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An analytic estimation of the Magnetotelluric response of one dimensional stochastic conductivity Earth structure.

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The complexity of the conductivity structure of the Earth's crust makes the study of electromagnetic wave propagation interesting because of the existence of a geoelectric environment with random variation of the conductivity. A random medium can be viewed as an ensemble of a multitude of heterogeneous media, called realizations, which differ from each other in the detailed structure of the fluctuation, but have some common statistical properties. In the random-medium approach one deals with statistical quantities of the medium and the relevant statistical quantities of the wavefield. In the present work we consider the particular case in which the conductivity depends only on the z coordinate (layered medium). Introducing a layer of thickness L with conductivity σ(z) = σo + σ(z),where σ represents the average conductivity of the layer and σ(z)is a random, uncorrelated, zero-mean function of the z coordinate, we estimate the propagation matrix to approximation order (kL)2, i.e. when the penetration depth of the MT variation is much greater than L, and we derive the magnetotelluric response when a randomly layered medium exists. We demonstrate the result for the case of a homogeneous half-space disturbed in its upper part by a randomly layered variation of the conductivity. The calculation of the relevant stochastic integrals also allows the determination of the statistical properties of the magnetotelluric response.

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