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Imaging Ionospheric Fine Structures Using Polarimetric SAR and GPS

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In this paper, we will present Faraday rotation images derived from polarimetric data collected using the Phased Array type L-band Synthetic Aperture Radar (PALSAR) onboard the Japanese Advanced Land Observing Satellite (ALOS). It will be shown that such space-borne radar techniques are capable of capturing 2D ionospheric structures with kilometer to sub-kilometer resolutions. This new capability will be demonstrated with examples of imaging ionospheric perturbations due to space weather and geophysical events, such as auroral arcs, ionospheric irregularities, and traveling ionospheric disturbances. The radar images are also compared with GPS-based measurements and models. While 2D ionospheric TEC maps derived from GPS data or 3D assimilative ionospheric model provide large-scale ionospheric ambient conditions, the rate of TEC measurements also derived from GPS data can be used to detect small-scale ionospheric irregularities that are associated with SAR images. The potential of combining SAR- and GPS-based ionospheric imaging at different spatial scales will be discussed, which can significantly enhance our capability of investigating outstanding ionospheric research topics and supporting mitigation of media effects on SAR.