1) The 410-425 nm region in co-added sky spectra. The example shown is from the UVES echelle spectrograph on the VLT,[Hanuschik, 2003] and is very similar to spectra obtained with the HIRES echelle spectrograph on the Keck I telescope. The prominent lines belong to the 9-1 and 10-1 bands of the newly-discovered O$_2$(c$^1\Sigma_u^-$-b$^1\Sigma_g^+$) system in the terrestrial nightglow. The average difference between the 28 HIRES and UVES lines measured in common is 0.0005 nm. The relatively strong Herzberg I 3-9 and Chamberlain 7-5 bands are found in the middle of this region. Also shown is a 200K DIATOM$^\text{TM}$ simulation of the c-b bands.[Slanger et al., 2003b]
2) HIRES/Keck I spectrum of the 440-550 nm region in the nightglow, obtained 1-2 hours after sunset, in March 2000. The sequences of lines are portions of the triplet and quintet series of O-atom Rydberg transitions generated from O\(^+\) radiative recombination, and these ultimately terminate in 130.4 and 135.6 nm emission. The emission intensities are found to accurately reflect the calculated effective cross sections for the radiative recombination process, [Escalante and Victor, 1992] and the highest atomic level observed is the 11d level of the quintet series, lying only 900 cm\(^{-1}\) below the O\(^+\) limit. These measurements span the 0.1-100 R intensity range, [Slanger et al., 2004]
3) Seasonal dependence of the intensity ratio of the sodium D$_2$/D$_1$ lines, for various measurements in 1975-2004. It has been conventionally believed that this ratio is single-valued in the nightglow, with the statistical value of 2.0. This is not the case, and high S/N data show great variation. There appears to be a semi-annual oscillation in the ratio, peaking in spring and fall, as is generally true for other emissions that involve O-atoms, including the sodium nightglow intensities. That the line ratio shows the same behavior is not fully understood, and is presumably related to the detailed chemistry of sodium nightglow emission, and possibly to the local [O]/[O$_2$] ratio.[Slanger et al., 2000]
4) Comparison of ionospheric (upper) and mesospheric (lower) O$_2$(b-X) 1-1 Atmospheric band emission, with spectral simulations at 900K and 200K. This emission is observed in both atmospheric regions, and can be distinguished from the ground by the rotational temperature of the band. When the ionospheric source reaction - O($^1$D) + O$_2$ → O($^3$P) + O$_2$(b$^1$Σ$^+$, v = 0,1) - is strong, then it overwhelms the mesospheric atom recombination source. High ionospheric emission is not limited to early evening. Band intensities of 100-150 R can be reached, suggesting that detection from space is possible, which would lead to altitude and temperature. Selective quenching of the v = 1 level with respect to v = 0 can be interpreted in terms of the local O-atom density.\cite{Slanger et al., 2003a}


