On imaging low-latitude F-region ionospheric structures using a small, low-power coherent backscatter radar interferometer

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Observations of ionospheric structures at intermediate (few km) scale sizes are limited, constraining our ability to test or validate theoretical advances, particularly those associated with instability processes. The interferometric radar imaging technique has proven to be useful for studies of ionospheric structures in the intermediate range of scale sizes.

In this talk, we will describe results of radar imaging using measurements made by a small, low power coherent scatter radar interferometer in Sao Luis, Brazil. The measurements were obtained by a 30 MHz, 8 kW radar system with the longest baseline of 150 m (15 λ). The measurements were processed using the Capon method, which is capable of producing images with a resolution of a few km in the zonal direction. The vertical resolution is dictated by the pulse scheme and, for the measurements used in this study, is about 2.5 km. Numerical simulations are used to test the algorithm and evaluate its performance.

The Capon technique is applied to measurements of different equatorial spread F events detected over the Brazilian sector. Results show that, despite the low power and short baselines of the interferometer, it is still possible to identify the narrow scattering channels associated with radar plumes. It is also possible to infer the morphology of the scattering structures including the tilt and bifurcations that are known features of ESF. The somewhat wide field-of-view of the interferometer allow us to track the evolution of ESF structures. We have also been able to identify different types of irregularity events occurring simultaneously within the beam. The results are discussed in light of irregularity theories, previous imaging observations made at the Jicamarca Radio Observatory, and the potential of small radar interferometers for imaging and science of space plasma.