Relationships between power spectrum of each component of gravity gradient tensor and subsurface structure

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We derived equations giving relationship between the pseud depth of a subsurface layer and the power spectrum of each component of the gravity gradient tensor.

In recent decades, the six components of the gravity gradient tensor have been observed by gravity gradiometry, and techniques for estimating subsurface structures and for extracting the structure boundary (edge) using these data have been studied and developed. In general, filtering plays an important role in these analyses. In the case of a gravity anomaly, the well-known relationship between the power spectrum and the pseud depth of a subsurface layer plays an important role in filtering. However, most of these studies using gravity gradient tensor data have not conducted filtering to extract the specified wavelength from the gravity gradient tensors for subsurface estimations. One reason for this omission might be that the wavelength characteristics differ among the components of a gravity gradient tensor. And, such relationships for gravity gradient tensors have not been shown thus far. Therefore, in this study, we derived relationships between the pseud depth of the subsurface layer and the power spectrum of the components of the tensor.

These relationships were derived from the relationship between gravity anomaly and its causative subsurface layer through the relationships between gravity anomaly and each component of the tensor in Fourier domain (e.g., Mickus and Hinojosa, 2001). In the deriving these relationships. It was assumed that the amplitude of the subsurface structure would be small enough than the average depth of the structure. As a result, it was found that all derived relationships were nonlinear to the wave number on a semi-logarithmic scale and that that, except for g_{zz} component, all spectra are not point symmetric with respect to the origin but has direction dependency.

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[References]
Mickus, K. L., and Hinojosa, J. H. (2001): The complete gravity gradient tensor derived from the vertical component of gravity: a Fourier transform technique, Jour. Appl. Geophys., 46, 159-174.

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