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$^{14}CO_2$ as a diagnostic for vertical transport in atmospheric transport models

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Atmospheric transport models can be used in combination with trace gas observations to infer sources and sinks of these gases. However, if the model transport is uncertain, this translates directly to uncertainties in the inferred sources and sinks. Most observations are made at the surface so errors in vertical transport distort the relationship between sources and concentration. Recent studies indicate that the vertical transport is poorly represented in most current models, especially over the continents. Comparison of modeled and observed distributions of a surface-emitted tracer with a well-known flux distribution can be used to better constrain the vertical mixing. $^{14}CO_2$ observations, as a proxy for fossil fuel CO_2 emissions, have the potential to be an excellent tool for this application. Recent advances in precision and sample size requirements for $^{14}CO_2$ measurements mean that $^{14}CO_2$ measurements can now be made routinely for vertical profiles and horizontal transects. We use $^{14}CO_2$ observations to examine vertical mixing scenarios in two atmospheric transport models: TM5 and LMDz. An initial set of $^{14}CO_2$ observations from the trans-Siberian railway (TROICA-8 expedition) has been compared with two different vertical mixing parameterizations in TM5. Whereas the standard TM5 mixing scheme appears in good agreement with observations, a faster vertical mixing scheme significantly underestimates the observed gradient.