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Refined prediction of GIA-induced variations in the Earth's rotation

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Climatic fluctuations dominate changes in the distribution of ice and water on the Earth's surface, which in turn affects climate itself. Continental ice accumulation and ablation and the accompanying changes in sea level result in the deformation of the solid Earth, a process termed glacial-isostatic adjustment (GIA). The resulting changes in surface topography and bathymetry affect the spatial pattern of sea-level change, which again influences deformation. The redistribution of ice and water, along with the mass redistribution in the Earth's interior also induce perturbations in the Earth's gravitational field and rotational characteristics. The wander of the rotation axis in turn induces variations in the centrifugal force and thus additional variations in sea level and surface deformations. Taken together, this means that the determination of sea-level change coupled with polar wander due to changes in ice-water mass is a complex geophysical and mathematical problem.

Assuming that the deformation in the Earth is small, the movement of the rotation vector can be described by the linearized Liouville equation. The numerical integration of it requires us to specify the temporal perturbation of the inertia tensor. The approach presented here is based on the MacCullagh formulae and derives this perturbation from the time-dependent variation of the second-degree spherical harmonics of the induced changes in the gravitational potential.

Once the Liouville equation is solved, the temporal variability in the centrifugal force is established. This driving force is then considered in the linear-momentum and Poisson equations governing GIA to compute the surface-deformation and gravitational-potential changes. This rotational feedback, called the rotational deformation, is mathematically described by particular terms in the field equations for GIA. We will present the effects of individual terms on surface deformation and sea-level variation. The ro-

tational deformations are treated in the time domain, which eliminates the need to apply the traditional Laplace-transform method and allows the conventional approach based on load Love numbers to be extended to the case of a 3-D viscoelastic earth model.