Submission code: 8VPKYX0MQZ

See this and other abstracts on our website: https://home.sbgf.org.br/Pages/resumos.php

Local Wavelet Spectrum: a powerful tool for the localized estimation of the depth-to-source of gravity and magnetic fields

Maurizio Fedi (University of Naples Federico II; Italy), Mahmoud Ahmed Abbas (University of Naples Federico II; Italy), Maurizio Milano (University of Naples Federico II; Italy), Ciro Messina (University of Naples Federico II; Italy), Giovanni Florio (University of Naples Federico II)

Local Wavelet Spectrum: a powerful tool for the localized estimation of the depth-to-source of gravity and magnetic fields

Introduction.

Spectral analysis provides high-resolution in the wavenumber-domain, but it has not resolution in the space-domain. In addition, the case of multiple sources is hard to be faced with standard techniques, such as the well-known Spector and Grant's method. To fix these issues, we can use alternative mathematical approaches that depend on both wavenumber and spatial location, such as the Continuous Wavelet Transform (CWT).

Method and Theory

Thanks to the properties of the Continuous Wavelet Transform, we may perform a scalogram analysis to characterize the field contributions for both their space and wavenumber contents. The scalogram is a 3D volume of CWT coefficients with space distances along the *x, y* axes and the wavenumbers, *k,* along the vertical axis. We have designed a local spectral analysis to estimate the depth to the source in specific regions of the 3D wavelet domain. Our goal is to apply the well-known method of Spector and Grant to wavelet spectra in different ways: a) selecting specific sub-volumes of whatever shape in the 3D scalogram; b) selecting 2D sections of the scalogram along profiles of whatever orientation in the space domain; c) selecting 1D vertical profiles (i.e., along the *k*-axis direction) in the 3D scalogram at one or more points of different spatial coordinates. We computed the CWT transform using several analyzing 2D wavelets, such as the Morlet wavelets (with different values of central wavenumber k_0 and of the Gaussian standard deviation σ), the Poisson wavelet, the Gaussian wavelet and others. The best results were obtained with the Morlet wavelet, provided that $\sigma k_0 > 5.5$, so satisfying the admissibility condition. The 2D Morlet wavelet is directional, so that we formed a multidirectional Morlet fan, with *n*-fold symmetry, by superposing its *n* suitably rotated copies.

Results and Conclusions

We first applied the method to the superposed synthetic anomalies generated by two prisms at different depths and with close horizontal positions. This case cannot be successfully treated by the Fourier power spectra, because its complete lack of space resolution cannot fix the evident interference between the anomalies of the two sources. Instead, the wavelet power spectra can be computed at different horizontal positions and so capture efficiently the different information about the depth. In this way, we obtained a correct estimation of the depth to the top and to the bottom of both the sources. We also studied the aeromagnetic anomaly field in Italy and identified complex interfering anomalies in the Vulture, Southern Italy, and Northern Sardinia areas. For both the areas, we were able to perform local spectral analyses which fully characterized the sources of the interfering fields. Also in this case, Fourier power spectra cannot be diagnostic for characterizing the different sources generating the interfering anomalies. In fact, no matter the position and size of the data window used for computing the power spectrum, we obtain a depth estimate related to the shallow source only, whose effect is dominant in the region. Instead, our local spectral analysis highlights the depths of the different sources well. For instance, in the Vulture area, we evidence a shallow source, mainly corresponding to a volcanic structure, and a deep source ensemble, deep more than 13 km which should correspond to intrusive igneous rocks related to the effusive volcanic activity of the Mt. Vulture.