Errors from asymmetric emission rate in spaceborne, limb sounding Doppler interferometry: A correction algorithm with application to ICON/MIGHTI

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The Michelson Interferometer for Global High-resolution Thermospheric Imaging (MIGHTI) on NASA's Ionospheric Connection Explorer (ICON) mission is designed to measure the neutral wind and temperature between 90 km and ~300 km altitude. Using the Doppler Asymmetric Spatial Heterodyne (DASH) spectroscopy technique, observations from MIGHTI can be used to derive thermospheric winds by measuring Doppler shifts of the atomic oxygen red line (630.0 nm) and green line (557.7 nm). Harding et al. (2017) describe the wind retrieval algorithm in detail, and point out the large uncertainties that result near the terminators and equatorial arcs, regions of large spatial gradients in airglow volume emission rates (VER). The uncertainties originate from the assumption of a constant VER at every given altitude, resulting in errors where the assumption is not valid when limb sounders, such as MIGHTI, observe regions with significant VER gradients. In this work, we introduce a new wind retrieval algorithm with the ability to account for VER that is asymmetric along the line of sight with respect to the tangent point. Using the predicted ICON orbit and simulated global VER variation, the greatest impact of the symmetric airglow assumption to the ICON vector wind product is found within 30 degrees from the terminator when the spacecraft is in the dayside, causing an error of at least 10 m/s. The new algorithm developed in this study reduces the error near the terminator by a factor of 10.

Keywords: Ionospheric Connection Explorer, Doppler shift sounding, Neutral wind retrieval

