WVR-Based Troposphere Delay Calibration of VLBI Observations on a 20 km Baseline

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Dual frequency (S/X band) Very Long Baseline Interferometry (VLBI) observations over a 20 km baseline at Goldstone, CA were conducted in order to demonstrate the troposphere delay calibration capability of current generation Water Vapor Radiometers (WVRs). Analysis of data taken in June and September 1994, employing a new 34 m beam waveguide antenna at one end of the baseline, is complete.

Data were taken both for single long scans ($\sim$ 2000 s) of transiting sources at nearly fixed elevation angles and for multiple short scans ($\sim$ 150 s) of sources distributed over the sky over $\sim$15 hr time scales. For scans when WVRs were copointed with the VLBI antennas to better than 1" at both ends of the baseline, and for appropriate detrending of the data, extremely strong correlations were exhibited between the VLBI post-fit residual delay and WVR station-differenced wet path delay, over all time scales. The deviations between the wet tropospheric delays inferred from the VLBI and WVR data can be accounted for quantitatively, indicating that the error budget for WVR calibration of a short baseline VLBI experiment is understood. Applying the WVR delays as a calibration to the VLBI delay model, before the parameter estimation step in the processing, resulted in a nearly factor of three reduction in the post-fit, root mean square delay residual. This is believed to be the most dramatic example of successful troposphere calibration reported to date.

JPL is developing an advanced WVR to serve as the critical element in a troposphere calibration system required to support the Cassini Gravitational Wave Experiment. A brief summary of the status of the advanced WVR project will also be presented.

Abstract Submission Form

1996 National Radio Science Meeting

Reference # 0000
Session 0.00

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5. No special instructions

Date received: 23 May 95
Date formatted: September 22, 1995
Form version: 1.0