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The Particle-Size Toolbox: 3D modelling of particle-size distributions in the subsurface

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This paper presents a Matlab toolbox for creating three-dimensional models of complete particle-size distributions in the subsurface. Three modules comprise the toolbox: (i) integration; (ii) optimization, and (iii) interpolation.
The integration module accepts a wide variety of input data from boreholes and surface samples. These are converted into a common format. Particle-size data are integrated using a combination of interpolation or Gaussian simulation techniques. Data can be calibrated to minimise the influence of different analytical techniques.
Data optimisation relies on subdividing the integrated data into geological units and gridding borehole data to a regular cell size. The optimization step applies principal component analysis to quantify and exclude noise from the data based on individual geological unit volumes. Typically two to three principal components are then used for interpolation.
The interpolation module involves standard semi-variogram modelling, cross-validation and interpolation procedures. These can run in Matlab using mGstat, or in Geovariances Isatis via batch processing. Interpolated principal component scores are back-transformed into complete particle-size distributions. Uncertainty in the modelled distributions is quantified by back-transforming the error variance to derive an upper and lower distribution envelope. These data can be used to derive a single measure of uncertainty for each particle-size distribution: the simplicial distance metric.