

ON THE EFFECT OF OCEAN TIDES ON THE SECULAR RETARDATION OF THE EARTH'S ROTATION

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Abstract. The classical problem of determining the secular retardation of the Earth's rotation due to the effect of tides (oceanic and bodily) has an important geophysical value in determining the possible existence of processes inside the Earth, which lead to secular variations of rotation of the whole Earth or its external layers.

Using new cotidal charts of the world ocean calculated by Bogdanov for the main tidal waves M_2 , S_2 , K_1 and O_1 and using the method of moments of tidal forces the retarding moment was found to be 8.3×10^{23} dyn cm. This is twice the amount of previous evaluations. (This method is superior to the method of calculating the dissipation of energy or the moments of frictional forces). This amount corresponds to a retardation of $3.8 \mu\text{s}/\text{century}$ in the speed of the Earth's rotation. But the observations of the Sun give only $1.9 \mu\text{s}/\text{century}$ for the retardation. Thus, there seem to be nontidal and probably internal processes, which accelerate the Earth's rotation by about $2 \mu\text{s}/\text{century}$. And this is without taking account of additional smaller effects of bodily tides. The search for these processes is an important problem.

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DISCUSSION

J. Sündermann: The basic tidal model of Bogdanov is a linear one. This should be sufficient for a rough 5° -model. But if you take into account the important shelf areas you must use a non-linear model because the typical nonharmonic behaviour of dynamical processes in shallow water areas is due to the nonlinearity of the basic equations.

N. Pariisky: The cotidal charts of Bogdanov were received using averaged observations made at coastal points. The shallow water perturbations were thoroughly filtered out. As the shallow coastal zones occupy only a small part of the ocean, the discrepancies in these parts can have very little effect upon the retarding moment calculated by the method of lunisolar tidal forces and not by the effect of friction.

H. Jeffreys: There is an acceleration due to the semi-diurnal thermal oscillation, which is not negligible. Pekeris has taken dissipation into account for the actual ocean form. He has so far taken the solid Earth as rigid; I have hopes that he will allow also for the bodily tide. I think also that he can improve the boundary condition.

N. Pariisky: Calculation of the retarding moment of lunisolar tidal forces is free from many difficulties present in the method of calculating energy dissipation. But it is important to have good cotidal charts. It is a very good idea to evaluate the possible effect of bodily tides upon oceanic tides. It seems necessary to take account of the Earth's deformation due to ocean tides in calculating the retarding moment. H. Takeuchi in 1952 has obtained a diminishing factor of 0.73. But this does not change the conclusion about the existence of unknown causes which accelerate the Earth rotation. The effect of bodily tides upon the Earth's rotation is also being studied.