



**X GEOQUANTI**  
Simpósio de Quantificação em Geociências

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# ANAIIS

## X SIMPÓSIO DE QUANTIFICAÇÃO EM GEOCIÊNCIAS

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Balneário Camboriú, Santa Catarina  
2025

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## MITIGATION OF OUTLIERS IN GRAVITY INTERPOLATION USING WEIGHTED EQUIVALENT SOURCES

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In a terrestrial gravity database, each data unit results from a field measurement conducted by an individual. Given the manual and labor-intensive nature of data acquisition, a high variability in measurement accuracy is assumed. Since these are geospatial data, filtering out discrepant values is a challenging process, as an anomalous value must be evaluated in relation to its neighbors but cannot be directly compared to areas with different geological contexts within the study region. The remaining alternative is to manually identify outlier points, a process analogous to the selective screening of impurities in a granular dataset. However, in large databases, the manual method, besides being laborious, does not ensure the effective removal of all anomalous values relative to their neighbors. Typically, the last outliers persist until the final processing stages, being identified only by the "spike" effect they produce in the interpolated grid. Ideally, a data analysis method should not only be automated but also allow control and traceability of the modifications, eliminating the subjectivity of manual selection. This study proposes an iterative weighting technique based on the equivalent source method to mitigate the effects of outliers in gravity data interpolation. The developed code implements an interpolation method based on equivalent sources (EquivalentSourcesGB), designed to reduce the impact of significantly discrepant data points. The function starts by receiving the coordinates and observed values of the data, along with parameters such as source depth, damping, and the maximum number of iterations. The process iteratively refines the interpolation by adjusting the estimated weights in each cycle. Based on misfit values—the difference between observed and predicted values—the weights are recalculated to minimize the influence of outlier points. Two methods are available for weight adjustment: the inverse of the absolute residual value or the inverse of its square. To prevent division by zero, only residuals above a defined tolerance are considered. In each iteration, the function also evaluates the stability of the process using a logarithmic analysis of the standard deviations of the residuals. If the derivative of the fitted logarithmic curve falls below a predefined threshold, the process is deemed stable, and the iterations are terminated. The loop stops when stability is achieved or when the maximum number of iterations is reached. At the end, the function returns the final adjusted weight vector, reflecting the reduced influence of outliers on the interpolation. This approach preserves most of the data while mitigating the negative effects of outliers, making the process more robust and reliable. Statistical data processing is an essential step in any scientific endeavor. In the case of geophysical data, an effective approach must consider the First Law of Geography: "Everything is related to everything else, but near things are more related than distant things." The method presented in this study incorporates this perspective by handling outliers in an iterative and quantitative manner using the equivalent source method. The technique was tested with real gravity data from the south-central region of Brazil and demonstrated effectiveness in improving the quality of the interpolated grid.

Keywords: Gravity Interpolation, Equivalent Sources, Outlier Mitigation