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# Terrestrial carbon sink observed from space: Sensitivity of atmospheric $CO_2$ growth rates and seasonal cycle amplitudes to surface temperature

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The terrestrial biosphere is currently acting as a net carbon sink on the global scale, exhibiting significant interannual variability in strength. To reliably predict the future strength of the land sink and its role in atmospheric $CO_2$ growth, the underlying biogeochemical processes and their response to a changing climate need to be well understood. In particular, better knowledge of the impact of key climate variables such as temperature on the biospheric carbon reservoir is essential. Global satellite measurements of column-averaged mole fractions of atmospheric $CO_2$, which offer complementary information to the accurate and precise but inevitably sparse ground-based measurements, can contribute to determine characteristics of the terrestrial carbon sink.

It is demonstrated using nearly a decade of SCIAMACHY nadir measurements that years with higher temperatures during the growing season can be robustly associated with larger growth rates in atmospheric $CO_2$ and smaller seasonal cycle amplitudes for northern mid-latitudes. We find linear relationships between warming and $CO_2$ growth as well as seasonal cycle amplitude at the 98 % significance level. The quantitative estimates of the corresponding covariations are consistent with those from the CarbonTracker data assimilated $CO_2$ product, indicating that the temperature dependence of the model surface fluxes is realistic.

The derived results suggest that the terrestrial carbon sink is less efficient at higher temperatures during the analysed time period. Unless the biosphere has the ability to adapt its carbon storage under warming conditions in the longer term, such a temperature response entails the risk of potential future sink saturation via a positive carbon-climate feedback.