DEFICIENCIES IN THE MODEL FOR THE CELESTIAL MOTION OF THE CEP AS DERIVED FROM A GODDARD/VLBI SERIES OF POLE OFFSETS FROM 1979 TO 1989

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ABSTRACT. A VLBI series of celestial pole offsets (designated as ERP(GSFC)90 R 01 in the IERS series of Earth Rotation Parameters) spanning 10 years has been used for deriving the corrections to the IAU constant of precession and to the main terms of the 1980 IAU series of nutation using the same method as Herring (1988) for constraining the corrections to the 9.3yr nutation and to the 18.6yr nutation in longitude. The estimated corrections have been found to be - 0.279"/c ± 0.02 "/c (formal error) for the IAU constant of precession and +3.13±0.15mas for the 18.6 yr nutation coefficient in obliquity. A circular term with a radius of the order of 0.25mas at a period of 430 days has moreover been revealed in the residuals as obtained after applying the estimated corrections to the series. If such a circular term in the celestial motion of the pole is due to the free core nutation, its estimated period would correspond to a core flattening of 2.687×10^{-3}, which is in good agreement with the one of 2.674×10^{-3} corresponding to the estimated amplitude of the retrograde annual nutation.

1. INTRODUCTION

The celestial pole offsets as derived, with a milliarsecond accuracy, from VLBI observations of radio-sources, include the deficiencies in the conventional models for precession and nutation at the date of the observations and are therefore well adapted to the estimation of the corrections to the IAU model for precession and nutation.

A VLBI series of celestial pole offsets (designated as ERP(GSFC)90 R 01 in the IERS series of Earth Rotation Parameters) from 1979.6 to 1990.0 has been analysed in this purpose. As this series spans only over 10 years, large correlations appear between the 9.3yr and 18.6yr terms as well as between the precession in longitude and the 18.6 yr nutation in longitude. Calculated corrections have therefore been applied both to the 9.3 yr nutation coefficients and to the coefficient in longitude of the 18.6 yr nutation, using the same method as Herring (1988), before estimating the corrections to the other terms.

This short paper summarizes the results obtained in such a study, which will be presented in further details in a more complete paper (Capitaine and Caze 1990).

2. ESTIMATED CORRECTION TO THE IAU PRECESSION AND NUTATION MODEL

Using the theoretical corrections for the nutations of a rigid Earth as given by Kinoshita and Souchay (1989), as well as the correction to the amplitude of the main nutations corresponding to a first estimated value of -0.87 mas/yr for the secular correction in

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longitudexsinε_0, allows us to compute the total theoretical correction to be applied, due to the rigid Earth model : $+ 0.194$ mas sinΩ + 0.462 mas sin 2Ω to dψ sinε_o ,

and: - 0.550 mas cosΩ - 0.224 mas cos 2Ω to dε,

and then to compute, from the estimated correction to the principal term in obliquity ("in-phase" and "out of phase" components), the "geophysical" part of the correction in dε from which the "geophysical" part of the correction in dψ sinε_0 can be derived (Herring 1988); this allows to constraint the total correction to the principal term in longitudexsinε_o to:

-2.276 mas for the "in-phase" component, and +1.602 mas for the "out of phase" component.

Using such corrections to the coefficients in longitude of the 18.6 yr nutation, as well as the corrections, as previoulsy computed, to the 9.3 yr nutation, allowed us to estimate the corrections to the precession and nutation model. The final correction to the constant of precession has been found to be: $\delta f = - 0.279''/c \pm 0.02''/c$ and the final estimated corrections to the 1980 IAU nutation series are given, with their formal errors, in Table 1.

Argument	Period	$\delta\psi \sin\varepsilon_o$	$\delta\varepsilon$
2☾	13.66 d		
in-phase		- 0.40 ± 0.02	0.34 ± 0.02
out of phase		- 0.03 ± 0.03	- 0.14 ± 0.02
☾ - p	27.55 d		
in-phase		- 0.10 ± 0.02	- 0.06 ± 0.02
out of phase		- 0.03 ± 0.02	- 0.01 ± 0.02
2⊙	182.63 d		
in-phase		0.66 ± 0.02	- 0.49 ± 0.02
out of phase		- 0.46 ± 0.03	- 0.45 ± 0.02
⊙- p	365.25 d		
in-phase		1.99 ± 0.03	1.86 ± 0.02
out of phase		0.49 ± 0.02	- 0.27 ± 0.02
Ω	18.61 yr		
in-phase		constrainted	3.13 ± 0.15
out of phase		correction	1.21 ± 0.17

Table 1: Estimated corrections to the main IAU 1980 nutation coefficients from the ERP(GSFC)90 R 01/VLBI series of celestial pole offsets from 1979.6 to 1990.0

The residuals as obtained after applying the previous estimated corrections to the series have been analysed for by a least squares adjustment of periodic terms which has clearly revealed a circular term, with a radius of the order of 0.25 mas at a period of 430 days. If such a circular term in the celestial motion of the pole is due to the free core nutation, its estimated period would correspond to a core flattening of 2.687×10^{-3}, which is in good agreement with the one of 2.674×10^{-3}, which can be derived from the amplitude of the retrograde annual nutation (-32.98 mas) as estimated from the present analysis.

3. REFERENCES

Capitaine, N. and Caze, B., 1990, 'Estimation of corrections to the IAU model for the celestial motion of the CEP from VLBI data', to be submitted to *Astron.Astrophys.*

Herring, T., 1988, 'Resolutions to the IAU nutation Working Group', July 1988.

Kinoshita H. and Souchay, J., 1990, 'The theory of the nutation for the rigid Earth model at the second order', *Celest.Mech*, in press.

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