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How to measure the strength of the lithosphere without using the admittance or coherence between gravity and topography

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The lithosphere is modeled using a differential equation characterized by a set of parameters, at least one of which, under the assumption of elastic behavior, is generally thought of as a proxy for its strength: the flexural rigidity (D), or, by extension, the elastic thickness. This lithospheric system then takes an input: topographic loading by mountain building and other processes, and maps it into an output: the gravity anomaly and the final, measurable, topography. The input is not measurable but some of its properties can be characterized. The outputs are measurable but the relation between them is obfuscated by their stochastic nature and the presence of unmodeled components. Estimating D, most usually in the spectral domain, generally involves constructing summaries of gravity and topography. Both admittance and coherence are popular; both are ratios of the cross-spectral density of gravity and topography to the power spectral densities of either, the whole sometimes squared. Despite the fact that neither admittance nor coherence are Gaussian, estimating D usually comes down to the least-squares fitting of a parameterized curve, where Gaussian behavior is tacitly assumed. In this two-step procedure, admittance or coherence are first estimated, and subsequently inverted for the strength parameters. Rarely, if ever, are lithospheric models found that satisfy both coherence and admittance to within their true error. Why don't they? Poorly characterized errors of admittance and coherence are not the only problems with this procedure. There is also the implicit annihilation of information during the construction of these statistics (coarsely sampled, sometimes squared, ratios, measures of the data as they are) themselves. Then there is the fact that we do not want to know coherence and admittance at all - we want to know properties of the lithosphere! In this presentation, we intend to abandon coherence and admittance studies for good, by proposing an entirely different method of estimating flexural rigidity, which returns it and its confidence interval, as well as a host of tests for the suitability of the assumptions made along the way, and the possible presence of correlated loads and anisotropy in the response. The crux of the method is that it employs a maximum-likelihood formulation that remains very grounded in the data themselves, and which is formulated in terms of variables that do have a Gaussian distribution.