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CO2 Vertical Profile Constraints from OCO and Thermal IR Measurements

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Understanding changes in the concentrations, global sources and sinks, dynamics and other processes that control the variability of atmospheric carbon dioxide (CO2) has emerged as one of the principal challenges of 21st century Earth system science. Satellite observations of atmospheric CO2 are poised to revolutionize our understanding of global carbon cycle science by providing unprecedented spatiotemporal resolution and coverage. Major advances are expected with the launch of the Orbiting Carbon Observatory (OCO) in 2009.

Here, we carry out an information content analysis for simultaneous retrieval of near IR (NIR) OCO and thermal IR data (e.g. TES and AIRS). Since thermal IR measurements are sensitive to changes in the middle and upper troposphere but CO2 in the lower troposphere is easier to detect using NIR measurements, the simultaneous retrieval from AIRS or TES and OCO would provide complementary information on the CO2 vertical profile. Preliminary results show a considerable increase in the information content and degrees of freedom in the combined retrieval compared to retrieval using only OCO or only TES or AIRS data. Combined retrievals from infrared and OCO data will significantly improve the estimation of atmospheric carbon sources and sinks by providing observational constraints on vertical as well as horizontal and temporal distributions of atmospheric CO2 in data assimilation and data fusion approaches. Further, we will select channels from the OCO weak and strong CO2 bands based on the information analysis. It will be shown that the retrieval results using the selected channels are closely equivalent to those using all the channels. The new retrievals are faster and have lower biases.