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Evaluating New Submillimeter Radio Telescope Sites with Infrared and Photographic Measurements of Atmospheric Moisture

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The Next-Generation Event Horizon Telescope (ngEHT) will enable new black hole science with the ability to make horizon-scale movies and image low-brightness features [1]. Those capabilities will be enabled, in part, by deploying telescopes at new sites with suitable submillimeter opacity, which depends strongly on the amount of local atmospheric moisture. To help evaluate candidate new sites, we have built an instrument to monitor atmospheric moisture. The device measures infrared radiation at 8 μm, which is largely derived from precipitable water vapor, and it records sky photographs (e.g., Fig. 1) from which we determine the cloud fraction using the technique proposed by Dev *et al.* [2]. In conjunction with radiative transfer modeling [3] that incorporates meteorological statistics from MERRA-2 [4], the field measurements help us evaluate the suitability of particular locations for the ngEHT array. In this update of [5], we will describe the field measurements and site characterization to date.

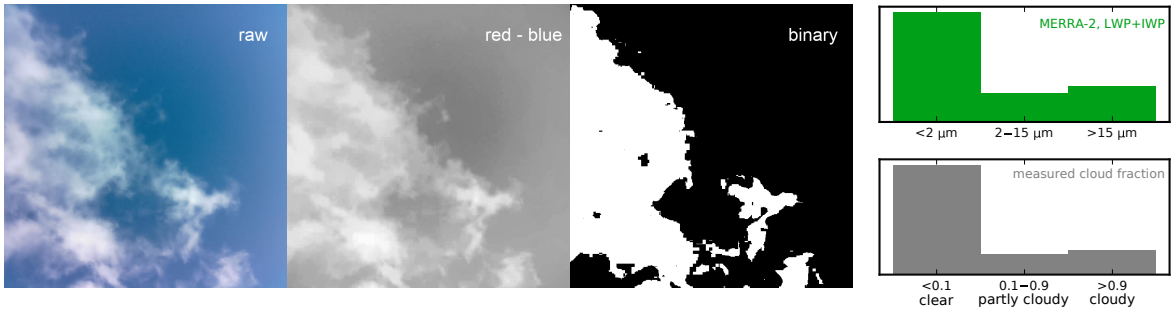

Figure 1. Sample sky photograph from a field test at the Submillimeter Array (SMA) showing the stages of the cloud analysis. The blue state counts at each pixel of a raw photograph are subtracted from the red ones. Those differences exceeding a threshold determined by ground-truth comparisons correspond to clouds as shown in the panel labeled "binary". Histograms of the summed liquid and ice water paths from MERRA-2 between February and June, 2020, are divided into three regions: less than 2, 2–15, and greater than 15 μm, which loosely correspond to clear-sky, partly cloudy, and cloudy conditions, respectively. When we bin the February–June cloud fraction measurements into small (less than 0.1), moderate (0.1–0.9), and large (greater than 0.9) fractions, we find our measured distribution is in good agreement with the MERRA-2 analysis showing predominantly clear conditions.

References

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