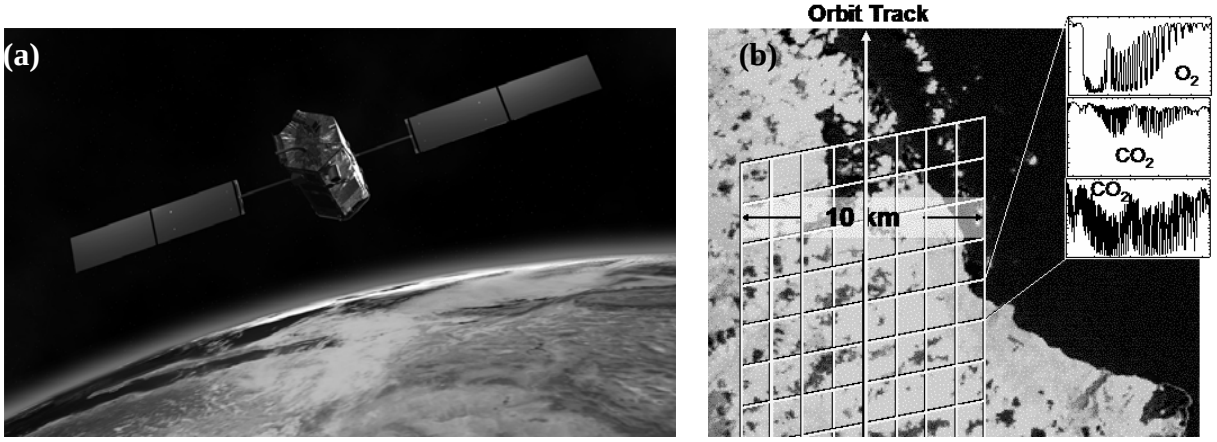
EXTENDING THE CO_2 MONITORING NETWORK TO SPACE: THE NASA ORBITING CARBON OBSERVATORY MISSION

D. Crisp and the OCO Science Team

Jet Propulsion Laboratory, California Institute of Technology, 4800 Oak Grove Drive, Pasadena, CA 91109, David.Crisp@jpl.nasa.gov

ABSTRACT

Precise, global, space-based observations of atmospheric CO_2 would complement the measurements made by the ground-based network and improve our understanding of CO_2 sources and sinks. NASA's Orbiting Carbon Observatory (OCO) Mission is being developed to address this need. OCO carries a high resolution grating spectrometer designed to measure the near-infrared absorption by CO_2 and molecular oxygen (O_2) in reflected sunlight. High resolution spectra taken in the CO_2 bands near 1.61 and 2.06 mm provide constraints on the CO_2 column abundance, with the greatest information content near the surface. Bore-sighted, high resolution spectra in the 0.76 mm O_2 A-band provide constraints on the surface pressure and atmospheric optical path length. The simultaneous, bore-sighted O_2 and CO_2 spectra from each sounding will be analyzed with a remote sensing retrieval algorithm to yield spatially-resolved estimates of the column averaged CO_2 dry air mole fraction, X_{CO2}.



(a) OCO spacecraft over the Earth. (b) OCO sampling approach. The instrument is a pushboom imaging spectrometer, which collects 4 to 8 soundings across a narrow (0.8°) swath every 0.333 seconds, as it moves along its orbit track at 6.78 km/sec. Each sounding consists of bore-sighted CO_2 and O_2 spectra and has an effective footprint of ~1.29 by 2.25 km at nadir.

As currently planned, the OCO Mission will be launched in September 2008. The observatory will fly ~12 minutes ahead of the EOS Aqua platform in the Earth Observing System Afternoon Constellation (A-Train). This 705 km altitude, near polar, sun-synchronous orbit has a 1:18 PM nodal crossing time and a 16-day repeat cycle, providing global sampling at semimonthly intervals. The instrument will collect 12 to 24 soundings per second as the Observatory moves along its orbit track on the day side of the Earth. A small sampling footprint (<3 km^2 at nadir) was adopted to reduce biases in each sounding associated with clouds and aerosols and spatial variations in surface topography. Thousands of soundings will be collected on regional scales each month. Clouds and other environmental factors will reduce the number of soundings available for retrieving X_{CO2} to only ~10 to 25% of the total, but even a small fraction of these data should be adequate to yield X_{CO2} estimates with accuracies of ~0.3 to 0.5% (1 to 2 ppm) on regional scales at monthly intervals. A comprehensive ground-based validation program will be used to assess random errors and regional to continental scale biases in the X_{CO2} product. The ground based CO_2 network will play in important role in this validation effort.