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Mapping of ultimate properties of coal using isometric log-ratio transformation and sequential Gaussian simulation

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Chemical and compositional properties of coal largely determine the coal handling, processing, beneficiation methods and design of coal-fired power plants. Furthermore, these properties impact coal strength, coal blending during mining as well as coal's gas content, which is important for mining safety. In order for these processes and quantitative predictions to be successful, safer and economically feasible, it is important to determine and map chemical and compositional properties of coals accurately in order to infer these properties prior to mining.

Ultimate analysis quantifies the principal chemical elements in coal. These elements are C, H, N, S, O and depending on the basis, ash and/or moisture. The basis for the data is determined by the condition of the sample at the time of analysis, with "as-received" basis being the closest to sampling conditions and thus to the in-situ conditions of the coal. The parts determined or calculated as the result of ultimate analyses are compositions, reported in weight percent, and pose the challenges of statistical analyses of compositional data. The treatment of parts using proper compositional methods may be even more important in mapping them, as most mapping methods carry uncertainty due to partial sampling as well.

In this work, we map the ultimate analyses parts of the Springfield coal, from an Indiana section of the Illinois basin, USA, using sequential Gaussian simulation of isometric log-ratio transformed compositions. We compare the results with those of direct simulations of compositional parts. We also compare the implications of these approaches in calculating other properties using correlations to identify the differences and consequences.