Characteristics of the Atmospheric CO2 Signal as Observed from the DC-8 during MILAGRO

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High temporal resolution (1 s) in-situ CO2 measurements were conducted aboard the NASA-UND DC-8 during the MILAGRO campaign providing regional-scale observations over Mexico, the Gulf of Mexico and several U. S. states bordering the Gulf. Preliminary investigation of these data reveals comparatively localized sources in relation to subsequent observations over the North Pacific where widespread CO2 enhancements were observed during phase 2 of INTEX-B. In this analysis, the CO2 signal is examined in conjunction with other tracers for source attribution. Examination of CO and CH4 to CO2 relationships in concentrated plumes shows two types of relationships: steeper correlations, typically attributable to efficient fossil fuel combustion associated with modern technologies; flatter correlations often associated with less efficient fossil fuel combustion and biomass burning. The observations associated with more efficient combustion are found at low altitudes throughout the sampling region except over Mexico City and have enhancements above background up to 4.5% and 65% for CO2 and CO, respectively whereas, those associated with less efficient combustion are entirely over Mexico City and are elevated 6.4% and 820% above background. There is a lower CO:CO2 correlation for the high efficiency (HE) observations than the low efficiency (LE) ones (R2 of 0.41 vs 0.81) indicating that the LE combustion has a more homogenous source. Ratios of CO (CH4) to CO2 above background in these enhanced plumes are similar to (well in excess of) ratios characterizing sources observed in other campaigns. For example, the average CO:CO2 ratio in the LE plumes are similar to the fossil fuel ratios from Chinese and Indian fossil fuel combustion inventories while those in the HE plumes are more representative of ratios from Japan and Korea.

The above generalizations, however, may be insufficient to explain fully the MILAGRO DC-8 CO2 data. Terrestrial and ocean influences may also contribute to the lower correlation for the HE observations. Biosphere source influences (e.g winter respiration) could make fossil fuel plumes appear more efficient. Initial STEM model runs indicate that the adjoint-derived source footprint for these observations includes the southern portion of Mexico which has the highest biosphere source/sink in the region. Follow-on analysis using STEM to model biospheric CO2 will be useful to quantify/remove the biosphere influence and then re-examine the CO:CO2 results.