$^{13}C/^{12}C$ Isotopic Constraints on Inter-Continental Transport of Fossil Fuel CO_2 & Black Carbon (BC) Aerosols

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The fossil fuel fraction-weighted carbon isotopic compositions for the top 9 countries in emissions (http//:cdiac.ornl.gov) have been calculated from 1990 to 2008. In contrast to a homogenized global mean value of $\delta^{13}C_{FF}$, it was noticed that there is actually a large difference in $\delta^{13}C_{FF}$ between China/India (around -25‰) and other nations (between -27‰ to -33‰), indicating the differences in structure of Fossil Fuel (FF) usage in those countries and the impact from different stages of their economic development (Figs. 1 and 2). With the rapid economic developments of China and other South Asian countries (e.g. India) over the last 10 years, the influence of FF emissions from China/India has been largely increasing on both regional and global scales. Could those influences be recorded in the C isotopic compositions ($\delta^{13}C$) of the atmospheric CO_2 and BC aerosols, the two important components in FF emissions?

To identify and verify those FF influences with a focus on Asia-Pacific Transport, the $\delta^{13}C$ measurements in the atmospheric CO_2 and BC aerosols at various locations in North America (e.g. Alert, Barrow, Estevan Point, Sable Island, Bermuda), North Pacific Ocean (e.g., Mauna Loa) and Asia (e.g., Beijing, China; Tae-ahn Peninsula, South Korea) have been analyzed. The results show that FF emission signals can be recorded in the $^{13}C/^{12}C$ isotopic compositions of the atmospheric CO_2 and BC aerosols and that the FF CO_2 signals from Asia could be transported across Pacific Ocean to North America.

The work suggests that high precision $^{13}C/^{12}C$ isotope measurements in air CO_2 and BC samples can be used, as independent methods, to identify/verify FF signals and their influences on both regional and global scales when the corresponding emission sources are isotopically distinguishable. The results could be also used to constrain transport models for quantifying the relative contributions of air masses from different source regions.

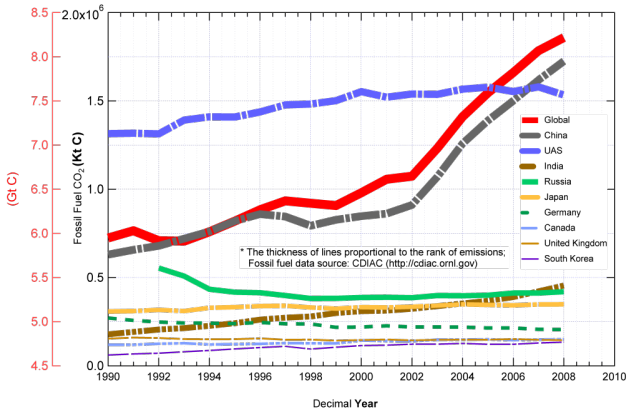

Figure 1. Fossil fuel CO_2 emission (Gt C) of top-9 countries in the world (in black Y axis) over the period from 1990 to 2008. The global mean is plotted again the red axis.

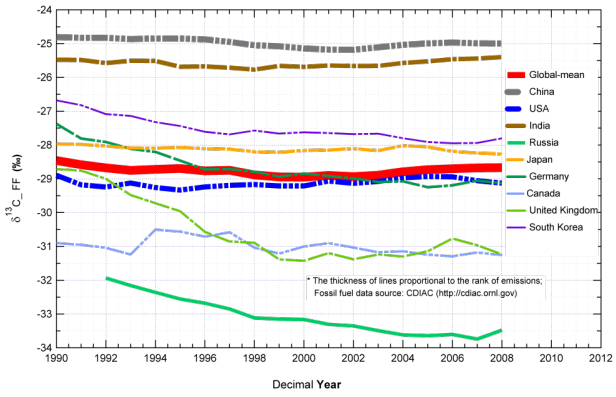

Figure 2. Fossil fuel mass fraction weighted carbon isotopic compositions ($\delta^{13}C_{FF}$ on VPDB scale) of the top-9 countries in the world over the period from 1990 to 2008. The global mean is in red.