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New solution of Earth Orientation Parameters in 20th century

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Abstract. We present a new solution of Earth Orientation Parameters, based on optical astrometry and catalog EOC-4.

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Recently we derived a new star catalog EOC-4 that contains not only the mean positions and linear proper motions, but also periodic changes, due to orbital motions, for double and multiple systems. The catalog, resulting from the combination of ARIHIP, TYCHO-2, Hipparcos and PPM with ground-based optical observations of latitude and universal time variations, contains 4418 stars that were observed in optical programs of monitoring Earth orientation during the 20th century; 600 of them are detected to have significant periodic components.

This catalog is now used, as a basic celestial frame, to obtain the Earth Orientation Parameters from optical astrometric observations of latitude/universal time/altitude in the interval 1899.7-1992.0. About 4.5 million individual observations from 47 different instruments (10 PZT's, 7 photoelectric transit instruments, 16 visual zenith telescopes and 14 instruments for equal altitude observations), located at 33 observatories, are used. Polar motion (x, y) is determined in 5-day steps for the whole interval studied, Universal time (UT1-TAI) covers the interval 1956.0-1992.0 (i.e., when the atomic time scale was available) also in 5-day step, and celestial pole offsets (dX, dY) with respect to most recent IAU2000 nutation and IAU2006 precession are modeled by second-order polynomials of time. As a by-product, rheological parameter $\Lambda = 1+k-l$ (combination of Love and Shida numbers k, l), governing the tidal motion of local verticals, is computed for each instrument. The average standard error of one observation is $\sigma_\circ = 0.184''$, slightly smaller than the one of our preceding solution with catalog EOC-3.

Apart from the dominant annual and Chandler wobbles in polar motion, it is demonstrated that Markowitz wobble (with period of about 28 years) is also present, in addition to a longer 78-year period. Spectral analysis of length-of-day changes, calculated from the differences between universal and atomic time scales UT1-TAI, confirms the tidal variations with periods 13.66, 27.56, 182 and 365 days, and also the variations caused by the atmosphere, with periods equal to 0.5, 1 and 6 years. Decadal variations with periods around 30 years are also visible. The solution will serve for further long-term Earth rotation studies.

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