KSM03 HARMONIC DEVELOPMENT OF THE EARTH TIDE-GENERATING POTENTIAL IN TERRESTRIAL REFERENCE FRAME

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ABSTRACT. The KSM03 harmonic development of the Earth tide-generating potential of Kudryavtsev (2004) is re-calculated into the Terrestrial reference frame and presented in the standard HW95 (Hartmann and Wenzel 1995) normalization and format.

The original KSM03 harmonic development of the Earth tide-generating potential (TGP) by Kudryavtsev (2004) is made in a reference frame defined by the true geoequator of date with an origin at a point A - that being the projection of the mean equinox of date. The development is based on the latest NASA/JPL ephemerides DE/LE-405,-406 (Standish 1998) and valid over two thousands years, 1000-3000.

The value $V(t)$ of the TGP at an arbitrary point P on the Earth's surface at epoch t is expressed in the KSM03 as

$$V(t) = \sum_{n=1}^{6} \sum_{m=0}^{n} \left(\frac{r}{R_E}\right)^n \bar{P}_{nm}\left(\sin\varphi'\right) \left[C_{nm}(t)\cos m\theta^{(A)}(t) + S_{nm}(t)\sin m\theta^{(A)}(t)\right] \qquad (1)$$

where R_E is the mean Earth equatorial radius; $\bar{P}_{nm}$ are the normalized associated Legendre functions; r and φ' are, respectively, the geocentric distance and latitude of the point P; $\theta^{(A)}(t)$ is the local mean sidereal time at P reckoned from the same origin point A - so that it is related to the Earth fixed east longitude (from Greenwich) λ of P simply as

$$\theta^{(A)}(t) = \lambda + GMST \qquad (2)$$

($GMST$ is Greenwich Mean Sidereal Time defined by a well-known expression by Aoki et al. 1982).

The KSM03 provides development of the coefficients $C_{nm}(t)$, $S_{nm}(t)$ to Poisson series of the following form

$$C[S]_{nm}(t) = \sum_{k=1}^{N} \left[\left(A^c_{k0} + A^c_{k1}t + A^c_{k2}t^2\right)\cos\omega_k(t) + \left(A^s_{k0} + A^s_{k1}t + A^s_{k2}t^2\right)\sin\omega_k(t)\right] \qquad (3)$$

where A^c_{k0}, A^c_{k1},$\cdots$, A^s_{k2} are constants and the arguments $\omega_k(t)$ are the forth-degree polynomials of time t

$$\omega_k(t) = \nu_k t + \nu_{k2}t^2 + \nu_{k3}t^3 + \nu_{k4}t^4. \qquad (4)$$

In total the KSM03 development of the Earth TGP includes 26,753 Poisson series [for all the coefficients $C_{nm}(t)$, $S_{nm}(t)$]. The minimum amplitude of the leading terms of the series (A^c_{k0} and A^s_{k0}) is 1×10^{-8} m^2/s^2; the same limit is set for the minimum values of $A^c_{k1}t$, $A^s_{k1}t$, $A^c_{k2}t^2$ and $A^s_{k2}t^2$ over 1000 years from the epoch J2000. The accuracy of calculation of the gravity tides at a mid-latitude station (Black Forest Observatory, Germany) made with use of the KSM03 series is 0.025/0.39 nGal (the r.m.s./maximum error) over 1600-2200 (Kudryavtsev 2004). It exceeds the accuracy of any previously made harmonic development of the Earth TGP in time domain by a factor of least three.

The series composing the original KSM03 harmonic development of the Earth TGP have TDB time argument and do not include a much less stable UT1 time argument which is necessary to calculate the TGP in the Terrestrial reference frame (TRF). Such an approach makes the KSM03 series valid over a long-term interval of time, 1000-3000, and helps to increase the development accuracy. However, for practical applications it is valuable to develop the TGP in the Earth-fixed TRF. Therefore coefficients of the KSM03 series in the TRF are re-calculated and transformed into the standard HW95 (Hartmann and Wenzel 1995) normalization and format. The KSM03 series represented in such a format include 28806 terms and can be directly used in development of nutation theories and precise calculations of tidal effects observed in the TRF.

The KSM03 harmonic development of the Earth TGP in the standard HW95 normalization and format is available at **http://lnfm1.sai.msu.ru/neb/ksm/tgp/ksm03.dat**.

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