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Ionospheric Disturbances Observed with the VLA Ionospheric and Transient Experiment (VLITE)

Abstract:

A new backend has been implemented for the Very Large Array (VLA) low-band system (<500 GHz) to specify mid-latitude ionospheric disturbances (the VLA is at 107.7°W, 34.1°N) with great precision and to monitor for transient cosmic sources. Dubbed the VLA Ionospheric and Transient Experiment (VLITE), the backend began science operations in November 2015 on 10 of the VLA's 27 dish antennas, continually observing in the 320-384 MHz range. Observations of cosmic sources at these frequencies with the VLA are sensitive to the horizontal gradient in total electron content (TEC). At VLITE frequencies, these observations can be used to characterize ionospheric fluctuations to a precision as good as 0.0002 TECU/km. An automated, real-time processing pipeline applies a specialized spectral analysis method these TEC gradient measurements to characterize the observed fluctuations on fine spatial (as small as ~1 km) and temporal (>2s) scales. When a single, dominant wavelike fluctuation is detected, a "drift-scan" image of this traveling ionospheric disturbance (TID) can also generated. In addition, a separate and complementary pipeline analyzes data from 20 continuously operating GPS receivers in the region around the VLA to contemporaneously characterize larger-scale disturbances. The ionospheric pipeline, initial results, and future applications of this system and the database it is generating will be discussed.