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A multi-sensor approach to estimation of tropospheric delays

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We will discuss techniques for optimal integration of atmospheric measurements from collocated GPS receiver, pointed WVR, and a barometer, capitalizing on the unique strength of each sensor, and minimizing the impact of the sensor's weaknesses. The goal is to improve our ability to estimate line of sight (LOS) total atmospheric delay, which is required in support of certain high precision applications, such as radio science, and deep space navigation. The benefits from improved atmospheric sensing extend to many other applications such as geodesy and time transfer.

The WVR's strength is its unparalleled accuracy in sensing the water vapor content along a given LOS, which produces the "wet" delay of a radio signal. But WVRs are incapable of measuring the contribution of the dry atmosphere to the delay, the fluctuations of which are a significant error source for certain radio science applications. GPS data is directly sensitive to the total tropospheric delay (wet plus dry). However, GPS analysis has so far failed to demonstrate comparable sensitivity to the WVR in resolving LOS delays. By using WVR to calibrate the line of sight wet delays affecting a collocated GPS receiver we will be able to tune the GPS estimation strategy to extract only the slowly varying dry delay component, improving the GPS retrieval accuracy. Barometric measurements may be used to further reduce the number of estimated parameters by modeling the zenith dry delay. The combined total delay provides the best estimate of the LOS total delay.

We assess the performance of these techniques primarily by examining time transfer performance across long baselines, using special experimental setup with pointed

WVRs and GPS receivers driven by highly stable atomic frequency standards.