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The continuous relaxation spectrum of Maxwell Earth models: a new method.

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We show a new method to compute spatial and gravitational perturbations of spherically symmetric self-gravitating Maxwell Earth models. This method is a generalization of the normal mode approach and it allows us to take into account continuous variations of all the material parameters. Indeed the usual normal mode approach can be used only if the relaxation spectrum is composed of isolated relaxation modes. We show that continuous variations of the rheological parameters are responsible for dense intervals on the real axis of the Laplace domain in which the Love numbers are not analytic. These intervals are associated to non Lipschitzian zones of the differential system describing momentum conservation and self-gravitation. Elsewhere the Love numbers are characterized by isolated relaxation modes, at the most denumerable. The evaluation of the Love number spectral density is time expensive and subject to numerical instability. However the inverse Laplace transformation is obtained more easily with respect to the approach based on the integration along the Bromwich path, the latter being unstable increasing the time. We validate the new method by comparing the viscoelastic spatial and gravitational perturbations of the PREM (Dziewonsky & Anderson, 1981), due to surface loading and tidal forcing, with those obtained by means of the Bromwich path approach. This generalization of the normal mode approach makes a step ahead in our understanding of viscoelastic relaxation processes. Particularly, we discuss how isolated relaxation modes are affected by continuous variations of the rheological parameters and we analyse the differences between compressional and compositional stratifications at large time scales.