Observations of Fluctuations in the Earth's Rotation Since 1630

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In order to analyze the decadal fluctuations evident in the Earth's rotation, observations spanning many decades, if not centuries, are required. During the past century, or so, a number of different observational techniques of varying accuracy have been employed, with each technique generally having a different averaging and sampling interval and being sensitive to a different subset and/or linear combination of the Earth rotation parameters. In order to produce a series of observed Earth rotation parameters spanning the greatest possible time interval, these diverse data sets need to be combined. However, care must be taken when doing this in order to first assign the appropriate weight to each observation and to account for any systematic differences (such as differences in bias and rate) that may exist. A Kalman Earth Orientation Filter (KEOF) is used at JPL for this purpose. Prior to their combination, adjustments to the data sets are made in order to place them within a common reference frame and weights are assigned to each observation based upon the residual scatter of each series with respect to a series of independent observations. The Kalman filter is then used to combine the corrected observations, producing smoothed, interpolated estimates of polar motion (PM) and UT1-TAI, as well as estimates of their excitation functions such as the length-of-day (lod). Recently, a number of lod data sets have thus been determined at JPL from the Earth rotation observations summarized in Table 1.

TABLE 1 Data Sets Combined

Data Set Name	Observed Component	Number of Observations	Span of Observations
Global Positioning System			
JPL FLINN Analysis	PM	185	1992.5-1993.1
Very Long Baseline Interferometry			
JPL92R01	T,V	990	1978.8-1993.0
CDPGLB869	UT1,PM	1412	1979.6-1992.7
IRIS27JAN93	UT1,PM	38	1992.7-1993.1
UT1MC03FEB93	UT1	1938	1984.3-1993.1
Satellite Laser Ranging			
CSR92L01	PM	1709	1976.4-1992.0
Lunar Laser Ranging			
JPL92M01	UT0,VOL.	1199	1970.3-1992.1
Optical Astrometry			
Int. Lat. Service	PM	951	1899.8-1979.0
Washington PZT	UT0	345	1956.0-1984.8
BIHSO84A02	UT1,PM	1461	1962.0-1982.0
Lunar Occultation			
Stephenson &	AT	30	1630.0-1775.0
Morrison (1984)	AT	201	1780.0-1980.0
Morrison (1979)	AT	396	1943.0-1975.0

The resulting lod data sets, summarized in Table 2, span different time intervals depending upon the particular subset of observations being combined, with the longest series, spanning 1630 1990, being obtained by combining all of the observations.

TABLE 2. Determinations of Excess Length-of-Day

Data Set Name	Number of Determinations	Interval Between Determinations	Span of Determinations
SPACE92I,	6091	1 day	1976.4 -199:3.1
COMB92I,	2269	5 day	1962.0- 993.1
ASTRO92I,	600	1 month	1943.0 993.0
1 UNAR92I.1	214	1 year	1780.0- 993.0
LUNAR92I.5	73	5 year	1630.0- 990.0

The determination of these lod data sets and their comparison with series of climate indicators such as the. Southern Oscillation Index (Sol) will be discussed.