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Characterizing Low-Latitude Ionosphere with GMRT

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Radio interferometers are used to observe astronomical sources in the sky, but during low-frequency observations, they must undergo a detailed calibration process to remove the effects of the ionosphere. This same calibration data can also be used to study the ionosphere itself. As upcoming radio telescopes become larger, it becomes increasingly essential to correct for ionospheric effects to obtain a clearer image of the sky. The Giant Metrewave Radio Telescope (GMRT) is an excellent candidate for studying the ionosphere in different array configurations, and in our recent study, it was shown that GMRT could detect variations in total electron content with a precision of 10^{-3} TECU and measure TEC gradients with a precision of $7 \times 10^{-4}\,\mathrm{TECU, km^{-1}}$. Methods were also introduced to perform spectral analyses on the calculated TEC gradient, effectively tracking individual waves associated with medium-scale travelling ionospheric disturbances and estimating their speed and direction. This study can provide insight into building pipelines that can correct ionosphere-induced phase errors in real-time for future telescopes such as the Square Kilometer Array (SKA).

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