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Carbon Dioxide Measurements from Space: Scientific Advance and Societal Benefit

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The dawn of the 21st Century finds spaceborne sensors poised to revolutionize the atmospheric CO2 record by providing high-quality measurements with unprecedented spatio-temporal coverage and density. Space-based CO2 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 CO2 concentrations in the mid-troposphere. These data provide important new constraints on the global distribution and transport of CO2. Future satellite missions dedicated to CO2 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. Japan's GOSAT mission, scheduled for launch in January 2009 will measure CO2 and CH4 spectral radiances via thermal and near infrared spectrometry to study the transport mechanisms of greenhouse gases with an emphasis on identification of CO2 sources and sinks on sub-continental scales in support of the Kyoto protocol. NASA's Orbiting Carbon Observatory (OCO), scheduled to launch in February 2009, will deliver measurements of column-averaged CO2 dry air mole fraction, XCO2, with the precision, temporal and spatial resolution, and coverage needed to characterize the variability of CO2 sources and sinks on regional spatial scales and seasonal to interannual time scales.

Satellite CO2 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. Deriving actionable information from these observation sources further requires coordinated efforts in carbon-cycle modeling, data assimilation, and data analysis – spanning multiple networks, spatial scales, disciplines, and agencies. A preliminary interdisciplinary planning effort was initiated in 2008 by the authors in concert with representatives of other government agencies, academia, and non-governmental organizations to identify the mechanisms and systems needed to facilitate such end-to-end coordination. In this paper we present a status of this effort, key findings, and future plans.