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Resolving the spatial-scales and drivers of high-latitude ionospheric irregularities using innovative ground-based radar techniques[1]

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The ionosphere contains a wide variety of plasma density structures, known as irregularities, whose properties impact the propagation of high-frequency radiation, such as radio waves. Resolving the spatial-scales of these irregularities (and thus their drivers) is challenging using Incoherent Scatter Radars (ISRs) either due to the long duration over which a scan of observations at a single altitude must be taken, or the large spatial separations that are associated with probing different locations at the same altitude simultaneously. Between 200 and 400 km altitude, plasma is magnetized, weakly-collisional, and participates in resonant charge exchange through collisions between O+ and O, leading to anisotropic ion temperatures at electric fields greater than 40 mV/m. At high-latitudes, geomagnetic field lines are nearly vertical, which, due to diffusion being the dominant transport mechanism parallel to the magnetic field and cross-field diffusion being slow at scales greater than 10 km, leads to changes in the vertical plasma density profile above 200 km altitude being predominately the result of scale height effects. Leveraging these points, this work employs a novel technique that uses volumetric plasma density measurements from phased array Advanced Modular Incoherent Scatter Radars (AMISRs) to resolve high-latitude ionospheric irregularity spectra at a higher spatial-temporal resolution than has been previously possible with ISRs. By applying this technique to high-latitude AMISRs, we can resolve the spatial-scales of irregularities in relation to different solar and geomagnetic parameters. This presentation will focus on spatial-scale variations between 20 and 110 km from November 28 to December 3 2016. Here, we distinguish variations that result from changes in geomagnetic activity from diurnal variations, such as an increase in the dominant spatial-scales at noon. This presentation will expand on this dataset and discuss the future goals of this work.

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