Mission Simulation of Space Lidar Measurements for Seasonal and Regional CO2 Variations

Kawa, S. R., G. J. Collatz, J. Mao, J. B. Abshire, X. Sun, C. J. Weaver

NASA Goddard Space Flight Center
Goddard Earth Sciences and Technology Center, University of Maryland Baltimore County

Results of mission simulation studies are presented for a laser-based atmospheric CO2 sounder. The simulations are based on real-time carbon cycle process modeling and data analysis. The mission concept corresponds to the Active Sensing of CO2 over Nights, Days, and Seasons (ASCENDS) recommended by the US National Academy of Sciences Decadal Survey of Earth Science and Applications from Space. One prerequisite for meaningful quantitative sensor evaluation is realistic CO2 process modeling across a wide range of scales, i.e., does the model have representative spatial and temporal gradients? Examples of model comparison with data will be shown. Another requirement is a relatively complete description of the atmospheric and surface state, which we have obtained from meteorological data assimilation and satellite measurements from MODIS and CALIPSO. We use radiative transfer model calculations, an instrument model with representative errors, and a simple retrieval approach to complete the cycle from "nature" run to "pseudo-data" CO2. Several mission and instrument configuration options are examined, and the sensitivity to key design variables is shown. We use the simulation framework to demonstrate that within reasonable technological assumptions for the system performance, relatively high measurement precision can be obtained, but errors depend strongly on environmental conditions as well as instrument specifications. Examples are also shown of how the resulting pseudo-measurements might be used to address key carbon cycle science questions.