CARMA Paired Antenna Calibration System (PACS) for Atmospheric Correction over Long Baselines

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Using a paired antenna calibration system (PACS), we present measurements of the atmospheric phase screen across the CARMA array by observing radio sources on long baselines over time intervals from two seconds to several hours with angular separations from 5 to 90 degrees. The atmospheric transparency is excellent for a large fraction of the year, but without this calibration system, imaging at 1 mm in the longest A- and B-configurations would be extremely limited. Solving for antenna phases samples the atmospheric path length differences through the atmosphere to each antenna. The sampled phases are interpolated to map the atmospheric phase screen as a function of time and angular separation of the radio sources. These data can be used to calibrate observations of a target source using one subarray of antennas from observations of calibration sources from the other subarray. To accomplish this we utilize the Sunyaev-Zeldovich Array (SZA) antennas, pairing up with the CARMA 6.1-m and 10.4-m antennas with these 3.5-m antennas on selected pads. The SZA antennas observe a quasar at 30 GHz a few degrees from the mm target source. The atmospheric delay measured at 30 GHz can be scaled up to 100 or 230 GHz because the dispersion in delay is minimal and ionospheric scintillation is negligible. The advantage of the paired antenna technique to other calibration approaches, such as fast-switching, is that the science target is observed continuously, increasing integration time on source. We present observational results utilizing the paired antenna calibration system to measure the atmospheric phase screen and compare with results obtained without this calibration system.