NOTE ABOUT A NEW EVALUATION OF THE DIRECT PERTURBATIONS OF THE PLANETS ON THE MOON'S MOTION

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The aim of this paper is to present the principal features of a new evaluation of the direct perturbations of the planets on the Moon's motion. Using the method already published in Celestial Mechanics (Standaert, 1980), we compute "a first-order theory" aiming at an accuracy of the order of the meter for all periodic terms of period less than 3 500 years.

From an external point of view, we mean by that :

a) keplerian orbits for the planets,
b) the ELP-2000 solution of the Main Problem proposed by Mrs. Chapront (Chapront-Touzé, 1980),
c) the first-order derivatives with respect to the constants of motion of the SALE theory of Henrard (Henrard, 1979).

On the other hand, from an internal point of view, the computations include :

d) the development in Legendre polynomials not only to the first-order in (a/a'), but also the following ones (up to the sixth-order for Venus, for example),
e) the contributions of the second-order in the Lie triangle,
f) second-order contributions coming from the corrections of the mean motions due to the planetary action.

In summary, this solution is a complete solution of a first-order model given by a), b) and c). However, in the comparisons with Brown's and Chapront's solutions, I have neglected the contributions arising from e).

With respect to Brown's solution, we obtain three classes of differences :

1) missing terms in Brown's theory,
2) a systematic error in Brown's solution due to a wrong intepretation of the angle D ; this causes a shift of 180° for all the odd terms in D,

O. Calame (ed.), High-Precision Earth Rotation and Earth-Moon Dynamics, 265–266.

https://doi.org/10.1017/S0252921100002682 Published online by Cambridge University Press

3) other differences essentially on the two bigger contributions.

In longitude, the global effects of the three classes of differences are respectively of about 175 meters, 800 meters and 2 kilometers. However, in the third class, the principal divergences concern long-period terms and part of the deviation is expected to be absorbed in the constants. In fact, neglecting the differences on (16 T - 18 V + 1) and (3 T - 10 V + 1), it remains, in this class, terms with a maximal effect of about 140 meters.

The agreement between Chapront's solution and ours restricted to the first-order (i.e. without e) is of the order of the meter. Our second-order, which is not computed by Chapront, gives inequalities of the order of 70 meters.

In latitude, there are not differences greater than 40 centimeters. In distance, the biggest divergence is of about 70 centimeters. In longitude, we find a difference of about 1.4 meter for the term (19 T - 18 V + 3 D - 2 F) with a period of 556 years. All the other divergences are less than 70 centimeters.

We are thus confident that, for the part of the perturbations we have evaluated, the accuracy of our solution is something like a factor of 1 000 better than Brown's theory.

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https://doi.org/10.1017/S0252921100002682 Published online by Cambridge University Press