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New two-dimensional radar observations of equatorial spread F at the Jicamarca Radio Observatory[1]

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Equatorial spread-F (ESF) is the general name given, for historical reasons, to low-latitude disturbances in the Earth's ionospheric plasma density and their signatures in different types of ionospheric sensors. The study of ESF is motivated by a better understanding of fundamental space plasma dynamics. It is also motivated by the impact of ESF on the propagation of signals used in civil and military applications. Significant contributions to our understanding of ESF dynamics have been made by ground-based radar observations at the Jicamarca Radio Observatory in Peru. The observatory is equipped with radar systems capable of making observations of the quiescent and turbulent states of the ionospheric plasma. Until recently, however, a steerable radar capability was not available to Jicamarca, which limited the observations to a few degrees within zenith. In 2014, a 14-panel version of the advanced modular incoherent scatter radar (AMISR-14) system was deployed at Jicamarca. AMISR is a modular, mobile radar facility with electronic steering capability to be used for studies of the Earth's upper atmosphere and space weather. A full AMISR-14 consisting of 128 building-block like (TX/RX) panels is capable of making measurements of the quiescent plasma and infer ionospheric parameters such as ion and electron temperatures, electron density, ion composition, and ion velocity. While AMISR-14 was not expected to be capable of making such measurements, tests were performed to investigate its ability to detect echoes from ESF irregularities. Two campaigns of AMISR-14 observations of ESF were performed at Jicamarca; one in August 2014 and another in July/August 2016. Analyses of the measurements show that not only ESF echoes can be detected by AMISR, but the dynamics of the ESF events in the magnetic equatorial plane can be inferred from a mode that takes advantage of the beam steering capability. In this talk, we will provide a brief introduction to ESF, followed by a description of ESF measurements using radar systems. We will then present examples of the new measurements made with AMISR-14. The observations are discussed in terms of ESF theory, and simultaneous observations made by collocated instruments.

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