Compensation for Spherical Geometric and Absorption Effects on Lower Thermospheric Emission Intensities Derived from High Earth Orbit Images

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Remote sensing of the atmosphere from high earth orbit is very attractive due to the large field of view obtained and a true global perspective. This viewpoint is complicated by earth curvature effects so that slant path enhancement and absorption effects, small from low earth orbit, become dominant even at small nadir view angles. The effect is further complicated by the large range of local times and solar zenith angles in a single image leading to a modulation of the image intensity by a significant portion of the diurnal height variation of the absorbing layer. The latter effect is significant in particular for mesospheric, stratospheric and auroral emissions due to their depth in the atmosphere.

As a particular case, the emissions from atomic oxygen (130.4 and 135.6 nm) and molecular nitrogen (two LBH bands, LBHS from 140 to 160 nm and LBHL from 160 to 180 nm) as viewed from the Ultraviolet Imager (UVI) are examined. The LBH emissions are of particular interest since LBHS has significant O2 absorption while LBHL does not. In the case of auroral emissions this differential absorption, well examined in the nadir, gives information about the height of the emission and therefore the energy of the precipitating particles. Using simulations of the viewing geometry and images from the UVI we examine these effects and obtain correction factors to adjust to the nadir case with a significant improvement of the derived characteristic energy. There is a surprisingly large effect on the images from the O2 diurnal layer height changes. An empirical compensation to the nadir case is explored based on the local nadir and local zenith angles for each portion of the image. These compensations are demonstrated as applied to the above emissions in both auroral and dayglow images and compared to models. The extension of these findings to other instruments, emissions and spectral regions is examined.