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## Three-dimensional modeling of the O<sub>2</sub>(<sup>1</sup>Δ) dayglow and implications for ozone in the middle atmosphere.

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Future space missions dedicated to measuring CO<sub>2</sub> on a global scale can make advantageous use of the O<sub>2</sub> band at 1.27 μm to retrieve the air column. The 1.27 μm band is close to the CO<sub>2</sub> absorption bands at 1.6 and 2.0 μm, which allows a better transfer of the aerosol properties than with the usual O<sub>2</sub> band at 0.76 μm. However, the 1.27 μm band is polluted by the spontaneous dayglow of the excited state O<sub>2</sub>(<sup>1</sup>Δ), which must be removed from the observed signal.

We investigate here our quantitative understanding of the O<sub>2</sub>(<sup>1</sup>Δ) dayglow with a chemistry-transport model. We show that the previously reported -13% deficit in O<sub>2</sub>(<sup>1</sup>Δ) dayglow calculated with the same model is essentially due to a -20 to -30% ozone deficit between 45-60 km. We find that this ozone deficit is due to excessively high temperatures (+15 K) of the meteorological analyses used to drive the model in the mesosphere.

The use of lower analyzed temperatures (ERA5), in better agreement with the observations, slows down the hydrogen-catalyzed and Chapman ozone loss cycles. This effect leads to an almost total elimination of the ozone and O<sub>2</sub>(<sup>1</sup>Δ) deficits in the lower mesosphere. Once integrated vertically to simulate a nadir measurement, the deficit in modeled O<sub>2</sub>(<sup>1</sup>Δ) brightness is reduced to -4±3%. This illustrates the need for accurate mesospheric temperatures for a priori estimations of the O<sub>2</sub>(<sup>1</sup>Δ) brightness in algorithms using the 1.27 μm band.