The Atmosphere as Laboratory: Aeronomy by Astronomy

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Astronomical sky spectra are proving to be a rich source of data on emissions in the terrestrial atmosphere over a broad range of altitudes (85-250 km). The high resolution (0.01-0.02 nm) and CCD detection associated with these spectra has led to much new information on species as diverse as the electronically- excited states of O_2, many O-atom Rydberg levels, weak OH lines, potassium, N_2^+, He, and Ca^+, over the 330-1000 nm spectral region. From nightglow emission, we have been able to characterize the O_2 states in vibrational levels not previously observed, and have detected $O_2(b)$ state emission from levels v = 0-15, emission to the $O_2(a)$ state in levels v = 1-11, and emission to the ground state in levels v = 0-15. In addition, we are able to see the fully-resolved O_2 UV emissions in the Herzberg I and Chamberlain transitions. There is considerable synergy when we observe the new atmospheric emissions while simultaneously studying the same emitters in the laboratory [1]. In related astronomically-oriented work, we have also made measurements of the Venus nightglow with the Keck and Apache Point (APO) telescopes, confirming older results which identified $O_2(c)$ state emission, and establishing for the first time that the oxygen 557.7 nm green line is an important Venus nightglow feature. Examples of the terrestrial spectra are available at http://www-mpl.sri.com/NVAO/download/Osterbrock.html

References:

[1] K. S. Kalogerakis, A. Totth, P. C. Cosby, T. G. Slanger, and R. A. Copeland, Laboratory Studies of the Production of Highly Vibrationally Excited $O_2(a)$ and (b) from $O_2(A)$ Relaxation, *Eos, Trans. Amer. Geophys. Union* **81**, F944 (2000).

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