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A Kalman filter to combine VLBI UT1 and GPS LOD estimates

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A Kalman filter has been designed, similar to that described by Morabito et al. (1988), to combine estimates of UT1-UTC from VLBI with biased length-of-day (LOD) estimates from GPS. The VLBI estimates come from the robust but less frequent 24-hr multi-station observing sessions as well as the nearly daily 1-hr single-baseline data. The analyses of the Goddard Space Flight Center VLBI group are used and assumed to be reduced self-consistently. In principle, we expect that a combined solution of the VLBI data with the stronger GPS station network and polar motion results would enhance the UT1 accuracy, but that aspect has not been studied here. The GPS LOD estimates of the International GNSS Service (IGS) are combined with the VLBI UT1-UTC by modeling the natural excitation of LOD as the integration of a white noise process (i.e., as a random walk in phase) and the UT1 variations as the integration of LOD. The variance of the excitation has been determined from the observed UT1 and LOD variances and agrees with the value found by Morabito et al. To account for the GPS technique errors, which express themselves mostly as temporally correlated biases in the LOD measurements, a Gauss-Markov model has been added to assimilate the IGS data. In addition, the GPS model includes a fortnightly sinusoidal term to capture possible errors in the IGS treatments of tidal effects.

This Kalman filter has been applied to the combination of Goddard VLBI UT1-UTC and IGS GPS LOD observations after both series have been corrected for known tidal variations. As a control to test the impact of the GPS LODs, a separate analysis has also been made with the VLBI data only. Using the output of regularized UT1 and

LOD values, both combinations have been compared with an independent time series of geophysical excitations of the Earth's axial angular momentum variations. Our study also examines a combined series of separate VLBI solutions by the International VLBI Service (IVS) and UT1 combinations from other groups. The comparison results will be presented and discussed, and the utility of our method assessed.