Geophysical Research Abstracts
Vol. 16, EGU2014-6836, 2014
EGU General Assembly 2014

Performance of a Space-based Methane Lidar

Christoph Kiemle (1), Gerhard Ehret (1), Pierre Flamant (2), Randy Kawa (3), and Ed Browell (4)

(1) DLR Inst. fuer Physik der Atmosphaere, Oberpfaffenhofen, Germany (christoph.kiemle@dlr.de), (2) LMD, Ecole Polytechnique, Palaiseau, France, (3) NASA Goddard Space Flight Center, Greenbelt, Maryland, (4) STARSS II Affiliate, NASA Langley Research Center, Hampton, Virginia

Future space-based lidar measurements of anthropogenic greenhouse gases are expected to close observational gaps particularly over remote, polar, and aerosol-contaminated regions where in-situ and passive remote sensing observation techniques have difficulties. Recently, a "Methane Remote Lidar Mission" (MERLIN) was proposed by DLR and CNES in the frame of a German-French climate monitoring initiative. The goal is to measure atmospheric methane at high precision and unprecedented accuracy sufficient to constrain the various surface sources significantly better than with the current observational network. The MERLIN mission will have a minimum operational lifetime of 3 years. It is currently in Phase B, in which all mission components are planned in detail. Launch is foreseen in 2017. The MERLIN data will primarily be supplied to inverse numerical models that use the globally observed concentration gradients to infer methane surface fluxes.

Simulations with an instrument model are used to assess the performance of this mission in terms of random error (measurement precision) with the help of MODIS and CALIPSO satellite observations of earth surface albedo and atmospheric optical depth, respectively. These are key environmental state parameters for integrated path differential absorption (IPDA) lidar which uses the surface backscatter to measure the atmospheric methane column beneath the satellite. Our results show that a lidar with an average optical power of 0.45 W at 1.6 μm wavelength and a telescope diameter of 0.55 m, installed on a low earth orbit platform (506 km), will measure methane columns at precisions of 1.2 %, 1.7 % and 2.1 % over land, water, and snow or ice surfaces, respectively. This applies to monthly aggregated measurement samples within areas of 50x50 km^2, and approaches the requirements that had been formulated by future users of the data in order to meet the abovementioned goal. Globally, the mean precision for the simulated year 2007 is 1.6 %, with a standard deviation of 0.7 %. In arctic and subarctic regions, lower reflectance due to snow and ice is compensated by denser measurements, owing to the orbital pattern. Over key methane source regions such as densely populated areas, boreal and tropical wetlands, or permafrost, our simulations show that the measurement precision will be between 1 and 2 %.