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Abstracts and Short Communications

Phenomenological Representation of Seismic Sources

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All the usual phenomenological representations of earthquake sources can be obtained from the stress glut, the difference between the elastic model stress tensor field and the true physical stress tensor field. For thermoelastic sources the stress glut is an ordinary function; for faults it is a singular distribution whose support is the fault surface. The equivalent force distribution is the negative divergence of the stress glut. The polynomial moments of the equivalent force and the stress glut are the two types of seismic moment tensors. The force moments are completely determined by the motion and the glut moments are not. If all the force moments are known, the motion is completely determined, and if all the glut moments are known the source is completely determined, along with the force moments and the motion. Contrary to some published work, the seismic moment tensor is not the integral of the stress drop, and the equivalent force is not the negative divergence of the stress drop. The most general point source has as stress glut a finite linear combination of derivatives of delta functions. It can be used to approximate real localized sources. There are point sources which produce no motion. Mechanisms exist by which a real fault may produce a seismic moment tensor with nonzero trace. Real faults probably can be represented as simple surface sources, a generalization of dislocation sources, but less inclusive than De Hoop sources.

References

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The Influence of the Core and the Oceans on the Chandler Wobble

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Elastic-gravitational normal mode theory is used to investigate the dynamical influence of the fluid outer core on the free wobble of a rotating, ellipsoidal Earth model which does not have surficial oceans. A self-consistent equilibrium tidal theory is then employed to determine the passive influence of the associated pole tide on this mode. These calculations yield the observed Chandler

wobble period to within its observational uncertainty; models of the Earth having elastic material properties inferred from high frequency seismological observations appear therefore to predict with good accuracy the response of the real Earth at a period of fourteen months. We find also that more precise measurement of the Chandler wobble period is not likely to constrain strongly the structure of the Earth's fluid core, that estimates of wobble excitation by earthquakes based on a quasi-static calculation of the Earth's response are correctly computed, and that the coupling between wobble and spin induced by the geographically irregular distribution of the oceans is sufficiently slight that it is unlikely ever to be observed.

References

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The Earth's Core-Mantle Interface Revisited

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Determinations of fluctuations in the length of the day have revealed changes due to the transfer of angular momentum between the Earth's "solid" mantle and the overlying atmosphere on time scales upwards of a few weeks, as well as the slower but more pronounced "decade variations" due largely (according to current ideas) to angular momentum transfer between the mantle and the Earth's liquid core. Improvements in techniques for monitoring the Earth's rotation (such as those afforded by recent advances in methods of ranging to artificial satellites and the Moon and of very-long baseline interferometry) should therefore lead to results of interest to meteorologists concerned with planetary-scale motions in the atmosphere and to geophysicists concerned with the magnetohydrodynamics of the core and the origin of the main geomagnetic field. The consideration of the stresses at the Earth's surface and at the core-mantle interface that bring about angular momentum exchange between the solid and fluid parts of the Earth raises a number of basic hydrodynamical questions requiring further experimental and theoretical research. In the case of the core, quantitative difficulties encountered by the suggestion that the stresses are electromagnetic in origin led to the idea of topographic coupling associated with hypothetical undulations of the core-mantle interface.

At a few kilometres in vertical amplitude, such "bumps" would not significantly influence seismic data but they would measurably distort the Earth's gravitational and magnetic fields and might account for a certain correlation between these fields. Indeed, it was as a direct outcome of a test of the "bumps" hypothesis that the correlation between the gravitational and magnetic fields was discovered. Having been introduced originally by the author in an attempt to account for the high variability of the frequency of geomagnetic polarity reversals and certain properties of the geomagnetic secular variation (for references, see Hide, 1977), the hypothesis is now supported by sufficient evidence to justify further work on its various implications for the Earth's internal structure and evolution. It will be particularly important in future work on the interpretation of long wavelength features of the geoid to take into account one direct implication of the aforementioned correlation between the Earth's gravitational and magnetic fields, namely that the broad features of the horizontal pattern of density variations in the mantle are probably characterized by a high degree of vertical coherence – much higher in fact than many workers have evidently been prepared to accept hitherto.

Reference

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