

Position Paper On  
Groundbased Measurements of Stratospheric Trace Constituents as a  
Function of Height by High Resolution UV Spectroscopy

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With recent advances in optical design techniques and detector technology, it has become possible to observe atmospheric emissions in the daytime in the presence of the large Rayleigh scattered daylight background. Using high resolution spectroscopy techniques we have obtained spectral images of the near-UV dayglow in the range 2,950-3,000 Å. These data have revealed the presence of a spectrum which is rich in its spectral detail. In particular, it has been possible to clearly identify rotational lines of the OH ( $A^2\Sigma + X^2\Pi$ ) 0,0 band which is generated by resonance fluorescent scattering of near UV sunlight. In addition, absorption features have been observed at wavelengths which coincide with absorption features of the ( $A^2\Pi + X^2\Pi$ ) 2,0 band of ClO. The value of information on these constituents to stratospheric photochemistry is well known.

There are certain advantages to being able to observe in emission, the primary one being that in the presence of both absorption by O<sub>3</sub> and self absorption, the brightness observed shows a strong dependence on the angle of elevation of the line-

of-sight, as well as on the solar zenith angle. At very small elevation angles, emissions from the stratosphere are effectively obscured, owing to  $O_3$  absorption. Also, the impact of the presence of OH on the observed spectrum is in absorption, because of strong quenching at tropospheric heights. As the elevation angle is increased, the region sampled also increases in altitude, and the OH signature on the observed brightness profile changes from one of absorption around  $\sim 40^\circ$  elevation angle to an emission signature.

We have calculated OH contribution functions as a function of altitude for different viewing geometries and have established that, at least in principle, the potential information content of the data that could be acquired should allow the data to be inverted to profiles of concentration vs. altitude from the troposphere to the stratosphere. There are many problems that still have to be resolved, however, particularly with regard to the transmission of light through the troposphere.

In order to estimate the statistical noise limitations of the large background emission on the measurements, we have computed the signal to noise ratio for OH emissions which arise from spherical shells, 1 km in thickness. These calculations have lead us to be optimistic about the viability of inverting the data. Signal to noise ratios in excess of 1000 are plausible.

We have been actively involved for the last 7 years in the development of techniques for the inversion of intensity measurements made from balloons and satellites in the presence of large scattered background emission and ozone absorption. Our

knowledge in this area has now developed to a level of maturity where we believe we can provide a quantitative assessment of the uniqueness (or validity) of the results obtained.

In addition to the advances in data reduction techniques that have been made, we are actively involved in the development of improved as well as new and more powerful measurement techniques.

In conclusion, we believe that high resolution ground-based UV spectroscopy offers a powerful new technique for obtaining measurements of key trace constituents in the stratosphere and troposphere.