CO$_2$(v$_2$)-O quenching rate coefficient derived from coincidental Fort Collins lidar and SABER measurements.

A.G. Feofilov (1,2), A.A. Kutepov (1,2), C.Y. She (3), A.K. Smith (4), W.D. Pesnell (2), and R.A. Goldberg (2)

(1) The Catholic University of America, DC 20064, USA
(2) NASA Goddard Space Flight Center, Greenbelt, MD 20771, USA
(3) Colorado State University, Fort Collins, CO 80523, USA
(4) National Center for Atmospheric Research, Boulder, CO 80305, USA

Among the processes governing the energy balance in the mesosphere and lower thermosphere (MLT), the quenching of CO$_2$(v$_2$) vibrational levels in collisions with oxygen atoms plays an important role. However, neither the rate coefficient of this process ($k$(CO$_2$-O)) nor the atomic oxygen concentrations ([O]) in the MLT are well known. The discrepancy between $k$(CO$_2$-O) measured in the lab and retrieved from atmospheric measurements is of about factor of 2.5. At the same time, the discrepancy between [O] in the MLT measured by different instruments is of the same order of magnitude. In this work we used a synergy of a ground based lidar and satellite infrared radiometer to make a further step in understanding of the physics of the region.

In this study we apply the night- and daytime temperatures between 80 and 110 km measured by the Colorado State University narrow-band sodium (Na) lidar located at Fort Collins, Colorado for retrieving the product of $k$(CO$_2$-O) x [O] from the limb radiances in the 15 μm channel measured by the SABER/TIMED instrument for nearly simultaneous common volume measurements of both instruments within ±1 degree in latitude, ±2 degrees in longitude and ±10 minutes in time. We derive $k$(CO$_2$-O) and its possible variation range from the retrieved product by utilizing the [O] values measured by the SABER and other instruments.