Geophysical Research Abstracts, Vol. 8, 01576, 2006
SRef-ID: 1607-7962/gra/EGU06-A-01576

Mutual information statistics for electroseismic time series

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We study the statistical properties of the average mutual information I considered as a random variable. An application to seismic signals, in particular to an electroseismic one, builded with two orthogonal components and associated to an earthquake of $M = 7.4$, is presented. The time series is divided in N windows of size m, and we compute I on each window. Then, we analyze the scaling behavior of these properties as m becomes small. Also, we compute a re-scaled average mutual information index $\lambda(I)$, which provides a measure of the strength of nonlinear correlations between these two components. That index is compared with the correlation coefficient, which only detects the linear dependencies between both components. We found that $\lambda(I)$ displays an irregular behavior and that almost all windows displays higher values of $\lambda(I)$ indicating strong correlation. However, there exists some windows with relatively lower values of $\lambda(I)$. Hence, we conclude that the irregular behavior of I indicates an anisotropy of the propagation of the electromagnetic fields in the earth's crust, that seems to be related with the particular seismic process taking place in México, where the signal was measured.