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Financial markets tools for multiscale analysis of geochemical and geophysical time series

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Financial markets specialists often use multiscale analysis on different kind of time series and many different tools have been developed for this task. Two of them, widely used, are: candlestick charts and technical indicators. Our approach consists in using both tools to analyze geochemical and geophysical time series in a multiscale fashion. We first represent the signal using candlesticks at different time scales. To detect changes in the time series we found convenient using the MACD technical indicator (Moving Average Convergence/Divergence), which provides a robust mean to compute the signal derivative even when noise is present. Comparing this indicator with other features of the time series, represented as candlesticks, allows marking the occurrence of significant changes in the signal trend. This analysis is performed simultaneously at different temporal scales and we developed a specific time-scale representation which allows identifying changes in the signal trend occurring simultaneously at different time scales.

The performances of our approach have been tested on synthetic time series showing its capability in detecting significant changes in the trends, even when the signals are affected by a low signal/noise ratio. We applied this method to a dataset of continuous CO_2 flux measurements in El Hierro (Canary Islands, Spain), before, during and after the 2011-2012 submarine eruption. Results show that the method would have been able to detect in near-real time, changes in the time-series trend related to relevant geophysical and/or volcanological phenomena. We conclude that the application of this method in real cases would be useful for the early-warning of hazardous geological events as volcanic eruptions.