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The importance of an accurate magnetic field for the estimation of Faraday rotation from total electron content.

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A plane polarized wave that propagates through a plasma, parallel to a magnetic field, suffers a gradual rotation of its plane of polarization called Faraday rotation. Likewise, radio beacon signals that traverse the ionospheric plasma encounter a parallel component of Earths geomagnetic field and the anisotropy of the medium. Many authors use the average value of the parallel magnetic field for estimation of Faraday rotation (FR) from ionospheric total electron content (TEC) measurements. Although it is known that the strength of Earth's geomagnetic field varies slowly at ionospheric altitudes, a reference height characteristic value or reference mean value may not always be sufficient. though commonly used.

Numerical modelling has demonstrated that FR, independent of carrier frequency, can be calculated more accurately by applying a weighted average in favour of the ground based values when using an average value of the magnetic field. Values for the electron density from the International Reference Ionosphere (IRI) and magnetic field from the International Geomagnetic Reference Field (IGRF) were sampled for several different days at different latitudes. The TEC was computed from the convolution of the electron densities from IRI and magnetic field values from IGRF. The effect on the conversion of the modelled TEC to FR along vertical paths for different values of the magnetic field, including the average, reference altitude and weighted average. They were compared with the conversion using IGRF as a function of altitude as the ideal solution. For all conditions, an average value for the magnetic field tends to underestimate the degree of FR. This work found that a weighted average in favor of the magnetic field values from lower altitudes improved results.

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