch et al., 2013, extended their analysis to four years of data in their final ACP version.

*Page 22736, line 24: The year 2007 is a La Nina year. CO<sub>2</sub> emissions might change over the equatorial Pacific Ocean compared to a normal year. Does fitting to the 2007 data have any influence to the regression results?*

The year 2007 was chosen because it is right in the middle of the timeseries. The reduction of the correlations of the difference SCIA-CT with the relevant parameters is similar when using the linear regression correction derived from 2007 on data of other years. Hence, we conclude that the choice of the year has only minor influence on the regression results. This can be attributed to the fact that the corresponding corrected systematic errors are likely larger than the expected influence of equatorial Pacific Ocean emissions at the distant flask sampling sites used in the linear regression.

*Page 22736, line 24: I would like to know the reason of selecting these 7 Carbon Tracker sites. In addition, are the regression coefficients robust against site selection?*

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As mentioned in the manuscript, one reason for selecting these sites is that the model-data-mismatch at these sites is small, which means that CarbonTracker is expected to simulate the corresponding surface flask observations well there. It is also beneficial that a wide range of retrieval conditions (e.g. low and high albedo, low and high water vapour amount,...) is covered by the selection to identify as much potential systematic error sources as possible. This additional reason is added in the revised version. In this sense the site selection can influence the regression results because a specific error source cannot be identified, if the corresponding condition range is not sufficiently covered by the selection. For example, adding Assekrem (high albedo) is expected to improve the regression with respect to sun-normalised radiance.

*Page 22737, line 25: I would like to see spatial distribution of XCO<sub>2</sub> at some year (say 2007) and the Carbon Tracker site locations. Did you retrieve over the oceans?*

A corresponding Figure is added in the revised version. It can also be seen in this Figure that there are no retrievals over the oceans.

*Page 22738, line 5: Which version of TCCON data did you use? GGG2012 or a previous version?*

We used GGG2012 TCCON data.

*Page 22738, line 10: The correction method is recently often applied to satellite retrieved data. In this case, the model-data-mismatch at the selected Carbon Tracker sites is already small (Page 22737, line 1). How much improvement is there before and after applying the correction at the 11 TCCON sites?*

There might be some misunderstanding here. Model-data-mismatch refers to the comparison of CarbonTracker and flask data and is thus interpreted as the expected ability to simulate observations at the assimilated flask site. This is stated more clearly in the revised version. TCCON is only used as an independent validation source and not for correction of the satellite data.

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*Page 22738, line 17: What shape is a typical column averaging kernel of SCIAMACHY? Do they have enough sensitivity near surface to take correlations with surface temperature anomalies?*

As mentioned in the manuscript, SCIAMACHY's measurements yield atmospheric CO<sub>2</sub> with high sensitivity down to the Earth's surface. A typical column averaging kernel peaks at the surface. Hence, SCIAMACHY is well suited to analyse correlations of CO<sub>2</sub> IAV with surface temperature anomalies.

*Page 22739, line 24: Are these contributions of biospheric fluxes, fossil fuel and fire emissions referred from Carbon Tracker results? I couldn't understand how you derive these contributions from the text.*

Yes, the contributions are derived from the analysis of CarbonTracker fluxes and growth rates. This is clarified in the revised version.

*Page 22740, line 13: For the Southern Hemisphere, which database did you use for the analysis?*

Surface temperature anomalies from the NASA Goddard Institute for Space Studies are used globally, for the Northern and the Southern Hemisphere. The corresponding text passage is rephrased to avoid the possibility of misinterpretation.

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