Global XCO_2 anomalies: Direct space-based observations of anthropogenic CO_2 emission areas from OCO-2 and comparison with inventory-based estimates

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Anthropogenic CO_2 emissions from fossil fuel combustion have large impacts on climate. In order to monitor the increasing CO_2 concentrations in the atmosphere, accurate spaceborne observations—as available from the Orbiting Carbon Observatory-2 (OCO-2)—are needed. In our recent work [*Hakkarainen et al.*, 2016] we provided a new approach to study anthropogenic CO_2 emission areas by deseasonalizing and detrending OCO-2 XCO_2 observations for deriving XCO_2 anomalies. The spatial distribution of the XCO_2 anomaly matches the features observed in the maps of the Ozone Monitoring Instrument NO_2 tropospheric columns, used as an indicator of atmospheric pollution, as well as the features observed in the ODIAC emission dataset. In addition, the results of a cluster analysis confirmed the correlation between CO_2 and NO_2 spatial patterns.

In this work, we study this idea further and provide the global XCO_2 anomaly maps for three full years 2015, 2016 and 2017. The patterns observed in these maps are compared with inventory-based estimates given by the Lagrangian particle dispersion model FLEXPART driven by the high-resolution ODIAC emission dataset. We also analyze the changes observed in XCO_2 anomaly maps and compare these changes to the inventory-based estimates, as well as to the changes observed in other trace gases (NO_2 and SO_2).

References

Hakkarainen, J., I. Ialongo, and J. Tamminen (2016), Direct space-based observations of anthropogenic CO_2 emission areas from OCO-2, Geophys. Res. Lett., 43, 11,400–11,406, doi:10.1002/2016GL070885.