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# Remote oxygen sensing by ionospheric excitation (ROSIE)

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The principal optical observable resulting from ionospheric modification (IM) experiments is the oxygen red line at 630 nm, originating with the O($^1D$ - $^3P$) transition. Because the O($^1D$) atom has a radiative lifetime of 110 s, it is very sensitive to collisional relaxation, and a decay faster than the radiative rate can be attributed to collisions with atmospheric particles. In contrast to the common practice of ignoring O-atoms in interpreting such observations in the past, our recent experimental studies on the relaxation of O($^1D$) by O($^3P$) have revealed the dominant role oxygen atoms play in controlling the lifetime of O($^1D$) at altitudes relevant to IM experiments. Using the most up-to-date rate coefficients for collisional relaxation of O($^1D$) by O, $N_2$, and $O_2$, it is now possible to analyze reliably the red line decays observed in IM experiments and thus probe the local O-atom density in the ionosphere. In this manner, we can demonstrate an innovative approach to remotely probe O-atoms at the altitudes relevant to IM experiments, test the current models for O-atom density in the ionosphere, and study its temporal, seasonal, altitude and spatial variation in the vicinity of heating facilities. We discuss the relevance to atmospheric observations and ionospheric heating experiments, report a preliminary analysis of data that have been accumulated from a number of IM sites, and present plans for more detailed collaborative studies in the future.