Stochastic investigation of the correlation structure of two-dimensional images of rocks from small to large scales

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We investigate the drop of variance vs. scale for geostatistical processes through the use of the climacogram-based variogram (CBV) and climacogram-based power-spectrum (CBS), where climacogram is the (plot of) variance of the space-averaged process vs. the spatial scale. Focus is given to the small and medium scale properties of the rocks and an attempt is made to link the CBV and CBS with these and provide certain stochastic characteristics based on their composition and resolution. The analysis is based both on microscale and macroscale data, as extracted from grayscale images of rocks. Also, comparisons are made, through Monte-Carlo experiments, to the autocovariance-based metrics (such as variogram and power-spectrum) for a variety of common (white noise, Markov and Hurst-Kolmogorov) processes. Finally, a parsimonious model is proposed that can adequately describe the second-order dependence structure of rocks for a large variety of scales.