Excitation mechanisms for the E-region O(^{1}S) dayglow including solar flares

R. Link (1), **G. Shepherd** (2) and B. Solheim (2)

(1) Algoma Research Inc., Fairfax Station, Virginia, USA, (2) Centre for Research in Earth and Space Science, York University, Toronto, Canada (gordon@yorku.ca / Fax: +1 416 736-5626 / Phone: +1 416 736 5247)

The Wind Imaging Interferometer (WINDII) on the Upper Atmosphere Research Satellite (UARS) acquired a half-million profiles of atomic oxygen O(^1S) 557.7 nm dayglow emission during its lifetime. The results show that an empirical relationship exists between the 557.7 nm dayglow and the solar zenith angle and solar $F_{10.7}$ flux, indicating the dominance of direct excitation processes. The dayglow emission exhibits two peaks: one in the F-region near 155 km associated with solar photoionization, and the other in the E-region near 105 km which appears to be caused primarily by photo-absorption of solar Lyman-β by O_2. During solar flares, the E-region component can be significantly enhanced (by factors of 2–3), concomitant with increased fluxes of energetic ($>$ 200 eV) electrons measured by the Particle Environment Monitor on UARS. In order to examine the production of dayglow O(^1S) 557.7 nm emission, a new photochemical model has been developed that includes the sources e + O, e + O_2, Lyman-β + O_2, $O_2^+ + e$, O_2^+ + N(^4S), and $N_2(A)$ + O, and includes Auger electron production by solar soft X-rays. The model ion chemistry has been validated against Millstone Hill incoherent scatter radar measurements of $E-$ and lower F-region electron densities. In this report, model results for the O(^1S) dayglow during both quiescent and solar flare conditions are presented and compared with the extensive WINDII 557.7 nm database, covering a wide range of solar activity.