



Recent advances in L-band SAR observation of ionospheric irregularities from low to high latitudes

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Recent studies suggest that L-band Synthetic Aperture Radar (SAR) satellite data can be used as a new tool to provide two-dimensional imaging of ionospheric plasma density irregularities caused by various sources and mechanisms from low to high latitudes. At low latitudes, equatorial plasma bubbles (EPBs) containing small-scale irregularities are known to deform SAR image by characteristic stripe-like structures aligned with the local geomagnetic fields e.g., [1], [2]. Auroral ionosphere at high latitudes produces plasma irregularities as a consequence of particle precipitation that can be captured in the phase data resulting in azimuth shifts of SAR signals [3]. Middle latitudes phenomena such as sporadic E layer or medium-scale traveling ionospheric disturbances (MSTIDs) can be detected by parameters derived from SAR phase data including interferometry e.g., [4], [5]. We present a short overview of SAR-derived ionospheric parameters that are used in these recent studies primarily from ALOS and ALOS-2 missions in the last decade and discuss how these parameters can advance our understanding of various ionospheric irregularities. We also focus on the importance of simultaneous observation of the same ionospheric volume from ground instruments. Regional-scale total electron content (TEC) map from a dense GNSS network can be compared with SAR phase derived parameters. Airglow images at night time show density depletion in the F-region associated with EPBs that are overlapped with a sequence of SAR images containing scintillation stripes. Incoherent Scatter Radars (ISRs) at high latitude provide signature of particle precipitation with altitude information. Coordinated observational campaigns allow direct comparison of these measurements from ground instruments with space-borne SAR parameters with the targeted ionospheric density structures.

References

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