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THE FEASIBILITY OF GROUND BASED LIDAR MEASUREMENTS OF STRATOSPHERIC HYDROXYL

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Currently much effort is being expended to develop ground based lidars for the routine monitoring of stratospheric ozone. These lidars operate at a fundamental wavelength near 308 nm and typically employ xenon chloride excimer lasers. When these systems have been shown to be successful the potential for using similar systems to monitor stratospheric hydroxyl by laser induced fluorescence excited in the A-X, 0-0 band, also near 308 nm, should be considered.

A program to study the kinetics and spectroscopy of 0-0 excitation of OH and to develop a tunable XeCl excimer laser has been completed at JPL. The XeCl laser can be tuned, with narrow spectral bandwidth, over the region from 307.5 - 308.5 nm which covers a number of OH absorption features, including the Q(1) bandhead. Many detailed spectroscopic excitation and detection schemes have been considered. In summary, the Q(21)1 absorption line at 307.847 nm is chosen for the excitation line and the overlapped Q(2)2, Q(12)2, Q(2)3 and Q(12)3 lines at 308.986 nm would be used for the fluorescence detection. By using a detector with a narrow spectral bandpass, matched to the fluorescence bandwidth of this this group of overlapped lines, the solar background can be reduced to an insignificant level. The type of filter appropriate to this scheme is the Fabry-Perot filter as developed for Doppler wind measurements, by Rees and Hays, and flown on Dynamics Explorer and UARS. Further details of the experimental arrangement will be given at the workshop.

The OH profile from "The Stratosphere 1981" together with the U.S. Standard Atmosphere data have been used to model the anticipated lidar returns. The lidar system parameters were based on the ozone systems as was the atmospheric transmission for the UV wavelengths. The results of this model show that a repeatability (or precision) of 1% could be achieved with an integration time of one hour, with a laser operating at 1 J/pulse and 30 Hz, over the altitude range from 25 to 75 km. The accuracy of the measurement is significantly poorer since the lidar inversion depends on the accurate knowledge of various state-to-state rate constants in the excited A state of OH. These data are only just becoming available and the accuracy is as yet undetermined. At best it is estimated that the overall accuracy would be about 10%. However, since the precision is high, statistical trend analyses could be performed with high confidence.