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The application of an innovative pre-processing method aimed at reducing irregularly sampled microgravity data

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Since 1987, discrete microgravity measurements have been accomplished at Mt. Etna (Italy) to recognize underground mass redistributions related to the ensuing volcanic activity. The gravity network is now composed of 71 stations 0.5 to 4 km apart and covers an area of about 400 km^2. One of the four subarrays of this network, a 24-kilometer East - West trending profile of 19 stations on the southern slope of the volcano, is surveyed at a higher sampling rate (usually quasi-monthly measurements, up to weekly during periods of paroxysmal activity) than the other subarrays. During ten years since its installation (summer of 1994), a large data-set has been collected with the measurements made along this profile. This 10-year period encompasses several eruptive events (both activity at the summit craters and lateral eruptions). An important issue with the above data-set is the need of separating the useful signal (i.e. the volcano-related one) from unwanted components (instrumental, human-made, seasonal and other kinds of noise). This task is complicated by the irregular sampling in both space (station along the profile are not evenly spaced) and time (the above cited changes in sampling rate). Obviously, frequency-domain filters can not be applied to address this shortcoming. We thus propose an innovative data pre-processing method for noise-filtering based on “Second Generation Wavelets”. By giving up translation and dilation and basing the calculation on a new approach called “The Lifting Scheme”, the “Second Generation Wavelets” allow wavelet transforms to be applied to irregularly sampled data, while maintaining properties of classical wavelets such as time-frequency localization and fast algorithms. Once the useful signal has been suitably separated from the noise, the residual 3D space-time image can be used to evidence, over the studied area and time-interval, (i) recurrences in both space (i.e. zones under which mass redistributions occur more frequently) and time (i.e. cyclic

processes) and (ii) microgravity anomalies correlated with the ensuing volcanic activity.