CO_2 MEASUREMENTS FROM SPACE: PRESENT AND FUTURE

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The dawn of the 21st Century finds spaceborne sensors poised to revolutionize the atmospheric CO_2 record by providing high-quality measurements with unprecedented spatio-temporal coverage and density. Space-based CO_2 observations will augment local and regional measurements from ground and airborne sensors, providing global context for existing measurements and covering regions not readily accessible or instrumented by other means. Hyperspectral data from the Atmospheric Infrared Sounder (AIRS), launched in 2002, have been used to produce global maps of CO_2 concentrations in the mid-troposphere, despite the fact that AIRS was primarily designed to produce temperature and water vapor measurements to improve weather forecasts. These data provide important new constraints on the global distribution and transport of CO_2. Future satellite missions dedicated to CO_2 observations will collect precise global measurements, enabling more detailed process studies and contributing to further improvements in coupled carbon-climate model development, initialization, and validation. NASA's Orbiting Carbon Observatory (OCO), scheduled to launch in December 2008, will deliver measurements of column-averaged CO_2 dry air mole fraction, X_{CO2}, with the precision, temporal and spatial resolution, and coverage needed to characterize the variability of CO_2 sources and sinks on regional spatial scales and seasonal to interannual time scales. Looking ahead, the National Research Council's recently released Earth science decadal survey recommends the Active Sensing of CO_2 Emissions over Nights, Days, and Seasons (ASCENDS) mission for launch in 2013-2016 to advance spaceborne CO_2 measurements by delivering day and night measurements for all latitudes and all seasons. The AIRS-OCO-ASCENDS series of NASA satellite CO_2 observations, combined with continued ground and airborne measurements, will improve our understanding of the natural processes and human activities that regulate the atmospheric abundance and distribution of this important greenhouse gas, generating both scientific advance and societal benefit.