



## 3D IED profile over the Indian Sector with LS-MARS method using NavIC aided GNSS data

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Numerous methods and techniques have been proposed to measure the electron density in the ionosphere. One recent technique shows the ionosphere's 3D electron density distribution. This is a function-based Computerized Ionospheric Tomography (CIT) method, namely the Least Squares method-Multivariate Adaptive Regression Splines (LS-MARS), combining MARS[1] with Ionosphere Electron Densities (IEDs) calculated by International Reference Ionosphere (IRI) to automatically choose the best-representing basis functions for the three-dimensional (3D) electron density inside that modeling area. Previously, this technique was used to study regions with 42 IGS stations between the 0°-30° E longitude and 30°- 60°N latitude and altitudes ranging from 100 to 1000 km[2]. This method shows proximal VTEC values with IGS station data.

In this study, usage of the LS-MARS method with NavIC combined with the GAGAN (23 receiver stations) and CORS (754 receivers stations) network would give us a clear understanding of the dynamic nature of the equatorial and low latitude ionosphere. NavIC(Navigation with Indian Constellation) is a regional satellite-based navigation system that provides coverage over India and a region extending up to 1,500 km. A comparative study of NavIC validates the result to probe the Ionosphere under various conditions[4].

To estimate the three-dimensional (3D) electron density distribution ionosphere is divided into a 3D grid, assuming that each voxel (3D cubic pixel) has uniform electron density. Each voxel is the size of 1°×1° lat-long and 50km high.

Estimating 3D IED distributions could also aid in studying different scale sizes & structures of ionospheric irregularities. This would be helpful while understanding the behavior of scintillation of NavIC/GPS signals in low latitude/equatorial regions. For the long-term period, data will help to find trends and implement Machine-Learning(ML) for space-weather modeling and forecasting. A vertical profile analysis of 3D IEDs would enhance understanding of the coupling between the lower neutral and upper atmosphere and the perturbation due to acoustic gravity waves.

### References

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