CO_2 Measurements from Space: Present and Future

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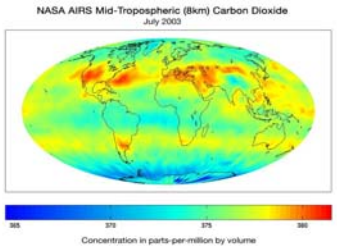
Introduction

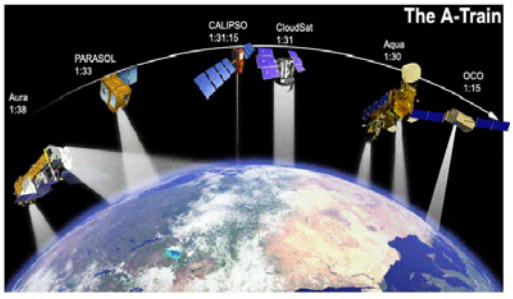
The dawn of the 21st Century finds spaceborne sensors poised to revolutionize the atmospheric CO_2 record by providing high-quality measurements with unprecedented spatio-temporal coverage and density. Space-based CO_2 observations will augment local and regional measurements from ground and airborne sensors, providing global context for existing measurements and covering regions not readily accessible or instrumented by other means. 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.

Atmospheric Infrared Sounder (AIRS)

The Atmospheric Infrared Sounder (AIRS) launched in 2002 aboard the Aqua spacecraft as part of the Earth Observing System's Afternoon Constellation ("A-train"). Though primarily designed to produce temperature and water vapor measurements to improve weather forecasts, hyperspectral data from AIRS have recently been used to produce global maps of CO_2 concentrations in the mid-troposphere. These data provide important new constraints on the global distribution and transport of CO_2.



AIRS CO_2 research data product showing monthly-averaged global CO_2 concentration in the mid-troposphere (8 km) at 100 km resolution. AIRS CO_2 data products will be publicly released in 2008.



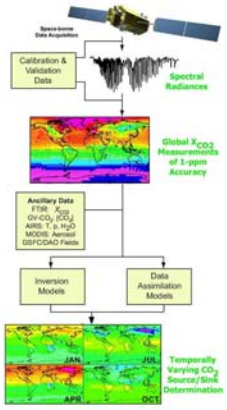
The Earth Observing System Afternoon Constellation ("A-train").

Future Missions

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.

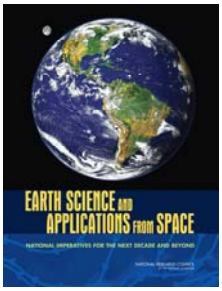
Orbiting Carbon Observatory (OCO)

NASA's Orbiting Carbon Observatory (OCO) is scheduled to launch in December 2008. OCO measures CO_2 and O_2 spectral radiances via passive near infrared grating spectrometry to provide column-averaged CO_2 dry air mole fraction, *XCO_2*, 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. OCO will fly in loose formation with the Afternoon Constellation to enable correlation of Earth observations with instruments onboard other A-train satellites, particularly AIRS.



ASCENDS

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. ASCENDS would advance spaceborne CO_2 measurements via active laser absorption spectroscopy to deliver day and night measurements for all latitudes and all seasons.



	Atmospheric Infrared Sounder (AIRS)	Orbiting Carbon Observatory (OCO)	ASCENDS
Launch Date	2002	2008 (scheduled)	TBD
Measurement Approach	Passive, Hyperspectral Infrared Sounder	Passive, Near Infrared Spectrometers	Active, Laser Absorption Spectrometer
Contribution to Atmospheric CO_2 Record	Global maps of mid-tropospheric CO_2	Variability of CO_2 sources and sinks	Day/night measurements for all latitudes and all seasons