

COMBINATIONS OF EOP MEASUREMENTS: COMB96                   EOP(JPL) 97 C 02  
  & POLE96                   EOP(JPL) 97 C 03

R. S. Gross (Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA 91109-8099, USA; [rsg@logos.jpl.nasa.gov](mailto:rsg@logos.jpl.nasa.gov))

A Kalman filter has been used to combine independent measurements of the Earth's orientation taken by optical astrometry and the space-geodetic techniques of LLR, SLR, VLBI, and GPS. The approach taken is the same as that used in generating previous such combinations (e.g., Gross, "Combinations of Earth Orientation Measurements: SPACE94, COMB94, and POLE94", *J. Geophys. Res.*, 101, 8729-8740, 1996) and will be only briefly described here. Prior to incorporation of the optical astrometric measurements, the space-geodetic measurements were first combined together, resulting in the combined EOP series EOP(JPL) 97 C 01 (also known as SPACE96), the description of which can be found elsewhere in this volume. The incorporation of the optical astrometric measurements was then done in two stages: (1) the BIH optical astrometric series (Li, BIH Annual Report for 1984, pp. D31-D63) was first combined with SPACE96 to form COMB96, and (2) the International Latitude Service (ILS) optical astrometric series (Yumi and Yokoyama, Results of the ILS in a Homogeneous System, 1980) was combined with COMB96 to form POLE96.

Prior to forming COMB96, the BIH astrometric series was first corrected to have the same bias and rate as SPACE96, the stated measurement uncertainties of the BIH series were adjusted by applying a constant multiplicative scale factor that made the BIH residual, when differenced with SPACE96, have a reduced chi-square of one; and those BIH data points whose residual values were greater than three times their adjusted uncertainties were deleted. In addition, in order to correct for systematic, seasonally varying effects in optical astrometric measurements, the annual term of the BIH series was adjusted to be in agreement with the annual term exhibited by SPACE96. The corrections thus determined and applied to the BIH series prior to its combination with SPACE96 are shown in Tables 1 and 2, with the 1-sigma formal uncertainties in determining these bias, rate, and annual term corrections being shown in parentheses.

The result of combining the corrected BIH optical astrometric EOP measurements with SPACE96 is designated EOP(JPL) 97 C 02 (also known as COMB96), spans January 20, 1962 to February 5, 1997 at 5-day intervals, and consists of values of PMX, PMY, UT1-UTC, their 1-sigma formal uncertainties, and correlations. The new 9.3- and 18.6-year terms in UT1 have been included in the COMB96 UT1 values for all epochs since the beginning of the series by adding the correction:

$$UT1_{new} - UT1_{old} = -0.176 \sin(\Omega) - 0.0042 \sin(2 \cdot \Omega) \text{ (ms)}$$

which is consistent with the new GST definition (see IERS Conventions (1996), pp. 21-22), but is of opposite sign to the correction given in IERS Gazette No. 8.

The ILS optical astrometric series was then combined with COMB96 to form POLE96 after first: (1) correcting the ILS series to have the same bias, rate, and annual term as COMB96, (2)

applying a constant multiplicative scale factor to the stated measurement uncertainties of the ILS series so that its residual, when differenced with COMB96, had a reduced chi-square of one, and (3) deleting those data points whose residual values were greater than three times their adjusted uncertainties (see Tables 1 and 2 for the values of the corrections applied to the ILS series). The result of combining the corrected ILS optical astrometric EOP measurements with COMB96 is designated EOP(JPL) 97 C 03 (also known as POLE96), spans January 20, 1900 to January 20, 1997 at 30.4375-day intervals, and consists of values of PMX and PMY, their 1-sigma formal uncertainties, and correlations.

ACKNOWLEDGMENTS. The work described here was performed at the Jet Propulsion Laboratory, California Institute of Technology, under contract with the National Aeronautics and Space Administration.

TABLE 1. ADJUSTMENTS TO BIAS, RATE, AND UNCERTAINTY

DATA SET NAME	BIAS (mas)			RATE (mas/yr)			UNCERTAINTY SCALE FACTOR		
	PMX	PMY	UT1	PMX	PMY	UT1	PMX	PMY	UT1
BIH	-0.397 (0.757)	-2.300 (0.658)	-8.260 (0.699)	1.026 (0.417)	0.885 (0.173)	5.235 (0.279)	1.819	1.627	1.894
ILS	-49.836 (2.185)	-1.477 (1.717)	---	0.019 (0.444)	-0.204 (0.349)	---	2.002	1.565	---

Reference date for rate adjustment of BIH series is 1980.0  
Reference date for rate adjustment of ILS series is 1970.0

TABLE 2. ADJUSTMENTS TO ANNUAL TERM

DATA SET NAME	COEFFICIENT OF SINE TERM (mas)			COEFFICIENT OF COSINE TERM (mas)		
	PMX	PMY	UT1	PMX	PMY	UT1
BIH	-5.796 (0.909)	-6.457 (0.626)	5.325 (0.732)	-3.383 (0.950)	9.220 (0.689)	-1.052 (0.778)
ILS	-0.492 (3.069)	7.738 (2.410)	---	9.239 (3.075)	-10.788 (2.415)	---

Reference date for adjustment of BIH series is 1980.0  
Reference date for adjustment of ILS series is 1970.0

ATTACHMENT 1

Technical description of solution JPL 97 C 02

- 1 - Technique: Combined
- 2 - Analysis Center: Jet Propulsion Laboratory
- 3 - Software used: Kalman Earth Orientation Filter (KEOF) OP-B
- 4 - Data span: Jan 62 - Feb 97 at 5-day intervals
- 5 - Celestial Reference Frame: Not Applicable
  - a - Nature:
  - b - Definition of the orientation:
- 6 - Terrestrial Reference Frame: Not Applicable
  - a - Relativity scale:
  - b - Velocity of light:
  - c - Geogravitational constant:
  - d - Permanent tidal correction:
  - e - Definition of the origin:
  - f - Definition of the orientation:
  - g - Reference epoch:
  - h - Tectonic plate model:
  - i - Constraint for time evolution:
- 7 - Earth orientation: EOP(JPL) 97 C 02
  - a - A priori precession model: Not Applicable
  - b - A priori nutation model: Not Applicable
  - c - Short-period tidal variations in x, y, UT1:  
  
When necessary, diurnal and semidiurnal tidal variations have been removed from the individual EOP series prior to their combination into EOP(JPL) 97 C 02. Diurnal and semidiurnal tidal terms have not been added back and are therefore not included in the values reported in EOP(JPL) 97 C 02.
- 8 - Estimated Parameters:
  - a - Celestial Frame:
  - b - Terrestrial Frame:
  - c - Earth Orientation: PMX, PMY, UT1-UTC
  - d - Others:

ATTACHMENT 2

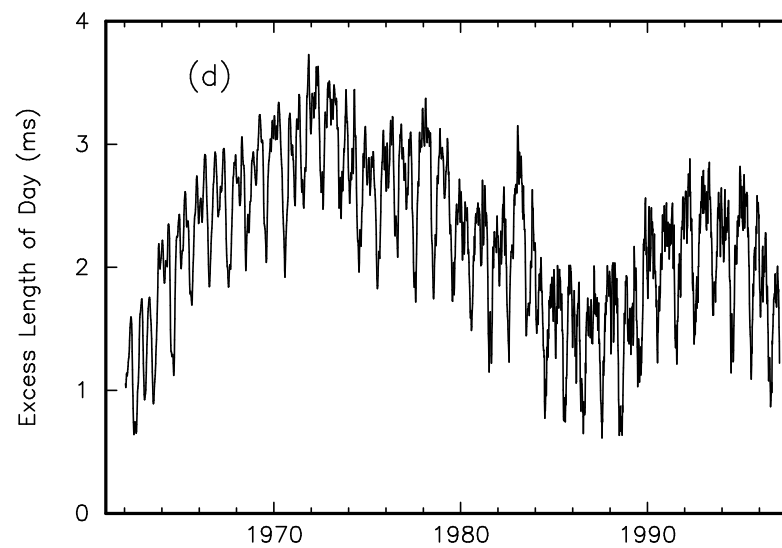
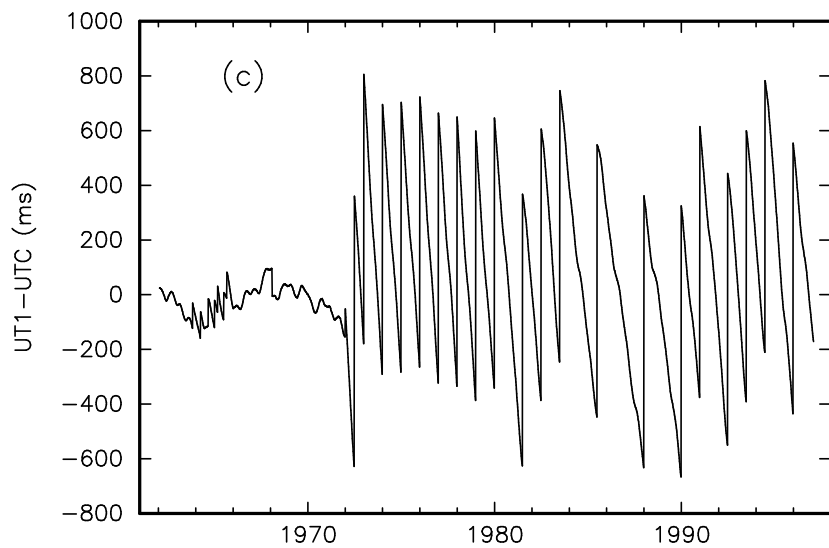
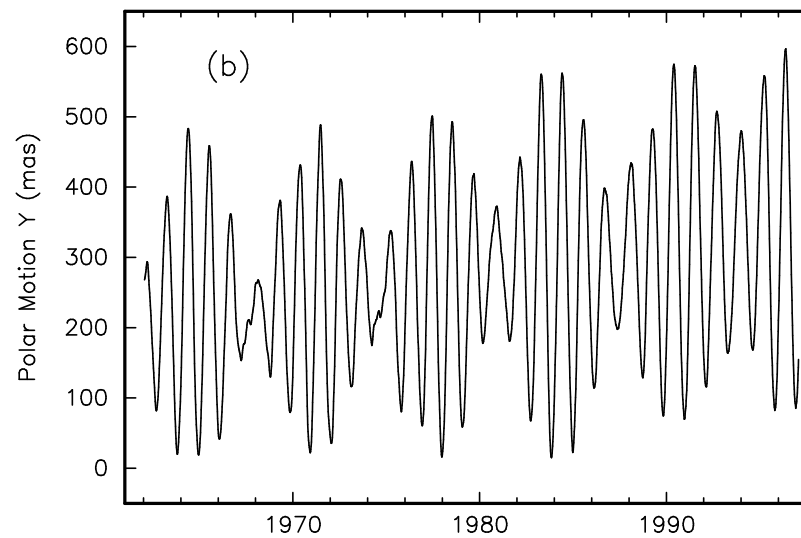
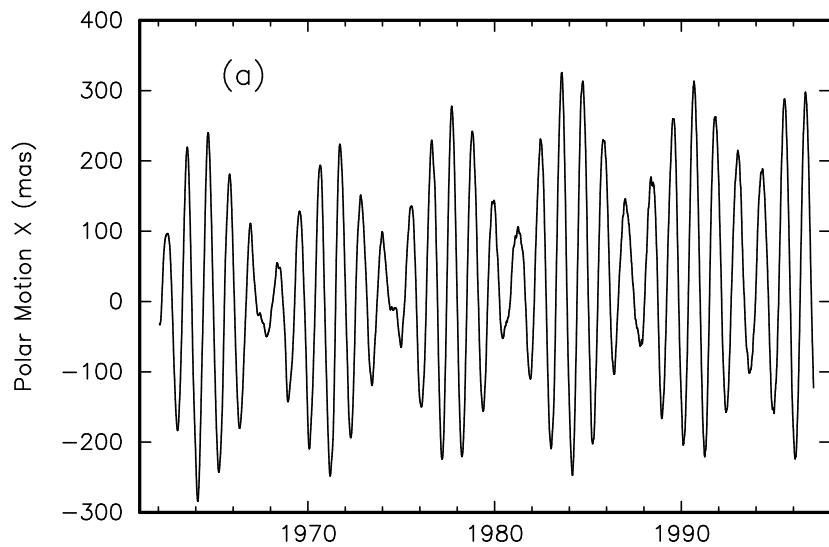
Technical description of solution JPL 97 C 03

- 1 - Technique: Combined
- 2 - Analysis Center: Jet Propulsion Laboratory
- 3 - Software used: Kalman Earth Orientation Filter (KEOF) OP-B
- 4 - Data span: Jan 1900 - Jan 1997 at 30.4375-day intervals
- 5 - Celestial Reference Frame: Not Applicable
  - a - Nature:
  - b - Definition of the orientation:
- 6 - Terrestrial Reference Frame: Not Applicable
  - a - Relativity scale:
  - b - Velocity of light:
  - c - Geogravitational constant:
  - d - Permanent tidal correction:
  - e - Definition of the origin:
  - f - Definition of the orientation:
  - g - Reference epoch:
  - h - Tectonic plate model:
  - i - Constraint for time evolution:
- 7 - Earth orientation: EOP(JPL) 97 C 03
  - a - A priori precession model: Not Applicable
  - b - A priori nutation model: Not Applicable
  - c - Short-period tidal variations in x, y, UT1:  
  
When necessary, diurnal and semidiurnal tidal variations have been removed from the individual EOP series prior to their combination into EOP(JPL) 97 C 03. Diurnal and semidiurnal tidal terms have not been added back and are therefore not included in the values reported in EOP(JPL) 97 C 03.
- 8 - Estimated Parameters:
  - a - Celestial Frame:
  - b - Terrestrial Frame:
  - c - Earth Orientation: PMX, PMY
  - d - Others:

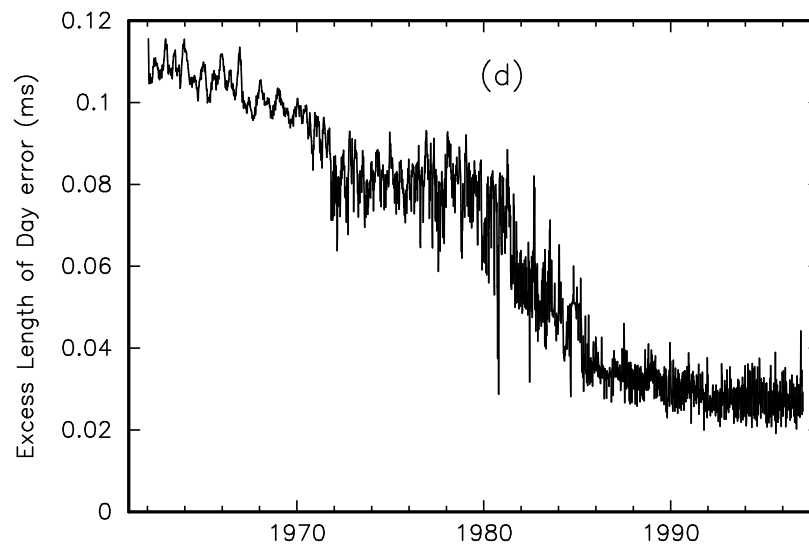
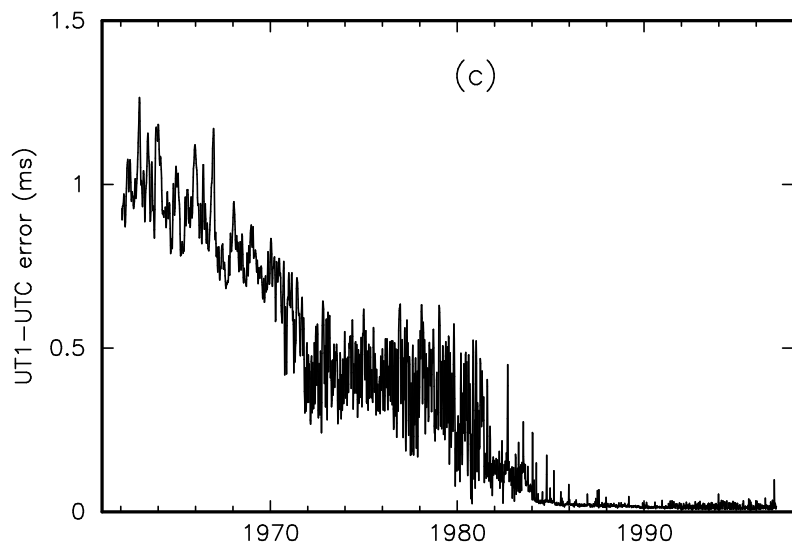
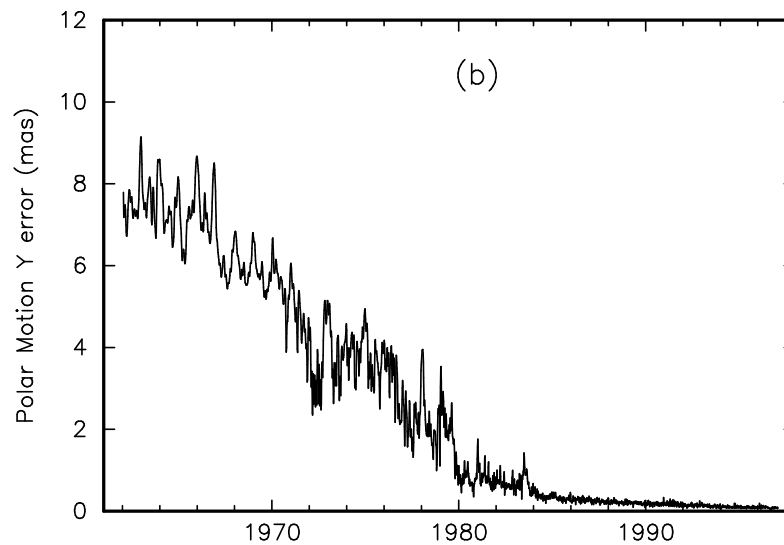
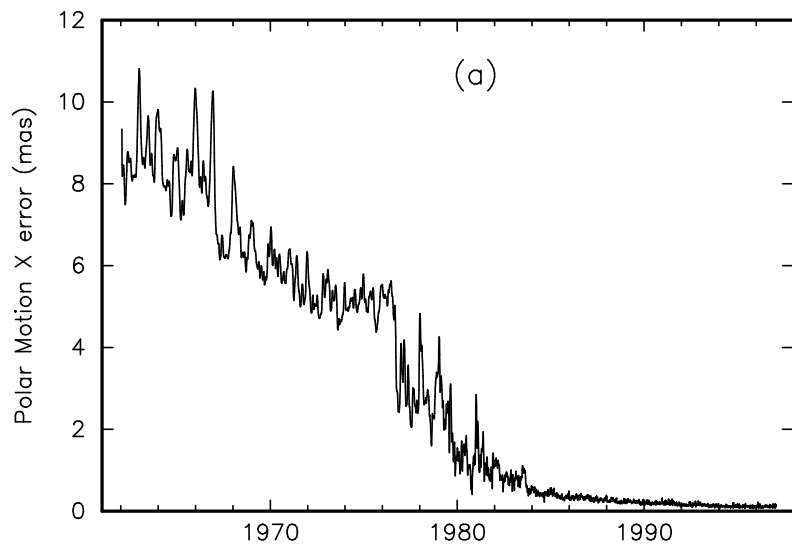




# COMBINED EARTH ORIENTATION SERIES: COMB96



# COMBINED EARTH ORIENTATION SERIES: COMB96





# COMBINED EARTH ORIENTATION SERIES: POLE96

