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Enhancement of of Gravimetric Data Visualisation for the Geological Characterization of the Continental Margin of Southeastern Brazil

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Introduction

Gravimetry is a principal geophysical tool broadly used to determine variations in gravitational acceleration across Earth's surface. These variations reflect subsurface mass distribution, enabling the construction of gravity models for subsurface studies. Such models allow inference of rock densities and the mapping of geologic features such as sedimentary basins, faults, igneous intrusions, and folds. The technique is especially useful in vegetated or sediment-covered areas where surface topography is not indicative of underlying geology.

Gravimetric interpretation is essential for mapping large tectonic features from surface cover to basement. This study uses publicly available satellite gravimetry, processed in a GIS environment to generate Free-Air and Bouguer anomalies and derivatives like the Tilt Derivative and Slope. The aim is to integrate these into enhanced images to better delineate weak structural features and identify neotectonic evolution patterns along the Southeastern Brazilian continental margin.

Method

The primary process began with the creation of Free-Air Anomaly and Bouguer Anomaly products. The Free-Air Anomaly is the field-measured anomaly of gravity and the theoretical sea-level value with topographic corrections removed. This product provides an initial impression of laterally varying crustal masses. Bouguer Anomaly accounts for station elevation and topographic effects. The simple Bouguer correction removes the influence of mass between the station and sea level, while terrain correction refines this using local topography. The resulting density variation map is more accurate: positive anomalies generally indicate denser rocks such as igneous intrusions, while negative anomalies reflect less dense units like sedimentary basins.

In addition to these primary anomalies, derived products were generated to enhance structural interpretation. The Tilt Derivative is widely used for mapping structural contacts in gravitational and magnetic fields, being effective for visualizing both shallow and deep structures. This filter produces zero values at source boundaries, positive values above sources, and negative values outside, aiding structural definition. The Slope, representing the rate of elevation change over horizontal distance, is frequently applied in GIS for mapping slopes and analyzing terrain. In this study, it was adapted to gravity anomaly data to enhance visualization of topographic and structural patterns.

All datasets, both basic and derived, were georeferenced and processed in a GIS environment. Color rendering and enhancement were based on the integration of anomaly and derivative information. This approach was fundamental in delineating structural continuities and subtle geological features, thereby enhancing the interpretation of gravimetric data.

Results and Conclusions

The integration of gravimetric data with derived products led to improved visualizations and interpretation of structural continuities. Comparing different datasets revealed patterns and provided a more detailed and supported representation of gravimetric features, significantly contributing to the geological characterization of the studied region.