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Modelling complete particle-size distributions from operator estimates of particle-size

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Estimates of particle-size made by operators in the field and laboratory represent a vast and relatively untapped data archive. The wide spatial distribution of particle-size estimates makes them ideal for constructing geological models and soil maps. This study uses a large data set from the Netherlands (n = 4837) containing both operator estimates of particle size and complete particle-size distributions measured by laser granulometry. This study introduces a logit-based constrained-cubic-spline (CCS) algorithm to interpolate complete particle-size distributions from operator estimates. The CCS model is compared to four other models: (i) a linear interpolation; (ii) a log-hyperbolic interpolation; (iii) an empirical logistic function; and (iv) an empirical arctan function. Operator estimates were found to be both inaccurate and imprecise; only 14% of samples were successfully classified using the Dutch classification scheme for fine sediment. Operator estimates of sediment particle-size encompass the same range of values as particle-size distributions measured by laser analysis. However, the distributions measured by laser analysis show that most of the sand percentage values lie between zero and one, so the majority of the variability in the data is lost because operator estimates are made to the nearest 1% at best, and more frequently to the nearest 5%. A method for constructing complete particle-size distributions from operator estimates of sediment texture using a logit constrained cubit spline (CCS) interpolation algorithm is presented. This model and four other previously published methods are compared to establish the best approach to modelling particle-size distributions. The logit-CCS model is the most accurate method, although both logit-linear and log-linear interpolation models provide reasonable alternatives. Models based on empirical distribution functions are less accurate than interpolation algorithms for modelling particle-size distributions in sandy sediments. Interpolation-based models represent a more practical approach to modelling distributions, because they can be adaptable to use as much data as available. Complete particle-size distributions modelled from operator estimates using the CCS algorithm are approximately six times less accurate than their equivalent distributions measured by laser analysis. Modelled distributions are limited by input data accuracy, rather than the specific interpolation algorithm used, which in comparison has very little influence.