

Estimating index of refraction in the scattering region using SuperDARN angle of arrival measurements

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The global network of SuperDARN radars have been consistently underestimating ionospheric velocities because the index of refraction in the scattering region has not been taken into account. The refractive index at SuperDARN HF frequencies is typically between 0.8 and 1.0 in the F-region although, in extreme cases, it may be much lower. A comparison of velocities measured by DMSP and SuperDARN indicates that SuperDARN does in fact underestimate velocities by a factor of about 0.8 to 0.9. Application of Snell's Law of refraction in a medium with spherical symmetry indicates that the index of refraction at the scattering point can be estimated from the elevation angle of the wave. Ray tracing has been performed using a number of 1-D and 2-D ionospheric electron density profiles. These simulations have confirmed that the relationship between elevation angle and refractive index is reasonably well defined, even when quite large horizontal gradients exist in the electron density. Therefore, by using the interferometry measurements of elevation angle, an estimate of index of refraction and a correction to the assumed Doppler velocity can be made for each individual ionospheric echo.