



Explaining the redistribution of carbon dioxide fluxes seen in satellite-based inversions

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Flux inversions using GOSAT total column carbon dioxide measurements have shown significantly different patterns than those using the surface-based measurement network, with a substantially larger temperate northern hemisphere sink and a larger carbon source from tropical land. In particular the large sink found in Europe is difficult to reconcile with inventories and process models. These differences are quite consistent across inversion models and retrievals. At times the discrepancy between the two flux estimates has been discounted as an artefact due to undiagnosed systematic errors, poorly resolved transport, or sampling biases in the satellite measurements. None of these hypotheses has yet been proven convincingly, however, and the generally good agreement between the satellite retrievals and ground-based FTIR measurements from TCCON suggest that systematic errors are not to blame.

This study presents evidence suggesting that the problem may instead lie with a sampling bias in the comparatively sparse surface network which, while constant in time, leaves large portions of the earth completely unsampled. This study presents simulations where satellite measurements were spatially filtered to include only those near the surface stations, and the resultant fluxes are found to converge to those based on surface measurements alone when increasingly tight spatial constraints are applied. This suggests that the location of the stations, even within a given region, has a significant impact on the flux pattern inferred. This study suggests that the information from the two data streams is in fact consistent, but that the surface network alone, while critical for the determination of interannual variability, particularly over longer time scales, is not sufficient to constrain the regional distribution of fluxes. These results support the robustness of the flux redistribution seen in satellite inversions. This raises further questions regarding how to harmonize these results with the estimates based on inventories and process models, which must be the topic of further inquiry.