

Sensitivity of CO₂ Flux Inversions to the Temporal and Spatial Distribution of Observations

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Inverse modeling of regional carbon dioxide (CO₂) sources and sinks is sensitive to the observational coverage of the observing network. Here we use the GEOS-Chem adjoint model to examine the sensitivity of observations to surface fluxes of CO₂ for data from the surface *in situ* network, the Total Carbon Column Observing Network (TCCON), the Greenhouse Gases Observing Satellite (GOSAT), and the Orbiting Carbon Observatory (OCO-2). We find that OCO-2 has the highest sensitivity to surface fluxes throughout the tropics and southern hemisphere, while surface observations have the highest sensitivity to surface fluxes in the northern extratropics (Fig. 1). We perform Observing System Simulation Experiments (OSSEs) to examine how differences in sensitivities influence the ability to recover surface fluxes. In particular, we examine the impact of the spatio-temporal coverage of the different observing systems on the ability of the inversion analyses to recover the timing and amplitude of the seasonal cycle of the surface fluxes.

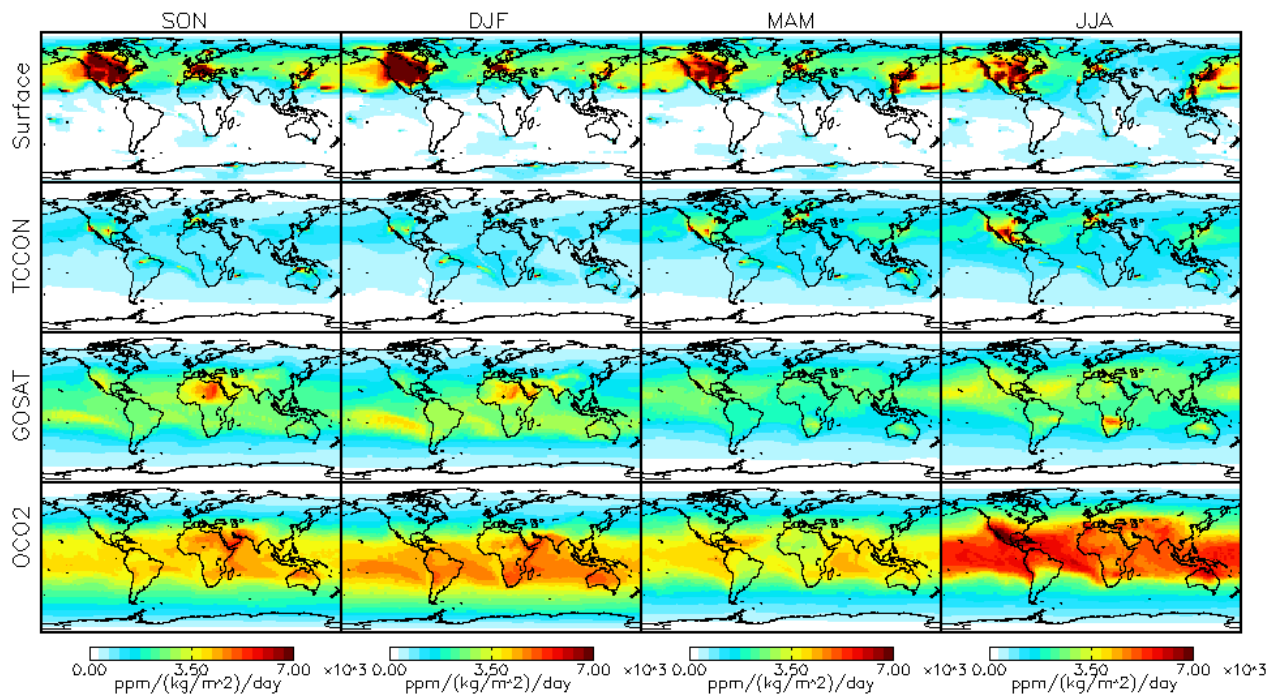


Figure 1. Seasonal sensitivities for surface *in situ*, TCCON, GOSAT, and OCO-2 observations to surface fluxes. Sensitivities are in observed quantity (ppm) per flux (kg/m²/day), resulting in units of ppm/(kg/m²/day).