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Title: Log-log-scaling in tidal harmonics of earth-tide catalogues

Abstract:

A still unsolved theoretical problem in earth tide research is the understanding of a rather perfect log-log-scaling of amplitudes from harmonic tidal constituents in tidal catalogues [1, 2]. Earth tides, resulting from differential gravitational solar and lunar forces acting on various parts of the earth, is a well-known phenomenon. A common presentation of tides, a so called a **tidal model**, is as a catalogue with entries for frequency, strength (amplitude), and phase shift (towards some reference time) of each individual harmonic. The total number of tidal constituents is obviously infinite owing to the fact that (a) any combination of tidal periods (long-period, diurnal, semi-diurnal, ter-diurnal, quarter-diurnal, etc.) is a harmonic constituent and (b) with increasing resolution tidal effects of other planets Venus, Mars, Jupiter, ... and finally any other celestial bodies have to be taken into account. Tidal catalogues, for practical use, list only the dominant harmonics, i.e., comprise between a few hundred and some ten thousand constituents [3, 4, 5]. Such numbers are big enough to screen the existence of self-similarities. When the number of constituents that surpasses a certain amplitude level is plotted against that level, a fractal distribution over at least four orders of magnitude is obtained. Remarkably, the fractal exponent appears to be quite close to 0.5. Accordingly, a refined tidal model, if complete, should have about ten times more harmonic constituents than a coarser model, when the smallest amplitude of the refined model is a hundred times lower than that of the coarser one. Whether this particular log-log-distribution marks an inherent feature of the dynamics of celestial bodies or is a coincidence with no further meaning is not yet clear. References [1] H.-J. Kuempel, *Fractals and Dynamic Systems in Geoscience*, J.W. Kruhl (Ed.), 213, Springer, Heidelberg (1994). [2] F. Roosbeek, *Geophys. J. Int.*, 126, 197 (1996). [3] Y. Tamura, *Bull. de l'Institut de Géographie et de Géologie de l'Université de Marrakech* 99, 6813 (1987). [4] Xi Qin-Wen, *Bull. de l'Institut de Géographie et de Géologie de l'Université de Marrakech* 105, 7396 (1989). [5] T. Hartmann and H.-G. Wenzel, *Geophys. Res. Lett.* 22, 3553 (1995).

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